A QUEST FOR KNOWLEDGE SYNCHRONIZATION BETWEEN EVIDENCE AND SPECIFICATION KNOWLEDGE BASES OF HEALTH CARE BUILDINGS DESIGN FIELD: AN ONTOLOGY-BASED APPROACH IN TURKISH CONTEXT

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ÖMER FARUK ALP

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
ARCHITECTURE

AUGUST 2022

Approval of the thesis:

A QUEST FOR KNOWLEDGE SYNCHRONIZATION BETWEEN EVIDENCE AND SPECIFICATION KNOWLEDGE BASES OF HEALTH CARE BUILDINGS DESIGN FIELD: AN ONTOLOGY-BASED APPROACH IN TURKISH CONTEXT

submitted by **ÖMER FARUK ALP** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy** i**n Architecture, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. F. Cânâ Bilsel
Head of the Department, **Architecture** _____

Prof. Dr. Mualla Erkılıç
Supervisor, **Architecture Dept., METU** _____

Examining Committee Members:

Prof. Dr. Hacer Ela Aral
Architecture, METU _____

Prof. Dr. Mualla Erkılıç
Architecture Dept., METU _____

Assoc. Prof. Dr. Yasemin Afacan
Interior Architecture and Environmental Design, Bilkent Uni. _____

Assoc. Prof. Dr. Ali Tolga Özden
Architecture, COMU _____

Assist. Prof. Dr. Altuğ Kasalı
Architecture., IZTECH _____

Date: 29.08.2022

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Last: Ömer Faruk Alp

Signature:

ABSTRACT

A QUEST FOR KNOWLEDGE SYNCHRONIZATION BETWEEN EVIDENCE AND SPECIFICATION KNOWLEDGE BASES OF HEALTH CARE BUILDINGS DESIGN FIELD: AN ONTOLOGY-BASED APPROACH IN TURKISH CONTEXT

Alp, Ömer Faruk
Doctor of Philosophy, Architecture
Supervisor: Prof. Dr. Mualla Erkılıç

August 2022, 210 pages

Attaining the highest quality is a shared goal for sub-fields of healthcare including the design of health care physical environments. Health care architects and design teams are obliged to base their design decisions on findings of empirical studies as the most privileged knowledge sources for rigorousity demanded. It results overall healthcare industry in handling the phenomenon from a rather positivist standpoint, and naming it as evidence-based design (EBD). Despite its potentials, EBD continues to emerge as a highly problematic field that highly deserves studying. Problem areas of its emerged and emerging contexts seemingly intensify on practical ones and diversely span to conceptual, analytical, and ontological ones. Through their critical reviewing and labelling, this thesis provides a conceptual framework for a system-wide EBD understanding and ontology-based evaluation of its knowledge base.

System-wide understanding of EBD brings the thesis into the question of knowledge synchronization inquired especially between propositional grounds of evidence-based studies and health care quality management and evaluation specification networks. The thesis systematically reviews and comparatively analyses knowledge

domains of both by referring to the existing knowledge domain modelling and mapping approaches. The thesis experimentally grounds its methodology on a coding-encoding-decoding trilogy that can be described to be exploiting mixed-method and methodical plurality principles of post-positivist research. The thesis scaffolds for a knowledge domain analysis and utilization tool named Taxograph. The thesis also casts a spatio-conceptual light (Ontograph) on knowledge domain incompatibilities identified between two distinct knowledge bases. The thesis signifies its main contribution as the reinforcement of a more fundamental ontological understanding of EBD notion, and process of realization, practical application, and evaluation of its knowledge base.

Keywords: Health, health care, health care system, health care building design, evidence-based design knowledge management and representation

ÖZ

SAĞLIK YAPILARININ TASARIM ALANINDA KANIT VE SPESİFİKASYON BİLGİ TABANLARIN EŞLEMESİNE YÖNELİK BİR ARAŞTIRMA: TÜRKİYE BAĞLAMINDA VARLIK TABANLI BİR YAKLAŞIM

Alp, Ömer Faruk
Doktora, Mimarlık
Tez Yöneticisi: Prof. Dr. Mualla Erkılıç

Ağustos 2022, 210 sayfa

Yüksek kalite beklentisi, sağlık fiziksel mekanların tasarımı dahil olmak üzere birçok sağlık alt alanı için ortak hedeftir. Sağlık mimarları ve tasarım ekipleri, tasarım kararlarını titiz araştırma kaynaklarının en ayrıcalıklısı olarak görülen ampirik çalışmaların bulgularına dayandırmak zorundadır. Bu durum sağlık endüstrisinin, olguyu oldukça pozitivist bir bakış açısıyla ele almasına ve bunu kanıta dayalı tasarım (KDT) olarak adlandırmasına neden olur. Potansiyellerine rağmen KDT kavramı, üzerinde çalışılmasını gerektiren oldukça sorunlu bir alan olarak var olmaya devam etmektedir. KDT'nin gelişen ve gelişmekte olan bağlamları ile ilgili problem alanları görünürde pratik alanlarda yaşanan problemlere yoğunlaşır ve kavramsal, analitik ve varoluşsal problemlere kadar uzanır ve çeşitlenir. Bu alanların eleştirel taraması ve kodlanması ile tez, sistem boyutlu bir KDT anlayışı geliştirir ve bu anlayışın bilgi tabanının varlık tabanlı değerlendirilmesi için kavramsal çerçeve sunar.

KDT'nin sistem boyutlu anlaşılması ve kavramsallaştırılması tezi, kanıta dayalı ampirik çalışmaları ve sağlıkta kalite yönetimi ve değerlendirmesi spesifikasyonlarının tasarımsal önermeleri arasındaki bilgi eşlemesi sorusuna yönlendirir. Tez, bilgi alan analizi için geliştirilmiş mevcut modelleme ve haritalama

yaklaşımlarına atıfta bulunarak bu boşluk alanlarını gözden geçirir ve karşılaştırmalı olarak analiz eder. Tez pozitivist dönem sonrası araştırmaların karma ve çoğulcu yöntem ilkelerinden yararlanarak metodolojisini deneysel bir kodlama-tanıtma-çözme üçlemesine dayandırır. Tez, Taxograph isimli bilgi alan analiz ve kullanım aracının geliştirilmesine yönelik altyapı hazırlar. Tez ayrıca iki bilgi alanı arasında oluşan bilgi alan uyumsuzluklarının kavramsal-mekânsal (Ontograph) tanımını ve tarifini yapar. Tez, asıl katkı alanını KDT kavramı ve bilgi tabanının anlaşılması, uygulanması ve değerlendirilmesi süreçlerinin varlıkbilimsel açıdan daha derin ele alınması olarak vurgular.

Anahtar kelimeler: Sağlık, sağlık sistemi, sağlık yapıları tasarımı, kanıta dayalı tasarım bilgisinin yönetilmesi ve temsili

To Irmak Duru

ACKNOWLEDGMENTS

I would like to thank my supervisor Prof. Dr. Mualla Erkılıç for her mentoring and encouragement that allowed me inquiring into a very tough subject out of its own place. I would not be able to understand, internalize, and ground 'evidence-based design' concept without her academic depth, teaching philosophy, and rather humane attitude. She contributed a lot to my maturity in my study area and surely the profession. Sincere and endless gratitude for her presence and trust all the way through.

Dr. Altuğ Kasalı's challenging comments and criticism helped me maintaining my critical mind in every stage of the thesis. Many thanks for his kind acceptance to be in our termly meetings, providing me an open call for help, as well as for his non-hesitation in providing support whenever I needed.

Prof. Dr. Hacer Ela Aral's extended knowledge profoundly helped me in handling the subject from a rather different methodical perspective that I had not thought about before. I would like to thank a lot for being in every critical stage of my thesis, and providing valuable readings from her own library.

I would like to thank thesis examination committee members Dr. Yasemin Afacan and Dr. Ali Tolga Özden for providing an external eye and contributing to the final evaluation process of the thesis.

I respectfully thank to METU Department of Architecture, its constituents including the academic and administrative staff and the students. I was given the opportunity to be part of the faculty equipped with great critical/analytical mind and progressing within an invaluably sincere, solidary, and democratic environment.

Many thanks to my mother Nazmiye Alp and father Prof. Dr. Ahmet Alp whose endless support was here to stay with me in this study as it was always in previous ones, as well.

Special thanks to my wife Hatice Ünal Alp and daughter Irmak Duru Alp as their contribution to the thesis process is beyond the scope and format of this thesis to describe. I exceptionally thank for their lovely support, and great tolerance, understanding and patience.

TABLE OF CONTENTS

ABSTRACT v

ÖZ vii

ACKNOWLEDGMENTS x

TABLE OF CONTENTS xii

LIST OF TABLES xv

LIST OF FIGURES xvi

LIST OF ABBREVIATIONS xix

CHAPTERS

1 INTRODUCTION 1

1.1 Context(s) 1

1.2 Problem Definition 5

1.3 Research Questions 8

1.4 Aims and Significance 9

1.5 Objectives and Methodological Issues 12

2 HEALTH CARE BUILDING DESIGN 15

2.1 Knowledge for Design 16

2.2 'Evidence-based Knowledge' for Health Care Buildings Design (HBD) 18

2.2.1 'Safety-oriented' domain 25

2.2.2 'Support-oriented' domain 27

2.3 Evidence-based Design (EBD) 29

2.3.1 Challenges 34

2.3.2 Efforts 36

2.4 Knowledge 'Utilization' and 'Translation' in EBD 39

2.4.1 ‘Multi-level’(s) of evidence-based knowledge utilization 40

2.4.2 ‘Integrated mechanisms’ of evidence-based knowledge translation and the role of HBD specifications 43

2.5 Summary and Room for Further Evaluation 48

3 HEALTH CARE QUALITY MANAGEMENT AND EVALUATION 51

3.1 ‘Health’, ‘Health Care’, ‘Healthcare’, and the ‘Quality Management and Evaluation’ (QMaE) in Healthcare 52

3.2 Evidence-based QMaE Specifications: US and UK Perspectives 55

3.3 ‘Health Transformation Program’ Movement of Turkey 59

3.3.1 A symptomatic case: Establishment of QMaE specifications 60

3.3.2 A counter case: Establishment of EBD practice culture 66

3.3.3 Highlights regarding the ‘knowledge gap’ occurring between the QMaE specification and evidence bases of HBD field 69

3.4 Major Challenge & Effort Areas Re-visited 73

4 ONTOLOGY-BASED ‘EVIDENCE-BASED DESIGN’ 77

4.1 Review of Current Discussions Intensified After the Global Pandemic 78

4.2 Philosophical grounds of an ‘Ontology-based’ EBD Conception 81

4.3 Precedents of ‘Ontology-based’ Research Methodologies and Methods ... 87

4.3.1 ‘Qualitative Content Analysis’ and ‘Grounded Theory’ 90

4.3.2 Ontology-based knowledge domain ‘MODELLING’ 94

4.3.3 ‘MAPPING’ ontologies 99

4.4 Chapter Summary 102

5 TAXOGRAPH 105

5.1 Thesis Material 105

5.2 Data Handling & Segmentation 108

5.3 ‘CODING’ Segments....111
5.4 Preliminary Determination of Significance Areas....114
5.5 ‘ENCODING’ for a Practical Knowledge Utilization Tool....119
5.6 Executive Summary of Key Findings....123
6 ONTOGRAPH....125
6.1 ‘Clustering’ as a Spatio-relational Act....125
6.2 ‘DECODING’ Relations & Pruning the Data....129
6.3 ‘MAPPING’ Ontologies & Identification of Structural Cases....132
6.4 Final representation of ‘Knowledge Domain(s)’ under individual ontological structures....136
6.5 Meta-Inferring & ‘NARRATION’ of Final Results....140
7 CONCLUSION....147
BIBLIOGRAPHY....159
APPENDICES
A. Reference list of evidence-based studies coded....173
B. Numerical data....191
C. Significance matrix of codes....193
D. Integrated matrix of taxonomic structures....196
E. Taxonomies of significant ontological cases....199
F. Rhino/Grasshopper scripts....203
G. Segments retrieved from particular ontological structures reviewed....204
CURRICULUM VITAE....209

LIST OF TABLES

TABLES

Table 3.1 Types and features of the existing specification network in Turkish healthcare 62
Table 3.2 Version history of the recently published health care quality and accreditation specifications in Turkish healthcare 63
Table 3.3 Highlights from MoH congress publications 70
Table 5.1 List of ‘codes’, ‘categories’, and color scheme of the thesis 112
Table 5.2 Significance table 118

LIST OF FIGURES

FIGURES

Figure 1.1. Research areas in relation to problems addressed by the thesis 11
Figure 1.2. Structure of the thesis 13
Figure 2.1. A conceptual diagram of EBD in relation to 'normative' design 20
Figure 2.2. A conceptual diagram of 'knowledge base' and methods of EBD and 'normative design' 21
Figure 2.3. A conceptual diagram of EBD in relation broader paradigmatic developments of the fields of architecture and health care 22
Figure 2.4. Major challenge & effort areas of EBD field 35
Figure 2.5. Initial implications regarding the shifts in the challenge & efforts areas of EBD when 'knowledge utilization' considered at 'multiple-levels' 43
Figure 2.6. Information flow and knowledge exchange in EBD at systems level .. 46
Figure 2.7. Key aspects of 'integrated knowledge translation' in EBD 47
Figure 3.1. Knowledge base and network of UK's EBD tool and toolkit(s) 57
Figure 3.2. Knowledge base and network of Turkey's QMaE Specification(s) 65
Figure 3.3. Major challenge & effort areas re-visited 76
Figure 4.1. The term 'Ontology' in philosophical senses and an 'Ontology-based EBD' Conception 85
Figure 4.2. Methodical underpinnings of 'knowledge domain definition' and 'mixed-method' research 88
Figure 4.3. Teleological underpinnings of 'coding', and the track followed by the thesis 103
Figure 5.1. Yearly distribution of evidence-based studies provided by CHD Knowledge Repository 106
Figure 5.2. Preliminary description of knowledge domains of evidence and specification documents reviewed and coded 107
Figure 5.3. Example of an identical 'key point summary' provided by CHD 109
Figure 5.4. Segmentation scheme of the thesis 110

Figure 5.5. Coding ‘frequency’, ‘intersection’, ‘centrality’ matrix 116
Figure 5.6. Examples for an identical/regular radar chart developed for the visualization and signification of numerical data 117
Figure 5.7. Statistically irregular and significant codes evaluated by ‘centrality’ 117
Figure 5.8. Taxonomy scheme of the algorithm developed..... 121
Figure 5.9. An example instance from Taxograph..... 122
Figure 6.1. An example ‘ontological structure’ 127
Figure 6.2. An example ‘cluster’ scheme provided by the MAXQDA 128
Figure 6.3. ‘Cluster’ schemes of QMaE and KPS documents inquired within S: ‘Settings’ coding category 130
Figure 6.4. Structural layout(s) and ‘pruning’ process followed by the thesis 131
Figure 6.5. ‘Mapping’ and identification of significant S: ‘Settings’ clusters..... 134
Figure 6.6. Software-based versions of ‘cluster’ layouts..... 135
Figure 6.7. Lists of evident ontological cases..... 137
Figure 6.8. Specification base represented as a single ‘ontological structure’ 138
Figure 6.9. Evidence base represented as a single ‘ontological structure’ 139
Figure 6.10. ‘Decoding’ structures into individual clusters, and the scheme of ‘comparison’ 140
Figure 7.1. Definition of the contribution areas of the thesis 148

LIST OF ABBREVIATIONS

ABBREVIATIONS

AC: Accreditation Canada

ACHS: The Australian Council on Healthcare Standards

AHRQ: Agency for Healthcare Research and Quality

AIA: American Institute of Architects

CHD: The Center for Health Design

EBD: Evidence-based Design

EBM: Evidence-based Medicine

EBP: Evidence-based Practice

HBD: Health Care Building Design

HERD: Health Environments Research & Design Journal

HHS: U.S. Department of Health & Human Services

IHI: Institute for Healthcare Improvement

IOM: Institute of Medicine

ISO: International Organization for Standardization

ISQua: The International Society for Quality in Health Care

JCI: Joint Commission International

KR&R: Knowledge Representation and Reasoning

MoH: Ministry of Health of Turkey

NHS: The National Health Service In UK

QCA: Qualitative Content Analysis

QMaE: Quality Management and Evaluation

RCT: Randomized Controlled Trial

RIBA: Royal Institute of British Architects

TSE: Turkish Standards Institute

WHO: World Health Organization

CHAPTER 1

INTRODUCTION

Within 20 years historical background since the first pairment of the notion of evidence-based design (EBD), this thesis identifies and suggests possibility of mentioning about three distinct contexts of EBD field. These include (1) **'emerged'** referring to its initial conceptualization provided after its incubation period, (2) **'emerging'** referring to its maturity period, and (3) **'re-emerging'** referring to the most recent pandemic and its subsequent period. By emphasizing the key points, mindsets, and main challenge & effort areas of each context, following introduction aims to capture a quick image of how the thesis positions itself within such a dynamic and constantly changing contextual and conceptual environment of EBD field.

1.1 Context(s)

Practicing based on proof, namely an 'evidence-based practice' (EBP) conception is one of the major strategies adopted by healthcare for ensuring the highest quality (Harvey & Kitson, 2015). Through the support and widening of its application, overall healthcare industry necessitates various aspects of health care being grounded on credible and reliable research findings as the evidence of their quality (Stankos & Schwarz, 2007). As such, it is supposed to diffuse into various sub-fields of healthcare including the design of health care physical environments. For this, health care building design (HBD) field mimics at 'evidence-based medicine' (EBM), underlines the necessity of integration of available body of evidence in design, and enforce it through the notion of EBD (Stankos & Schwarz, 2007; Viets, 2009; Viets & Anderson, 2011). Despite a broad range of knowledge sources that may inform an HBD process, EBD field deems formal/academic/empirical research (evidence-

based studies) the most rigorous knowledge sources to be utilized **(Problem 01)**[1]. And this makes EBD a bourgeoning field of study of which the trajectory has been mainly shaped; more intensely than EBM, around a broad range of different problems faced during an evidence-based HBD process.

One major category of problems reported by EBD literature is related with evidence-based studies themselves. Accordingly, EBD literature considers the content including the number and prevalence of evidence-based studies as premature, limited, and narrow in scope and length which is deemed insufficient to inform an HBD process (Stankos & Schwarz, 2007; Moore & Geboy, 2010; Rashid, 2013; Zhang et all., 2017) (**P.02)**. Despite the rigorously strict methodical stance adopted by the evidence-based researchers, existing evidence-based studies are still reported to be open to research biases (Laursen et all., 2014; Taylor & Hignett, 2016; Hall et all., 2017), and further reported to be failing to provide explicit cause and effect relations for overly complex, multifaceted, and peculiar design contexts of health care physical environments (Martin & Guerin, 2006; Becker & Carthey, 2007) **(P.03)**. Additionally, the scattered and unorganized nature of evidence-based studies makes their compilation and storage difficult for accessing at (Durmisevic & Ciftcioglu, 2010; Davidson, 2017) **(P.04)**.

For responding to all these difficulties, EBD field utilizes more of systematic reviews as the secondary sources of research studies aiming to collect, review, and appraise the state-of-art literature of evidence-based studies in an organized and methodically bias-free way (Nelson et all., 2005; Clarke, 2011; Codinhoto et all., 2007; Kaijanaho, 2014). However, strict assessment criteria of systematic review studies make a significant amount of evidence-based studies excluded while ignoring peculiarities

[1] It is a naturally occurring and situated fact that is frequently reported in entire EBD literature by calling and describing required knowledge base through certain concepts such as ‘credibility’, ‘reliability’, ‘rigorousity’, ‘robusticity’, and so on.

of the health and design belonging to different demographic and geographical contexts (Hall et all., 2017) **(P.05)**.

More important than the above-outlined problems related with evidence-based studies themselves, another major category of problems is related with the ambiguity of how and by whom evidence-based studies should be expected to be utilized **(P.06)**. Accordingly; for this, early conceptions of EBD underline the key role of health care architects in consuming evidence-based studies as the ground of their design decisions. This means to be developing theoretical frameworks for treating health care architects as scientist-practitioners, HBD as a scientific design field, and EBD as a scientific design practice model (Baumbusch et al., 2008; Hall et all., 2017). This further requires also to develop supplementary EBD education and certification programs for health care architects for further developing their formal and academic research skills (i.e. EDAC program provided by CHD). However; because of the continuation of practical difficulties caused by the inefficient skills and lack of required research vocabularies of health care architects for collecting, analyzing, and interpreting both evidence-based studies and their systematic reviews (Nelson et all., 2005; Martin & Guerin, 2006, 2007; Becker & Carthey, 2007; Viets, 2009; Codinhoto et all., 2010; Chong et all., 2010; Viets & Anderson, 2011) **(P.07)**, primary aim of EBD literature gradually moves away from developing theory with implicit statements of desired scientificity left behind (P.08), to developing more practical solutions especially by means of providing health care architects some knowledge translation mediums[2] including: web-based knowledge repositories, excel-based EBD tool and toolkits, and computer-based decision-support models and frameworks, and so on **(referring to P.04, too)**. Today, majority of these mediums have not been survived for long either for their impracticalities because of their limited knowledge search, filtering, representation, and reasoning capabilities

[2] i.e. InformeDesign©', 'CHD Knowledge Repository', 'AIA Knowledge Net', DQI (Design Quality Indicator), PEAT (Patient Environment Assessment Team), ASPECT (A Staff & Patient Environment Calibration Tool), AEDET (Achieving Design Excellence Evaluation Toolkit), and so on.

(P.09); or for failing to sustain the underlying evaluative studies of the knowledge domain of evidence-based knowledge which is required to feed them forward **(P.10)**[3].

Here further more important than the practicality and usability issues of the above-outlined knowledge translations mediums as end-products, their development process contributes especially by means of envisioning alternative levels of knowledge utilization that defines EBD more as a 'multi-leveled' and more 'integrated' knowledge utilization model. This means to gradually expand the expected level of knowledge utilization from health care architects as individual practitioners (initiated mainly by 'Hamilton, 2003') **(emerged context)** to overall health care systems through which design practice of health care architects and design teams; together with the operational actives of health care organizations, is guided, regulated, and evaluated **(emerging context)**. For this, one particular integrated knowledge translation medium is pointed out to be HBD specifications (design standards, codes, and guidelines) for their potentials in translating key findings of evidence-based studies, transliterating (beyond translating) it for design, hence serving as a rather intrinsic part of an HBD process (Hamilton, 2009; Hignett & Lu, 2009; Lindahl et all., 2010; Mills et all., 2015; Wanigarathna et all., 2016).

As such; and according to the emerging evidence-based conception of HBD specifications, EBD literature scrutinizes further into questions and problems of how evidence-based studies can be integrated into HBD specifications **(P.11)**; and for this, what should be their proper representation to be more meaningful for their referrers **(P.12)**, as well as how they can be more effectively utilized during an EBD process **(P.13)**. Upon the consideration of these issues; as well as influenced from the broader health care quality movements taken place in the field, EBD literature explores limitations of traditionally existing HDB specifications, and embraces more recently established health care quality management and evaluation (QMaE)

[3] This is one of the key arguments of the thesis that will be elaborated more in Chapter 4.

specification networks of healthcare that address not only the prescription of design but also performance-based guidance, evaluation and accreditation of the design quality of health care physical environments (i.e. Zimring et all., 2008; Codinhoto et all., 2010; Wanigarathna et all., 2016; Quan et all., 2017). Despite the extensive efforts spent for the realization and further supporting the evidence base of QMaE specifications; however, desynchronized nature of evidence and specification knowledge bases of HBD field are continued to be deemed competing or even contradictory sources of knowledge informing around a HBD process (Phiri, 2014; Zhou, 2014) (**P.14)**. Additionally; when considering the establishment processes of QMaE specifications as a collective act involving stakeholders both in local and international scales, the case of health care systems of countries which are less familiar with EBD notion is still a remaining question (Chen et all., 2016) (**P.15)**.

With this understanding of the emerged and emerging contexts of EBD field, all these issues and more recent developments can be argued to be unfolding EBD more as systemic issue, and its further investigation requires a system-wide exploration of some of (1) conceptual, (2) analytical, as well as (3) ontological underpinnings of the knowledge base of EBD that constitutes the main ground for problem definition, research questions, as well as aims and objectives of this thesis. The thesis considers these within its **re-emerging context** that will be elaborated in the following section.

1.2 Problem Definition

Conceptual: This thesis defines one major aspect of the ongoing problem areas of EBD field as conceptual. Conceptual problems of EBD field start with the implicities in its initial conceptualization as a scientific design practice model, and continues through the ambiguities in its later conceptualization when considered as a knowledge utilization model. Therefore; followed by implicity and continued through ambiguity, conceptual problems of EBD field are aimed to be resolved by integrity of overall health care systems that allows involving of healthcare stakeholders at multiple levels. For this; and alternative to its 'scientist-practitioner'

(emerged) conception adopted, more recent intensified efforts on QMaE specifications display an 'embedded research' (emerging) approach that requires robusticity of overall health care systems in realizing their evidence-based knowledge sources.

Over the last few years especially after the global pandemic (Covid-19) period intensified philosophical discussions, the expected robusticity of health care systems is further demanded to be blended with a 'resilient healthcare' understanding and a 'complex system' approach that requires and allows adding new knowledge sources to the evidence base of QMaE specifications. These include not only the positivist research but also others with various underlying post-positivist (not limited to post positivist) ontological perspectives (Brambilla, et. all., 2019; Marcheschi, et. all., 2019; Sandal et. all., 2019; Zwart, 2021). Considered together with the underlying emerging context of EBD, what all these mean in situ is what is named by this thesis as **'re-emerging'** context of EBD field, and it calls a significant shift in the main conception of EBD:

- from a scientific and positivist approach concerning more about questioning and measurement of solely the health care architects' ability to integrate evidence-based studies in design,
- toward a systemic and post-positivist approach that concerns more about the same for overall health care systems especially during the establishment of QMaE specifications.

Analytical: In relation to the question and measurement of health care systems' ability to integrate evidence-based studies in QMaE specifications from HBD standpoint, health care quality assurance systems are required to be further realized to be the situated contexts of continuous quality control, management, and improvement of the many aspects of healthcare (WHO, 2008). In this regard, QMaE specification documents set by quality assurance systems do not usually concentrate on a single quality aspect, rather prepared as generic documents aiming to address a broad range of different quality issues including also the design quality of health care physical environments. Additionally; and more importantly, QMaE specifications are supposed and claimed to be evidence-based as expected; however, their evidence

base is implicitly embedded and codified within their establishment process. Realization and further supporting the evidence base of QMaE specifications requires advanced evaluative processes of knowledge filtering, scoping, hence providing a comparative knowledge domain definition of the evidence and specification knowledge bases of HBD field.

Here in relation to the question of less progressed contexts of EBD, Turkish healthcare stands as an ignored case to be exploited for investigating above-outlined conceptual and analytical underpinnings of a system-wide EBD conception and exploration. Review of the existing little research carried out in Turkish context (i.e. indicates that health care architects and design teams in Turkey shares a high demand on evidence-based HBD and QMaE specifications yet having not a direct engagement with evidence-based studies in front (i.e. Berberoğlu, 2010; Sioofy Khoojine, 2020; TMMOB, 2015; Şensoy, 2015). This makes Turkish context a symptomatic example of intensified efforts of achieving EBD more at systems level, hence a rather informative context of problems faced during the integration of evidence-based studies in QMaE specifications. These includes 'inclusion', 'coverage', as well as 'compatibility' issues resulted in 'knowledge gap' areas occurring between evidence and specification bases, as well as between the architectural design/research communities and Ministry of Health (MoH) of Turkey as the central authority on setting the demanded specification networks.

Ontological: In relation to the necessity of 'knowledge gap' areas to be identified and further realized; as well as for dealing with the above-outlined conceptual and analytical problems of EBD field both in international and local contexts, this thesis argues that the problem is rather more ontological. And for this, the thesis further argues that 'ontology' conception should be effectively applied to EBD conception and it needs to be developed to be referred both in philosophical and methodical senses.

In philosophical senses, 'ontology' conception is referred by this thesis to further to mean (1) globally changing attitude of overall healthcare industry in favor of a

‘resilient’, ‘complex’, and post-positivist research paradigm that envisions a ‘non-linear’, ‘emergent’, as well as more inclusive knowledge base underpinned with various other post-positivist research perspectives then only the positivist ones. ‘Ontology’ conception is referred by this thesis to mean also (2) the differentiated worldviews, design/health perceptions, as well as interest areas of various healthcare stakeholders that result in differentiated knowledge domains as the main cause of ‘knowledge gap’ areas under investigation. For dealing with these ‘knowledge gap’ areas, this thesis refers to ‘ontology’ conception to mean also (3) ‘ontology-based’ knowledge domain ‘coding’, ‘modelling’, and ‘mapping’ methods reviewed, adopted, and applied throughout the thesis.

1.3 Research Questions

Throughout the inquiry reflected for the above-outlined problem areas and contexts of EBD field, research questions that recursively guided this thesis have become multiple and prolificated through inquiry. These included in order with:

- Question of **notion**: When compared to situated design methods existing and being applied during an architectural design process, what is EBD notion standing for and referring to?
- Question of **ground**: To what extend and in which grounds are the demanded robusticity and rigorousity, namely the scientificity conceptions are handled by EBD literature?
- Question of **scale**: When compared to precedent knowledge utilization approaches, in what other scales could evidence-based studies be expected to be applied and further conceptualized?
- Question of **medium**: Among the various different types, formats, and scales of knowledge translation mediums being suggested, where and in what potentials or limitations are HBD specifications positioned?

- Question of **applicability**: To what extend are the knowledge representation and reasoning capabilities of existing knowledge translation mediums respond to practical needs of their referrers?
- Question of **realization**: What could be the particular methods and methodologies of dealing with competing and incompatible nature of various different knowledge sources of EBD field?

1.4 Aims and Significance

By inquiring into the above-listed research questions, this thesis undertakes a broad scope for a rather holistic yet comprehensive view of EBD notion and its knowledge base. The thesis exploits its broad scope to develop a more fundamental ontological understanding of EBD notion, and methodically plural and applicable evaluation of its knowledge base.

As part of the ontology-based EBD conception developed by the thesis, the thesis discloses EBD notion as a mode of 'embedded research', and suggests it to be understood more as a system-wide and multi-leveled knowledge utilization phenomenon. The thesis questions overall health care systems' inclusion, coverage, and compatibility capabilities by means of integrating findings of evidence-based studies within their health care quality management and evaluation specification networks. Over case-wise significancies provided by the rather informative and symptomatic context of Turkish healthcare, the thesis argues that realization of EBD's knowledge base requires rather more holistic and complex knowledge representation and reasoning processes than ongoing knowledge translation and utilization mediums adopted. For this, the thesis re-visits and reinforces teleological links between philosophical and methodical means of referring to ontology conception. The thesis superimposes existing quantitative knowledge domain modelling and qualitative mapping approaches as to complement each other, and serve for a peculiar knowledge domain analysis methodology. In the end, the thesis provides the required analytical background for the development of practical

(Taxograph) and evaluative (Ontograph) mediums of the knowledge base of EBD field.

Key findings of this thesis address a broad range of problems (Figure 1.1) and target audiences including but not limited to; for example:

- For health care architects and design teams, the thesis can help in creating referential links between available bodies of evidence and specification knowledge sources.
- For evidence-based researchers, the thesis can help in scoping the potential areas of research gaps for further studying.
- For specification-makers, the thesis can help in developing strategies and roadmaps for further improving the evidence base of QMaE specification networks provided.

Entire research processes the thesis experienced and documented; on the other hand, may also relate other fields that EBD notion can instrumentally be corresponded to. These includes and again not limited to; for example:

- architectural history, theory, and criticism field with no particular inquiry in health care domain;
- philosophy of science
- architectural design research and design studies,
- knowledge translation, utilization, representation and management fields,
- cognitive and machine learning fields, and so on.

Based upon the peculiarities of research context and research goals, this thesis can be described to be a critical/evaluative, comparative/analytical, as well as experimental study aiming to address limitations of EBD notion from a post-positivist research perspective. A detailed structure of the thesis is provided in Figure 1.2.

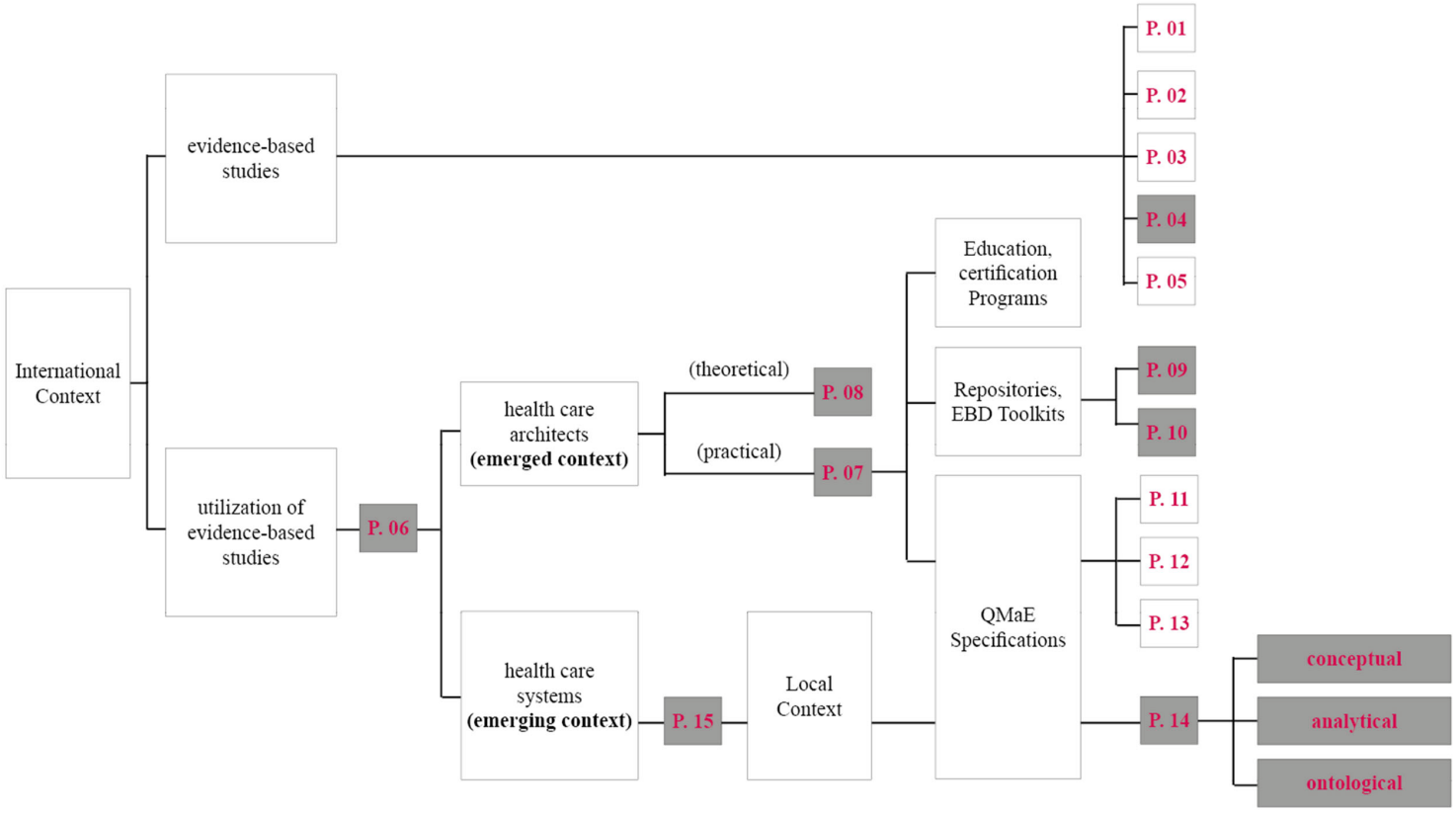


Figure 1.1. Research areas in relation to problems addressed by the thesis

1.5 Objectives and Methodological Issues

The thesis fulfills the above-outlined aims by following six research objectives as listed below:

- **O. 01 / Chapter 2:** to review historical, theoretical, and conceptual frameworks of the emerged context of EBD as a design practice model, to develop a multi-level approach to the knowledge utilization problem, and to develop a conceptual framework for explaining how the ongoing challenge and effort areas shift when moving the expected knowledge utilization in EBD from architects to systems level;
- **O. 02 / Chapter 3:** to review EBD more as a system-wide phenomenon; explore strengths and limitations of HBD and QMaE specifications; and accordingly, to develop knowledge about the recent systemic changes and recently established QMaE specification networks of Turkish health care;
- **O. 03 / Chapter 4:** to provide an ontological inquiry into EBD notion, and to explore 'ontology-based' methods and methodologies of 'knowledge gap' areas to be identified, analyzed, and visualized;
- **O. 04 / Chapter 5:** to collect, review, structure, and code evidence and specification knowledge sources for further scoping by reference to their inclusion capabilities;
- **O. 05 / Chapter 5:** to analyze evidence and specification bases' inclusion and coverage capabilities, and to explore their practical implications as a knowledge utilization tool;
- **O. 06 / Chapter 6:** to reveal potential areas of knowledge gaps, and to define and describe knowledge domain incompatibilities identified between evidence and QMaE knowledge bases of EBD field.
- **O. 07 / Chapter 7:** to define and collect distributed knowledge produced by various stages of the thesis, provide conclusive final remarks, to further ideate, discuss, and suggest for developing potential improvement strategies.

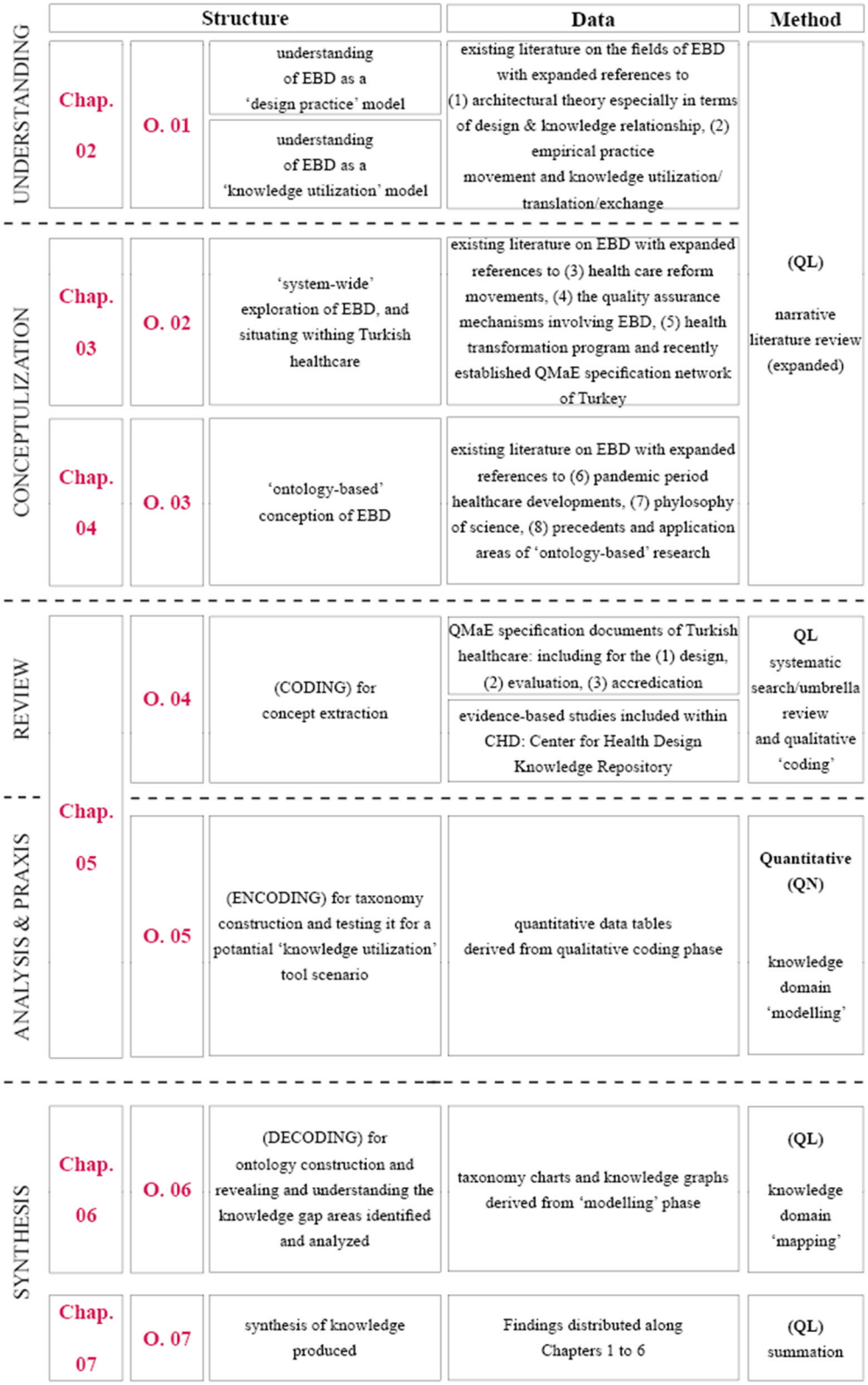


Figure 1.2. Structure of the thesis

CHAPTER 2

HEALTH CARE BUILDING DESIGN

> "The dark side of this trend is the appearance of practitioners who would like to be associated with evidence-based design but who haven't done the hard work to become current. Given the almost endless potential sources of information, there is a need to reach speculative conclusions about the design implications of narrow studies. The architect's role is crucial in translating and applying the research to useful designs. Inexperienced practitioners will find it difficult to make the leap from data to a successful design. Vast numbers of confounding variables in any setting make single-minded solutions suspect. An architect has an obligation as a sacred public trust, granted with licensure, to use the most reliable information available. As in the story of Pandora's box, which, once opened, could not be closed, an architect cannot avoid the moral responsibility for what he or she knows after encountering compelling evidence. Using research findings to improve design decisions comes naturally for many architects. Adding rigor to what we already do is fundamental to this shift to evidence-based practice. The clear business case for good design–and an even stronger case for design linked to positive performance and economic results–suggests that the trend is here to stay" (Hamilton, 2003).

The present chapter provides the first part of the literature review of the thesis. From reference to the initial conceptualization of evidence-based design (EBD) notion by (Hamilton, 2003) as an emerged context, the chapter initially takes one step back and provides a historical inquiry into the originating contexts, rationales, and underlying principles and methods of evidence-based approaches in health care buildings design (HBD) field, and EBD accordingly. Then the chapter gradually moves to the present and explores the rather comprehensive challenge and efforts areas of the desired evidence-based HBD practice reported by EBD literature. The chapter deals with the complexity of the problem area of EBD by developing a conceptual framework aiming to analyze their nature and interrelation supported by a series of analytical diagrams. At the end, the chapter provides a temporary departure from the initial conceptualization of EBD as a 'design practice model' toward its conceptualization

as a ‘knowledge utilization model’. By doing so, the chapter explores the critical role of HBD specifications for the translation and utilization of evidence-based knowledge studies by health care architects during their designing processes.

To begin with, following section provides an attempt to unfold the conceptual journey of HBD field from the generic term of ‘knowledge’ to the EBD-specific term of ‘evidence’, and explore the implications of this journey from ‘design’ standpoint.

2.1 Knowledge for Design

Demystification of what architects know, how they think, and how they design has always been into the interest of academics, researchers, and practitioners in the field of architecture. Often time, authors compared and contrasted architects with other professionals to define the peculiarities of architecture as a design discipline and architects as design professionals. One consensus that was agreed upon has been the view that of the uniqueness of architecture in its epistemological grounds, and architects in their cognitive and methodical strategies adopted during the designing process. Existing literature frequently reported that unlike the other professionals such as engineers and medical professionals who tend to work on narrow subjects and well-defined problems, architects try to cover a broad range of issues and problems which are ‘ill-defined’ and ‘wicked’ that cannot be fully described by scientific theories and prescriptive methods (Reitman, 1964; Rittel & Webber, 1973). Accordingly, underlying cognitive processes of architects when making design decisions are often defined by the literature as ‘solution-focused’ and ‘knowledge-driven’ as opposed to the ‘problem-focused’ and ‘information-driven’ practice models that may be adopted in other disciplines (Kruger & Cross, 2006).

Meanwhile the view that of the uniqueness of architecture and architects has also been reported to be limited in their own rights. Numerous other ideas and explanations have been produced to explain the phenomenon: (1) architecture is unique in its own right that cannot be compared with scientific practices, (2) architecture should turn to science to be credible and strong, (3) architectural design

practice is a form of research that can already be considered as scientific (Till, 2008). A similar trilogy is: (1) architecture is unique but its uniqueness can be studied scientifically ('science of design'), (2) architectural design process can be wholly scientific ('design science'), (3) architectural design process can be scientifically informed while keeping its own norms and values ('scientific design') (Cross, 2001). Here at this point, realization of the nature of 'architectural knowledge' has the most potential power to explain many things yet not a very straightforward task for further evaluation.

Certain aspects of architectural knowledge make the realization difficult because: (1) architectural knowledge is 'contextual', 'time-related,', 'temporary', 'transformative', and 'ideological' (Berber, 2001); (2) architectural knowledge is dependent on and barrows from many other disciplines for developing its own knowledge which forms an 'episodic' and 'discursively fragmented surface' (Basa, 2009; Lawson, 2010); (3) architectural knowledge is not explicit; rather, it is 'ambiguous', 'seemingly invisible', and 'embedded' in the form of 'tacit knowledge' (Wright, 2012). It is intricately plural and mixed because architects may utilize any kind of knowledge spanning from technical, practical, scientific, empirical, theoretical, moral, ethical, critical, aesthetic knowledge to many others from other areas, disciplines, and issues. Its peculiarity is embedded in the form of tacit knowledge because; ideologically, concepts of experience, intellectual integrity and capacity, critical, ethical and aesthetic value judgements are the most important issues that can direct a designing process.

Following the above-mentioned emphasis on the intricately multi-layered and dependent nature of architectural knowledge, and based upon Smith & Lytle's (1999) trilogy of knowledge in relation to practice (knowledge for/in/of practice), architectural knowledge can be argued to be an umbrella term comprising three strata of 'design knowledge' as these are: 'knowledge for design', 'knowledge in design', and 'knowledge of design', each corresponding to different stages (-pre, development, and -post) of architectural design process. Here on, design thinking and practice of architects becomes as equally important concepts as architectural

knowledge itself; however, they are again paradoxically difficult to realize because design problems faced in different design contexts require different types of knowledge and research from different sources; and differentiated knowledge types and research sources result in architects altering their cognitive minds, and methodical and procedural strategies adopted in designing process. Depending upon different nature and complexities of different design contexts, architects may need to develop not only some intuitive design methods and strategies such as 'craft evolution' and 'design-by-drawing' but also some other logical and scientific methods that require different kinds of thinking and designing processes (i.e. linear, non-linear, cycling, branching, adaptive, incremental etc.) (Jones, 1992). This is especially true for the design of some specific building types, including health care buildings, that may require specialism, a very specialist knowledge, and high level of external knowledge utilization which puts the 'knowledge for design' (or fits into the particular context of this thesis as 'evidence-based knowledge') forward for further evaluation.

2.2 'Evidence-based Knowledge' for Health Care Buildings Design (HBD)

Health care buildings are complex physical and medical settings of which design requires architects to be knowledgeable and experienced; for example, about the types of hospital rooms (single or multiple, same-handed or mirrored etc.), their arrangement in relation to nurses and supply locations, their views and solar orientation, appropriate physical dimensions of spaces, materials used, environmental control strategies, ancillary processes (communication systems, information technology, monitoring devices, entertainment systems), color and décor selection and so many others (Hamilton, 2010). To respond to such problems, architects try to apply what we can categorize practical and technical knowledge derived from their past experience and research from informal sources such as anecdotes based on professional experience on previously completed projects, in-house institutional research, HBD specifications, informal best practice

benchmarking as precedents, feedbacks derived from expert knowledge and judgement, manufacturers' literature, product specifications, personal visits to comparable facilities, communication with colleagues, study tours, and seminars and so on (Becker & Parsons, 2007; Chong et all., 2010; Kasalı, 2013).

However, beyond this; in HBD field, one common expression is also that 'normative' design approaches based on previous experience on design, common sense intuition and interpretations, research derived from informal sources, and usually the skills learnt through formal architectural education do not respond to changing needs and demands of health care industry (Hamilton, 2003, Martin & Guerin, 2007; Chong et all., 2010; Wanigarathna, 2014). Rather; health care industry demands for alternative models of design practices as one of those is referred by the notion of EBD. Based on the afore-mentioned issues regarding the peculiarity of the knowledge requirements of HBD, and together with a more extensive literature review carried out in the following sections, EBD can initially be described through Figures 2.1 and 2.2.; and argued to be locating itself as a model of scientific design practice which requires a mode of problem-focused and information-driven design thinking; hence can be perceived as an example to the ongoing perspectives of (1) architecture should turn to science to be credible and strong, (2) and architectural design process can be scientifically informed while keeping its own norms and values.

Here before proceeding with EBD, it is sensible to provide a brief historical background of the originating contexts, rationales, as well as early forms and visions of evidence-based approach in HBD field, and it can initially and conceptually be seen in Figure 2.3.

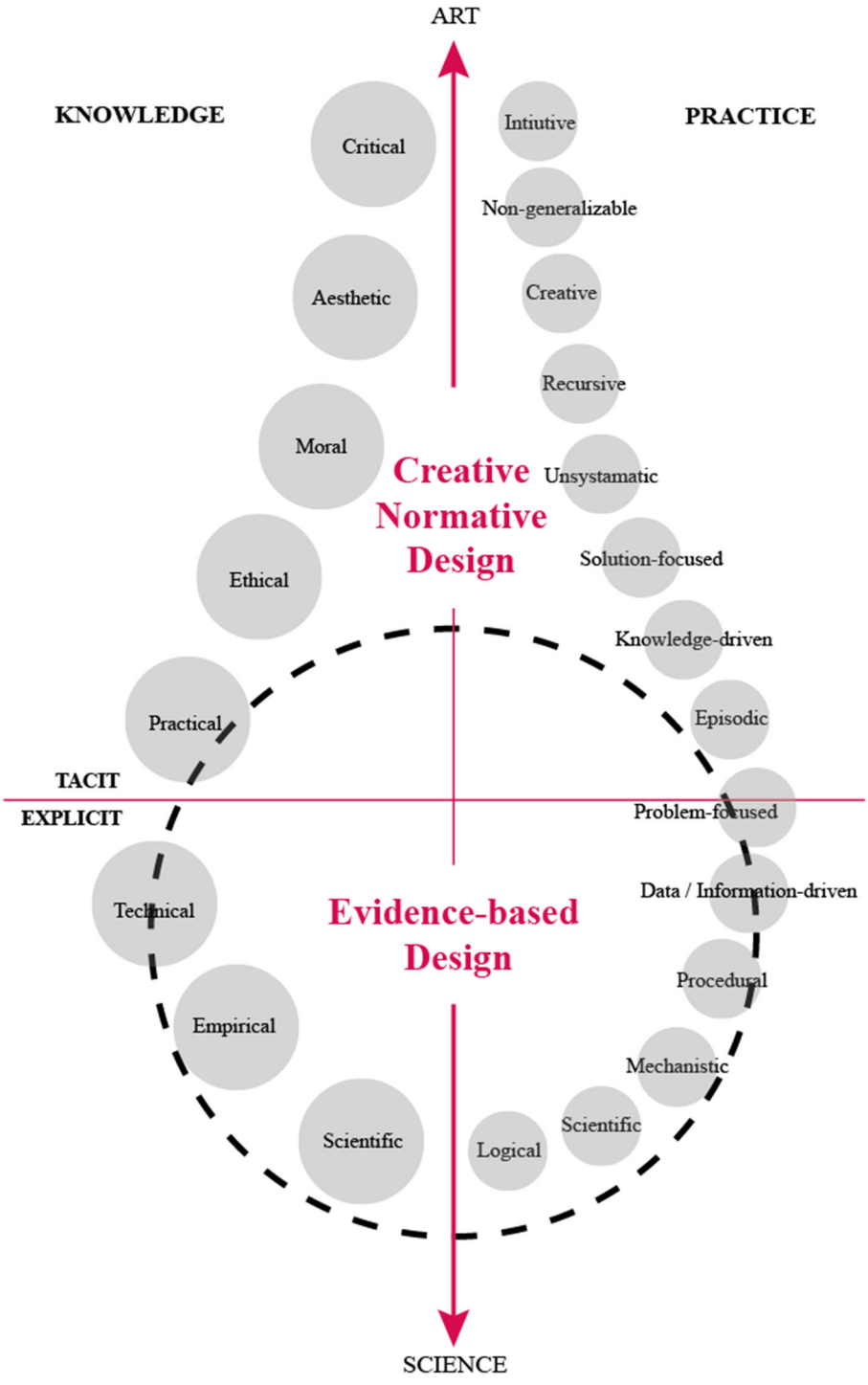


Figure 2.1. A conceptual diagram of EBD in relation to ‘normative’ design

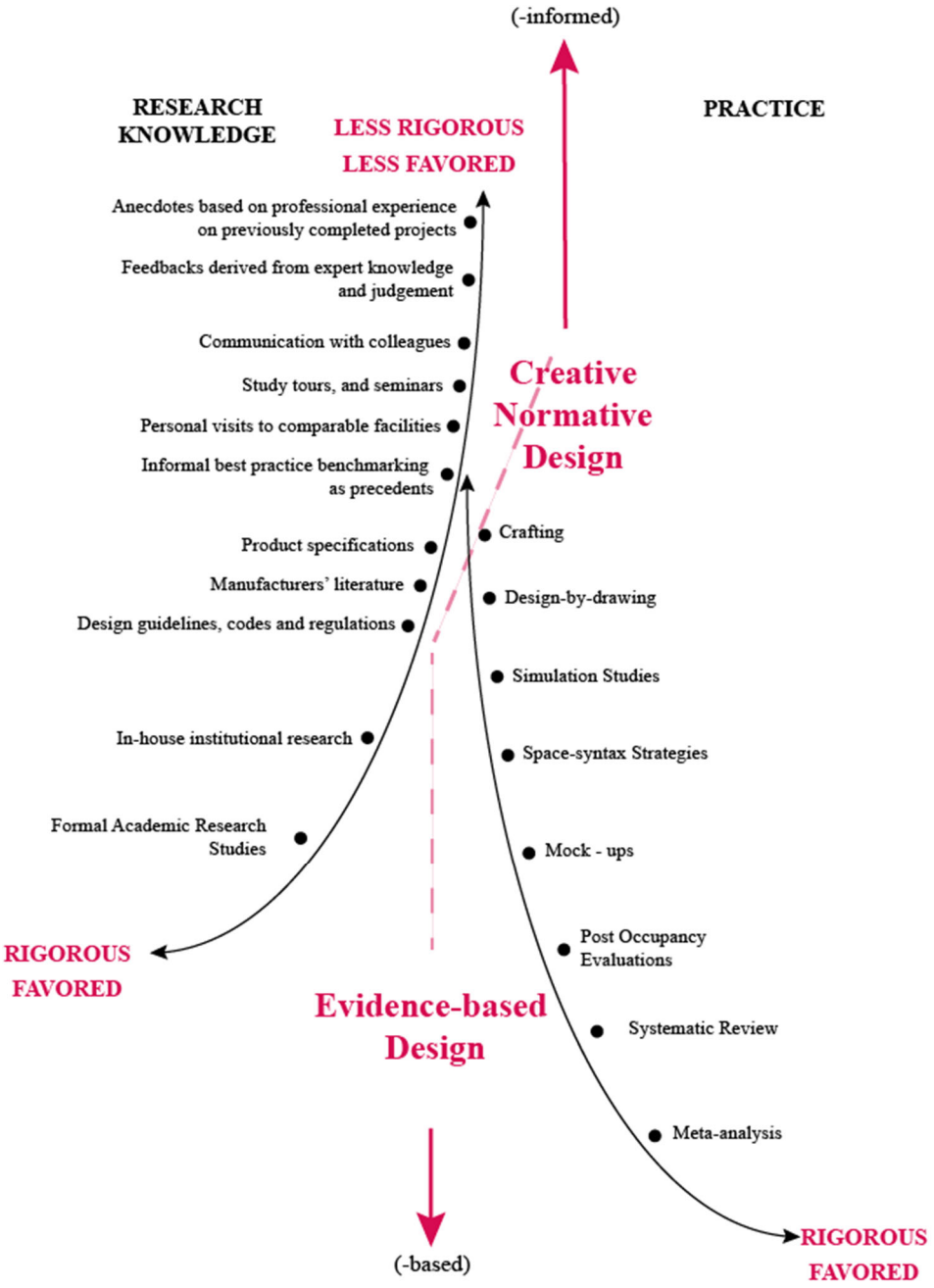


Figure 2.2. A conceptual diagram of 'knowledge base' and methods of EBD and 'normative design'

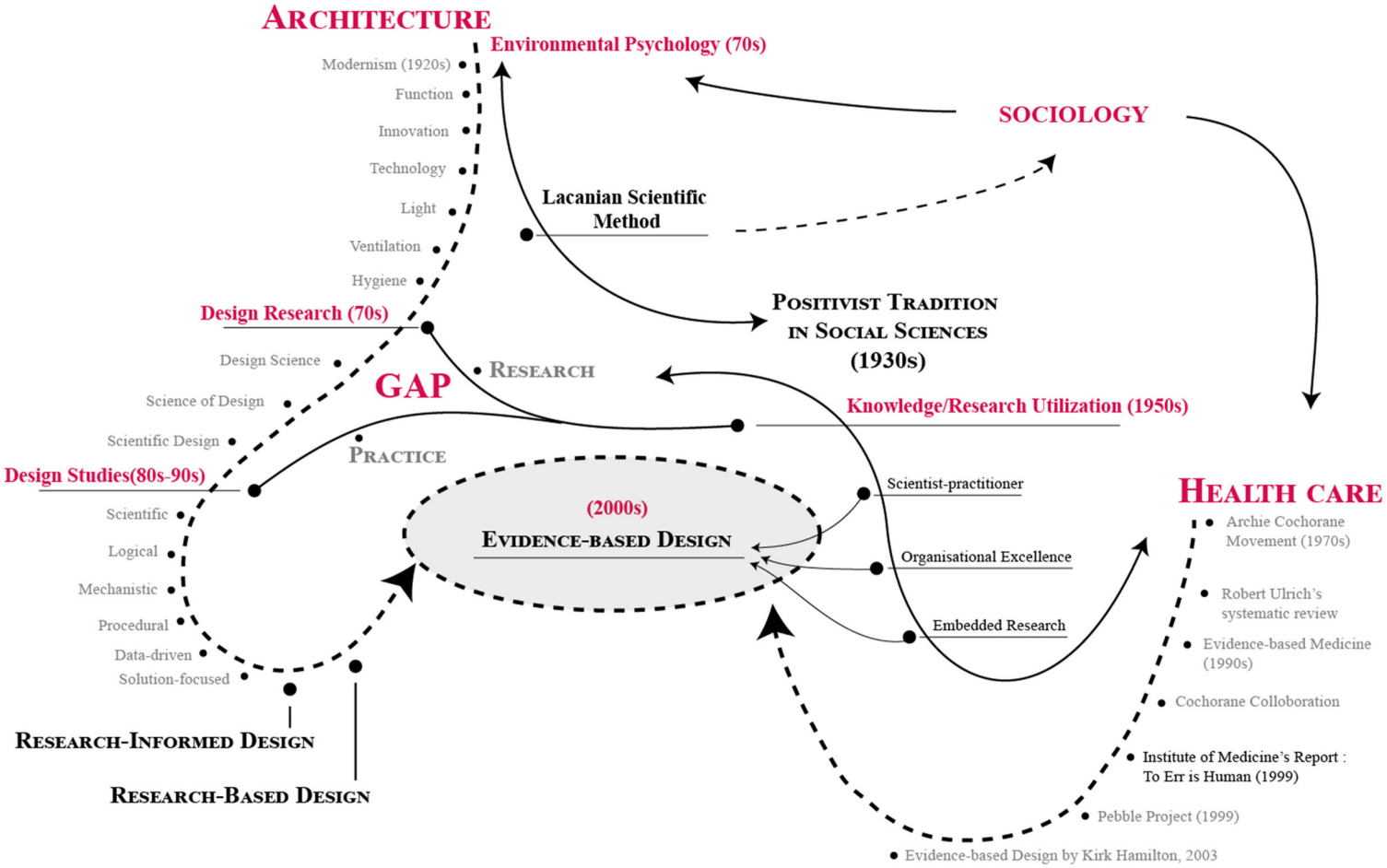


Figure 2.3. A conceptual diagram of EBD in relation broader paradigmatic developments of the fields of architecture and health care

Historically, although EBD is a concept which was first emerged in 2000s, historical roots of the overall principles of evidence-based approaches in HBD dates back to designing processes of 19th century 'pavilion type' hospital buildings in England and French (Francis et all., 1999; Gesler et all., 2004; Aravind & Chung, 2010; Lundin, 2015). Pavilion type hospital buildings as a dominant design trend that spanned from mid-19th century to late 20th century were simply meant to be hospital building complexes consisted of detached or semi-detached building blocks, either isolated or linked to each other with linear corridor attachments (Pevsner, 1976). But more important than their form and layout, they were the precedents of initial hospital designs informed and guided by the findings of studies carried out by empirical research methods (Forty, 2003). These primarily included John Pringle (a 18th century physician in France)'s experiments on the effects of natural ventilation on patients' recovery times, and Florence Nightingale (a nurse and social worker)'s design principles and guidelines based on epidemiological data of 19th century hospital buildings in England (Pevsner, 1976; Forty, 2003).

Since the end of 19th century, when the professionalism in architecture field predominantly emerged to be visible over HBD, and together with the influence of the 'mechanization'[4] on HBD, initial architects specialized in hospital design faced with a complex body of knowledge required not only for dealing with the medical and functional but also the technical and engineering requirements of health care buildings (Hughes, 2000; Forty 2003). For dealing with such complexity in the knowledge area, one strategy was to move the expected level of knowledge utilization from individual design professionals toward the systems through which the design is practiced accordingly. Accordingly, in 1950s, The National Health Service (NHS) in the UK initiated one of the first and most initiative development in 'systems approach' to health care and established a full set of specification

[4] A concept referring to substitution of some services and functions of hospitals with mechanical technologies such as vertical circulation, mechanical ventilation and so on.

documents (standards, codes, technical memorandums, and guidelines) covering a broad range of issues such as service planning, briefing, designing, building systems, components, equipment, management, and procurement of hospital buildings (Francis et all., 1999). Resulted specification documents grounded on concrete research findings as being the final products of some 'systematic' and 'rigorous' validation processes by the insights of researchers from a vast variety of different disciplines such as medical specialists, physicians, nurses, technicians, statisticians, architects, planners, historians and so on (Francis et all., 1999; Duffy & Hutton, 2004; Price & Lu, 2013). When considered from architects' standpoint, they have been; for decades, providing architects important sources of knowledge codifying the key findings of multidisciplinary research; hence becoming a very integral part of designing process (Francis et all., 1999; Mohan, 2002; Duffy & Hutton, 2004). They have also been serving the purposes of knowledge 'dissemination', 'translation' and 'transfer' in design without even needing architects' direct interaction with institutional research underpinning their establishment process (Gesler et all., 2004; Hamilton, 2009; Price & Lu, 2013; Rashid, 2013; Wanigarathna et all., 2016).

Unlike the 20th century systems approach to the relationship between architects and HBD knowledge, more recent developments in HBD field echoes their far pasts of 19th century by means of the efforts for systematically re-explicitizing the design knowledge referred by design professionals. Similar to their predecessors from medical field, today what authors name as 'safety movement' or 'rigorous paradigm' in HBD necessitate architects having a more direct engagement with formal research findings in front (Becker & Parsons, 2007; Shoemaker et all., 2010). Healthcare industry requires architects to expand their practical and technical knowledge to scientific knowledge; as well as requiring to apply the principles and methods of formal research demanding a multidisciplinary inquiry into the increasingly complex and challenging world of scientific world (Hamilton, 2003; Martin & Guerin, 2006; Zimring & Bosch, 2008; Lawson, 2010; Ulrich et all., 2010; Anderson, 2019). Accordingly; over the last decades; there has been a growing reliance on empirical

research studies ranging from medical, environmental and engineering to sociological, psychological and anthropological studies that addresses a broad range of design-related issues and their expected influence on overall health care outcomes (Ulrich & Zimring et all., 2004, 2008; Taylor & Hignett, 2016; Hall et all., 2017; Fay et all., 2019).

All these forces that health care architects are being exposed to can be argued to be the symptoms of two major belief systems which have interactionally been developed based on the belief on the power and the critical impact of design in contributing to the health care outcomes. This thesis categories the first belief system as 'safety-oriented', suggesting that the design of health care environments can prevent hospital-acquired health care treats in place (i.e. injuries, falls, infections, delays and so on). Another belief system is 'support-oriented', suggesting that design of health care environments can promote emotional uplifting on patients, hence instrumentally contribute to positive health care outcomes (i.e. view of nature, lightning, color, decoration and so on). When compared with their domains of interests, both belief systems also differ in terms of their resemblance with their historical origins; as the first develops as the successor of the traditional understanding of the linkage between design and health outcomes (mechanical) while the latter develops as a newly emerged system of inquiry, constituting the contemporary understanding of the linkage between design and health care (psychological). Here it is helpful to scrutinize more on the rationales and development processes of each because they are also strong statements in understanding the different natures and complexities of the evidence-based knowledge base (or more commonly named as 'evidence base' in the literature) of HBD field.

2.2.1 'Safety-oriented' domain

Triggered by what is described in the literature as 'alarming' or 'shocking' reports of Institute of Medicine (IOM), safety-oriented approach to design is one of the most

initiative foundation, and also turning point behind the pioneering health care movements all over the world. IOM had reported in its ("To Err Is Human: Building a Safer Health System", 2000) report that a significant number of patients in the US die each year from hospital-acquired treats. In its ("Crossing the quality chasm: A new health system for the 21st century", 2001) report, threats to health care were organized into a more 'systemic approach': being caused by 'clinical processes', 'human performance', 'technology', and the 'physical environment' (Becker & Parsons, 2007; Shoemaker et all., 2010). Particularly the bold emphasis on design factor of physical environments resulted in the existing health care buildings stock of the industry being questioned in terms of their quality and effectiveness.

After IOM's reports, and upon the consensus that existing hospital buildings do not respond to the changing needs of health care, healthcare industry witnessed a worldwide 'hospital construction boom' (Jones, 2004; Ulrich & Zimring et all., 2004; Nelson et all., 2005; Stichler, 2007; Malkin, 2008; Shoemaker et all., 2010). New investment plans raised the question of whether or not they are delivering value for money (Codinhoto et all., 2010). Hospital designers recognized the fact that despite the similar nature of projects and problems they are dealing with, mistakes had been repeated (Lawson et all., 2003). Quality of health care environment was considered risky if it had not been designed based on empirical research findings as the sources of evidence (McCullough, 2010).

Domain of the evidence base of the required health care reform movement was also shaped accordingly. Studies relating design and safety, linking primarily the technical and functional aspects of design to health care outcomes became significant to be referred to. Studies showed that locating sinks and gel dispensers closer to staff work paths, switching from multi-bedroom system to single-bedroom ones, using proper hydraulic and ventilation systems, avoiding warm temperatures reduce hospital-acquired airborne and waterborne infections significantly (Codinhoto et all., 2007; Alfonsi et all., 2014). Constant exposure to fluorescent light increases the risk of skin cancers, and low frequency (red) light contributes to night sleep quality; while contrastly, high frequency (blue) light results in increased sleep-wave and day

walking to be desirable for sleepy infants (Codinhoto et all., 2007). Carpeted rooms and corridors increase infection rates while decreasing patient falls (Codinhoto et all., 2009). Adequate and proper use of handling systems, eliminating sharp- and hard-edged furniture prevent patient falls and staff injuries and so on (Brown & Ecoff, 2011; Malone & Dellinger, 2011).

Safety-oriented approach to design was also significant for providing a ground for the adaptation of another belief system. IOM's shocking reports and through which the realization of the power and impact of the design on improving overall health care outcomes brought some; what normally had emerged in 1970s, discussions into surface. New belief system emerged to be a critique of safety-oriented approaches to health care and design; especially for its tendency on sustaining overly dominant influence of the medical and mechanical trends of 20th century health care. Accordingly; the field of medical sociology flaggered the new movement as elaborated in the following section.

2.2.2 'Support-oriented' domain

In 1970s in the field of medical sociology, concepts of 'justice' and 'equality' was influential for challenging and suppressing the power of medical profession over health care (Gerhardt, 1989). Medical sociologists claimed that all the social aspects of life become more and more 'medicalized', and treated only through the perspective of diseases. 'Disease-oriented' health care understanding was perceived to be far from improving people's health; rather with the side effects of treatments, the health and autonomy of patients on their own health state is exacerbated and deprived. The proposed formula was named as 'health promotion' (later on turned to be 'proactice health care'), which was emerged as an idea to educate patients for interfering with their own health, as well as leading a shift from a 'treatment-oriented' health care toward a 'prevention-oriented' health care understanding (Lupton, 1997). In this regard, health promotion signified 'holistic', 'patient-centered' and 'proactive' approaches to health care for suppressing the power of

medical professionals and proposing a ‘consumerist view’ of health care in which the control shifted out of care-givers to receivers, and the mere issues of safety and effectiveness were extended to the patient preferences, needs and values (Berwick, 2009; Reynolds, 2009; Epstein & Street, 2011).

Influence of the discussions initiated by the field of medical sociology became fully evident in a health symposium held in 1985 in Paris. Academics, practitioner, leading health care organizations underlined the limited understanding of the notion of ‘health’ as only the physical fitness of body; and as a result, World Health Organization (WHO)’s definition for health found resonance and gained prestige to be acknowledged (Junior & de Lima Paula, 2008). WHO’s definition of health was; as keeping its validity today, groundbreaking for broadening the conceptualization of health into a “complete state of physical, mental and social well-being, not merely the absence of infirmity” (WHO, Constitution of WHO). The most concrete and direct interaction of HBD with these developments in health care field was grounded on the notion of ‘salutogenesis’, which was theorized and conceptualized by Aaron Antonovsky (an American medical sociologist) in his seminal book of (‘Health, Stress, and Coping’, 1979). Antonovsky categorized health care in two models. Traditional model was ‘pathogenesis’; a term describing the study of diseases and their origins. The emerging model was; on the other hand, ‘salutogenesis’ as the study of how to create, enhance and improve physical, mental and social wellbeing. For this; a notion called ‘salutogenic design’ aimed at reducing health care settings-related mental risk factors such as stress, anxiety, depression, frustration, isolation and so on (Becker et all., 2010; Lyon, 2017).

Following the above-mentioned developments in medical sociology, domain of the evidence base of the new design movement broadened from clinical, epidemiological, and engineering studies to new areas of environmental, behavioral, sociological, anthropological and psychological studies. The new movement resulted in a significant increase in the number of empirical studies questioning the psychologically therapeutic effects of health care environments (Gesler et all., 2004; Codinhoto et all., 2009). Studies showed that use of ambient orange color in waiting

areas lowers anxiety, increase mood and calmness; music in health care environments provides therapeutic effects and reduces stress and anxiety; view of natural scenery, providing indoor courtyards and atria with greenery provide positives distractions, shorten recovery times, reduce the usage of pain-relief drugs; use of art contents enhances patient-nurse communication and promotes psychological restoration; colors in patient rooms and corridors mitigate social isolation and provides easier way-finding while; on the other hand, single patient room layouts eases noise control, allows for high-quality sleep and provides better experience of privacy; and so on (Zhang et all., 2019).

2.3 Evidence-based Design (EBD)

Started with ‘architectural knowledge’ and refined through ‘design knowledge’, ‘knowledge for design’, ‘evidence-based knowledge’ for HBD, and ‘evidence base’ of EBD field, previous section provided a view into the originating contexts and rationales of the conceptual journey of HBD field from ‘knowledge’ as a generic term including all kinds of knowledge toward ‘evidence’ as a more specific term referring to a particular type of knowledge of which the reliability and validity is necessitated to be grounded in scientific means. Historically, although all this process is rather comprehensive in terms of its implications for the field of ‘architectural theory’, trajectory of EBD literature has been mainly shaped upon dealing with a rather more comprehensive area of practical challenges faced during the adaptation of EBD concept by architecture field. This section will temporarily re-build on the ‘design’ and ‘knowledge’ divide and explore the nature and complexity of the ongoing challenge and effort areas of EBD field.

Before proceeding with EBD, it is necessary to provide a brief background about the overall principles and methods of its philosophical and methodical counterpart in medical fields because EBD and many other EBP models share some common philosophical and practical underpinnings derived originally from medical fields.

‘Evidence-based practice’ or ‘evidence-based’ (ness) as a self-descriptive adjective refers to a generic decision-making model based on providing a shift from an authority-based practice driven by mere opinion and experience toward a practice driven by systematic search for concrete research findings as the sources of evidence (Stankos & Schwarz, 2007). Overall principles and methods of evidence-based (ness) are originally developed in 1990s for the clinical practice of medical professionals, particularly for EBM.

In 1970s, Archibald L. Cochrane (a medical doctor in the UK) had a critical standing against practicing based on the constant skills and knowledge learnt in school, and exposed a need to develop alternative practice models based on the synthesis and innovative use of new research in the clinical decision-making process of medical professionals. Cochrane argued that every-day practices of clinicians including treatment, interventions, tests and procedures may harm than good because of lacking evidence that demonstrate their efficiency and effectiveness (Cochrane, 1972). Motivated from Cochrane’s view into clinical practice; in 1990s, a group of scholars called ‘EBM Working Group’ coined the notion of EBM and labeled it as a ‘paradigm shift’ for the conventional clinical practice and education of medical professionals (Guyatt et all., 1992). An initial and the most acknowledged formal definition of EBM was provided by (Sackett et all., 1996) as follows:

> “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.”

Accordingly, the new paradigm challenged the mere issues of clinical experience and intuition in practice, and claimed that clinicians are more fallible, when prescribing what works or what does not work, then the observational and experimental research findings derived from natural clinical settings (Charlton & Miles, 1998; Haynes, 2002; Sehon & Stanley, 2003). Accordingly, ‘randomized controlled clinical trials’ (RCT) as the most rigorous applied research methods of fundamental basic sciences of medicine such as biology, pathology, physiology, biochemistry was moved at the top of knowledge sources referred in clinical

decision-making process. And the secondary research sources of systematic literature review and analysis methods; 'systematic reviews' and 'meta-analyses', turned to be a very integral part of clinical decision-making process of medical professionals, as well as the processes of establishment of mechanisms of clinical practice standard and guidelines (Cook et all., 1997; Bero et all., 1998; Haynes, 2002; Tranfield et all., 2003).

Following these developments taken place in medicine, influence of the practice of EBM exceeded the boundaries of first the clinical practice of medical professionals and then of the overall health care field. In health care field, many other disciplines; such as -nursing, -public health, -health policy, - pharmacy, - mental health, - psychiatry adopted evidence-based decision-making model (Charlton & Miles, 1998; Harari, 2001; Haynes, 2002). Outside the health care field, other disciplines such as -social work, -crime prevention, -education, and -design also embraced the philosophy and principles of EBM (Viets, 2009).

HBD was among the fields which was affected from the profound EBP movements. Adaptation of EBP by design field was achieved through a strong analogy created between medical professionals and architects (Stankos & Schwarz, 2007; Viets, 2009; Viets & Anderson, 2011). In 1993, The Center for Health Design (CHD) was founded with a mission of integrating health-related research knowledge into the design process of health care buildings. The foundation aimed to bring medical specialists, architects, interior designers, contractors, and management professionals together to collaborate and apply the principles of EBP in design (CHD, About Us). Twenty years later after the foundation of CHD, Kirk Hamilton; professor of architecture at Texas A&M University and director of CHD provided the initial conceptual framework regarding the practical application of EBP in HBD. Accordingly naming EBP in design as EBD; (Hamilton, 2003) defined four levels of design practice gradually moving from passive use of knowledge as the regular design practice of architects toward a more active model including the stages of literature review, hypothesizing, measuring, reporting and publishing; which are

altogether named as the practice characteristics of 'scholar-practitioners' or scholar-architects.

Following its initial conceptualization, and based upon a strong analogy created with EBM, (Hamilton & Watkins, 2009) provided the first formal definition of EBD as:

> "a process for the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project."

Additionally; (Hamilton & Watkins, 2009) explained; again with a strong analogy with EBM, the rationale behind EBD as a respond to and also a criticism of the traditional, unstructured approaches in making decisions in the designing process of buildings as quoted in the following: "now it is time to take our profession to a new level of knowledge-based practice; one that is aggressive in its methodology for acquiring a more robust and rigorous degree of knowledge for the design of buildings, a methodology and a process that demands different ways of working, new allies, different kinds of recourses and different kinds of talent."

The strong analogy created between EBM and EBD meant architects to provide empirical cause and effect relations between their design decisions and health care outcomes, and formulate research questions and hypothesizes as similar to clinical interventions of medical professionals as exemplified by the following studies:

> "What are the effects of soft music during evening ours on hospitalized elderly patients?"; or, "In inpatient hospital units, does the implementation of acoustic guidelines reduce unit decibels, and increase patient and staff satisfaction?" (Brown & Ecoff, 2011),

> "As a result of incorporated decentralized nursing station supplies on the units, the distance walked by the staff will decrease, staff fatigue will decrease, and the time spent by staff in direct patient care will increase." (Joseph & Hamilton, 2008); and so on.

Hence; at its core, EBD was initially conceptualized as a design practice model which shared the tenets of medical fields by means of the 'scientific rigor' adopted

in the decision-making process of medical professionals (Stankos & Schwarz, 2007; Roberts et all., 2016). EBD as analogous to many other EBP models was grounded on the belief that decision-making process of architects are more reliable when grounded on 'credible research' findings than the sole intuition and personal experience (Baumbusch et al., 2008; Viets, 2009; Brown & Ecoff, 2011; Thyer & Myers, 2011; Peavey & Vander Wyst, 2017).

In EBD field, 'credibility' or 'reliability' is generally associated with the types, methods, and processes of research referred during the designing process. Although the field acknowledges research in many forms, formal research types of peer-reviewed scientific publications are weighted the highest credibility. Overall; such studies are hypothesis-driven and empirical as to provide causal links between HBD and expected health care performance outcomes. In this regard; unlike the limited extent and scope of traditionally referred body of research findings on HBD (safety-oriented) when the main attention of design was more on building performance efficiency, cost, and clinical functionality, literature reviews show that empirical research on HBD gradually addresses a broader range of design issues including the occupants' perception of environmental quality and comfort (Ulrich & Zimring et all., 2004, 2008; Taylor & Hignett, 2016; Hall et all., 2017; Fay et all., 2019).

As part of EBD, scientific inquiry into the HBD necessitates also a systematic inquiry into to the stages and methods of its usage by architects during their designing process. EBD basically aims to systematize the designing process as to trigger the utilization of evidence-based knowledge or what we can further refine as 'evidence-based studies' of empirical research findings in the decision-making processes of architects. Accordingly; an EBD process identically looks like as being composed of the following stages: understanding and analysis of design problems, developing EBD concepts, collecting relevant research findings, synthesis and translation of findings into design, prototyping and testing, and finally measuring and publishing the outcomes of design and research (Hamilton, 2003; Joseph & Hamilton, 2008; Codinhoto et all., 2010; Brown & Ecoff, 2011). For doing so, architects are required to have advanced research skills to formulate research questions and hypotheses,

review the literature, and establish empirical linkages between their design and its potential implications on health care performance outcomes (Hamilton, 2003; Codinhoto et all., 2010; Chong et all., 2010; Alfonsi et all., 2014).

Through its overall principles and objectives, EBD finds support and resonance widely by many of the political, sectorial, educational, and organizational stakeholders in the industry. These include for example: leading health care organizations (i.e. IOM, WHO), national institutes of architects (i.e. AIA, RIBA), governmental agencies (i.e. NHS, HHS), health care accreditation and certification firms (i.e. JCI, AC, ACHS, ISQua), graduate programs specialized in HBD (i.e. Design & Health Program in Georgia Institute of Technology School of Architecture, Healing Architecture Program in Sheffield School of Architecture), HBD journals and magazines (i.e. HERD, The Lancet, The Journal of Health Design, Healthcare Design Magazine) and so on.

Constituting the primary motivation behind this context of wide acceptance; according to earlier studies of the originators of EBD (Hamilton, 2003; Ulrich & Zimring et all., 2004); in the end, it is accepted to be a very 'rigorous' and 'robust' design practice model in lowering costs, achieving higher efficiency, ensuring safety and triggering the utilization of the key findings of environmental studies for the design of more pleasant, therapeutic, comfortable as well as supportive health care environments.

2.3.1 Challenges

Despite all its potentials and the wide acknowledgement that EBD has found over the last decades, 'integration' of evidence-based studies in design has not been easy. EBD has introduced the HBD field some major challenges that today; especially in the originating countries of EBD (primarily the US, UK), many of the architectural schools hosting specialized research groups in HBD, as well as leading HBD journals publishing extensive research about EBD, keep spending efforts for developing tools, methods and strategies to support, widen, and facilitate its practice in HBD.

Accordingly; in relation to integration of evidence-based studies in design, challenges reported in EBD literature can be grouped according to their relevancy with the following five aspects of evidence-based studies. Following these, their relation with the ongoing effort areas of EBD can be represented through Figure 2.4.

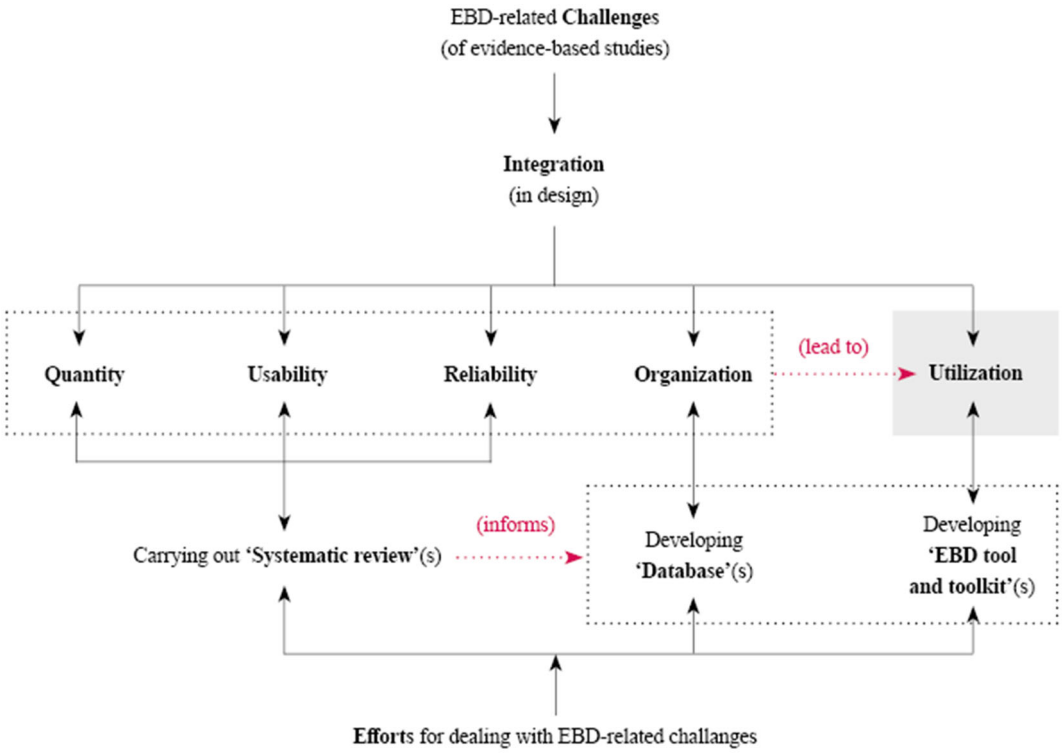


Figure 2.4. Major challenge & effort areas of EBD field

- **'Quantity'** mainly refers to challenges related with the amount and prevalence of evidence-based studies. For example, authors suggest that evidence-based studies are still premature, less in number, and narrow in scope for informing HBD (Stankos & Schwarz, 2007; Moore & Geboy, 2010; Rashid, 2013; Zhang et all., 2017),
- **'Usability'** refers to challenges related with the sufficiency of evidence-based studies in informing designing process. For example; authors report the insufficiencies of empirical research methods in providing explicit cause and effect relations for the built environments (Codinhoto et all., 2010; Durmisevic & Ciftcioglu, 2010). It is also claimed that evidence-based

studies are not often project-specific and do not translate the findings into useful design criteria (Martin & Guerin, 2006; Becker & Carthey, 2007).

- **'Reliability'** refers to challenges related with the rigor of underpinning research methods and processes of evidence-based studies. Although EBD field heavily favor evidence-based studies because of their high reliability, studies such as (Laursen et all., 2014; Taylor & Hignett, 2016; Hall et all., 2017) point that evidence-based studies are and may still be prone to research biases.
- **'Organization'** refers to challenges related with the compilation and storage of evidence-based studies for easing its accessibility to its referrers. Challenges reported in this category can be exemplified with (Durmisevic & Ciftcioglu, 2010; Davidson, 2017) that authors indicate the difficulties of accessing evidence-based studies because of their scattered and unorganized form in the literature.
- **'Utilization'** refers to challenges faced during the application of evidence-based studies by architects. Having more emphasis on this category; EBD field frequently suggest that architects do not necessarily have equal levels of formal research skills and vocabulary with medical professionals; hence it is indeed very difficult for architects for collecting, analyzing and interpreting the knowledge derived from evidence-based studies (Nelson et all., 2005; Martin & Guerin, 2006, 2007; Becker & Carthey, 2007; Viets, 2009; Durmisevic & Ciftcioglu, 2010; Codinhoto et all., 2010; Chong et all., 2010; Viets & Anderson, 2011).

2.3.2 Efforts

Major efforts for responding to the above-outlined challenges can also be classified under three categories as below.

- **'Systematic review'(s)** aim to address the challenges related with the 'quantity', 'usability' and 'reliability' of evidence-based studies. Systematic

reviews are the ‘secondary research’ studies carried out for reviewing, analyzing, and synthesizing of the findings of ‘primary research’ studies; hence producing bodies of new evidence in a bias-free way (Nelson et all., 2005; Clarke, 2011; Codinhoto et all., 2007; Kaijanaho, 2014). Originally developed in 1990s in medical fields for informing practice guidelines of health care professionals (Cook et all., 1997; Bero et all., 1998; Tranfield et all., 2003), today systematic review is a widely adopted method in a wide range of EBP models including also the EBD (Codinhoto et all., 2008). For EBD; according to their scopes and research areas, systematic review studies can also be categorized as follows:

- systematic review studies reviewing the literature through a bottom-up approach as concentrating on particular aspects of design and health care outcomes; for example, (Taylor & Hignett, 2016) by patient falls, (Gharaveis et all., 2018) by team work and communication, (Hadi et all., 2019) by the effects of light on sleep-related psychological factors, (Fay et all., 2019) by decentralized nursing stations, (Jiang & Verderber, 2017) by circulation zones, and so on.
- systematic review studies reviewing the literature through a top-down approach for producing meta-knowledge about the overall extent and scope of evidence-based literature. Such studies; as their nature, aim to concentrate on all possible aspects of design and health care outcomes; for example, (Ulrich & Zimring et all., 2004, 2008; Codinhoto et all., 2008, 2009; Laursen et all., 2014; Zhang et all., 2019), and so on.

o **‘Database’(s)**; from a dictionary stand point (OED, Webster), are structured data sets which are generally stored online and accessed by computer software. For the particular context of HBD, databases can be considered as follows;

- database(s) developed for the particular purpose of informing design aims to deal with the challenges related with the organization of evidence-based studies. They are analogously parallel with, and also based on

systematic reviews by means of critically appraising evidence-based literature and providing architects a compilation of latest available body of evidence. Different from systematic reviews; on the other hand, practicality and user-friendliness are prioritized as to allow architects searching online by the particular aspects of design, health care outcomes, and their implications for design as clear and useful design criteria (Martin & Guerin, 2006; Sailer et all., 2008; Martin, 2009). Some of the well-known are 'InformeDesign©', 'CHD Knowledge Repository', 'AIA Knowledge Net' and so.

- database(s) developed for informing many other disciplines and professions do not have the particular purpose of appraising evidence from design point of view; whilst on the other hand storing important evidence which are often utilized by EBD database developers and systematic reviewers. (Edelstein, 2008)'s key findings show that generic databases such as i.e. 'PubMed Medline', 'EBSCO', 'ProQuest' are also utilized by architects during their designing process.

o **'EBD tool and toolkit'(s)** mainly deals with challenges related with the utilization of evidence-based studies by architects. According to its dictionary meaning (OED, Webster), a tool (computing) is an item of software developed for achieving a particular task or function. Similarly, a toolkit (or toolset) refers to a set or library of tools designed for construction of more advanced usage programs in specific application areas. Majority of tools developed for the particular application of EBD field are UK-origined and developed through the collaboration between Sheffield School of Architecture and NHS; as their inter-relational explanation is comprehensively provided by (Phiri, 2014). Accordingly, parallel to online databases, EBD tool and toolkits refer to systematic reviews but different from databases, they do not only translate evidence-based studies into design criteria but also the evaluation criteria and checklists of the quality of the design outcomes. For doing so, EBD tool and toolkits are generally intended

to function in parallel with the existing specification networks of NHS and UK's building procurement systems. Some of the well-known are DQI (Design Quality Indicator), PEAT (Patient Environment Assessment Team), ASPECT (A Staff & Patient Environment Calibration Tool), AEDET (Achieving Design Excellence Evaluation Toolkit), and so.

Based on the above-classified overall challenge and effort areas of EBD, here it can be argued that despite the existence of a variety of EBD-related challenges, particularly challenges related with the 'utilization' of evidence-based studies comes into prominence for being also led by others including 'quantity', 'usability', 'reliability', and 'organization' of evidence-based studies. Overall aims and principles of the efforts for dealing with EBD-related challenges bring also the 'utilization' into prominence as the primary motivation source in behind. Therefore, following section will provide an expanded reading of the notion of EBD from an alternative conceptual ground, and scrutinize more about the ongoing mechanisms of knowledge translation and utilization in EBD.

2.4 Knowledge 'Utilization' and 'Translation' in EBD

'Knowledge Utilization' (also called 'research utilization' or 'knowledge translation') is a bold field of study in its own right that aims to respond to the chronic problem of 'knowledge gap' between the two communities of research and practice (Glaser, 1976; Weiss, 1979; Rogers, 1983; Reid, 1994; Landry et all., 2001; Jacobson et all., 2003; Nutley et all., 2008; Davies et all., 2010). Described in the seminal works of Everett M. Rogers (1983) and William J. Reid (1994) as 'empirical research tradition' and 'empirical practice movement', literature on knowledge utilization links the origins of initial works on knowledge utilization field to the increased scientific research activities in social sciences in 1960s; yet the gradually emerged demands on utilizing the empirical findings of these studies for improving the quality and effectiveness of public services. Accordingly; according to (Glaser, 1976);

during the following two decades, the field concentrated on the three major aspects of knowledge utilization as these are in the following:

- stages of development, dissemination and implementation of research knowledge produced and accumulated in social sciences,
- identifying factors and variables to deal with the delay in adaptation of developed knowledge,
- developing models for appropriate and timely utilization.

2.4.1 'Multi-level'(s) of evidence-based knowledge utilization

By the end of 2000s; studies (Davies et all., 2010; Nutley et all., 2008) identified three major developed models of knowledge utilization as these were classified by their expected 'level of utilization' as below:

- **'scientist-practitioner'** or 'science-push' model' which aims to achieve utilization through research-minded practitioners who are supposed to be equipped for having their own skills for keeping up-to-date with the research and developments in their peculiar fields.
- **'organizational excellence model'** which aims to achieve utilization through developing research-minded local practice cultures in organizational scale,
- **'embedded-research model'** which aims to achieve utilization at the level of systems and processes including the establishment of governmental and organizational policies; hence requiring the NOGs and policy-makers to play the key role.

When EBP movement is considered from knowledge utilization standpoint, few studies (Jacobson et all., 2003; Baumbusch et al., 2008; Hall et all., 2017) has linked EBD and other EBP models to the former developments taken place in knowledge utilization field. Accordingly; authors suggested that among the three models developed in knowledge utilization field, EBP movement in general and EBD in

particular were initially formulated as a ‘scientist-practitioner’ models. However; because of the limitations and inefficiencies of ‘one-way’, ‘unidirectional’, ‘logical’ and ‘passive’ characteristics of information flow in the initial approach, fields gradually concentrated on the crucial concepts of knowledge ‘exchange’ and ‘reciprocity’; and aimed at more ‘interactive’ mechanisms of knowledge ‘translation’ among various stakeholders who are involved in EBD practice at various levels.

When knowledge utilization in EBD is considered at multiple levels; apparently to date, studies in EBD literature has concentrated on many of these, and provided significant insights and conceptual frameworks for further studies. These studies can be exemplified; according to the level of knowledge utilization that their research areas concerned with, as below.

Level 1: Architects

- revealing EBD as a design practice model, and providing procedural models for its application by architects in a HBD process (Hamilton, 2003),
- EBD in relation to analogy created between architects and medical professionals (Stankos & Schwarz, 2007; Viets, 2009; Viets & Anderson, 2011),
- situating evidence-based approach in design especially in terms of the ways of knowing, thinking, and designing of architects in HBD process (Lawson et all., 2003; Lawson, 2010; Wanigarathna et all., 2011),
- conceptual and methodical differences between EBD and other research-informed or research-based design practice models (Peavey & Vander Wyst, 2017),

Level 2: Project teams

- role of evidence in interdisciplinary HBD teams (Kasalı, 2013),
- HBD project teams’ use of evidence in an EBD process (Kasalı & Nersessian, 2017),

Level 3: Service founders, CEOs, administrators and other organizational boards

- role of service funders, CEOs, and health care administrators for an EBD process (Nelson et all., 2005; Zimring et all., 2008),
- organizational decision-making process adopted in the selection of EBD concepts (Shoemaker et all., 2010),

Level 4: Policy makers including NGOs and governmental agencies

- EBD in relation to NGOs, governmental agencies, health care quality and safety assurances systems, and HBD specifications (Hamilton, 2009; Hignett & Lu, 2009; Lindahl et all., 2010; Mills et all., 2015; Wanigarathna et all., 2016).

When gradually moving from level 1 to 4; and from the consideration of EBD at architects level to its consideration at systems level, the multi-level approach in knowledge utilization in EBD implies some major shifts in the main concern, challenge and effort areas of EBD. Accordingly; main concern of EBD field can be argued to be moving beyond how architects design based on the findings of evidence-based studies into how the findings of evidence-based studies can be translated into information which is more meaningful to design professionals. Analogously, integration of evidence-based studies that was defined as the major challenge area of EBD exceed the boundaries of design and includes also their integration in systems through which the EBD practice of architects and project teams is carried out accordingly. Therefore, when considered from this perspective; effort areas that was elaborated in previous section can be reconsidered as the efforts for establishment of integrated knowledge translation mechanisms among the various stakeholders who are involved in knowledge utilization at various levels (Figure 2.5).

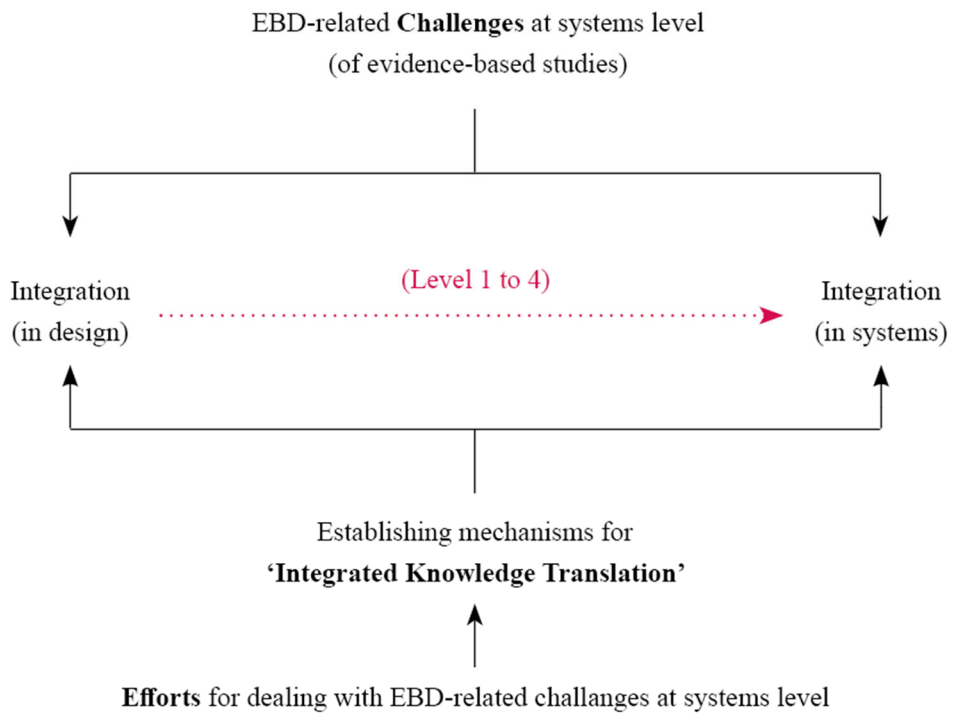


Figure 2.5. Initial implications regarding the shifts in the challenge & efforts areas of EBD when 'knowledge utilization' considered at 'multiple-levels'

2.4.2 'Integrated mechanisms' of evidence-based knowledge translation and the role of HBD specifications

Here in accordance with the before-mentioned multi-level approach to knowledge utilization in EBD, and through the consideration of EBD at systems level, HBD specifications (specifications set by HBD standards, codes, principle, guidelines, quality indicators, checklists, and so on) can be argued to play a critical role in providing a reciprocal interplay among the various levels of knowledge utilization in EBD. Accordingly; in architects and project team levels, HBD specifications are already known to be serving as a very intrinsic part of the designing processes of architects and design teams. Additionally, considering the overall challenge and effort areas of EBD that was elaborated in previous section, HBD specifications are also among the major sources of knowledge utilized during the development of EBD tool and toolkits. In health care organizations and systems levels, HBD specifications

are additionally important because HBD specifications are often utilized by NGOs and governmental agencies to ensure the communication and information flow between the various stakeholders in the industry, and provide effective ways of quality assurance, control, evaluation, and improvement of the design of health care buildings.

It is for the above-mentioned reasons that; over the last decade, EBD literature has been reporting HBD specifications to be critical in knowledge translation in EBD, and reveals potentials of utilizing evidence-based studies through evidence-based HBD specifications. For doing so; alternative to the certain aspects of evidence-based studies, EBD literature seems to concentrate on three major aspects of HBD specifications, and these can be listed as below.

- '**Integration'** of evidence-based studies in HBD specifications,
- '**Representation'** of evidence-based studies in HBD specifications,
- '**Utilization'** of HBD specifications by health care architects and design teams in their designing processes.

For example; (Hamilton, 2009) suggests that as long as HBD specifications are supported by convincing and sufficient evidence, as well as preserving the freedom to make flexible design decisions, HBD specifications can provide a positive impact on achieving a balance between the overly rational design expectations of evidence-based approach in design and the irrational and emotionally intuitive decision-making processes of architects. Additionally, (Hignett & Lu, 2009)'s retrospective analysis of the utilization of HBD specifications by architects reveals the validity of the need for HBD specifications but different from their predecessors, architects need the HBD specifications to be evidence-based. And (Wanigarathna et all., 2016) suggests by reference to the Nigel Cross's concept of 'designedly ways of knowing' (Cross, 2001) that if key findings of evidence-based studies are achieved to be represented as suitable in HBD specifications, this might facilitate and improve in turn both the utilization of evidence-based studies by architects and their effectiveness in design practice.

Based on these views into the critical role of HBD specifications in utilization of evidence-based studies in design, Figure 2.6 further represents the ongoing efforts for dealing with EBD-related challenges at systems level, and describes the information flow and knowledge exchange in the ongoing mechanism of integrated knowledge translation in EBD. Here apart from the aspects such as 'quantity', 'usability', 'reliability', 'organization', 'utilization', and 'integration' of evidence-based studies; or the 'representation' and 'utilization of HBD specifications; the need of evidence-based HBD specifications refers to the relationship between HBD specifications and evidence-based studies. In doing so; a further three key aspects of integrated knowledge translation in EBD can be listed as below, and their relation with other aspects can be represented through Figure 2.7.

- **'Inclusion'** refers to the extent to which evidence-based studies are utilized in the establishment processes of HBD specifications.
- **'Coverage'** refers to the extent to which evidence-based studies utilized in the establishment processes of HBD specifications can respond to the knowledge requirements of architects, and HBD accordingly.
- **'Compatibility'** refers to the extent to which knowledge domains of evidence-based studies and HBD specifications fit each other when informing architects and design teams during an EBD process.

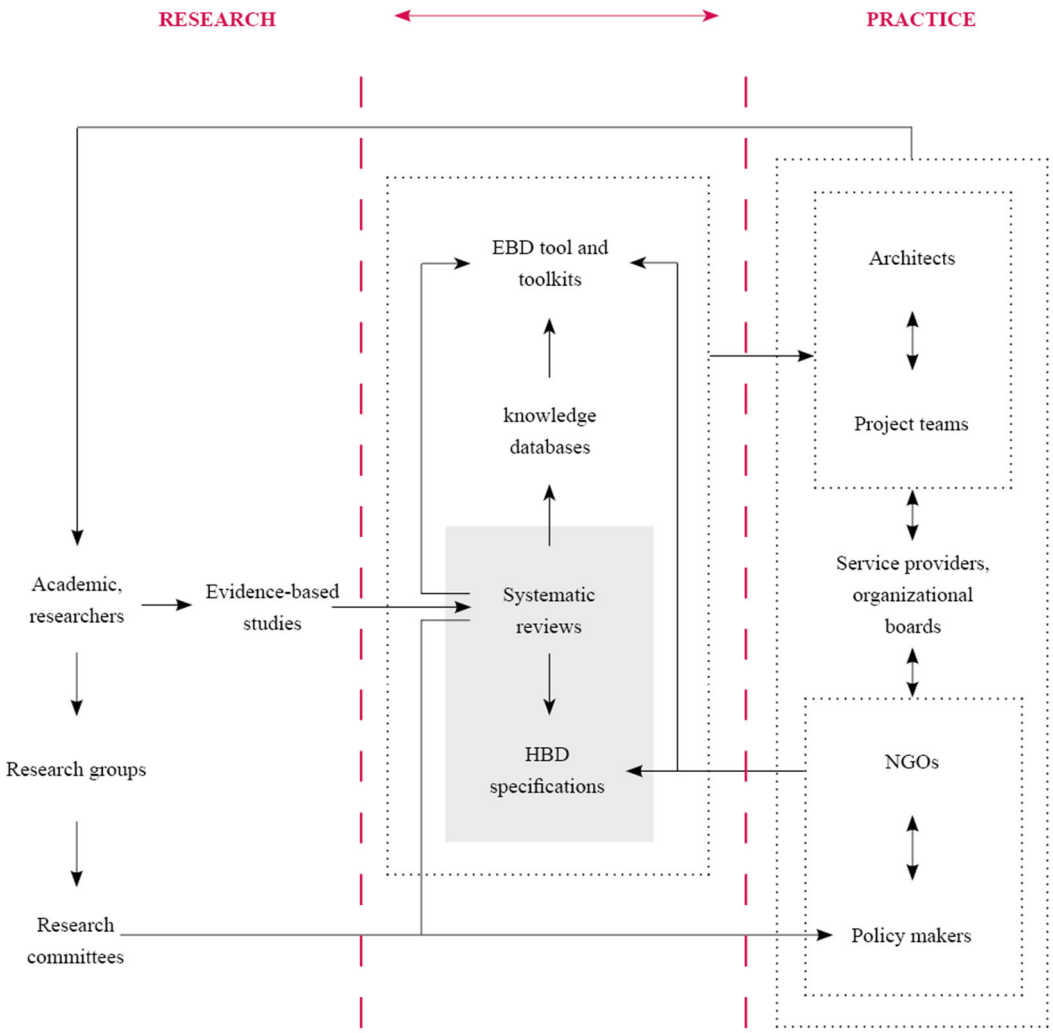


Figure 2.6. Information flow and knowledge exchange in EBD at systems level

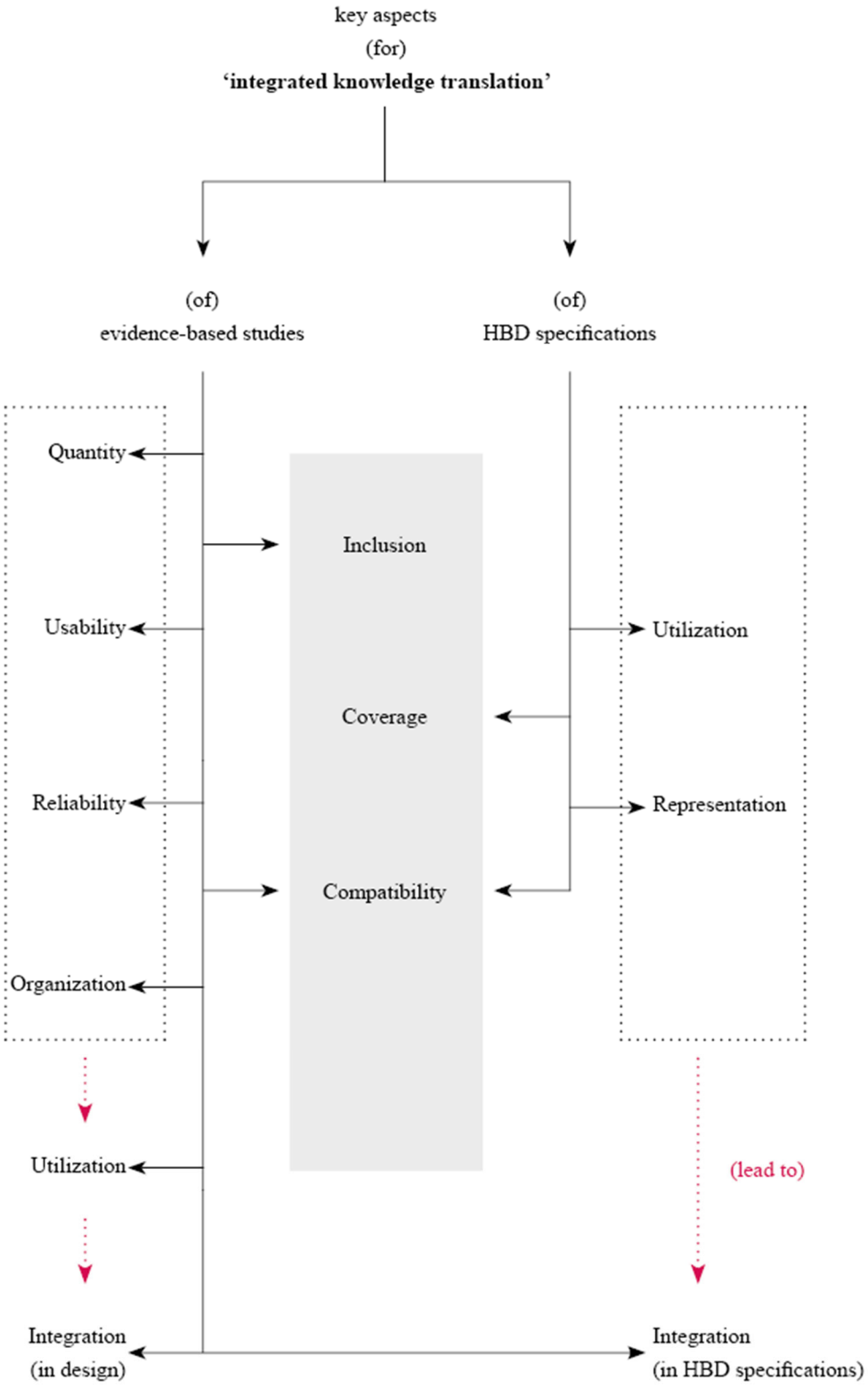


Figure 2.7. Key aspects of 'integrated knowledge translation' in EBD

2.5 Summary and Room for Further Evaluation

Following the scrutinization of EBD as a 'design practice model' which aims to integrate the findings of evidence-based studies in design, the chapter defined some of the key aspects of evidence-based studies as the major underlying challenges for their integration in design. These were primarily listed and elaborated as the 'quantity', 'usability', 'reliability', 'organization', and 'utilization' of evidence-based studies; and among them, EBD literature was deemed to have more emphasis particularly on the difficulties faced during the 'utilization' of evidence-based studies by health care architects during their designing process. Therefore, the chapter carried out an expanded literature review of EBD, and explored alternative ways of reading it especially from the knowledge utilization standpoint. As a result, it was argued that although EBD was initially and primarily conceptualized as a concept which concerns more about the utilization of evidence-based studies in design at architects level, more recent approaches and viewpoints into knowledge utilization in EBD actually refer more to a systemic issue including the establishment of broader mechanisms of 'integrated knowledge translation' and 'utilization' in EBD at multiple levels including the project teams, health care organizations and systems and so on. In doing so, the chapter identified HBD specifications to be critical, and listed and elaborated some of their key aspects for further evaluation. Based on the insights obtained from studies that question the potential ways of utilizing evidence-based studies through HBD specifications, these aspects were listed as the 'integration', 'representation', and 'utilization' in/of HBD specifications; and as the common ground, EBD literature was deemed to be exposing a need for evidence-based (ness) for HBD specifications.

Throughout the chapter, the thesis emphasized the two above-mentioned differentiated views of reading EBD especially by means of the different challenge and effort areas that are implied as potential areas of contribution for further studies. Accordingly, when gradually moving from the consideration of EBD at architects level to EBD at systems level; the chapter further argued that, the need of evidence-

based HBD specifications results in a temporary move beyond the potential study areas of the relationship between evidence-based studies and design, or the relationship between HBD specifications and design, but more toward the relationship between evidence-based studies and HBD specifications. Therefore; in addition to concentrating on the above-mentioned aspects of evidence-based studies; or of the HBD specifications, the chapter defined the aspects of the relationship between evidence-based studies and HBD specifications including their ‘inclusion’, ‘coverage’, and ‘compatibility’ as the main areas of investigation for the thesis. But before doing so, next chapter will provide an additional expanded literature review of EBD in relation to the establishment processes of health care buildings design, guidance, evaluation, and accreditation specifications in international and national contexts.

CHAPTER 3

HEALTH CARE QUALITY MANAGEMENT AND EVALUATION

> "… in a field that demands both rigorous and artful decisions? Many who practice or employ design are eager for strong, credible evidence that can lead to reliable guidelines and standards… to produce a guideline or a standard? If at some point enough evidence accumulates to be convincing, then many would expect that checklists, guidelines, principles, standards, regulations, or building codes could be promulgated with some confidence. This, then, would mean that the evidence had led to a product" (Hamilton, 2009: p. 52).

Having scrutinized the emerged context of EBD as a 'design practice model', and continued through its conceptualization as a 'knowledge utilization model', this chapter presents the second part of the literature review of the thesis. From reference to (Hamilton, 2009), and to the rest of few researches within which evidence-based knowledge 'utilization' and 'translation' issues are considered more at systems level, the chapter provides an expanded literature review of the establishment processes of HBD specifications or namely the evidence-based quality management and evaluation specifications as an emerging context. While doing so; the chapter explores the ongoing approaches and viewpoints regarding the critical role of evidence-based knowledge and EBD within the progressed contexts of EBD including the US and UK. Thereon the chapter introduces the recent systemic changes in Turkish healthcare as a significant case deserving further evaluation. By further digging into some of the peculiarities of the design and research fields of HBD in local context, as well as the publications of Ministry of Health of Turkey, the thesis names one of the major problems behind the integration of evidence-based studies in the specification network of Turkish healthcare as a 'knowledge gap' occurring between the specification-makers and architectural design and research communities in local and international contexts.

Following section starts by exploring the second conceptual journey of the thesis as it is from the term ‘health’ as a base concept for HBD field toward the ‘micro’ and ‘macro system’(s) of the ‘quality management and evaluation’ (QMaE); and accordingly; from the ‘HBD specifications’ toward ‘QMaE specifications’.

3.1 ‘Health’, ‘Health Care’, ‘Healthcare’, and the ‘Quality Management and Evaluation’ (QMaE) in Healthcare

WHO defines ‘health’ as “a state of complete physical, mental, and social wellbeing not merely the absence of disease or infirmity” (WHO, Health Systems Glossary). Analogously; from the dictionary standpoint (i.e. OED, Webster), ‘health care’ means “efforts to maintain or restore physical, mental or emotional well-being by trained or licensed professionals”. Beyond the efforts of individual professionals, health care is also a systemic issue. Turning back to WHO’s glossary of terms; WHO defines ‘system’ for health care as “all the activities whose primary purpose is to promote, restore and/or maintain health (including); the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve.” (WHO, Health Systems Glossary). Hence concepts of ‘health system’, ‘health care system’ or ‘healthcare’ by itself (often used interchangeably) refer to the totality of a broad range of collective efforts spent for improving the ‘quality’ of health care services.

Here ‘quality’, according to dictionaries, refers to “a peculiar and essential character” or the general and desired excellence of “a character, disposition, and nature of an object or a person”. For many fields and sectors ranging from service and manufacturing to healthcare; ISO defines ‘quality’ for any service or product as “the degree to which a set of inherent characteristics fulfills the requirements” (ISO, 2015). Considered for the particular context of healthcare, ‘quality’ and the major concerns related with the quality in healthcare can be specified by WHO’s definition. Accordingly, WHO defines ‘quality’ for health care as “the extent to which health

care services provided to individuals and patient populations improve desired health outcomes" (WHO. What is quality of care?).

For ensuring quality, key concept of 'quality management' (QM) comes into prominence as a term referring to "coordinated activities to direct and control an organization with regard to quality"; and for this; QM is responsible for the establishment of 'quality planning', 'quality assurance', 'quality control', and 'quality improvement' policies, objectives, and procedures (ISO, 2015). The totality of the mechanisms through which the QM is achieved is named by ISO as 'quality management system' (QMS). According to ASQ, QMS is a "formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives". A QMS "helps coordinate and direct an organization's activities to meet customer and regulatory requirements and improve its effectiveness and efficiency on a continuous basis" (ASQ, What is QMS?).

As part of the 'quality assurance' efforts of a QMS, QM involves also the establishment of certain 'quality evaluation' programs aiming objective measurement of performance information that, when collected and analyzed, can lead to continuous quality monitoring and improvement. A summary of quality evaluation programs that health care industry is heavily subject to can be listed as below:

- **'licensure'** referring to a governmental authority's obligatory and formal procedure for granting health care professionals or organizations permission to provide health care services;
- **'accreditation'** referring to a non-governmental organization's voluntary-based and formal procedure for evaluating a health care organization in regard to pre-established quality standards;
- '**certification'** referring to a governmental or non-governmental authority's voluntary-based or obligatory formal procedure to evaluate a health care professional or organization in regard to pre-established quality standards (Rooney & Van Ostenberg, 1999).

For establishing quality standards, international organizations such as JCI and ISQua set evidence-based criteria, and national governmental institutions such as HHS and NHS collaborate with their international organizations as well as with the academics, researchers, and practitioners in the field for setting down and organizing their own network of what is named in (Rooney & Van Ostenberg, 1999) and also adopted in this thesis as 'quality management and evaluation' (QMaE) specifications in local context. Continuous quality measurement through QMaE specifications is key to gather performance feedbacks from the field, reveal potential areas of quality gaps, identify factors that influence overall performance outcomes, as well as indicate future strategies for further improvement (WHO, 2008).

Performance data gathered in health care systems of different countries reveals quality gaps caused by many factors in many different scales. While the majority of these gaps are heavily reported to be caused by the factors related to the broad-scale systemic design issues of healthcare in macro scales; such as the lack of risk assessment and prevention policies (WHO, 2002), lack of universal health coverage funding models (WHO, 2010), and inadequate monitoring systems for sustainable development of health care quality (WHO, 2015), they are also caused by the factors related to the sub-processes and environments within which health care organizations, service providers, and professionals function and practice. The strategy adopted by the overall health care industry requires a 'multi-level approach to change' that relates not only the system-makers but also the stakeholders implementing those systems in health care delivery. (Ferlie & Shortell, 2001) groups these efforts by the levels of their intervention areas under four categories. These includes 'individual'(s), 'group/team'(s), 'organization'(s), and 'larger system/environment'(s), which all refer to 'multiple-level approach' to 'quality' in health care, and gradually move from the efforts for providing individual practitioners and practice teams with the required practice guidelines, protocols, and EBP centers to the establishment of QMaE specification networks.

For all the levels of change and innovation in health care, today many of the leading health care organizations all over the world (i.e. WHO, AHRQ, IHI) adopt IOM's

definition of the ‘effectiveness’ of health care and the changes made for improving the quality of health care as it is linked to the condition of “being based on evidence-based guidelines and scientific knowledge” (IOM 2001). In this regard; for responding to the ‘effective’ quality demands of health care, over the last decades, health care industry worldwide witnesses profound health care reform movements diffusing into various levels of healthcare including the everyday practice, methods, and procedures of various different professional cultures ranging from medical professionals to health care architects in micro scales as elaborated in previous chapter (EBD as a design practice model), as well as into the establishment of evidence-based QMaE specification networks that will be elaborated in the following sections.

3.2 Evidence-based QMaE Specifications: US and UK Perspectives

QMaE specifications; at their cores, are legal statements set for addressing a broad range of different quality issues[5] with regard to a broad range of desired quality aspects[6]. Over the last two decades, the linguistic expression and the domain of interests of specifications have been tending to move away from the traditional understanding of their ‘prescriptive’ language toward a more ‘performance-based’ specification understanding. (Hamilton, 2009; Hignett & Lu, 2009; Wanigarathna et all., 2016). Broad characteristics of both prescriptive specifications and performance-based specifications are that the first specify the features of any design-related products by their size, shape, material and other dimensions and properties in detail to be complied with, whilst the latter specify the overall performance outcome itself, then allowing and expecting the design team to come up with their own specific design solutions (Zimring et all., 2008). Accordingly; prescriptive

[5] i.e. IOM’s list of ‘clinical processes’, ‘human performance’, ‘technology’, and the ‘physical environment

[6] i.e. WHO’s six domains: ‘safety’, ‘effectiveness’, ‘patient-centeredness’, ‘timeliness’, ‘efficiency’, and ‘equability’

specifications consist more of standardized regulatory standards and codes which often limit flexibility and interpretation while performance-based specifications consist more of guiding criteria which allows for creative interpretation and innovation (Nelson et all., 2005; Hignett & Lu, 2009; Codinhoto et all., 2010).

In this regard; despite the tendency of the literature in favoring the latter to the first, the issue is not such black and white. According to (Wanigarathna et all., 2016), health care architects and design teams prefer to refer both as to be the performance-based specifications in the -pre and concept design phases of a health care building design project yet prescriptive specifications in the detailing and technical design phases. From this perspective, a balance in-between has been reported to be a strong challenge to be achieved by overall health care systems who are responsible for establishing the required specification networks (Hignett & Lu, 2009; Codinhoto et all., 2010; Chong et all., 2010; Wanigarathna et all., 2016; Quan et all., 2017).

Among those, apart from the US as the originating context of EBD as a design practice model, perhaps one of the most concrete case is the UK which has been updating its procurement system to adopt EBD practices more at system level. For this; since more than ten years, NHS in the UK has been collaborating with School of Architecture at University of Sheffield, which had until a recent time a specialized research group called ‘Healing Architecture Research Group’. NHS consults the research group in the development process of a number of evidence-informed design and evaluation tool and toolkits informed by a series of different resources including evidence-based knowledge sources of systematic reviews and HBD specifications. Based on the comprehensive view provided in (Phiri, 2014), the textually explained knowledge base of these tool and toolkits is visualized by this thesis in Figure 3.1.

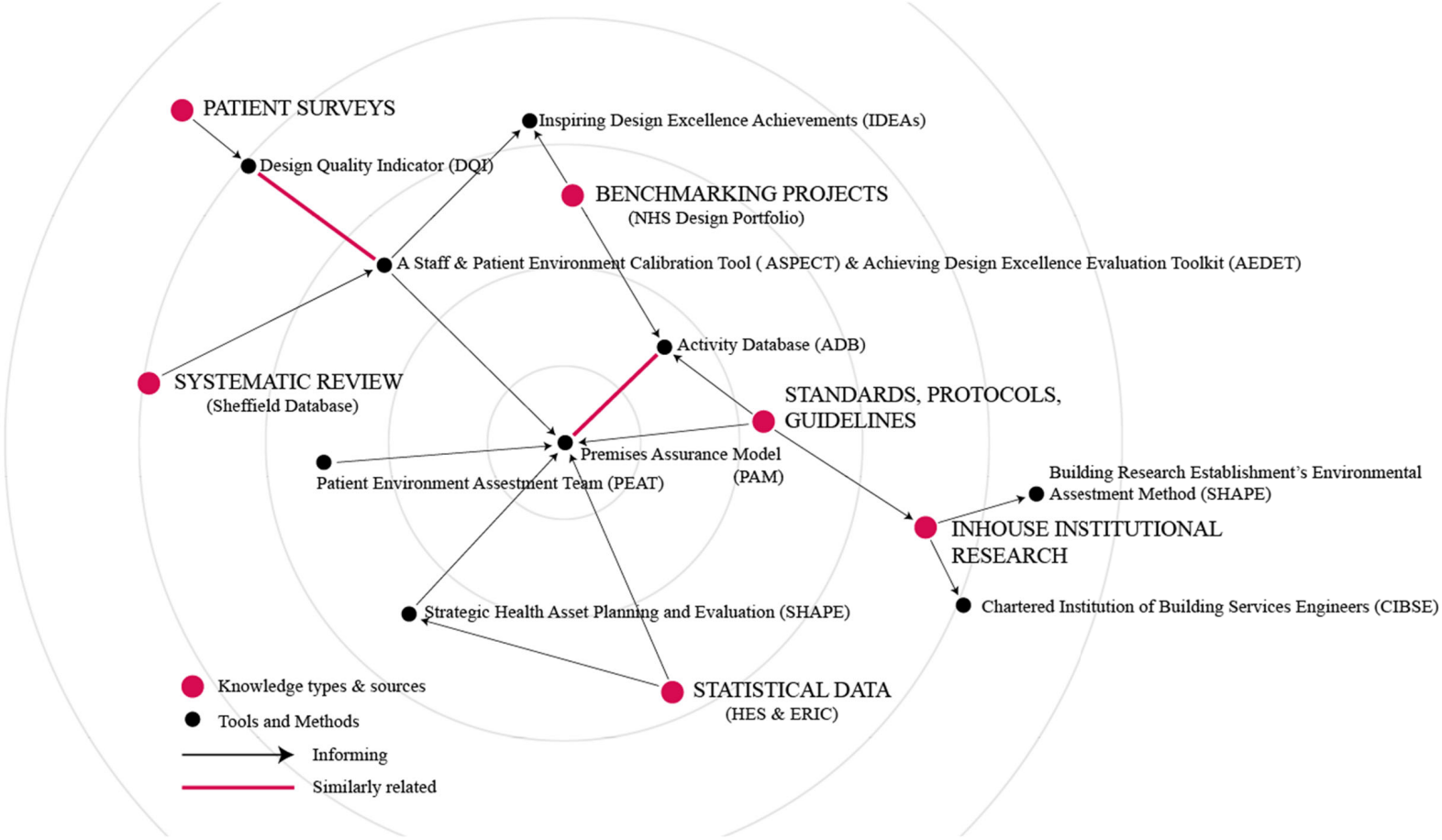


Figure 3.1. Knowledge base and network of UK's EBD tool and toolkit(s)
(visualized based on Phiri, 2014)

Here it is visible that the two evidence sources of systematic reviews and HBD specifications are independently and competitively informing around, and the major challenges faced are described by (Phiri, 2014) as caused by the tension between non-evidence-based and evidence-based specifications of the UK healthcare as quoted below.

> So much of what has been done in the past and to which extensive reference is made is about standards and compliance which our experience suggests drive quality down rather than up. Standards and compliance get far too specific and thus compromise design innovation. An example is HBNs (Health Building Notes) and the like, which often over-specify on a non-evidence-based approach. So, we get standards for minimum floor areas an examination room and a consulting room that are minimally different. The result in design practice is that both become maxima not minima for cost reasons, and then cause inflexibility because they are different and inflexibility in use because experience shows neither room is actually likely to be used for the purpose specified after relatively short-use periods. This is an ignorant legacy of functionalism which believed we could actually specify functions accurately (which we cannot) and then compounded the error by neglecting qualitative measures of psychological rather than physical need. Such document also concentrated on what could easily be measured rather than what was desirable. So, for example an HBN might specify the number of tiles needed for splash back over a washbasin or the number of coat hooks in the bathroom, but say nothing about a view from a window… ASPEC/AEDET Evaluation, IDEAs tools were developed by the University of Sheffield Healthcare Research Group to foster excellence and quality in contrast to the mandatory standards and compliance criteria. However, AEDET Evaluation is constrained by the need to relate to the DQI (Design Quality Indicator) which has many failings. DQIs contain statements that are not generally agreed to be valid and which are included without any justification or support. Many are inappropriate and are based on the value judgement of those who drew them up. The research group tried to remedy as many as they could… An important difference with ASPECT is the evidence-based, whereas AEDET 1st Generation / DQI is prejudice-based. ASPECT is based on a survey of and analysis of empirically based evidence. The IDEAs tool takes this set of notions even further by turning its back on the old constraints of the HBNs (Phiri, 2014).

Apart from the more progressed contexts of EBD including the US and UK, it is important for the overall research concern of this thesis, and also of (Phiri & Chen, 2014) and (Zhou, 2014), and also concerned by a particular Ph.D. research program

in China (Chen et all., 2016), how evidence-based knowledge can be integrated at health care systems of countries which are less familiar with EBD is still a remaining question. With this regard, the most recent systemic changes introduced through 'Health Transformation Program' movement of Turkey provides us both:

- a symptomatic case for observing health care quality efforts in macro scales especially in terms of the move from traditionally existing HBD specifications to newly emerged QMaE specification networks,
- a counter case of the efforts spent in micro scales especially in terms of the limited adaptation of EBD culture in local context of HBD field in Turkey.

3.3 'Health Transformation Program' Movement of Turkey

Health care industry worldwide has been witnessing profound health care reform movements since 1980s. While the focus of these reform movements in the past was mainly under the influence of 'World Bank' projects that particularly aimed to control the rising costs of health care services; especially since the end of 1990s and through the initiative role of WHO, more attention has been started to be given to improving the quality of health care and its performance outcomes (Sen & Koivusalo, 1998; Ferlie & Shortell, 2001). Health care reform movements, at their cores, are generally initiated by political and organizational re-structuring of the 'regulation', 'finance', and 'provision' of health care services, and continues with the establishment of quality management mechanisms and evaluation programs (Saltman & Figueras, 1998; Wendt et all., 2009; Lindahl et all., 2010). For this, systemic design decisions of healthcare such as deciding on whether the regulatory structure should be centralized or decentralized, financing should be based on taxation or statutory social insurance, or the provision of services should be by public or private or shared in-between are one of the major areas of concern that national and international authorities on health care undertake to deal with in macro scales (Collins & Green, 1994; Kolehmainen-Aitken, 1988; Saltman & Figueras, 1998; Ferlie & Shortell, 2001; Wendt et all., 2009; White, 2015). In doing so, policy-

makers and organizational boards are urged to collaborate and utilize a broad range of 'epidemiological', 'sociological', 'organizational behavior', and 'management' evidence in international and national contexts for making the right selections for an optimal and successful health care system (Saltman & Figueras, 1998).

Among those; initiated by 1987 'Basic Health Law', followed by a series of 'World Bank' projects in 1990s, and continued through 'Health Transformation Program' (HTP) in 2000s, health system in Turkey is a symptomatic case for its long history of healthcare reform movements. Especially the most recent one, HTP movement is accepted by the existing literature to be the most significant one for having embodied the previous efforts and become subject to the international literature (i.e. WHO, The Lancet) as a 'remarkable revolution in health' or 'a successful health system reform' (WHO, 2012; Horton & Lo, 2013). Accordingly, in the literature, many studies exist analyzing the broad-scale systemic changes of HTP, and suggest that what makes HTP movement very significant is the large-scale political and organizational restructuring based on the division of power among public and private sectors for a new context of 'participation', 'reconcilement', 'volunteerism', and 'competition' (Akbulut et all., 2010; Agartan, 2015; Avsar 2017; Yılmaz, 2017). What this means for Turkish health care industry in situ is also explained as the gradual withdrawal of the state from its central role in provision and finance of health care services while strengthening its central role in regulating both the public and private sectors.

Apart from the systemic changes related with the regulation, finance, and provision of health care services, HTP movement is also accepted to be significant for its interventions on the existing specification network of healthcare in Turkey. Following sub-sections will elaborate more on these with a particular inquiry on how the design of health care buildings in Turkey is guided, evaluated, and accredited.

3.3.1 A symptomatic case: Establishment of QMaE specifications

Health care architect in Turkey are traditionally and mandatorily required to comply with certain prescriptive specifications (HBD) set by central government agencies,

local municipalities, as well as chambers of different design-related professional groups including architects, engineers, and so on. Defined by the laws and regulations, and primarily guided by ISO and TSE with regard to construction law of Turkey, numerous numbers of different prescriptive specification documents[7] exist codifying the technical and functional requirements of health care physical environments. Here in this regard; what makes HTP movement also significant is its desire to move away from this 'ISO oriented' specification period toward a 'quality and accreditation oriented' specification period (Yıldız, 2017). MoH as the central regulatory authority in Turkish health care explains this move as a 'move toward a service or performance-oriented approach that encourages innovation in organizations, highlights applicability, and make things easy-to-use and inclusive' (MoH, 2015). What this means for health care buildings design sector in Turkey in situ is the additional performance-based specification (QMaE) documents not only for design but also the guidance, evaluation and accreditation of the quality of health care physical environments. This thesis categorizes the existing specification network of Turkish healthcare by their (1) relevancy (generic or design-specific); (2) primary intended usage (regulatory, guiding, and evaluative), (3) obligatory status (mandatory, advisory, voluntary), (4) occupancy stages that they relate specification-users (-pre and -post), and (5) language as either being prescriptive or performance-based as displayed in Table 3.1.

Accordingly, following the before-mentioned ISO/TSE-oriented codes of the design of health care buildings in Turkey **(A)**; in accordance with the quality objectives of HTP movement, **(B)** MoH initially published an instructional design guidance book titled as: 'Guidance for Minimum Design Standards for Healthcare Buildings in Turkey'. As the initial and latest version published in 2010, the document directly targeted healthcare architects and design teams for more for guiding and informing their designing processes rather than mandatorily regulating them. According to

[7] for fire safety, noise control, waste management and the list goes on

MoH's introduction to the guidance, this new vision and mindset owned primarily to MoH's extensive research to its international counterparts such as AIA, ADA, and JCI specifications for health care buildings; as well as their critical examination and testing through some workshops and seminars hosted in national context. Compared to traditional design standards, specifications included design recommendations and goals & objectives of design as more open to interpretation.

Table 3.1 Types and features of the existing specification network in Turkish healthcare

<table>
<tr><th colspan="2">Name</th><th>Relevancy</th><th>Intended Usage</th><th>Obligatory Status</th><th>Occupancy</th><th>Language</th></tr>
<tr><td>A</td><td>Design</td><td rowspan="2">Design-Specific</td><td>Regulatory</td><td>Mandatory</td><td rowspan="2">-pre</td><td>Prescriptive (HBD)</td></tr>
<tr><td>B</td><td>Guidance</td><td>Guiding</td><td>Advisory</td><td rowspan="3">Performance-based (QMaE)</td></tr>
<tr><td>C</td><td>Evaluation</td><td rowspan="2">Generic</td><td rowspan="2">Evaluative</td><td rowspan="2">Voluntary</td><td rowspan="2">-post</td></tr>
<tr><td>D</td><td>Accreditation</td></tr>
</table>

Another major change that HTP has introduced to the existing specification network was required upon the necessity for establishing a national health care quality evaluation mechanism which related more of the post-occupancy stages of health care buildings. According to strategic transformation plan of MoH, one of the major components of new health system was establishing a financially and administratively autonomous mechanism for the evaluation and accreditation of health care services (MoH, 2012).

(C) In accordance with this component, a new organizational structure was aimed to be integrated into the overall organizational schema of MoH. Originally named as 'National Quality and Accreditation Institution' in 2003, the intended institution was founded first in 2007 under the name of 'Office for Performance Management and Quality Improvement' and renamed as 'Department of Quality and Accreditation in Health' in 2012. Within the process, MoH launched its earliest quality evaluation

program in 2005 by setting 100 initial in-house quality evaluation standards for public hospitals. Through an additional instructional notice published in 2007, MoH expanded the number of standards to 150. In 2008, MoH started to compile and publish the re-expanded and revised versions of quality standards as a series of comprehensive instructional book sets titled as HKS: 'Service Quality Standards' and SKS: Quality Standards in Health. Compared with the earlier versions, each version of additional book sets either gradually increased the numerical number of standards or refined existing ones as to expand and enhance their scope and content for addressing a broader range of operation, management, and other aspects including the design of health care buildings (Table 3.2).

Table 3.2 Version history of the recently published health care quality and accreditation specifications in Turkish healthcare

Name	Version	Year	Standards/Evaluation Criteria
-	V. 1	2005	100
-	V. 2	2007	150
HKS	V. 3.1	2008	354/900
	V. 3.2	2009	388/1450
	V. 4	2011	621
SKS	V. 5	2016	557/1100
	V. 6	2020	523/1599
SAS	V. 1	2015	59/242
	V. 2	2018	58/239

(D) Additionally, and lastly, starting from 2013, MoH aimed its newly established QMaE specification network having international identity; and for this applied to external inspection of ISQua (named frequently as the 'accreditor of accreditors') (MoH, 2015). Finally refined based on 'ISQua International Principles for Healthcare Standards', MoH published SAS: 'Standards of Accreditation in Health' in 2015 (V.1) as its initial ISQua-accredited specification sets to be later on updated in 2018 (V.2) as a voluntary quality evaluation and accreditation program for health

care service providers in Turkey. Here when compared with category A and B prescriptive design and performance-based guidance specification documents, quality evaluation and accreditation specification documents concentrated not only the quality of health care physical environments but have been formulated more as generic documents relating a broad range of quality issues including primarily the operation and management of health care buildings.

And finally, according to 'Standard Development Algorithm' of MoH (MoH, 2015), 'Standard Development Guide' of TUSEB/TUSKA[8] (MoH, 2017), and the introduction and bibliography of the existing specification documents including the guidance (MoH, 2010), evaluation (MoH, 2020), and accreditation (MoH, 2018) standard sets, review of scientific research studies are claimed to constitute one of the main underlying principles of the establishment processes of QMaE specifications of Turkish healthcare (Figure 3.2). And especially for the quality issues related with the health care services and clinical practices, MoH frequently claimed the specifications to be 'evidence-based'. However, in terms of the specifications related with the quality of health care physical environments, existing literature lacks evaluative studies analyzing their evidence-based knowledge base. Next section will elaborate QMaE specifications more in this sense, and reveal a highly problematic area caused by the limited recognition of EBD practice culture in Turkish context.

[8] 'Department of Quality and Accreditation in Health' and 'TUSEB/TUSKA: Institute of Health in Turkey / Institute of Health Care Services Quality and Accreditation in Turkey' as the departments founded in 2012 and 2015 by MoH for the particular aim of guiding the standard development processes of SKS and SAS programs.

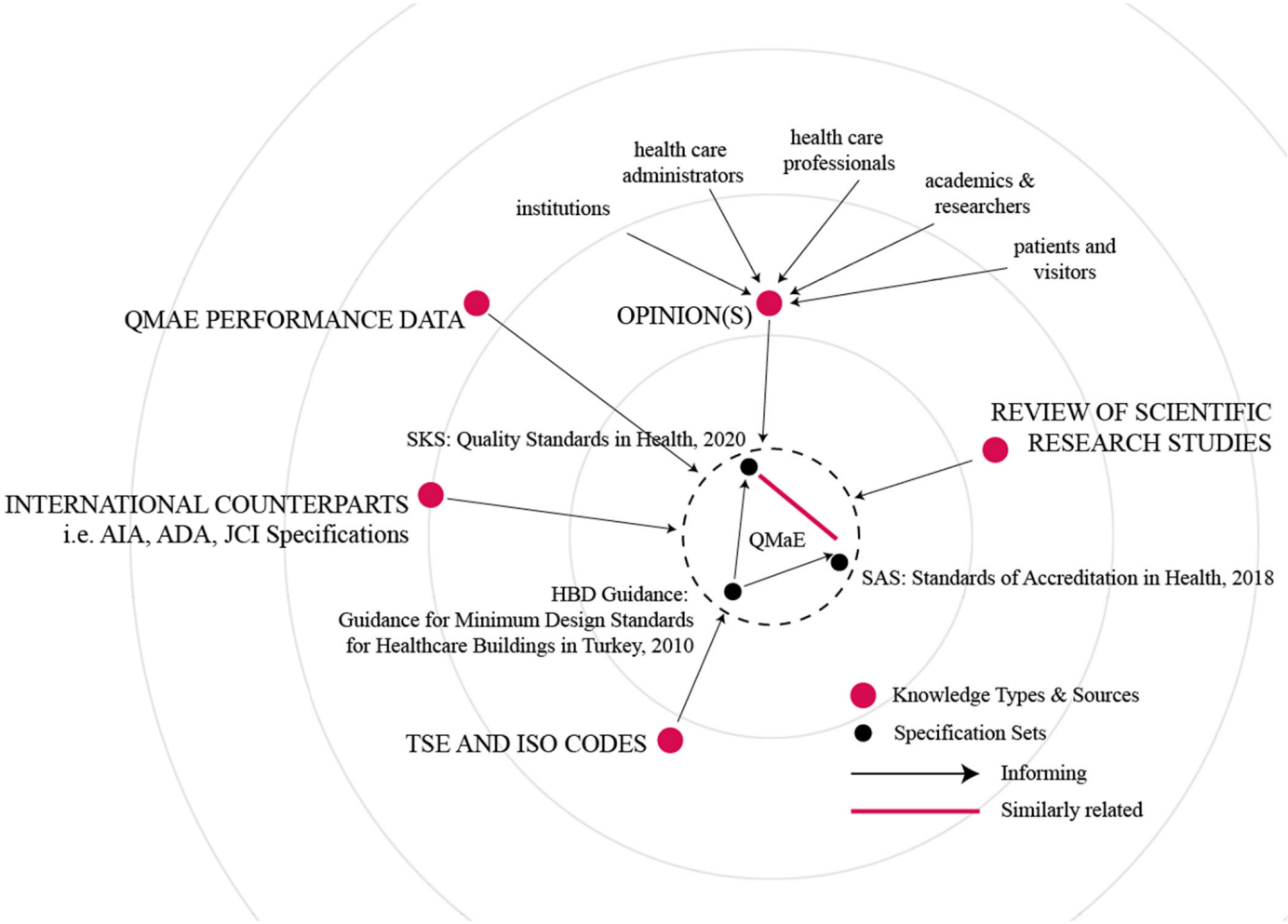


Figure 3.2. Knowledge base and network of Turkey's QMaE Specification(s)
(Visualized based on 'introduction' and 'bibliography' of MoH Specification documents)

3.3.2 A counter case: Establishment of EBD practice culture

Following the review of the quality efforts of health care industry in international contexts; and of the symptomatic example of the recently established QMaE specification network of Turkey, efforts for the adaptation of evidence-based practice culture in micro scales; especially the EBD as in HBD field, can be argued to be a counter case in Turkish context when compared to more progressed countries of US and UK. Behind this, peculiarities of the design and research fields of health care physical environments in Turkish context especially in terms of the overreliance on QMaE specifications can be argued to be playing the key role.

Accordingly; when the design field of health care physical environments in Turkey is reviewed – how health care architects design and what are the major issues that they are dealing with – there are little formal research studies about the design practice of health care architects in Turkey. Among those; a master thesis completed by in 2010 by Özge Berberoğlu takes EBD as a research concern. Accordingly, (Berberoğlu, 2010) makes an interview with three practicing health care architects in Turkey, and some of the interview questions are about their opinions about health care quality and the role of EBD. What is agreed upon are:

- their determinations regarding the lack of awareness about EBD in Turkish health care building design sector,
- their considerations of EBD as an unrealistic goal to be expected to be adopted by Turkish health care architects,
- hence their suggestions regarding the necessity of considering EBD more in terms of the quality evaluation and accreditation mechanisms that Turkish health care architects are more widely practicing accordingly.

Another and a more recent example is doctoral study of Negar Sioofy Khoojine that provide knowledge about the implementation of EBD during the intensive care unit designing processes of health care architects in Turkey. One of the research outcomes of the thesis is to determine that architects do not usually have a direct

engagement with evidence-based knowledge studies yet a high reliance on MoH specifications (Sioofy Khoojine, 2020).

In this regard, an expanded search into the other areas of publications than the formal research studies; for example; TMMOB (Chamber of Architects of Turkey)'s publications, it can be observed that little attention has been paid to design and design problems of health care buildings. Among those, a TMMOB/Adana journal published in 2015 that takes health care buildings as the main subject aims to bring health care architects together, share the problems faced during their design practice, and review the latest design solutions and cases in an international context (TMMOB, 2015). Parallel to the before-provided opinions of three interviewees; authors that published their views and opinions in this journal do not even mention about EBD. Instead, authors frequently underline the certain limitations of the existing health care building specifications, and indicate their need for more effective and informative specifications for their designing practice. Additionally, a web-interview carried out with one of the most leading health care buildings design firm in Turkey reveals also EBD as a concept that is out of the scope; and parallel to the problems stated about the lack of design standards and guidelines, the design chief of the firm mentions about their own design standards developed by themselves for achieving the highest quality in health care (Şensoy, 2015). Nevertheless, all these implications regarding the lack of awareness about EBD in Turkey should not mean that practicing health care architects in Turkey do not utilize evidence-based knowledge. Despite not naming it as EBD, many of the authors and interviewees display a very clear vision of the new approaches and advancements taken place in international context of health care building design; and in this regard, mentions about their efforts to follow the state-art-of-art knowledge in a regular and interdisciplinary basis.

When the research field of health care physical environments in Turkey is reviewed; many studies (mainly books) exist in the form of health care buildings design guidelines aiming to provide health care architects and projects teams certain design rules, principles, and example plan layouts for dealing with some of the functional

and technical aspects of health care building design. On the other hand, there is little research aiming to review the state-of-the-art-evidence, or to generate new pieces of evidence for informing the next practices. And even in these little, the notion of EBD is not referred, and the reviewed or generated pieces of evidence are mainly considered from the perspective of design and evaluation specifications of health care buildings. For example, (Ergenoğlu & Aytuğ, 2007) review the literature on the notion of 'healing space' and underlines the limitations of the existing specifications in responding to the 'patient-centered' design requirements of health care buildings. (Ergenoğlu & Tanrıtanır, 2013) suggest the necessity of broadening the scope of health care design and evaluation specifications as to include criteria that gives more emphasis on concepts such as 'aesthetic' and 'accessibility' of health care environments rather than only the criteria about dimensions of the environments. Similarly, a Ph.D. thesis completed in 2012 concerns the same, and develop a knowledge database and design support model not only for the issues about the dimensions of health care environments but more about the cognitive and social aspects (Biket, 2012). Additionally, (Güç et all., 2013) suggests the necessity of considering health care physical environments not only in technical aspects but also in social aspects including the evaluation of the 'space', 'perception', and the 'cognition'. Similarly, (Aydın & Sungur, 2018) underlines the 'accessibility', 'orientation', and 'scenery' aspects of health care buildings in urban scale, and suggests the necessity of building design and evaluation specifications to include such evaluation criteria.

3.3.3 Highlights regarding the 'knowledge gap' occurring between the QMaE specification and evidence bases of HBD field

Following the aforementioned overreliance on HBD specifications, an additional expanded search into MoH's publications (Table 3.3.)[9] reveals numerous numbers of authors and speakers sharing their ideas and research about how the improvement of the quality of health care physical environments can improve health care outcomes and user satisfaction yet almost none of them has a professional expertise in any design-related discipline including architecture, engineering, medical planning, and so on. Some medical professionals suggest that although it is not their main area of expertise; for increasing their clinical effectiveness and safety, they often need to make interventions regarding the design of health care physical environments as exemplified below.

> "What does hospital architecture affect, our security? Indeed, the hospital architecture and the safety of our employees or our patients overlap exactly, the more robust, the more efficient we are, the safer we are if we work within a functional architecture. But there is not much work on this, there is not in our country, well, after that, I draw something as the chief of emergency, my Chief Physician draws, or even my Minister, but really, we do not take part in it as parts of a complex whole" (translated) (MoH, 2010: p. 143).

> I have been working as a manager in this hospital for seven years. We planned the emergency a few times, what did we do in our last planning? I want to talk about it briefly. We went to an emergency congress with our chief physician. We got the opinion of a Belgian architect for the emergency room architecture. We were planning to enlarge the emergency department in terms of quantity. He warned us, he said that growing in size is not the right answer, in fact, you will plan the emergency in such a way that it will be like a letter envelope. You can enlarge the paper whenever you want, reduce it whenever

[9] These includes the proceeding books and speech texts of the 'MoH International Congress on Quality and Performance in Health' held between 2009-2018 annually, 'MoH Journal of Quality and Performance in Health' held between 2010-2018 biannually, and 'MoH Quality and Safety Best Practice Awards' books published between 2011 and 2016 biennially. 'Mimar' (architect) and 'mimari' (architecture), 'tasarım' (design), 'mekan' (space / environment) keywords were searched out of approx. twenty thousand pages of the total documents: '
(https://shgmkalitedb.saglik.gov.tr/TR,8759/kongre-yayinlari.html)

you want. You will understand the benefits of this later, he said. Indeed, that's our emergency room right now (translated) (MoH, 2013: p. 109).

Table 3.3 Highlights from MoH congress publications

Document	Year	Page	Main Theme	Sub-theme	Relevancy
MoH: I. International Congress on Health Care Quality and Performance (Proceedings Book /Vol. 1-3)	2009 (Vol. 2)	p. 256	Evaluation of patient satisfaction rates	Necessity of renovation of old buildings	indirect
MoH: II. International Congress on Health Care Quality and Performance (Proceedings Book /Vol. 1-3)	2010 (Vol. 1)	p. 277	Fire safety	Architects' awareness of fire standards; availability of floor plans in case of fire	indirect
	2010 (Vol. 1)	pp. 288-313	Design of surgery room and post-anesthesia care unit		direct
	2010 (Vol. 2)	p. 121	Organizational culture in hospitals	Symbolic meaning of the architecture of hospital buildings	indirect
	2010 (Vol. 3)	pp. 143-164	Safe hospital concept	Health care building design and the role of EBD	direct
MoH: III. International Congress on Health Care Quality and Performance (Poster Proceedings Book)	2011	p. 97	Sterilization unit employees' safety	Health care physical environments-related risk factor and the obligation to meet safety codes	indirect
MoH: III. International Congress on Health Care Quality and Performance (Speech Texts Book)	2012	p. 38	Importance of health care quality evaluation standards and their role in international issuance	Description of hospital architecture by a health care professional	indirect
MoH: Journal of Quality and Performance in Health	2013	6(2) pp. 55-69	Accessibility and carpark issues caused by typical-project implementation		direct
MoH: IV. International Congress on Health Care Quality and Performance (Speech Texts Book)	2013	p. 105	Structuring and functioning of emergency departments	Experiences of a health care professionals with regard to design of emergency departments	indirect

Document	Year	Page	Main Theme	Sub-theme	Relevancy
		p. 109	Health care administration	Experiences of a health care administrator with regard to architectural design consultancy received from an international design firm	indirect
MoH: Quality and Safety Awards on Health (1 – 4)	2013 (2)	p. 59	Laboratory workers' perception of laboratory safety	Arrangement of laboratory layouts according to safety criteria	indirect
	2014 (4)	pp. 133-160	Barrier-free hospitals	Evaluation of the design quality of health care physical environments'	direct
MoH: V. International Congress on Health Care Quality and Performance (Proceedings Book /Vol. 1-3)	2014 (Vol. 2)	p. 171, 186,187 ,189	Risk factors related with the surgery rooms, ICUs, and emergency services	Incompatibility of the architecture of health care physical environments	indirect
MoH: VI. International Congress on Health Care Quality and Performance (Proceedings Book)	2016	p. 39, 42	Health care providers organizational identity and the role of quality evaluation management	Influence of architectural appearance of hospitals on user satisfaction, façade and the design of hospital surroundings, location.	indirect
		p. 299	Health care professionals' views on accessibility of disabled users	Role of the design of health care physical environments in eliminating physical barriers	indirect
MoH: VII. International Congress on Health Care Quality and Performance (Verbal Proceedings Book)	2018	p. 124	Disabled patients' user satisfaction	Using interior design features on the exterior appearance of hospital buildings	indirect

Additionally, a review of the reference lists of the authors and speakers who shared their opinions and research within these publications reveals a limited number of evidence-based studies derived from any design or design-related disciplines. It must be because of this limitation that the evaluation criteria of the studies concerned about the quality of health care physical environments, and the concepts referred for

describing the quality of health care physical environments accordingly are very narrow in scope, and limited to certain aspects such as ‘angles of corridors’, ‘carpark capacity’, ‘length and width of patient rooms’, ‘lighting’, ‘temperature’, ‘cleanness’, ‘tidiness’, ‘ventilation’, ‘noise level’, ‘ergonomics, ‘radiation’. Additionally; some of them are conceptually uneven such as ‘appearance of hospital exteriors’, ‘good architectural appearance’, ‘modern and contemporary view of environments’, ‘magnificence’ of building, and so on.

Accordingly, when the speech of the only architect who has participated in MoH congresses (2010-2018) is reviewed, Ayhan Karadayı underlines the very technicality of the subjects discussed in the congress, suggest the necessity of considering more of the psychological and social aspects of health care physical environments, and indicates EBD as one of the ways of achieving it. Similarly; in the same congress meeting, a MoH representative indicates the lack of support that they found from architectural design and research community in Turkey, and suggest and demand to/from Turkish architectural schools to establish specialized research and education programs in the fields of health care buildings design and research[10].

> MoH Representative: “Without further ado, I would like to invite our speakers immediately; Dear Assistant Professor Ayhan Karadayı, from Karadeniz Technical University, Faculty of Architecture. As you know about the hospital architecture, there are very few people who are interested in this issue in our country. When we consider both the functionality, the number and the economic size of the hospitals, we want the hospital architecture to be formed as a special area. This is the special request of the Ministry of Health Treatment Services from the faculties of architecture in your presence, as the stakeholder that built the largest hospital, now we want the hospital architecture as a department”[11].
>
> Guest Speaker: The hospital should offer a healing environment not only with medical operations but also with its environment. Here, natural light, access to nature, getting close to one's family and relatives, controlling the noise,

[10] MoH: II. International Congress on Health Care Quality and Performance. Proceedings Book / Vol.3: pp.142-164
[11] Ibid., p.142 (İrfan Şencan / MoH Representative, head of ongoing congress session)

and even the odor factor, which we have never considered, are very important. There are loads of examples using it commercially. We can use this evidence-based design in design as well as in medicine as well as in architecture. From the data we obtained from here, for example, "naso-comial", that is, airborne infection, air quality is very important, it is important in transition from ward system to single bed, lighting conditions, in terms of patient safety, in terms of reducing errors, natural light, reflected light or artificial light, some textures, for example, we cannot see in all kinds of light, we can go wrong diagnosis and so on… Evidence-based design should be included not only in building design but also in processes. Natural environments should be included as much as possible. We are creating an artificial world, but I say that it is against human nature, that we should never separate it too far from where it came from[12].

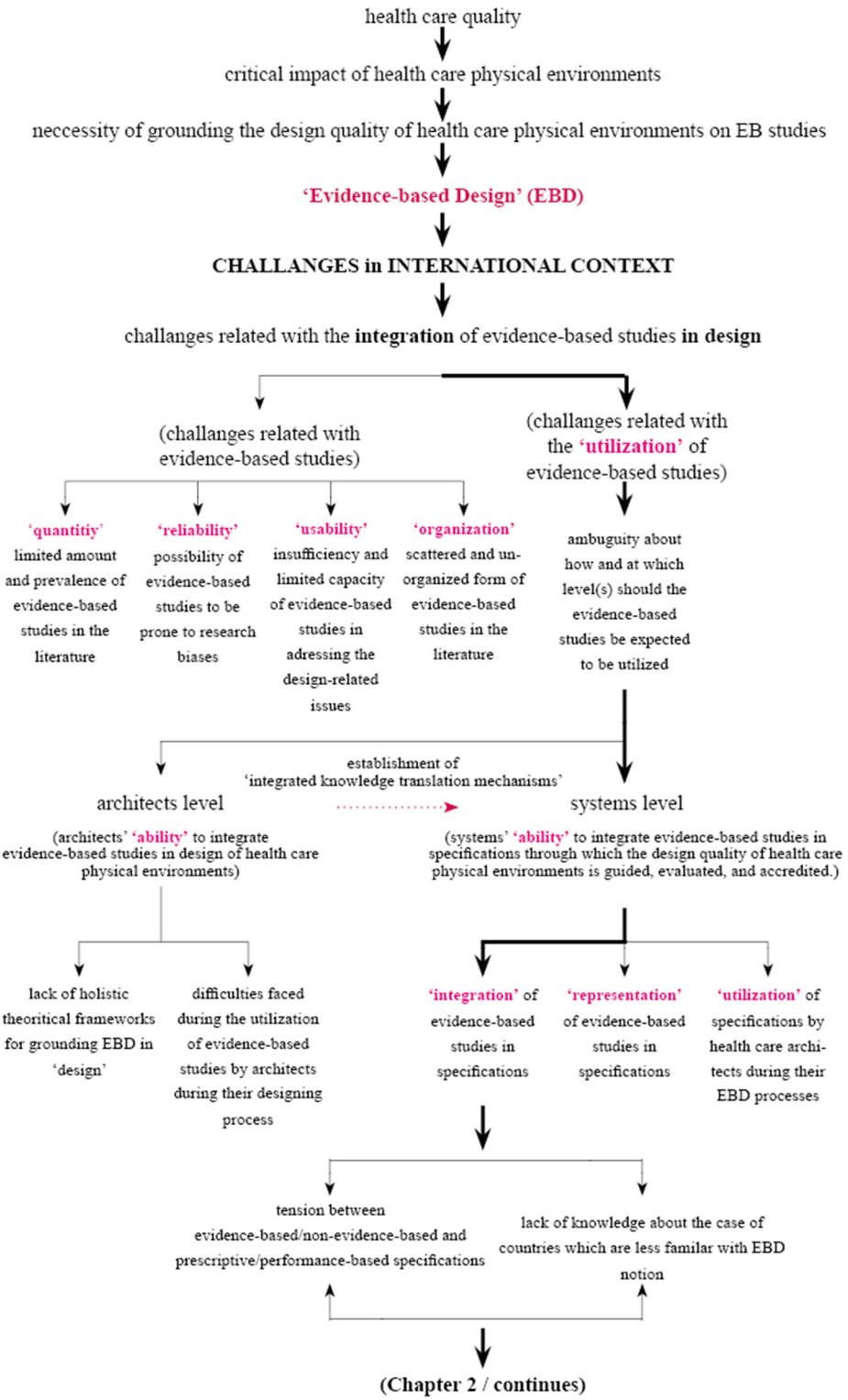
3.4 Major Challenge & Effort Areas Re-visited

Here in accordance with the issues discussed throughout the thesis, challenges related with the integration of evidence-based studies in QMaE specification network of Turkish healthcare can be further refined as below and their relation to the challenges faced in international context (also continuation of chapter 2) can be described through Figure 3.3.

- lack of research interest in health care buildings design field; and accordingly, the limited amount and prevalence of evidence-based studies in local context;
- lack of consciousness of health care architects in Turkey about EBD, yet their high reliance on building specifications;
- and finally, the lack of support from architectural design and research community in Turkey for the establishment of these specifications.
- Accordingly, these challenges can be conceptually explained through the SERVQUAL service quality model developed in 1985 (Parasuraman et al., 1985), and has been adopted and currently being used by many of the leading

[12] Ibid. p.143 (Ayhan Karadayı / Professor in 'Architecture Department in Karadeniz Technical University in Turkey, and publishes extensively in health care building design field)

international health care quality evaluation and accreditation mechanisms including also the ones of MoH. According to SERQUAL model, if a quality gap arises between customers of a service and its providers, it may have been caused by five different areas of gaps including the 'standardization gap', 'knowledge gap', 'delivery gap', 'communication gap', and 'satisfaction gap'(Çıraklı et. all., 2014; Kalaja et. all., 2016). Although the model particularly underlines these gaps from the perspective of customers and service providers relationship, this thesis barrows especially the first gap concept of SERQUAL model, and explains the challenges related with the integration of evidence-based studies in Turkish context as a 'knowledge gap' occurred between specification-makers and the architectural design and research community in local and international scales. In this regard, following chapter will deliver the research design of the thesis (namely a 'knowledge gap analysis') with an additional literature review of the related phylosophical grounds and methodical approaches.


health care quality
critical impact of health care physical environments
neccessity of grounding the design quality of health care physical environments on EB studies
'Evidence-based Design' (EBD)
CHALLANGES in INTERNATIONAL CONTEXT
challanges related with the integration of evidence-based studies in design
(challanges related with evidence-based studies)
(challanges related with the 'utilization' of evidence-based studies)
'quantitiy' limited amount and prevalence of evidence-based studies in the literature
'reliability' possibility of evidence-based studies to be prone to research biases
'usability' insufficiency and limited capacity of evidence-based studies in adressing the design-related issues
'organization' scattered and un-organized form of evidence-based studies in the literature
ambuguity about how and at which level(s) should the evidence-based studies be expected to be utilized
establishment of 'integrated knowledge translation mechanisms'
architects level
systems level
(architects' 'ability' to integrate evidence-based studies in design of health care physical environments)
(systems' 'ability' to integrate evidence-based studies in specifications through which the design quality of health care physical environments is guided, evaluated, and accredited.)
lack of holistic theoritical frameworks for grounding EBD in 'design'
difficulties faced during the utilization of evidence-based studies by architects during their designing process
'integration' of evidence-based studies in specifications
'representation' of evidence-based studies in specifications
'utilization' of specifications by health care archi-tects during their EBD processes
tension between evidence-based/non-evidence-based and prescriptive/performance-based specifications
lack of knowledge about the case of countries which are less familar with EBD notion
(Chapter 2 / continues)

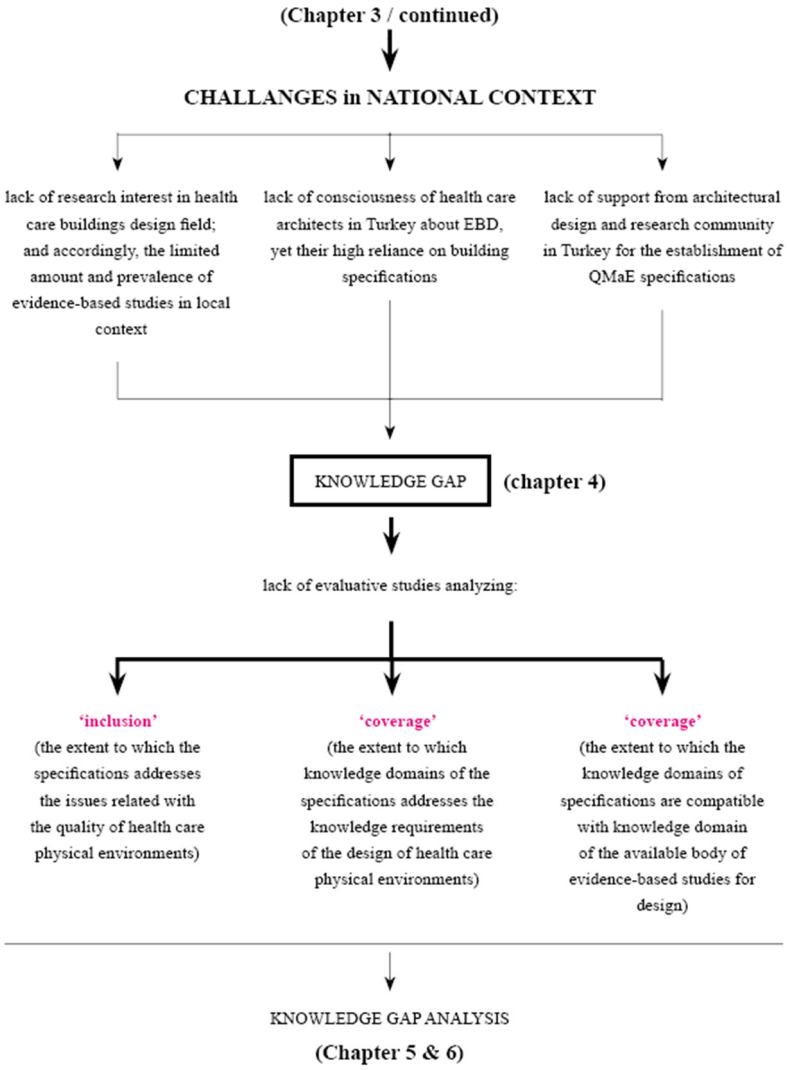


Figure 3.3. Major challenge & effort areas re-visited

CHAPTER 4

ONTOLOGY-BASED 'EVIDENCE-BASED DESIGN'

> "After nearly 2 decades, it is time to follow up with reminders of what was in the original and additional thoughts that improve the understanding of the concept. The weakness of Level 1 is the failure to seek both positive and negative feedback, upon which to act in a process improvement model. At the time, I did not address the difficulty practitioners might have in gaining access to credible research, which has continued to be a major problem… Level 2: My personal opinion is that Level 2, with its commitment to hypothesis and measurement, is the real baseline for evidence-based practice. I don't think design practices can legitimately claim to be operating in an evidence-based or research informed manner if they are not measuring the intended outcomes associated with their design decisions… Level 3: In my experience, the real advantage lies in letting the world know that the practitioner or firm is a leader in advancement of the profession and committed to learning from their projects while obtaining positive results for clients… An evidence-based practitioner has an obligation to share the lessons from measurement of outcomes with the larger field… Level 4: I should have said that not all projects merited a Level 4 report and that not all practitioners needed to work at an academic level. Only a limited number of projects in any firm deserve to be subject to rigorous research, measurement, and the peer-reviewed reporting of Level 4.… the four levels still have validity. We should, however, recognize that all projects don't need to rise to the highest levels and that the skills of practitioners will vary according to their education, experience, and project role" (Hamilton, 2020).

In relation to the analysis of the 'knowledge gap' named in previous chapter to define one of the major obstacles to the integration of evidence-based studies in QMaE specifications in Turkish context, this chapter provides an overview of the related philosophical grounds and the methodical approaches adopted in the research design of the thesis. While doing so, the most recent developments taken place in EBD field after the global pandemic (COVID-19) establishes an important frame of reference for developing an 'ontology-based' conception of EBD and strenghing the validity of the determinations and arguments, as well as the methodical approaches of the thesis.

4.1 Review of Current Discussions Intensified After the Global Pandemic

Global pandemic has been continuing to challenge health care systems of countries all over the world. On the one hand, health care systems deal with the insufficiencies of health care infrastructures such as limited surge capacities, interrupted supply chains, staff shortages, communication breakdowns, and so on (Capolongo, et. all., 2020). On the other hand, health care systems find opportunity to test the knowledge base and methodical strengths of EBP models with regard to pandemic problems.

Latest studies; for example (Crocker, 2021), indicate that majority of existing research stock of EBD field had been carried out in western contexts, hence pointing out the failure of systematic reviews of RCTs in responding problems belonging to different demographic contexts. Even in their own contexts, health care industry reports the effective use of RCTs for measuring patients' response in quantitative manners such as drug and vaccine development while facing with their limited capabilities when responding to the behavioral anomalies of patients and visitors during their vaccination and process processes (Greenhalgh, 2020; Capolongo, et. all., 2020; Zwart, 2021). More importantly and accordingly; according to (Greenhalgh, 2020), some of the philosophical discussions intensifies as to critically re-evaluate an evidence-based practice conception based on a 'singular conception of truth', a 'linear model of causality', 'deconstructive approach to problem-solving'; hence in specific, the desired scientific cause and effect relationship (named PICO model) that has been deemed to be ineffective in responding to the COVID-19 period problems of health care. What is suggested is the need to have an extend from '20th century epistemology' of EBM toward '21st century epistemology' to better respond the cases under 'uncertainty' and 'unpredictability'. A very particular viewpoint that has been getting attention is 'complex system' approach which calls for a 'non-linear' and 'emergent' causality, and encourages the 'flexibility' and 'plurality' of research by augmenting 'mixed-method case studies' in support of RCTs (named as 'primary research') and 'narrative reviews' in support of 'systematic reviews'

(named as ‘secondary research’) (Rutter, et. all., 2017; Greenhalgh, et. all., 2018; Greenhalgh & Papoutsi, 2018; Greenhalgh, 2020).

Analogously, global pandemic has also been challenging in micro scales; namely the HBD field, especially in terms of the inefficiencies of the existing hospital building stocks under crisis. This was rather visible in the early months of the global pandemic. Accordingly, on the one hand, health care industry faced an accelerated process of transforming non-sanitary building typologies (i.e. trade center, schools, airports) into health care spaces, non-medical spaces (i.e. external greenery spaces, entrances, lobbies, corridor and waiting areas) into beds; and additionally, witnessed an unprecedented demand for temporary solutions including the inflation and tent structures (Copolongo, et. all., 2020). In addition to the interventions alike and many others including the prominent design aspects such as ‘flexibility’, ‘safety’, ‘air quality’, ‘HVAC’ (heating, ventilation, and air conditioning) and ‘laminar flow’ systems of health care physical environments, HBD field also faced with the limitations of systematic reviews of evidence-based studies in built environment when it came to understanding of patients’ prioritization of social aspects of spaces such as less ‘distraction’, more ‘social interaction’, and so on (Sandal et. all., 2019; Zwart, 2021). Additionally, HBD field also faced with the limitations of guidelines and standards as another major sources of knowledge failing to answer constantly changing design problems of health care physical environments under crisis (Bernhardt, et. all., 2021). For this; studies such as (Brambilla, et. all., 2019) and (Marcheschi, et. all., 2019) underlined the need for a ‘resilient health care system’ understanding for the continuous evaluation of health care physical environments; and for this, pointed out the need for constantly adding new knowledge to the health care quality infrastructures and QMaE mechanisms of health care organizations such as JCI, ACSQ, AC, and so on.

Hence, and more importantly, global pandemic continued also stressing traditional ways of HBD, and resulted the overall health care industry in reconsidering the overall principles and methods of EBD. This was rather visible in the latest ‘ARCH: Architecture Research Care & Health’ conference held in 2020 in the early months

of the pandemic. According to (Zwart, 2021); reflecting on the review of presented studies, one of the major emerging themes of the conference was the intensified discussions regarding the changing attitude of EBD field in favor of a 'naturalistic constructionist approach' over the traditionally adopted 'positivist approach'. And the key support for this change was provided by the keynote speech of Kirk Hamilton who as one of the originators of EBD delivered his critical view that "there is more to architectural design than evidence"[13] (Zwart, 2021).

Here following the above-outlined discussions regarding the changing attitude of EBD field, this thesis interprets the demanded change as a move or early indications of a paradigm[14] shift from its positivist conception (emerged context) toward what is named in this thesis as 'post-positivist'[15] conception (emerging context). This change will later on be named and described by this thesis as an emerging demand for an 'ontology-based' conception of EBD. For this, following two sections will provide a literature review to develop an 'ontology-based' conception to further describe the (4.2) philosophical grounds and (4.3) methodical approaches of the emerging context of EBD field. In the end, two different senses of 'ontology-based' conception provided (philosophical/methodical) will establish the ground for the research design (4.4) and the validity (4.5) of the thesis.

---

[13] Later on, published in 2020 as an article in HERD journal entitled as 'Evidence-based Practice: Four levels re-visited'.

[14] A taxonomy of various research paradigms ranging from 'positivism' to 'postpositivist', 'critical theory', and 'constructivism' (i.e. Guba & Lincoln, 1994); or ranging from 'traditional science' to 'technical rationality', 'interpretivism', 'intuitionism', and 'pragmatism' (i.e. Altman & Rogoff, 1987) can be provided in detailed with their clear-cut differences or common grounds; however within the scope of this thesis, as well as in terms of the nature and the scope of the philosophical discussions of EBD after global pandemic, this chapter continues concentrating on two extremes with a particular attention to 'post-positivist' (including but not limited to postpositivist') alternatives of 'positivist' stance of 'traditional science'.

[15] Often named in the existing literature as 'interpretative paradigm', 'phenomenological paradigm' (Wildemuth, 1993); 'naturalistic paradigm' (Owen, 2008); 'anti-positivist paradigm', 'post-behaviorist paradigm' (Hekman, 1983) and so on; what is preferred to be named in this thesis as 'post-positivism' is meant to include a broad range different research paradigm(s) emerged after mid-20th century with their differentiated degrees of opposition against 'positivism'.

4.2 Philosophical grounds of an 'Ontology-based' EBD Conception

Ongoing discussions intensified after the global pandemic are deemed by this thesis as significant to recall earlier studies in EBD literature which had proactively claimed one of the major underlying problems of EBD to be rather more philosophical requiring inquiries into the 'ontological'[16], 'epistemological'[17], as well as 'methodological'[18] underpinnings of the knowledge base of EBD.

Keith Diaz Moore and Lyn Geboy had warned EBD field in 2010 that any architect who comes from 'critical tradition' approaches the terms 'best', 'credible', and 'rigorous' with extreme caution. By reference to (Altman & Rogoff, 1987)'s taxonomy of varying underlying 'world views' of science, they had demarcated EBD from 'traditional science' by suggesting it to be understood more as a 'praxis' and

---

[16] **'Ontology'** is a branch of philosophy of science that deals with the systematic consideration and conception of 'reality', and produces assumptions to describe 'what exist', 'what it is', 'what it means for someone or somebody to be. Various different ontological assumptions; at their extremes, can be summarized to be ranging from **'realism'** as claiming the 'reality' to be absolute, singular and independent of social factors to **'relativism'** as claiming it to be multiple and dependent on and constructed by social factor.

[17] **'Epistemology'** is another branch of philosophy of science that deals with the systematic consideration and conception of how that 'reality' turns out to be 'knowledge', and produces assumptions regarding its 'truth' and 'validity', as well as how it is 'generated', 'acquired', and 'communicated'; hence, its relation to the 'knower'. Various different epistemological assumptions; at their extremes, can be summarized to be ranging from **'objectivism'** as claiming the knowledge to be externally generated, acquired, and communicated of which the 'truth' and 'validity' is desired to be grounded on concrete and reliable measurement rules and principles to **'subjectivism'** claiming the 'knowledge' to be internally constructed by social actors belonging to various different context and that makes it open to the interpretation of 'knower' or 'researcher' based upon various different contexts of problems and the nature of inquiries.

[18] **'Methodology'** is another branch of philosophy of science that deals with the systematic consideration and conception of the particular processes and 'methods' adopted during/for 'knowing'. Analogously, existence of differentiated ontological and epistemological views and opinions result in various different methodological approaches that ranges from **'experimental'** approaches aiming for testing and verification of pre-established theories and hypothesizes in manipulated 'natural' settings to **'hermeneutical'** approaches aiming to extract meaning through interpretation in its 'naturalistic' social settings.

'action-research'[19], hence requiring alternative and multi-dimensional ways of knowing and doing. For this, they had suggested a more inclusive epistemological conception of the knowledge base of EBD field as quoted below:

> "research-based knowledge that is the most appropriate to the question at hand and of the highest rigour as defined by the worldview from within which the research was conducted…With this understanding, evidence-based design should be defined as environmental design that is informed by the totality available of evidence gleaned through the most up-to-date, credible research conducted according to the highest standards of rigour appropriate for that given research approach, which is then applied in a critical and appropriate manner in order to achieve collective intentions" (Moore & Geboy, 2010: p. 112).

Here in relation to the realization of the above-quoted expanded definition of the knowledge base of EBD, and especially in terms of bold emphasizes on the peculiarities of the underlying 'worldviews', nature of 'problems' and the 'research questions', a very significant study in EBD literature had been provided by Nadeeshani Wanigarathna who has been publishing extensively on the sources, flows, and types of evidence in EBD (i.e. Wanigarathna et. all., 2021) including also HBD specifications (i.e. Wanigarathna, 2014, Wanigarathna, et. all., 2016). By reference to (Bhaskar, 1975) and (Archer, 1995)'s 'critical realist' view of science that forms the underlying ontological perspective of her subsequent studies, her doctoral dissertation (Wanigarathna, 2014) developed a stratified ontological conception of EBD knowledge. Accordingly, she argued that the so-called peer-reviewed evidence-based studies as claimed to constitute the 'empirical layer' of EBD knowledge are not standalone sources of knowledge but more of the outcome of some events that exist in real time ('actual layer')[20] and social objects generating 'mechanisms' and 'structures' as the 'contingent conditions' of certain belief and

[19] What is meant with 'action research' is the practical knowledge developed and accumulated by the participatory process of various health care stakeholders

[20] For example; the global pandemic.

reasoning systems ('real layer)[21]. Here accordingly, one of the major problems of the emerged context of EBD field was implied to be resulted by the limitations of their underlying 'ontology' in understanding the 'temporal', 'emergent', 'morphogenetic', 'contingent' conditions of social phenomenon hence being 'suffocated' by the efforts to provide explicit cause and effect relationships in design. To build more on Wanigarathna's 'critical realist' view of EBD, this thesis deems further elaboration of the concept of 'ontology' as critical for its potential to serve as a demarcation criterion by itself especially for/between the positivist and post-positivist conceptions of EBD.

A very critical point to start with is that while the conception of 'ontology' is often grasped within 'positivist paradigm' as 'metaphysical', 'unstable', 'unscientific', and even 'meaningless' (Packer & Goicoechea, 2000); within the 'post-positivist' paradigm(s), 'ontology' is often grasped as the priori condition of 'epistemology' that can be further described through Susan Hekman's expression as quoted below:

> "ontology precedes epistemology; the act of knowing entails that being is revealed." (Hekman, 1983: p.208).

Here Susan Hekman's understanding and determination regarding the ontology-epistemology divide[22] is critically important for demarcating traditionally exiting positivist view of science belonging to the 'natural' phenomenon from its 'post-positivist' alternatives belonging to the 'social' phenomenon[23]. By describing the emergence of post-positivist paradigm as 'a move from epistemology to ontology', Hekman describes the positivist tradition in science as prioritizing more of the

---

[21] Including for example safety and support-oriented belief systems elaborated in chapter 2 or the differentiated perceptions of health care physical environments between EBD researchers and specification-makers as elaborated in chapter 3 over the case of MoH congresses and proceedings.

[22] Provided through a comparative reading of the critical debate heated between Hans-Georg Gadamer and Jürgen Habermas.

[23] As well as few others such as (Packer & Goicoechea, 2000) expressing the phenomenon as quoted: "ontology not just epistemology".

‘epistemology’ while its post-positivist alternatives more of the ‘ontology’. However, the suggested move or prioritization from/of ‘epistemology’ to/over ‘ontology’ does not refer actually to a complete denial of ‘epistemology’ or a total embracement of ‘ontology’ (as noted to be complementing each other) but more of relating the level of the complexity of their underlying ontological perspectives. This complexity difference can be best exemplified in Martin Heidegger terms.

In ‘Being and Time’ (1962), Heidegger describes ‘ontology’ conception of ‘natural sciences’ (named as ‘traditional’ conception of ‘ontology’) to be more limited to the question of ‘beings’ as a term conceptualized by Heidegger as ‘ontic knowledge’ for referring to the physical and empirical substances of ‘reality’. On the other hand; the ‘ontology’ conception of ‘humane sciences’ (named as ‘fundamental’ conception of ‘ontology’) which is conceptualized as ‘ontological knowledge’ is more related with ‘being’ as a term referring to the abstract and transcendental substances of ‘reality’, and constitutes the priori conditions of ‘ontic knowledge’. In Heidegger terms, an ‘ontological inquiry’ goes beyond the ‘object-matter’ approach of ‘ontic sciences’, and concerns more with totality of ‘physical’, ‘temporal’, ‘spatial’, and ‘subject-matter’ properties (underlying worldviews, mindsets, and belief-systems of the inquirer) of both ‘physical’ or ‘social’ objects that are (again in Heidegger terms) ‘onticified’ or ‘objectified’ for scientific investigation.

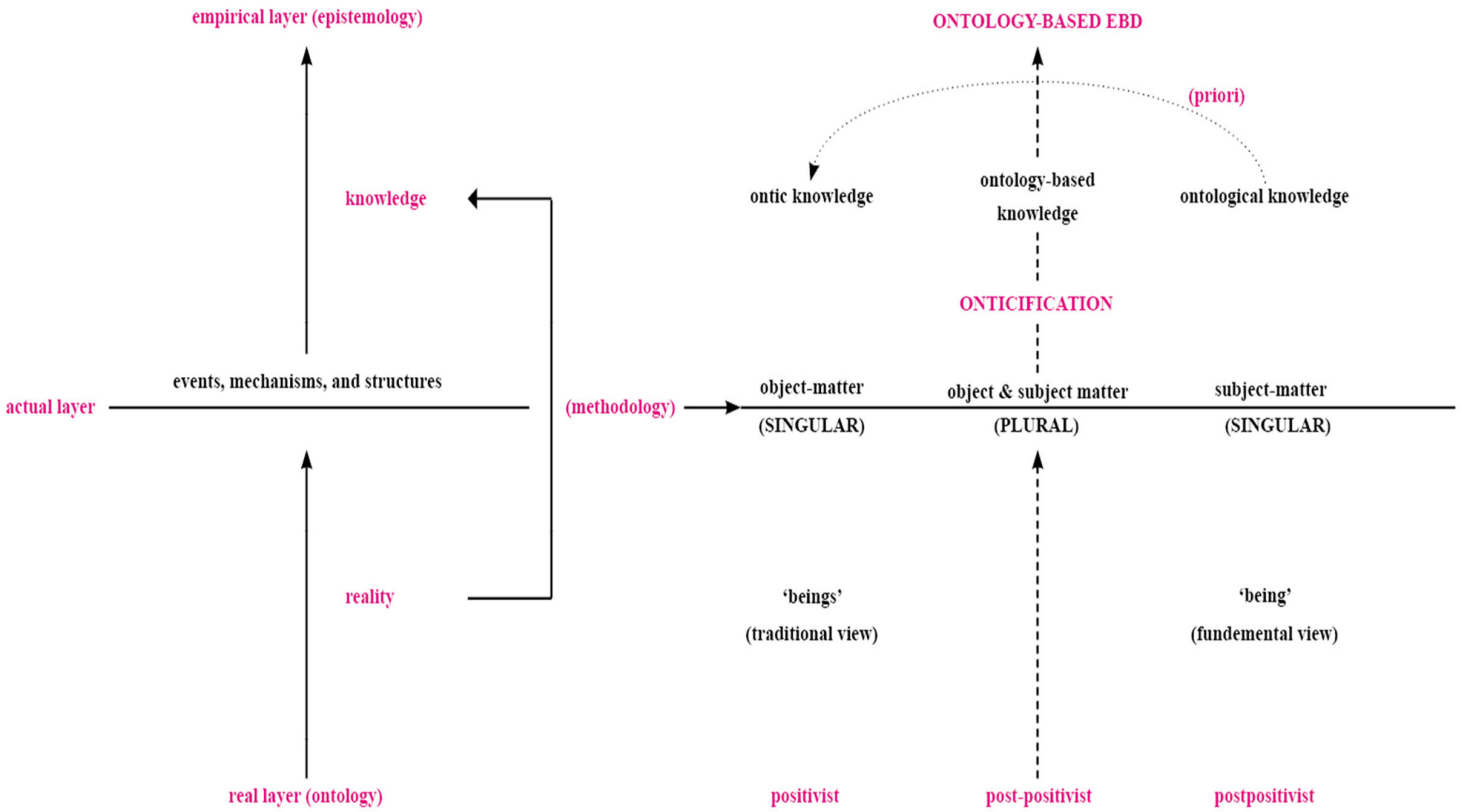


Figure 4.1. The term 'Ontology' in philosophical senses and an 'Ontology-based EBD' Conception

With this understanding (Figure 4.1); and considered in parallel with the 'critical realist' perspective, post-positivist view of science interacts with ontology-based (refers both to ontic and ontological) of the 'empirical layer' through holistic consideration of the temporal and spatial conditions of 'actual layer', and it is interpreted through the subject & object-matter properties of inquirer. While doing so, a post-positivist research design mimics at traditional view of science for identifying and studying objects within their 'naturalistic' settings. For this; the 'truth' and 'validity' of the 'ontology-based knowledge' produced out of a post-positivist research is not expected to be 'certain' or 'demonstrable'; instead, it is 'partial' and grounded on the 'probability' of getting closer to the 'reality' (Aközer, 1989; Guba & Lincoln, 1994). Such an epistemological position results post-positivist research approaches in adopting a 'pluralist' methodological strategy claiming that "there is no such a thing as one correct scientific method" (Wildemuth, 1993). Instead; 'pluralists' advocate through an interpretive lens the method to be applied in a particular study to be 'generative', 'inclusive', 'holistic', 'value-based' based on the research question to be addressed, proliferated through inquiry, and shaped according to before mentioned peculiarities of various different research contexts and inquiries (Wildemuth, 1993; Walsh & Evans, 2014). Based on a literature review provided by (Caruth, 2013), broad characteristics of 'pluralist' research methodologies are:

- necessitating for the design of more complex research processes,
- allowing for multiple data types to be analyzed including both 'qualitative' and 'quantitative'[24],

[24] Some of the listed models classified in the study are listed as follows: **convergent parallel model**: simultaneous collection, merging, and using of both qualitative and quantitative data; **explanatory sequential model:** quantitative data collection followed by qualitative data to enhance the quantitative findings of the study; **exploratory sequential model:** qualitative data collection followed by quantitative data to explain the qualitative findings of the study, **transformative model:** no matter which model is adopted, flexible uses of both qualitative and quantitative data for a possible change in perspective of the study.

- capability to answer a broader range of different research questions as the researcher is not limited with a single research design,
- resulting in more robust conclusions provided by the cross validation of the findings of multiple research processes.
- time-consuming and expansive,
- necessity of the researcher(s) to learn and apply multiple methods in a single study,
- more open to criticism of methodological purists; and so on.

Following all these discussions and viewpoints, this thesis names 21st century post-positivist research paradigm(s) as 'ontology-based' as a term referred by this thesis to mean an 'ontological inquiry' to be developed into the knowledge domain of EBD field. For this; following section will provide a review of precedent 'ontology-based' research methodological and methods developed for interacting with the ontic/empirical knowledge base of a given domain, and with a particular attention brought into the domain of EBD field.

4.3 Precedents of 'Ontology-based' Research Methodologies and Methods

The term 'ontology' from a dictionary standpoint refers either to (1) a branch of philosophy concerning about the 'nature of existence', or (2) to the particular ways and methods of studying the sets of entities and their relationships existing within a particular domain or namely the subject area (OED, Webster). Methodically speaking, it specifies what is inherent or important in an 'empirical phenomena'; and often requires particular ways of 'characterizing', 'annotating', 'labeling', and 'indexing' of classes of entities found within the 'reality' of the given domain (Bodenreider, Smith & Burgun, 2004; Goertz & Mahoney, 2012). Hence, an ontological inquiry into a domain of a knowledge area is constituted by the identification of (1) 'classes', (2) 'properties', (3) 'relationships'; hence the construction of 'ontological structures' of the selected domain to be reviewed, analyzed, and represented (Acierno & Cursi et all., 2017; Rožanec, & Novalijaet, et

all., 2021). Followed by the systematic arrangement of entities in groups according to established criteria ('classification'), and re-arrangement of those groups of classes according to their interrelations ('taxonomy'), here 'ontology' in this sense can be further defined as an advanced and holistic process of structuring taxonomic relations representing the 'domain' definition of the study area (Van Rees, 2003).

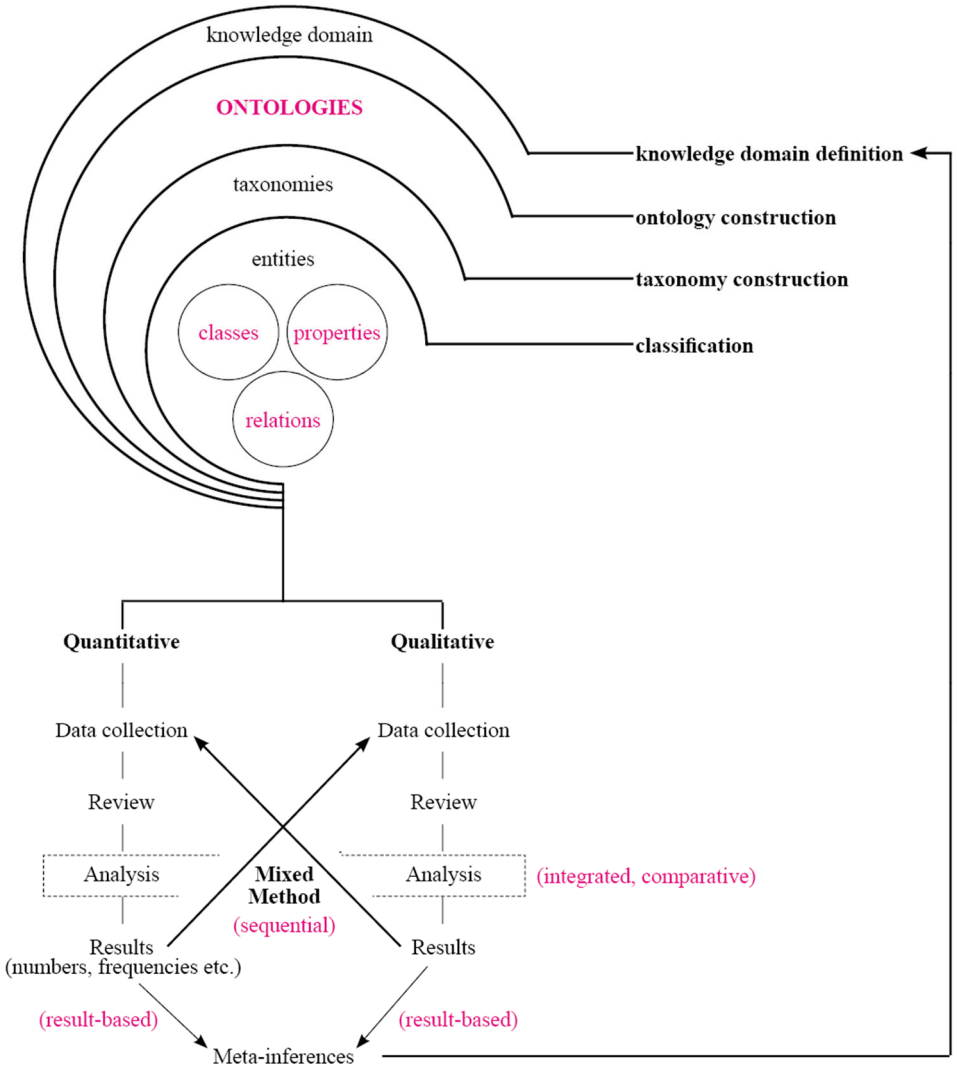


Figure 4.2. Methodical underpinnings of 'knowledge domain definition' and 'mixed-method' research

An ‘ontology-based’ inquiry (Figure 4.2) is originally rooted and belonging into the natural phenomenon referring; for example, to the scientific discovery, labeling, classification, and taxonomy of specifies, earth formations; or examination of diseases, symptoms, treatments, and so on. Today; theoretically explained by Hans-Georg Gadamer’s seminal work: ‘Truth and Method’ (1975), and his famous argument equivalencing the ‘nature of things’ to ‘language of things’, application of an ‘ontology-based’ research approach has diffused also into the social phenomena referring to the semantic interpretation of social, cognitive, political, and linguistic contexts over their written or transcribed, verbal or non-verbal forms. With the advancements in technology in computer sciences over the last two decades, ‘ontology-based’ approaches have been envisioned also to include computer-based methods including; for example, the statistical and logical processes of text or document clustering, tokenization, automated-coding, statistical pattern and similarity analysis, term weighting, and so on. As such, an ‘ontology-based’ research approach varies from scientific to statistical, logical, as well as sematic and interpretive approaches to be adopted in a broader range of fields ranging from natural and medical sciences, to information technologies, organizational knowledge management and engineering, artificial intelligence and machine learning, digital humanities, phenomenology, hermeneutic, and so on.

When moving from the natural phenomenon to social phenomenon, written or transcribed textual data constitute the basic unit of analysis as ‘empirical objects’; and the term ‘coding’ in this sense refers to researchers’ initial process of labeling thematic objects determined within the text, labeled by concepts (named as ‘codes’), and organized under meaningful and cohesive coding ‘categories’ (Sun, 2017). Again, briefly summarized by (Sun, 2017), while the quantitative approaches to coding (often computer-based) are prioritizing numerical ‘frequencies’ and ‘quantifiable relationships’ for identification, qualitative approaches follow a semantic route necessitating the researchers’ close reading of text and ‘interpretive’ interaction with the text data. For ‘coding’, the methodical stance of this thesis is in favor of a qualitative approach and the following sub-section will elaborate more on

the overall principles, methods, and sub-categories and processes of 'qualitative coding' over two precedent approaches.

4.3.1 'Qualitative Content Analysis' and 'Grounded Theory'

'Qualitative coding' is used to analyze text data through interpretation. 'Interpretive' stance taken in qualitative coding makes it adhere to 'naturalistic paradigm'; hence stands as a commonly adopted method especially in the early stages of various post-positivist research approaches (Hsieh & Shannon, 2005; Cho & Lee, 2014). Among the numerous research approaches adopting 'qualitative coding', one of the earliest versions of qualitative coding appears as part of 'qualitative content analysis' (QCA)[25]. Emerged out of the criticism of the quantitative coding approaches of the 1950s, QCA was suggested as "a research method for subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Downe-Wamboldt, 1992). Here what is very critical about qualitative coding in QCA is that of the coding of the 'latent content' (underlying meaning) of the text data while in quantitative coding it often searches and codes for the literal occurrence the contents that are searched for, thus referring to the 'manifest content' (Hsieh & Shannon, 2005; Assarroudi et. all., 2018; Kibiswa, 2019). Following QCA, another bold approach which is heavily grounded on 'qualitative coding' is 'grounded theory'. Contributed to the literature in 1967 by Glaser and Strauss as a reaction to the 'positivist' stance of 'traditional sciences',

[25] According to various modes of thinking adopted during the coding stages, three distinct categories of QCA exist and these are: **'conventional'** QCA (named also as 'inductive') referring to a coding process through which the codes are directly derived from the text data, and it requires researcher's close reading and richer understanding of the text data; **'directed'** QCA (named also as 'deductive') referring to a coding process through which the researcher utilizes the already existing theories or priori research to create codes; and as the analysis proceeds, the coding schemes are re-visited and refined; **'summative'** QCA referring to a coding process of searching the text for the variations in the contextual usage of certain keywords defined during the research design of the study; then the variations are coded accordingly, and the results are mostly quantified at the end of the process (Assarroudi et. all., 2018; Kibiswa, 2019).

‘grounded theory’ provides an umbrella methodology of qualitative coding, and envisions particular ways of thinking about qualitative data conceptualization and analysis (Strauss & Corbin, 1994). One of the bold characteristics of ‘grounded theory’ approach to qualitative coding is named as ‘constant comparative analysis’ referring to a process[26] of simultaneous of handling ‘data collection’, ‘coding’, and ‘analysis’ phases so that it iteratively informs and shapes the subsequent coding phases of the research (Groat & Wang, 2002).

Although the two ‘qualitative coding’ approaches of QCA and ‘grounded theory’ are quite similar in their qualitative coding phases; especially in terms of their -pre and the -post stages, they differ by their research contexts and how coded data is analyzed. Based upon a comprehensive comparative literature review provided by (Cho & Lee, 2014), below is scrutinization of the major areas of differences listed under five categories and elaborated as below:

- **Background: ‘**QCA’ is treated by the existing literature more as a method, and ‘grounded theory’ more as a holistic theoretical framework and methodology.
- **Goals and rationales:** Primary aim of ‘grounded theory’ is to generate a theory or theoretical preposition to explain a phenomenon, hence focuses more on the interrelations between codes and coding categories. On the other hand, primary aim of QCA is systematic description of the meaning of a certain phenomenon, hence stops search when the extracted codes and categories are matured enough to describe their meaning.

[26] The process is carried out under three stages: **‘open coding’** referring to the initial stage of close-reading of text data, interpreting, fragmenting into concepts, comparing similarities and differences between various concepts, and organizing initial categories or sub-categories; **‘axial coding’** referring to exploration of the relationship between concepts and their categories, testing and hypothesizing them against the original data and research context (named also as ‘theoretical sampling’), hence the stage of final refinement before reaching out a theory; **‘selective coding’** referring to the last stage of selecting certain concepts and categories having deemed to be strong enough to generate a theory or theoretical propositions (Corbin & Strauss, 1990).

- **Level of abstraction:** While the level of abstraction and interpretation during coding in QCA is limited to the distance between the 'manifest' and 'latent' meanings of the text data coded (low level of abstraction); in 'grounded theory', the level of interpretation and abstraction goes beyond the 'latent' meaning and described through its transformation into a theory (highest level of abstraction).
- **Data analysis:** In QCA, analysis is carried out primarily over the properties and descriptions of the concepts and categories identified within the original text data. For this, researcher's mode of thinking can vary from inductive, to deductive and summative but the whole process is often linear and the researcher is required to wait till the end for analysis. In 'grounded theory', analysis goes one step further and carried out over the abstraction of the relations identified between various codes and coding categories. For this, 'grounded theory' adheres more to an inductive process not in the same linear sense as it is in QCA but more as a cyclical process through which the analysis starts at the very beginning and continues in each and every step until there is no more input left to feed the previous stages.
- **Evaluation of trustworthiness:** Triangulation, member checking, and peer debriefing are common methods to check the credibility and increase the trustworthiness of both QCA and 'grounded theory'. However, different from QCA, 'grounded theory' also seeks for theoretical 'significance' and 'sensitivity' to be faithful to the existing theories and mindsets.

Following the above-listed variations in the overall principles, methods, and processes of QCA and 'grounded theory'; here according to the ongoing 'ontology-based' conception provided by this thesis, 'grounded theory' approach to qualitative coding can be argued (as one additional variation) to be more 'ontology-based' as having a bold emphasis on the holistic investigation of taxonomic and structural relations among concept and categories (aiming to be more descriptive of the knowledge domain) yet QCA is less 'ontology-based' and isolated accordingly. On the other hand; especially in terms of how data is analyzed (one final variation), while

the analytical stages of ‘grounded theory’ are well-defined (‘qualitative induction’) and tightly embedded within the ‘coding’ phase (‘concurrent’), QCA’s analytical stages can be more open-ended and adoptable to various different research contexts that may require sequential and mixed-method research designs.

For example; in EBD literature, one of the little research studies adopting ‘qualitative coding’ approach is the before-mentioned doctoral dissertation of Nadeeshani Wanigarathna. Motivated thorough a ‘critical realist’ interpretation of EBD, research design provided by (Wanigarathna, 2014) includes a ‘qualitative coding’ phase (of ‘evidence-based studies’) followed by quantification and visual analysis (mainly tabulation) of data derived from qualitative coding phase. By doing so; Wanigarathna provides a comprehensive view into the domain-specific knowledge of EBD field, explores various different types and formats of evidence utilized by health care architects and design teams, as well as develops models and frameworks for how they can be more effectively expressed and represented. In this regard; despite not indicated explicitly as such (named as ‘qualitative data analysis’ instead), Wanigarathna’s doctoral study can be shown as an example to the application of CQA in EBD field, resembling especially of its summative model.

Doctoral dissertation of Altuğ Kasalı; on the other hand, applies ‘grounded theory’ for ‘qualitative coding’ of the design process of health care design teams (over transcription of verbal data) as part of ethnographic inquiry adopted during the research. For this, research study designed by (Kasalı, 2013) includes an advanced ‘qualitative coding’ phase starting with identification of emerging conceptual classes and sub-categories which are later on further refined and developed as the main categories (named as ‘super-ordinate categories’) as the theoretical substances to be tabulated and narrated. By doing so, Kasalı contributes to EBD literature a comprehensive view and ‘thick description’ of EBD culture demystifying various forms of evidence utilized during an EBD process, as well as how they are translated, represented, and communicated by various different professional groups who are involved in the design. In this regard; despite not indicated explicitly as such, Kasalı’s doctoral study is interpreted by this thesis as another example to ‘critical

realist' view of EBD knowledge not only inquiring into the empirical later but also to its underlying socio-cognitive 'mechanisms' and structures.

To sum up as a sub-section summary; and adhering to the ongoing 'critical realist' views of EBD, this thesis acknowledges 'grounded theory' as a holistic theoretical framework of 'qualitative coding' while benefiting mainly from the flexibility of QCA in using both qualitative and quantitative methods. For this; different from two approaches, this thesis makes a further methodical contribution to EBD field by augmenting the 'representational' possibilities of 'qualitative coding' that will be reviewed and elaborated in the following two sections.

4.3.2 Ontology-based knowledge domain 'MODELLING'

Explicitizing inter-relational properties of the entities of a knowledge domain constitutes one of the major important steps of an 'ontology construction' after 'coding'. Different from the qualitative induction model adopted by 'grounded theory', or qualitative induction/deduction/summation models of QCA as both belonging to the realm of 'social sciences', a 'quantitative inductive' model of 'ontology construction' exist and belongs mainly to the realms of artificial intelligence and information technologies. In addition to the ongoing aims of 'grounded theory' (generating theory to understand) and QCA (extracting meaning to describe), what is often named and described by the existing literature as 'ontology-based knowledge domain modelling' (i.e. Acierno et. all., 2017; Gayathri & Uma, 2018; Konys, 2018) concerns more with providing practical solutions to the field. These includes; for example, supporting 'information interoperability' and 'knowledge sharing', enabling computable 'reasoning', as well as providing means to identify 'missing knowledge' and 'knowledge gaps' within or across various different domains (Rožanec et. all, 2021). In other words, a 'modelling' approach to 'ontology construction' is meant to provide a formalized computable framework for knowledge 'capturing', 'processing', and 'reuse' which is 'shared', 'communicated',

and ‘managed’ by all the experts who are involved (Ilal & Günaydın, 2017; Gayathri & Uma, 2018).

According to a comprehensive literature review provided by (Konys, 2018), an ‘ontology-based knowledge domain modeling’ process; at its core, consists of the following stages: (1) literature review, (2) concept extraction, (3) taxonomy construction, (4) ontology construction, (5) reasoning, and finally (6) consistency verification. While the majority of existing ‘modelling’ studies are identical in applying ‘quantitative approach’ to ‘coding’ (initial three stages); few studies (i.e. Pidgeon et. all., 1991; Yuen & Richards; 1994; Schreiber & Carley, 2004; Urban, 2009) blends ‘qualitative coding’ with ‘quantitative modelling’. For this; ‘qualitative coding’ is followed by ‘encoding’, as a term referring to a process of translating structured data (taxonomies) into computable language hence allowing for computer reasoning and logics. And for this, ‘knowledge graphs’ are the most powerful and common methods utilized for ‘knowledge representation and reasoning’ (KR&R).

Based on the literature reviews provided by (Gayathri & Uma, 2018; Rožanec et. all, 2021), ‘representational’ capabilities of knowledge graphs include the representation of ‘semantic’, ‘spatial’, and ‘temporal’ structural properties of objects as elaborated below.

- **Semantic**: referring to the properties related with conceptual roots of objects including their classes and categories represented by differentiated colors, shapes, or so;
- **Spatial:** referring to the properties related with the position/location and form of objects including their size and categories represented by edges;
- **Temporal:** referring to the properties related with the relational constraints of objects represented by texts on edges such as ‘after’, ‘before’, ‘overlapedby’, ‘includes’, and so on.

Additionally; based on the literature review provided by (Chen et. 2020), ‘reasoning’ capabilities of knowledge graphs include ‘rule-based’, ‘representation-based’, and

‘neural-network based’ processes of making meta-inferences hence obtaining new knowledge from the existing data as elaborated below:

- **Rule-based:** referring to a ‘logical network’ constructed by the researcher based on manually determined logic rules identified within the domain. For this; an identical ‘rule-based’ knowledge graph representation consists of ‘conceptual layer’ (semantic), ‘rule layer’ (temporal), as well as ‘paths layer’ (spatial) to be utilized by various ‘random walk’ algorithms for predicting new data.
- **Representation-based:** named also ‘embedding-based’ or ‘distributed’ representation, representation-based reasoning refers to a process of translating taxonomic structures (entities, relations, attributes) to a continuous and linear ‘vector space’. This vector space is then processed by algorithmic models including ‘tensor factorization’ (decomposing high-dimensional arrays into multiple low-dimensional matrices), ‘distance’ (vector lengths between two matrices), and ‘semantic matching’ (weighted hierarchical structure between multiple vectors), and so on.
- **Neural Network-based:** referring to an advanced version of ‘representation-based’ approach to ‘reasoning’. Different from the translation of entity matrices to a linear vector space, a neural network-based approach relates multiple entities at multiple dimensions for minimizing the missing information faced during vectorization. For this, some ‘machine learning’ algorithms and methods including ‘convolutional’ (for ‘semantic layers’), ‘recurrent’ (for ‘spatial layers’), and ‘reinforced’ (for ‘temporal layer’) are mainly utilized.

Following the above-outlined overall principles and methods of a ‘modelling’ approach to ‘ontology construction’; two precedent research studies are deemed to be relevant for the ‘evidence’ and ‘specification’ research contexts of this thesis.

For ‘evidence base’ (for evidence-based studies of EBD field), a computational framework of a tool was developed by Sanja Durmisevic and Ozer Ciftcioglu in 2007

and further refined in 2010 for its practical use by 'Netherlands Board of Healthcare Institutions'. According to (Durmisevic & Ciftcioglu, 2010); 'FlexTool' aimed at taming 'knowledge complexity', supporting 'knowledge integration', as well as providing a 'decision-support' model for the design and 'performance-based' evaluation of HBD processes in situ. For this, each particular design and evaluation aspect existing with the domain of EBD is represented by 'neural network-based' knowledge graph consisting of nodes (aspects), links (weighted sums of their importance), and the resulting 'fuzzy model' (hierarchical structure of relations). Through the 'feed-forward' feature of the model developed, it was intended to allow multi-layered connection of the findings of various studies, as well as the 'model expansion' when new studies are introduced to the existing literature. Additional and lastly; however, authors reported the practical difficulties of developing and utilizing this type of 'modelling' approach because of the lack of evaluative studies producing 'meta-knowledge' about the existing aspects and especially their relational weights accordingly.

For 'specification base', another computational framework and model was developed by Sibel Macit İlal and Murat Günaydın in 2017. Although it did not address HBD field in particular, (İlal & Günaydın, 2017) aimed at developing an 'automated compliance checking system' for 'semantic' and 'rule-based' KR&R of housing codes in local context in İzmir/Turkey yet reported also to be applicable to other fields and contexts. For this, authors proposed a three-stage process of model development methodology including the stages of: (1) domain analysis, (2) domain representation, and (3) model implementation. For analysis stage, the scope of specification documents, chapters, and clauses are qualitatively coded into various types of conceptual objects and rule statements to be later on encoded by model-makers and software engineers. Representation stage included 'domain level' (classes of objects such as spaces, zones, building elements, and so), 'rule level' (conditional links between objects and identified within statements), 'rule-set level' (hierarchical structure between various rules), and finally 'management level' (summation of various rule and rule-sets listed for a particular object). For the

implementation stage; the model was considered to be a ‘plug-in’ software integrated into the existing BIM (building information modelling) tools.

Here as a sub-section summary, a ‘modelling’ approach to ‘ontology-construction’ can be argued to be a quantitative abstraction method complementing the KR&R capabilities of ‘qualitative coding’, hence further supporting its knowledge domain understanding and description aims in practical means. In relation to the ongoing knowledge ‘translation’ and ‘utilization’ problems of EBD field, and considering the rather limited KR&R skills of the existing excel-based EBD tool and toolkits, a ‘modelling’ inquiry into EBD domain is deemed by this thesis as a necessary yet less-studies approach. However, necessity of highly complex mathematical and statistical models and algorithms that are required to provide a fully capable tool make it applicable to a relative narrow range of studies including this study. For this, this study mainly utilizes the ‘representational’ capabilities of ‘modelling’ while testing and providing a background for its practical implications as a computer-based knowledge utilization tool, then leaving space for future studies especially for the ‘reasoning’ stages.

Hence this thesis’s application of KR&R capabilities of a ‘modelling’ approach can be described to be limited with only its ‘taxonomy construction’ stage as a process allowed this thesis translating conventional data tables (obtained from the initial stage) into a single-layer vector graph (representation-based) through which the ‘semantic’ features of coded objects are encoded, represented, and tested for a potential tool scenario. For ‘spatial’ features as constituting the most critical stage of ‘ontology construction’ after ‘taxonomy construction’; on the other hand, this thesis utilizes a ‘mapping’ approach not only because of the practical difficulties of ‘modelling’ but also for its envisioning multidimensionality, holistic view, critical reading and interpretation, allowing for making meta-inferences, hence ‘synthesis’ of the knowledge gap areas to be identified and analyzed for the end of the study.

4.3.3 'MAPPING' ontologies

Following 'qualitative coding' (review and concept extraction) and its quantitative 'encoding' ('modelling' for taxonomy construction), third and the last stage of this thesis (ontology construction) applies 'cartography' for 'decoding' the 'spatial' properties of thematic objects identified within the knowledge domain of EBD field, and modelled and partially analyzed during the previous stage.

Here 'cartography'; from a dictionary standpoint', is a generic term referring to any type and process of drawing 'maps' that can be ranging from 'scientific' to 'artistic' means (OED, Webster). A 'scientific' conception of 'cartography' belongs mainly to the realm of geographical sciences, namely referring to projection of objects belonging to the earth surface. An 'artistic' conception of 'cartography'; on the other hand, is a relatively new and burgeoning approach which is named by the existing literature as 'critical cartography', and theorized as a 'cultural turn' and 'linkage' of the 'quantitative' model of 'geographical' cartography ('conventional') to/toward 'human geography' especially in terms for 'mapping' underlying 'power' relations (Perkins, 2003; Crampton & Krygier, 2018). In this regard, 'critical cartography' is accepted by the existing literature (i.e. Elden, 1998; Leszczynski, 2009; Crampton, 2009) as an 'ontological inquiry', and suggested to be serving as a rather intrinsic method and common language shared across many of the post-positivist research fields ranging from social and critical theory, literary criticism, and cultural geography to many other fields requiring creative and artistic inquiry.

Application areas and particular methods of 'cartography' are numerous but especially for the 'mapping' approach adopted in critical and creative fields combining art and science with social and critical theory (i.e. architectural, urban, landscape design and planning fields), a rather comprehensive view is provided by 42th issue of (TMMOB, 2019). Accordingly; following a sharp contrast to its

'authoritarian scientific'[27] means, Aral (editor) describes the 'contemporary' meaning of 'maps' to be referring to the 'social' and 'cultural' objects, "mediating between inner mental and outer physical worlds", hence allowing for human reasoning at various scales. For this, 'mapping' practice of 'contemporary' cartographic fields (nuanced also from 'mapmaking' practice of 'conventional cartography') is defined as an 'experiential', 'experimental', and 'open-ended' process (resulting in 'maps' not as an end-product) of investigating multi-relational[28] properties of objects found within the 'territory' inquired into; which is then followed by 'subjective' interpretation through 'provocative', 'artistic', 'creative', and 'original' visualization methods. Therefore; in the end, 'mapping' is conceptualized as a 'creative' and 'relational' act of conceptualization of a broad range of different spatial territories ranging from the physical to socio-cultural and information spaces.

Here especially for a 'mapping' approach applied into the 'information space' of a knowledge domain, doctoral dissertation of Yigit Acar can be shown as relevant to the knowledge domain and gap analysis aims, as well as the mixed-method methodical stance of this thesis. Following a computer-based 'quantitative coding' phase, (Acar, 2017) develops what is interpreted in this thesis as a qualitative/analytical/inductive 'academic cartographic'[29] 'mapping' approach for inquiring into the scholar activities and information spaces of urban design field in

---

[27] By reference to (Harley, 1987), author means the 'impersonal' and 'de-socialized' nature of the 'map' and 'mapmaking' conceptions of conventional cartography.

[28] Including both relational (relationship both with their space) and inter-relational (relationship among themselves) properties.

[29] What is named in the existing literature as 'academic cartography' is an implied analytic conception (i.e. Crampton, 2011; Acar, 2017; Hind et. all., 2018) of another neo-cartographic method that fits into an in-between (conventional/critical) cartographic approach, and can be referred and adopted in two different means: (1) cartography of scholar activities, and (2) cartography for any other types of analytical inquiries seeking for alternative representation methods than its scientific means. With this understanding, 'academic cartography' can be defined to be sharing the tenets of 'critical cartography' in its distance to positivist stance of conventional maps while prioritizing certain 'design aspects' of conventional maps (i.e. accuracy, functionality, clarity, and so) as to augment its readability for easing information sharing and delivery.

Turkish context. While doing so; (Acar, 2017) provides a comprehensive literature review of 'cartographic theory'; describes 'maps' as the 'partial' display of 'reality', 'mapping' as a 'selective' and 'reductive' process of exploring 'what is important' within that 'reality'; hence it is further described to be one's personal involvement (with underlying cognition and aims) with information space as the 'signifier' of its 'evident aspects' and 'relations' in their 'specific location' at their 'specific moment'. Here in this sense; considering 'maps' as non-objective[30] but rather 'subjective' agents of 'reality'; (Acar, 2017) explains the 'validity' problem of 'maps' by suggesting the 'mapping' process to be considered at two distinct levels of information transition occurring: (1) from 'reality' to 'map, (2) and from 'map' to the 'viewer'. Accordingly; Acar explains the first as a 'teleological action' of which the 'validity' is grounded on its underlying aim and purpose rather than its 'cause' as an end product. On the other hand; for the latter, Acar defines it as a 'communicative action' in Jürgen Habermas (1984) terms, namely referring to a 'validity' conception grounded on 'intersubjective agreement' of a group of people working on the same map through shared modalities.

Here building on Acar's literature review and 'validity' consideration; 'credibility' of 'maps' can be further explained in Edward Tufte terms. In his 'Beautiful Evidence' (2006), Tufte attributes 'maps' an evidential significance of picturing other empirical substances (numbers, words, images, and so), serving as the mediums of their 'understanding' and 'reasoning', hence generating new types of evidence for further investigation. From this perspective, 'mapping' is treated to be one of the modes of 'evidence presentation' that is further described to be a 'moral' and 'intellectual' act of the inquirer who is responsible for maintaining the 'quality', 'relevance', and 'integrity'. For this, Tufte determines 'evidence presentation' as an

[30] Based on an expression: "no map is objective" quoted by Acar from Peter Turchi's seminal work 'Maps of Imagination' (2004) to consider the 'blank space' of 'maps' as their genuine components, and not existing within the material world.

‘analytical design’ task of ‘truthful’ and ‘ethical’, hence ‘accurate’ expression of ‘evidence’ without ‘distortion’ and ‘corruption’ of what original data have to say.

With this understanding, this thesis interprets ‘maps’ as the physical embodiments of abstract relations of entities of a certain domain; and ‘mapping’ in this sense referring to a procedural embodiment of critical investigation and creative representation of the spatio-relational properties of those entities. According to the ongoing ‘ontology-based’ conception developed in this thesis, this thesis further interprets ‘mapping’ as another ‘ontology-based’ KR&R method adopted not for quantitative ‘encoding’ as it was in ‘modelling’ approach but for ‘decoding’, as a term referred by this thesis in Deleuze & Guattari (1988) terms, namely a particular way of qualifying quantified information by moving from ‘hierarchical’, ‘binary’, ‘linear’, and ‘symmetrical’ structuring and representation model of ‘arborescent’ thinking to ‘non-hierarchical’, ‘non-linear’, and ‘networked’ model of ‘rhizomatic’ thinking that envisions creative, analytical, as well as imaginative exploration of ‘interbeing’(s).

4.4 Chapter Summary

To sum up as a chapter summary, this thesis applies a broad range of knowledge review, analysis, representation, and reasoning approaches that can be simply summarized under three categories and stages: (1) coding, (2) decoding, and (3) encoding. While doing so the thesis experimentally benefits from possibilities of both qualitative and quantitative approaches for developing an ontology-based knowledge gap analysis methodology. These are formulated sequentially as a mixed-method research study and utilized as complementary stages for validity & consistency checking. At the end, the thesis interprets and synthesize key findings through narrative interpretation. Building onto the previously provided theoretical/methodical background, an interrelational conceptual diagram of those can be provided in Figure 4.3.

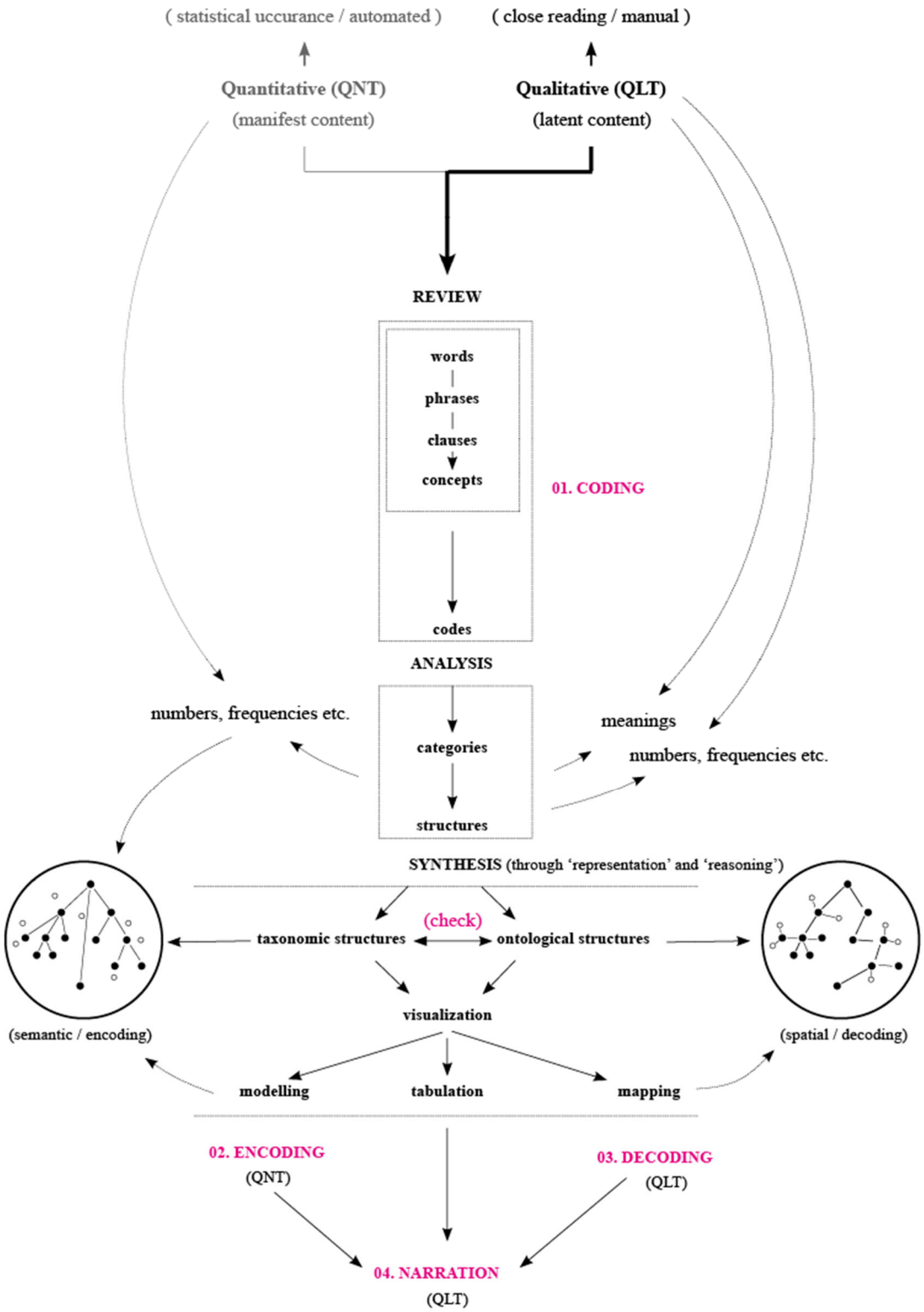


Figure 4.3. Teleological underpinnings of 'coding', and the track followed by the thesis

CHAPTER 5

TAXOGRAPH

5.1 Thesis Material

Material to be reviewed and analyzed in this thesis is comprised of two knowledge sources of EBD field: (1) evidence-based studies and (2) QMaE specifications. For specifications, the thesis concentrates on the latest versions of QMaE specification documents of MoH in Turkey. These include 'design', 'evaluation', and 'accreditation' specification documents that was elaborated in Chapter 3. For evidence-based studies, the thesis applies an 'umbrella literature review' approach through which particularly EBD Knowledge Repository of CHD[31] is selected to be reviewed.

Aim of 'Knowledge Repository' is explained by CHD to provide EBD field with an extended library of evidence-based studies (n: 5,621)[32] that are indexed and listed by the review team, and suggested as bibliographic sources. Among these, n:868[33] of sources are reviewed and provided with their 'key point summary' (KPS). Further among these; and by late 2021, n:366[34] was provided with their source link that were searchable[35] in other indexes such as 'google scholar' or their primary publication website. In this thesis, only these 366 of evidence-based studies are taken under focus for further review and coding (listed in Appendix A).

---

[31] https://www.healthdesign.org/knowledge-repository
[32] Latest access by April, 2022
[33] Latest access by April, 2022
[34] Latest check by late 2021
[35] For further checking and dealing with bibliographic inconsistencies identified in some of the sources provided in the website

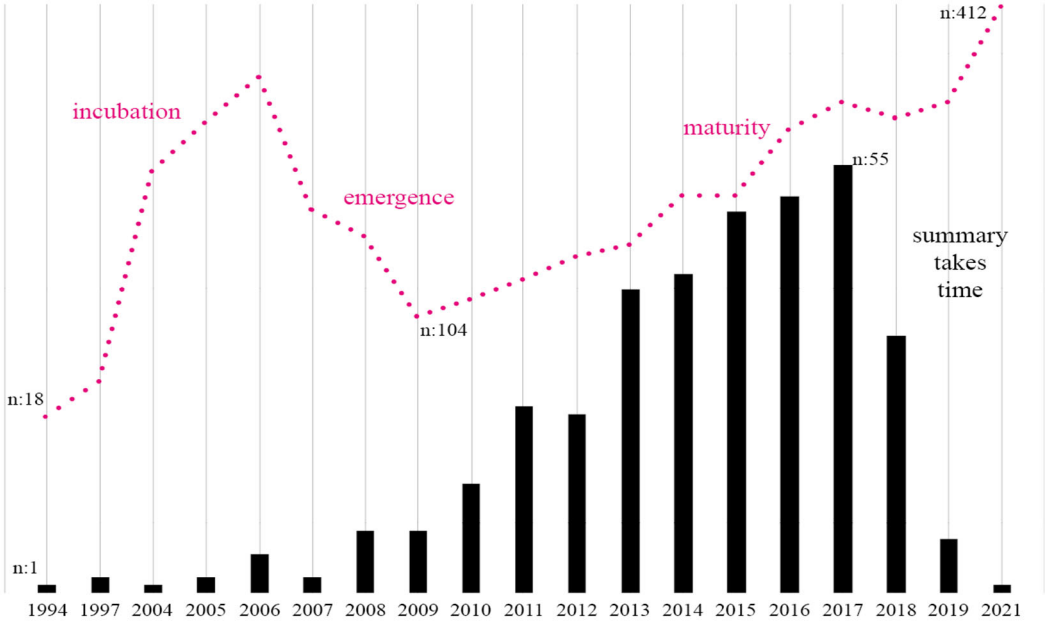


Figure 5.1. Yearly distribution of evidence-based studies provided by CHD Knowledge Repository
(listed/above – reviewed below)

Analysis of yearly distribution of studies listed and reviewed (Figure 5.1) confirms three major time periods existing in the development of EBD field and its evidence-based study knowledge base accordingly. Building onto the extended historical review provided in Chapter 2, these can be argued to be as follows:

- **Incubation period:** referring to the period when research interest on evidence-based research had peaked yet not naming it EBD;
- **Emergence period:** referring to the period when EBD notion had emerged and gained its full-fledged popularity especially by means of its theoretical grounds and its conceptualization,
- **Maturity period:** referring to the period when healthcare sector witnessed a hospital construction boom that necessitated up-to-date evidence-based research in practical means.

On the other hand, sharp decline in the number of studies summarized in more recent years is reasoned by this thesis as being caused by practical difficulties and time considerations in summarizing available bodies of evidence-based studies by CHD review team.

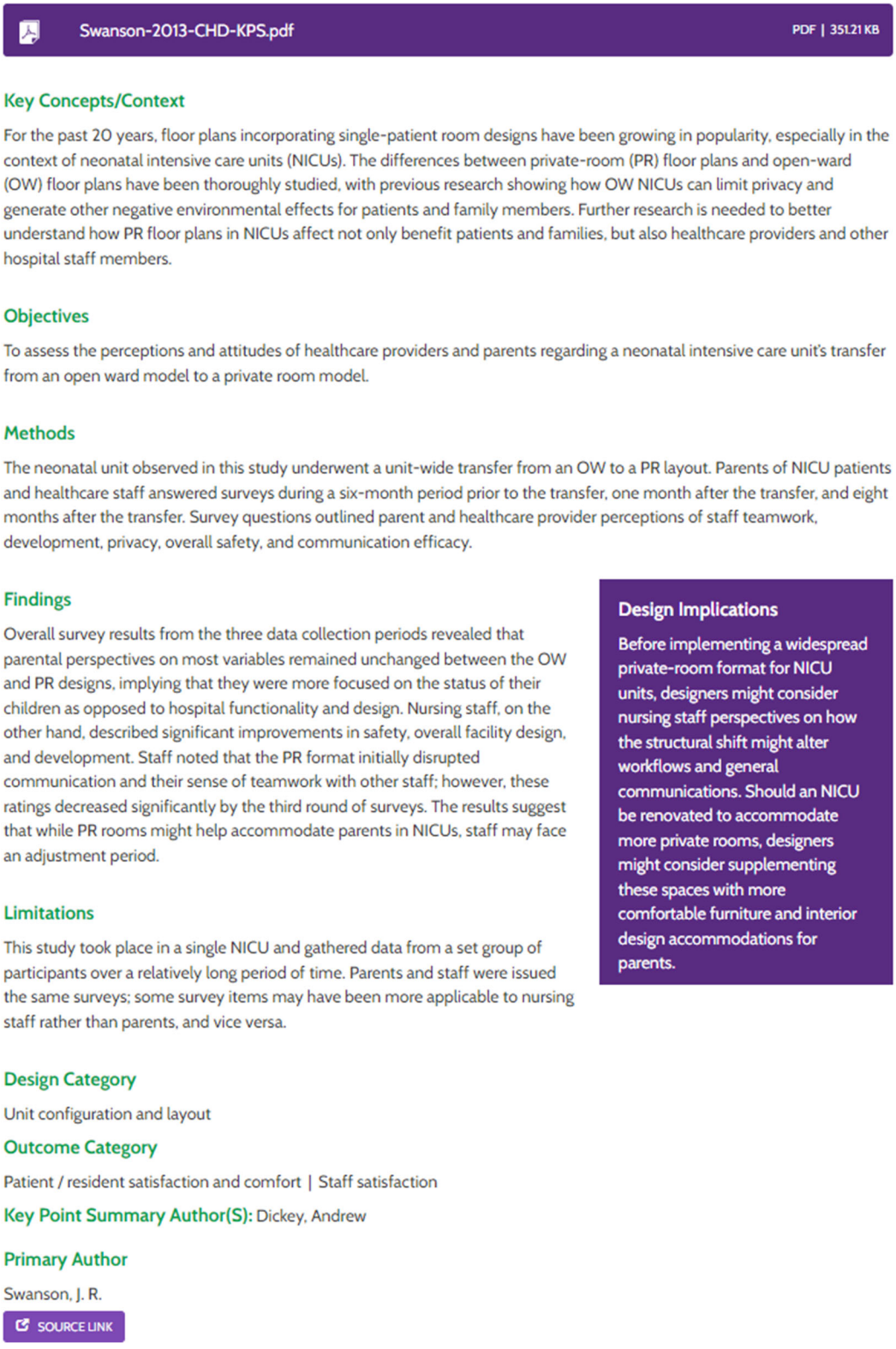
For the above-mentioned specification and evidence documents, this chapter's aim is to make a comparative analysis of knowledge domain differences especially by means of particular areas of significance that are paid attention to in different degrees. A preliminary description of these differences is provided in Figure 5.2.

Figure 5.2. Preliminary description of knowledge domains of evidence and specification documents reviewed and coded
(above: evidence / below: specification)

5.2 Data Handling & Segmentation

The thesis handles content identified within individual documents in segments. For the segmentation of specification documents, the thesis mainly follows original structure and format of the relevant document if it is structured and formatted as a specification code book (i.e. ‘evaluation’ and ‘accreditation’ documents). If this is the case, the thesis segments the entire document either by individual sentences or paragraphs according to their original coding scheme and order. If it is a plain-text document; for example, the ‘design guidance book’, then the thesis makes a closer reading of the document, and segments either by individual sentences or phrases identified within an individual paragraph, hence within their same place. In the end the thesis reaches at a total number of 743 specification segments in total.

For the segmentation of evidence-based studies; namely the KPS(s) provided by CHD, the thesis grounds on the KPS format of CHD instead of the original publication format and lengths of the related evidence-based study. Accordingly, an identical KPS document consists of summary of ‘key concepts’, ‘objectives’, ‘methods’, ‘findings’, ‘limitations’, as well as and more importantly ‘design implications’ of the related KPS document (Figure 5.3). This thesis particularly utilizes ‘design implication’ content for textual analysis and coding. Aim of selecting KPS(s) and their ‘design implication’ part is for having a commensurable ground with specification sentences especially by means of identical propositional ground provided within identical lengths and scopes. Hence in the end, the thesis refers to all KPS documents and a total n:366 ‘design implication’ segments to be qualitative coded in the following section, and these are visualized together with specification documents in Figure 5.4.



Swanson-2013-CHD-KPS.pdf PDF | 351.21 KB

Key Concepts/Context

For the past 20 years, floor plans incorporating single-patient room designs have been growing in popularity, especially in the context of neonatal intensive care units (NICUs). The differences between private-room (PR) floor plans and open-ward (OW) floor plans have been thoroughly studied, with previous research showing how OW NICUs can limit privacy and generate other negative environmental effects for patients and family members. Further research is needed to better understand how PR floor plans in NICUs affect not only benefit patients and families, but also healthcare providers and other hospital staff members.

Objectives

To assess the perceptions and attitudes of healthcare providers and parents regarding a neonatal intensive care unit's transfer from an open ward model to a private room model.

Methods

The neonatal unit observed in this study underwent a unit-wide transfer from an OW to a PR layout. Parents of NICU patients and healthcare staff answered surveys during a six-month period prior to the transfer, one month after the transfer, and eight months after the transfer. Survey questions outlined parent and healthcare provider perceptions of staff teamwork, development, privacy, overall safety, and communication efficacy.

Findings

Overall survey results from the three data collection periods revealed that parental perspectives on most variables remained unchanged between the OW and PR designs, implying that they were more focused on the status of their children as opposed to hospital functionality and design. Nursing staff, on the other hand, described significant improvements in safety, overall facility design, and development. Staff noted that the PR format initially disrupted communication and their sense of teamwork with other staff; however, these ratings decreased significantly by the third round of surveys. The results suggest that while PR rooms might help accommodate parents in NICUs, staff may face an adjustment period.

Limitations

This study took place in a single NICU and gathered data from a set group of participants over a relatively long period of time. Parents and staff were issued the same surveys; some survey items may have been more applicable to nursing staff rather than parents, and vice versa.

Design Implications

Before implementing a widespread private-room format for NICU units, designers might consider nursing staff perspectives on how the structural shift might alter workflows and general communications. Should an NICU be renovated to accommodate more private rooms, designers might consider supplementing these spaces with more comfortable furniture and interior design accommodations for parents.

Design Category

Unit configuration and layout

Outcome Category

Patient / resident satisfaction and comfort | Staff satisfaction

Key Point Summary Author(S): Dickey, Andrew

Primary Author

Swanson, J. R.

SOURCE LINK

Figure 5.3. Example of an identical 'key point summary' provided by CHD (KPS 320)

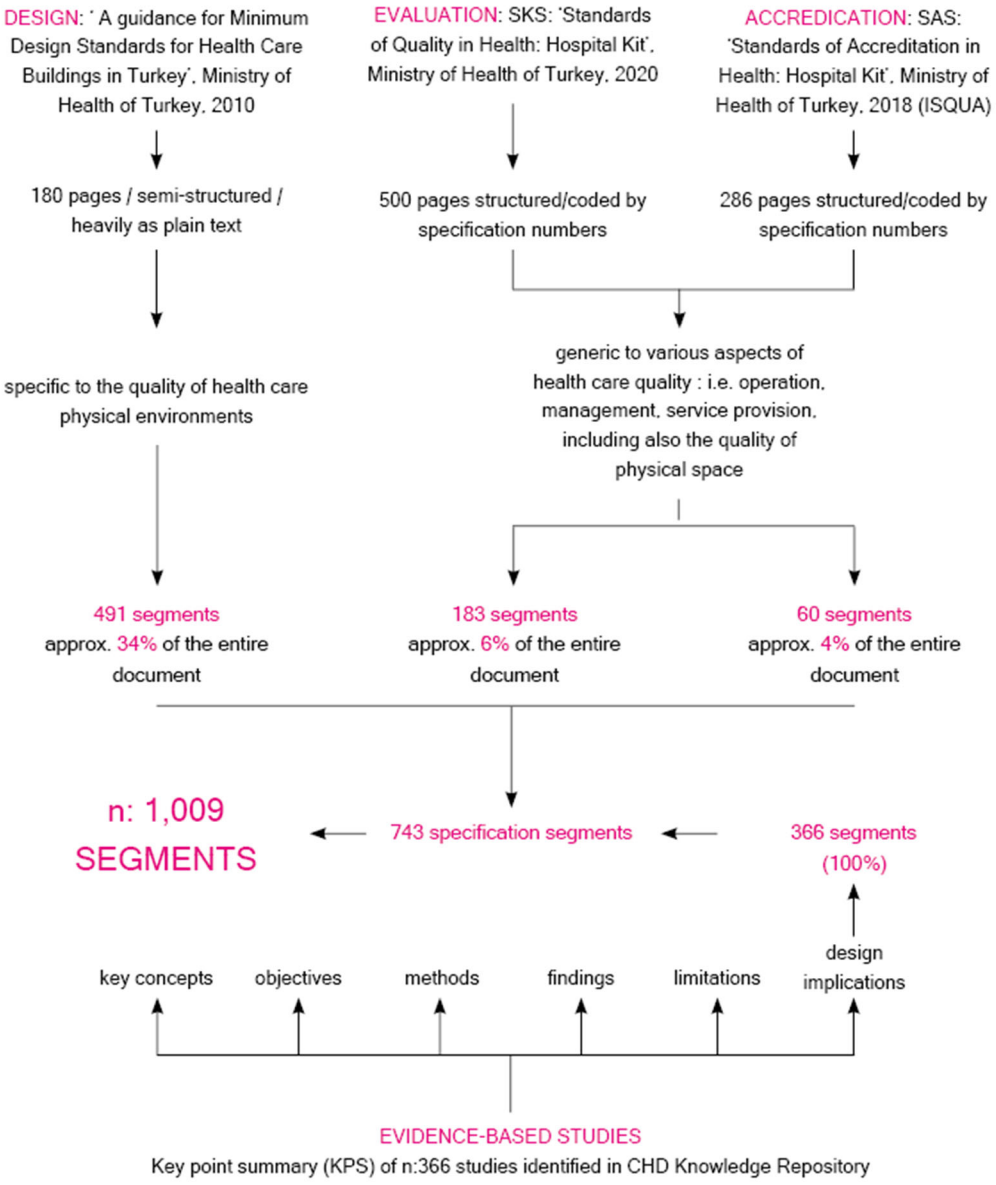


Figure 5.4. Segmentation scheme of the thesis

5.3 'CODING' Segments

In accordance with the 'interpretive coding' and 'coding of the latent content' principles of 'qualitative coding', the thesis closely reads each segment, and fragments each into various phenomena that may be comprised and expressed of/by either a single word or a phrase. For example; for the below quoted specification segment:

> "**6.5.1.1:** The location of intensive care unit should be determined so that building traffic does not need to pass through. There should be seating, waiting and information area for patient accompaniers. These areas can be combined with other similar areas" (MoH, Design Guidance, 2010: p.82).

… without making judgement related to the validity and truth of its proposition, the thesis labels and names 9 fragments and these are (1) 'intensive care unit', (2) 'location', (3) 'traffic', (4) 'patient', (5) 'accompanier', (6) 'seating area', (7) 'waiting area', (8) 'information area', (9) 'combinability'. As the labeling process continues for other segments, and the number of fragments increases, the thesis cumulatively groups similar fragments, and creates more generic and inclusive themes, and these are named as individual codes; such as for the above example:

- **S2:** 'ICU(s)': the code refers to and includes all types of ICU(s) that are specified in other segments,
- **S6:** 'waiting room/area(s)',
- **S14:** 'reception/infodesk/patient admission/lobby areas and hallways'
- **M1:** 'plan layout/organization': the code refers to and includes all types of phrases recalling interventions such as circulation, distance between settings, orientation, location' etc.,
- **M6:** 'user profile',
- **C6:** 'modularity/flexibility/multi-hub',
- **C8:** foot/building traffic, and so on.

Accordingly, above-quoted segment is fragmented into 9 phrases, re-arranged under 7 codes, and grouped under 3 coding categories: (1) S: 'Settings', (2) C: 'Concepts', (3) M: 'measures. A full list of entire codes and coding categories for all segments and documents is provided with their representative colors in Table 5.1. These are the final results obtained after elimination of numerically (coding frequency) non-

significant codes. The number and determination of coding categories is inspired and guided in this thesis from the existing knowledge domain classifications that are commonly utilized in systematic review studies mentioned in Chapter 2, and automated-compliance checking studies reviewed in Chapter 4 for specifications.

Table 5.1 List of 'codes', 'categories', and color scheme of the thesis (each category ordered by coding 'frequency')

Coding Category	Code
Settings (areas/rooms/spaces/units/ cabins etc.)	**S1:** patient rooms **S2:** ICU(s) **S3:** emergency units **S4:** wet spaces/bathrooms/toilets etc. **S5:** operating/surgery rooms/theaters **S6:** waiting rooms/areas **S7:** nurse/nursing stations **S8:** entrance and exists **S9:** birth units **S10:** laminar flow/isolation rooms **S11:** work areas/stations **S12:** storage rooms/units **S13:** open areas/gardens/greeneries **S14:** reception/infodesk/patient admission/lobby areas/hallways **S15:** corridor/hallways **S16:** info/therapy/consultation/confortation/meeting rooms **S17:** physical examination rooms **S18:** radioactive imaging cabins/rooms **S19:** fast-tracking/resuscitation rooms/areas **S20:** office rooms **S21**: staff/patient preparation/resting areas/rooms **S22:** patient preparation/resting and observation units **S23:** labs **S24:** social and physical activity/support/entertainment areas **S25:** kitchen/dining areas **S26:** stretcher/wheelchair storage/parking areas **S27:** end-of-life/palliative care/lotus rooms **S28:** sterilization/disinfection/decontamination rooms **S29:** drug/contrast agent preparation/storage room/areas **S30:** chemical, biological, radiological, nuclear decontamination rooms

Coding Category	Code
Concepts	**C1:** hygiene/infection control **C2:** safety/security **C3:** visibility/sight/monitoring **C4:** privacy/confidentiality **C5:** psychology **C6:** modularity/flexibility/multi-hub **C7:** accessibility **C8:** foot/building traffic **C9:** efficiency/performance **C10:** teamwork/communication/monitoring systems **C11:** spatial/physical/psychological comfort **C12:** falls/injuries **C13:** design and construction process **C14:** ease of mobility/movement **C15:** soundproofing/acoustic **C16:** workflow efficiency/speed/intensity **C17:** patient-centeredness **C18:** social interaction/participation/encounters **C19:** cost **C20:** waste/hazard management **C21:** choice/control/autonomy of patients **C22:** positive & negative distraction **C23:** way-finding/navigability **C24:** sleep/circadian entrainment **C25:** therapeutic / healing **C26:** durability/maintainability
Measures (tangible & intangible)	**M1:** plan layout/organization **M2:** area/size (sqm) **M3:** quantity **M4:** dimensions **M5:** single or shared **M6:** user profile (patient/visitor/accompanier/relatives/child etc.) **M7:** technical features/specs **M8:** aesthetic/visual attractiveness/appearance **M9:** color
Equipment	**EQ1:** sink/lavatories **EQ2:** medical devices **EQ3:** HVAC systems **EQ4:** patient beds **EQ5:** signage systems **EQ6:** storage cabinets **EQ7:** furnishing/artwork/nature view/scenery **EQ8:** stretcher/wheel chair **EQ9:** continuous power supply modules **EQ10:** handrail/grab bars **EQ11:** patient/visitor chairs **EQ12:** hand dryers/jell dispensers **EQ13:** curtain/separators
Environmental Variables	**EN1:** daylight and lighting **EN2:** soundscape **EN3:** air quality **EN4:** temperature **EN5:** noise/sound level **EN6:** exterior/nature view **EN7:** humidity
Elements (building)	**EL1:** material/details/finishes **EL2:** door/door openings **EL3:** walls **EL4:** windows **EL5:** ceilings **EL6:** flooring **EL7:** lift and elevators **EL8:** stairs **EL9:** ramps

5.4 Preliminary Determination of Significance Areas

Both for the above-outlined coding and subsequent tabulation process, the thesis utilizes a software named as MAXQDA. It allows coding and analysis of 'qualitative and mixed-method' data introduced in textual or multimedia formats. One of the key underlying/methodical aspects of it is to make numerical aspects of coded data visible; and this is key for statistical data analysis and visualization.

Numerical data obtained through the software is interpreted and benefited mainly in three categories:

- **Frequency:** referring to the number of instances (segments) that each code is referred to;
- **Intersection:** referring to the number of instances/segments that each code is referred within the same segment together with other codes;
- **Centrality:** referring to the number of other codes (not instances) that each code is referred together within the same segment with other codes.

Based on the data tables (Appendix B) obtained through the software, final results were visualized and provided in Figure 5.5. Accordingly; for the sake of final interpretation, 'frequency' and 'intersection' ratios are interpreted as indicating the 'degree of attention' paid to a certain code within a certain document. For example; according to its frequency and intersection metrics; 'patient rooms' (S1) can be displayed to be the most signified concept within the totality of evidence-based knowledge including KPS and specification documents. It is also valid for only evidence-based studies when they are isolated. When specification documents are isolated; on the other hand, ICU(s) (S2) comes into signification.

'Centrality' metric is; on the other hand, interpreted by the thesis as a sign of 'conceptual significance' meaning that the related code is referred by a particular document more relatedly and interactively with other codes. For example; for the totality of evidence-based knowledge evaluated, 'wet spaces including bathrooms, toilets etc.' (S4) is referred more interactively than ICU(s) (S2), and 'emergency

units' (S3) although 'frequency' and 'intersection' ratios of each is higher than S4. The same applies when evidence-based studies are isolated. When specification documents are isolated; on the other hand, 'ICU(s)' (S2) comes into significance although its 'frequency' and 'intersection' ratios are identical with the KPS documents.

Here one critical point that should be noted is the fact that 'intersection' ratio of each code is highly dependent on its coding 'frequency'. Reason of this is because the coding scheme of the thesis requires labeling textual content segment by segment, not phrase by phrase. Overall, this usually result in statistical non-significancies especially in terms of their implication for any significance area deserving further evaluation. As such, the thesis utilizes 'frequency' and 'intersection' ratios as a unified consideration metric yet regularly checks the convergence of each other for consistency during/of the coding process.

For this; the thesis represents each code within a 'radar chart' scheme (Figure 5.6) that each code is proportional only within its own right (Appendix C: Significance matrix). Here aim is to reveal the proportional significances (not numerical) and allowing seeing the statistical irregularities and patterns that deserves further attention. Accordingly, comparison of 'frequency' and 'intersection' metrics does not display any significance as expected yet 'centrality' metric bringing 12 codes into significance; and these are provided in Figure 5.7. Final results were also sorted and tabulated together in Table 5.2 by filtering and signifying especially by means of the differences between KPS and specification documents.

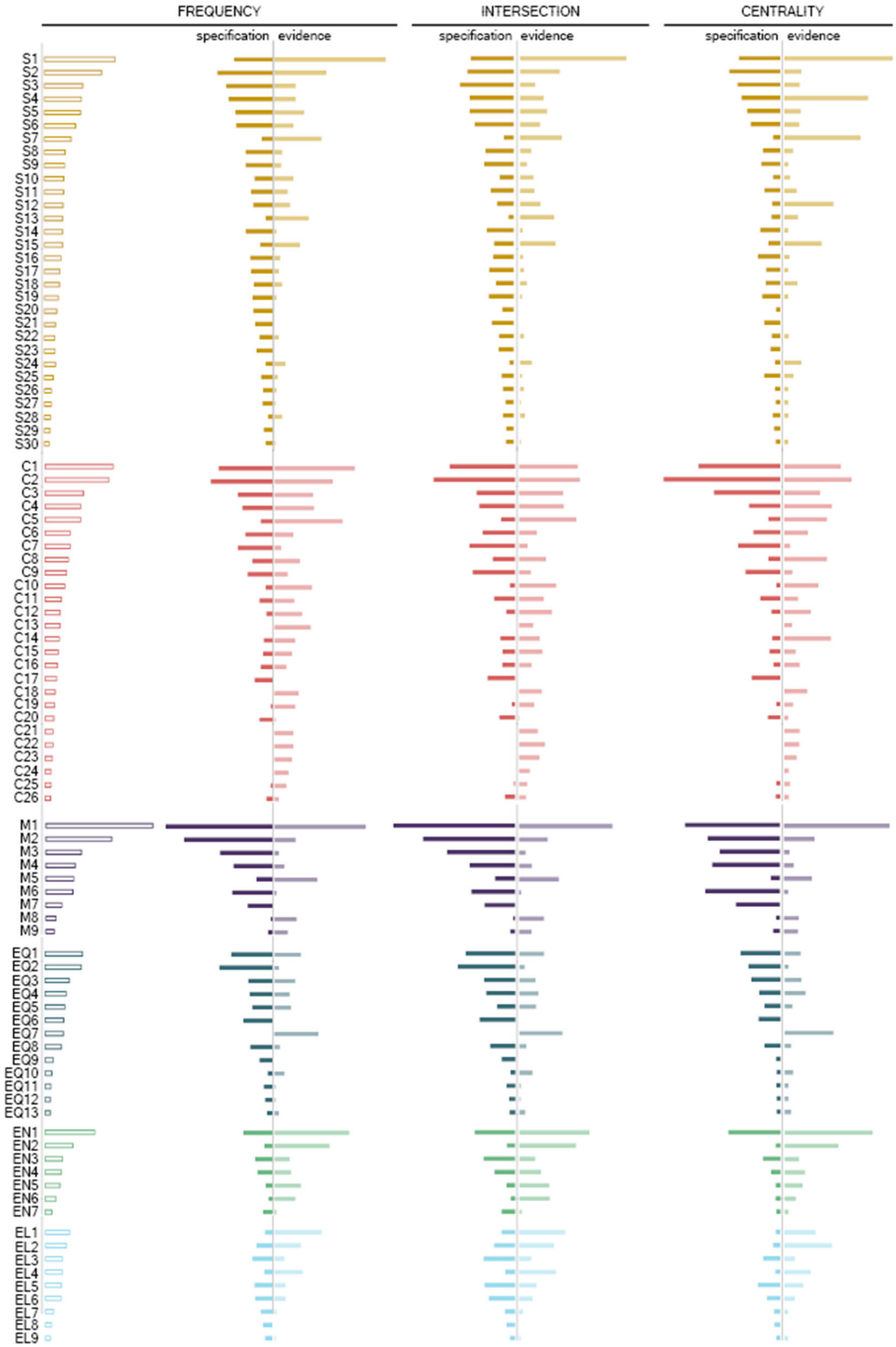


Figure 5.5. Coding ‘frequency’, ‘intersection’, ‘centrality’ matrix
(each column is numerically scaled in its own right)

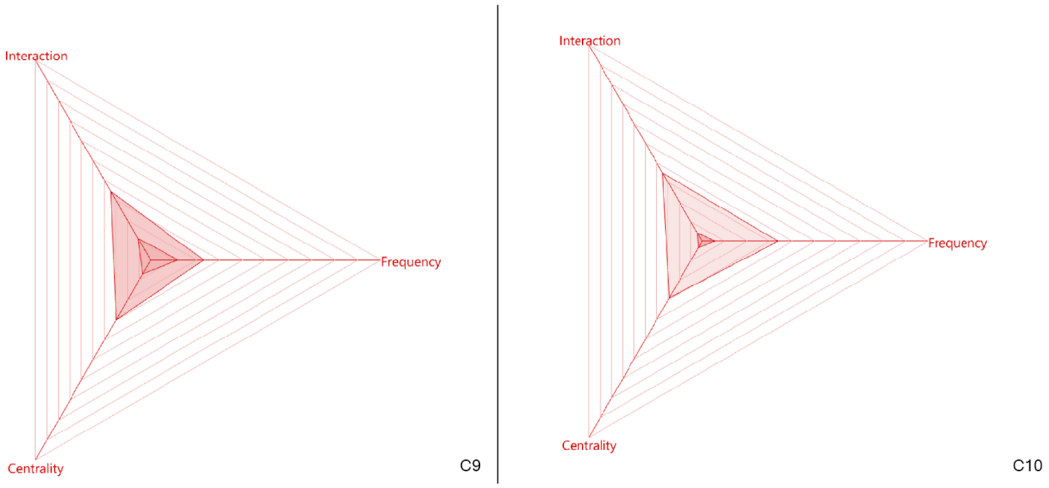


Figure 5.6. Examples for an identical/regular radar chart developed for the visualization and signification of numerical data (proportionally scaled)

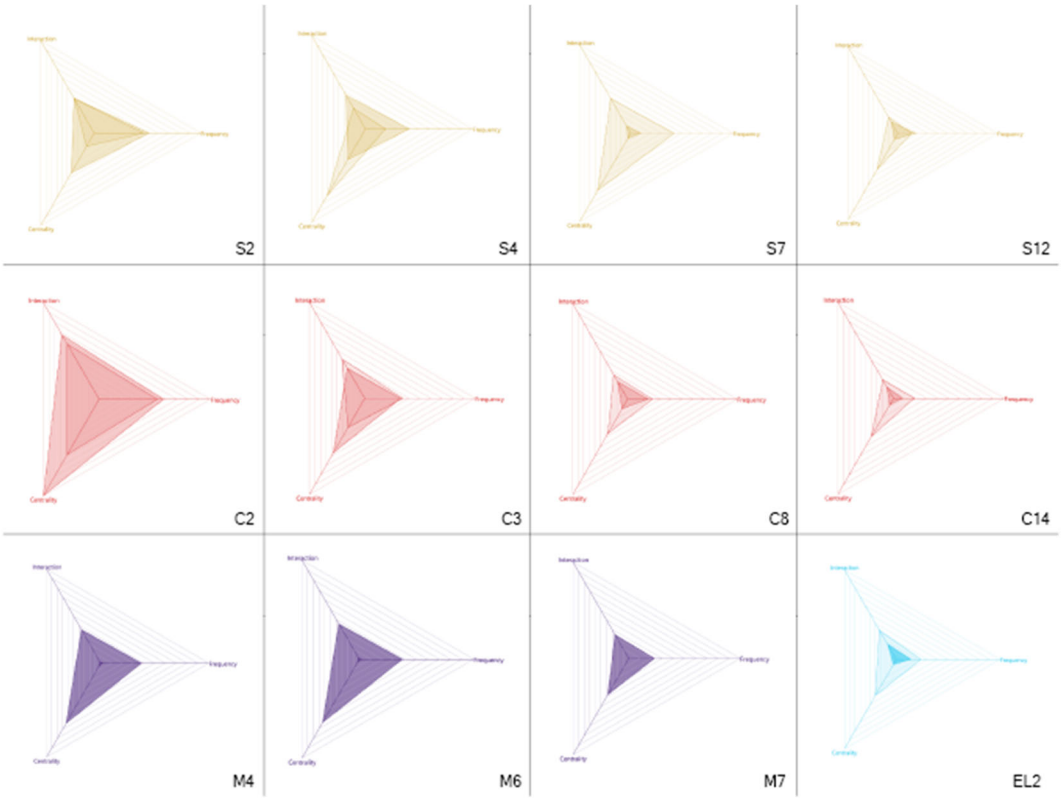


Figure 5.7. Statistically irregular and significant codes evaluated by ‘centrality’

Table 5.2 Significance table

Knowledge Base	Specification Base	Evidence Base
Frequency & Intersection	**S3:** emergency units **S4:** bathrooms **S6:** waiting rooms/areas **S8:** entrance and exists **S9:** birth units **S14:** reception/infodesk/patient admission… **S16:** info/therapy/consultation/confortation… **S17:** physical examination rooms **S18:** radioactive imaging cabins/rooms **S19:** fast-tracking/resuscitation rooms/areas **S20:** office rooms **S21**: staff/patient preparation/resting areas/rooms **S22:** patient preparation/resting … units **S23:** labs **S25:** kitchen/dining areas **S26:** stretcher/wheelchair storage/parking areas **S27:** end-of-life/palliative care/lotus rooms **S29:** drug/contrast agent preparation… **S30:** chemical, biological, radiological… **C7:** accessibility **C17:** patient-centeredness **C20:** waste/hazard management **M2:** area/size (sqm) **M3:** quantity **M4:** dimensions **M6:** user profile **M7:** technical features/specs **EQ2:** medical devices **EQ6:** storage cabinets **EQ8:** stretcher/wheel chair **EQ9:** continuous power supply modules **EQ11:** patient/visitor chairs **EQ12:** hand dryers/jell dispensers **EN7:** humidity **EL3:** walls **EL7:** lift and elevators **EL8:** stairs **EL9:** ramps	**S1:** patient rooms **S7:** nurse/nursing stations **S13:** open areas/gardens/greeneries **S15:** corridor/hallways **S28:** sterilization/disinfection/decont… **C5:** psychology **C10:** teamwork/communication/monitor… **C12:** falls/injuries **C13:** design and construction process **C14:** ease of mobility/movement **C18:** social interaction/participation… **C19:** cost **C22:** positive & negative distraction **C23:** way-finding/navigability **C24:** sleep/circadian entrainment **C25:** therapeutic / healing **M5:** single or shared **M8:** aesthetic/visual attractiveness… **M9:** color EQ7 **EQ10:** handrail/grab bars **EN1:** daylight and lighting **EN2:** soundscape **EN5:** noise/sound level **EN6:** exterior/nature view **EL1:** material/details/finishes **EL2:** door/door openings **EL4:** windows
Centrality	**S2:** ICU(s) **C2:** safety/security **C3:** visibility/sight/monitoring **M4:** dimensions **M6:** user profile **M7:** technical features/specs	**S4:** bathrooms **S7:** nurse/nursing stations **S12:** storage rooms/units **C8:** foot/building traffic **C14:** ease of mobility/movement **EL2:** door/door openings
Neutral	**S5:** operating/surgery rooms/theaters **S10:** laminar flow/isolation rooms **S11:** work areas/stations **S24:** social and physical activity/support/entertainment areas **C1:** hygiene/infection control **C4:** privacy/confidentiality **C6:** modularity/flexibility/multi-hub **C9:** efficiency/performance **C11:** spatial/physical/psychological comfort **C15:** soundproofing/acoustic **C16:** workflow efficiency/speed/intensity **C21:** choice/control/autonomy of patients **C26:** durability/maintainability **M1:** plan layout/organization **EQ1:** sink/lavatories **EQ3:** HVAC systems **EQ4:** patient beds **EQ5:** signage systems **EQ7:** furnishing/artwork/nature view/scenery **EQ13:** curtain/separators **EN3:** air quality **EN4:** temperature **EL5:** ceilings **EL6:** flooring	

5.5 'ENCODING' for a Practical Knowledge Utilization Tool

Instead of elaborating on the aforementioned significance areas code by code individually and isolatedly, the thesis handles coded data according to their inter-relational structures and structural properties. For this; and having elaborated more in Chapter 4; one of the main principles adopted is an 'ontology-based' knowledge domain mapping approach through which especially the spatio-relational properties of the coded data is visualized, analyzed, and interpreted for synthesis. As the preliminary stage of identification 'ontological structures', a 'taxonomy construction' process is needed.

For this, the particular KR&R method is selected in this section to be a 'representation-based' knowledge graph of which the aim is to translate coded data into a single-layered vector graph that can be described to be resulting in 'low-dimensional', 'hierarchical', 'linear', and 'symmetrical' structures. For this, the thesis develops a Rhino/Grasshopper algorithm (Appendix F) for further processing raw data, and allowing for the analysis of 'semantic' structures and their implications for knowledge consumers.

The thesis names the 'representation-based' knowledge graph produced out of the developed algorithm as 'Taxograph' and its 'single-layered' vector space is designed to function according to a multi-leveled knowledge utilization scheme. Accordingly:

- **Layer 1:** allows for isolating any code that is intended to be inquired into;
- **Layers 2 &3:** allows for comparatively (between evidence and specification) exploring inter-relational properties and significance scheme ('frequency' and 'intersection') of the selected code with other codes within multiple coding categories;
- **Layer 4:** allows for accessing at the list of relevant bibliographic sources either with their KPS or specifications segments,

- **Layer 5:** allows for further exploration and extended review of the coding scheme of the related/interested KPS or specification segment before visiting the actual source within its own place.

Potential usage scenario of 'Taxograph' and its instances (Appendix D) is intended to serve for both practical and analytical purposes. As noted in Layers 1/4/5, practical ones include easing the filtering and sorting processes of complex data sets, identification of significance areas, and leading the inquirer into related knowledge source for further exploration and reviewing.

As noted in Layers 2&3, analytical one includes making the coding scheme of the selected code ('frequency' and 'intersection') comparatively visible. For example; for 'wet spaces' (S4) to be inquired within C: 'concepts' category, the particular instance captured in Figure 5.8 displays certain concepts such as and in order with 'accessibility' (C7), 'hygiene/infection control' (C1), and 'privacy/confidentiality' to be numerically more referred by specification documents when compared to other concepts within the same category. Here apart from its coding frequency (numeric); proportion-wise, 'accessibility' (C7) comes also into further signification.

Building on the above-mentioned viewing and interpreting approach; additionally, a proportion-wise comparison of both evidence and specifications strings can allow for further classification of codes according to their signification by two different document types, exemplified as below:

- specification documents: C: 1/3/4/6/7/9/10/11/17
- KPS documents: C: 2/5/8/12/13/14/18/21/22/24

This will be one of the key complementary methods in interpreting selected ontological structures in the following chapter.

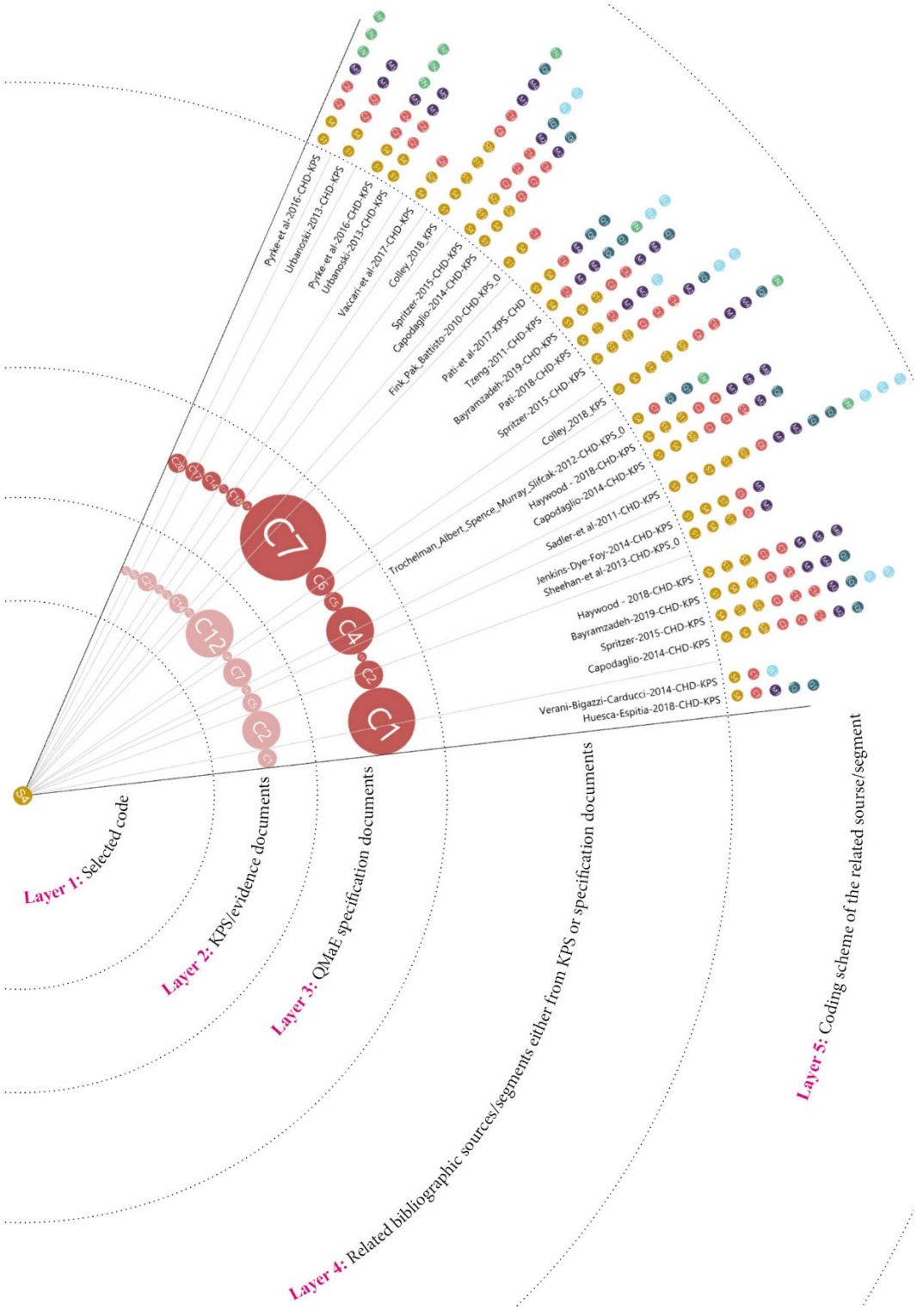


Figure 5.8. Taxonomy scheme of the algorithm developed
(S4: ‘wet spaces’ inquired within C: ‘concepts’ coding category)

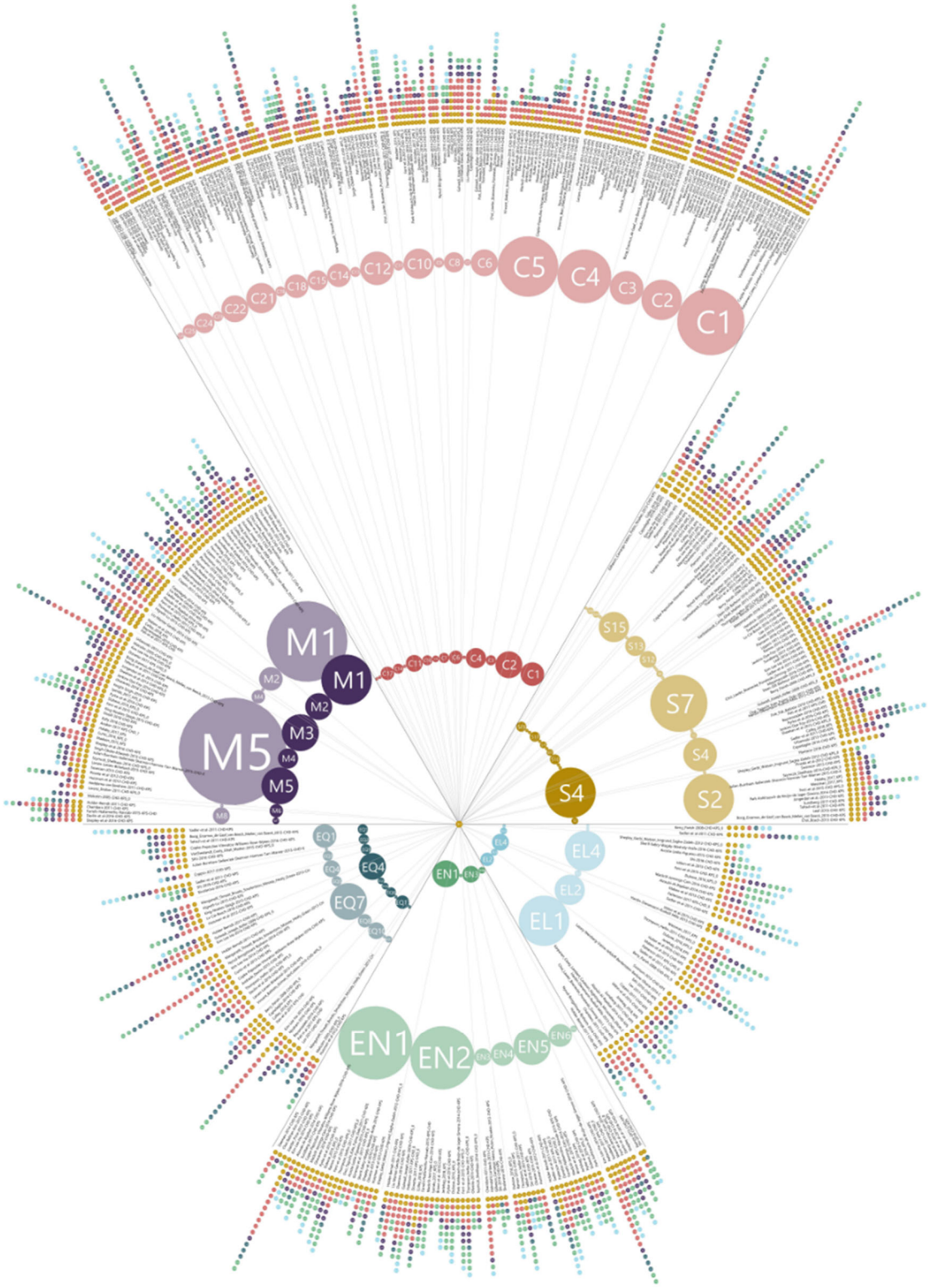


Figure 5.9. An example instance from Taxograph
(S1: ‘patient rooms’)

5.6 Executive Summary of Key Findings

Based on the outcome of particular ‘coding’ and ‘encoding’ methods introduced and applied in this chapter for reviewing, testing, and analyzing the thesis material, following determinations can be made especially over the interpretation of Table 5.2.

For specification documents reviewed, it can be argued that certain coding categories including and in order with S: ‘Settings’, M: ‘Measures’, EQ: ‘Equipment’, and EL: ‘Building Elements’ are the most significant conceptual categories referred within the propositional ground for the design quality of health care buildings. Within S: ‘Settings’ category, specification documents can be argued to cover the broadest possible range of different settings with the exceptional attention paid for ICU(s) (S2). Specification documents can be further claimed to be handling health care building settings especially over their particular M: ‘Measures’ which are generally preferred to be the most tangible ones such as ‘area/size’ (M2), ‘quantity’ (M3), ‘dimensions’ (M4), and so on. These can be further argued to be very detailed and over-considered together with the related equipment and building elements.

For KPS documents reviewed; on the other hand, coding categories including and in order with C: ‘Concepts’, S: ‘Settings’, and EN: ‘Environmental variables’ can be argued to be the most significant conceptual categories. Within C: ‘Concepts’ category, KSP documents reviewed can be argued to be covering a broadest possible range of concepts recalling both the ‘support-oriented’ and ‘safety-oriented’ knowledge domains of evidence-based knowledge. Frequency/intersection-wise; and for the ‘support-oriented’ knowledge domain, certain concepts such as ‘psychology’ (C5), ‘social interaction/participation’ (C18), ‘positive & negative distraction’ (C22), ‘therapeutic / healing’ (C25) come into significance yet being less dominantly and frequently referred within specification documents. Centrality-wise, concepts such as ‘foot/building traffic’ (C8) and ‘ease of mobility/movement’ (C14); and frequency/intersection-wise, ‘falls/injuries’ comes into signification for ‘safety-oriented’ that also recalls functionality and efficiency of health care settings. These can be further argued to be very detailed and over-considered together with tangible

aspects of the design quality of health care buildings, not in the same sense with specification documents but more related with EN: ‘environmental variables’ that further recalls the measurement of environmental performance and efficiency. Yet and in contrast to specification documents, KPS documents can be lastly argued to cover a narrow range of S: ‘Settings’ that can be considered as a sign of over-study, and it will be an important inquiry subject of the following chapter.

CHAPTER 6

ONTOGRAPH

Continuing over the preliminary description provided in previous chapter, this chapter further refines the evaluative picture of knowledge domain differences occurring between QMaE specification and KPS documents. For this, the chapter applies a 'decoding' approach through which qualitative 'coding' and quantitative 'encoding' approaches are merged for (1) exploration of spatio-relational properties, (2) identification and construction of particular ontologies, (3) 'mapping' and interpretation over significant ontological structures to be further refined. Overall, the entire process can be described to be superimposition of various data types and analysis methods of which; as noted before, the convergence is also key for consistency checking and validity considerations of the thesis.

6.1 'Clustering' as a Spatio-relational Act

For the exploration of spatio-relational properties of a given knowledge domain, 'clustering' is a common method that applies a computer-based approach for bringing entities together according to pre-established data constraints. Especially the bold emphasis on spatiality (conceptual not physical) turns 'clustering' to be the basic unit of constructing ontologies and analyzing their ontological structures.

'Ontology' understanding of this thesis requires each cluster to meaningfully come together. Accordingly; from its broadest perspective, each segment (n:1009) coded in previous chapter can be considered to be providing the ground for 'meaning' for a number of codes coming together and creating a cluster. For example; for the below quoted KPS 204 segment, 'self-sanitizing' feature of copper material provides meaning for particular codes including S1, C1, C19, M1, EL1 coming together and creating a cluster. Here the KPS 204 document itself is the place and reason why this

clustering occurs. The same applies for the document KPS 224 that brings S2, S7, S11, C1, M5, EL1, EQ2, EQ10 together and forms a cluster.

> **KPS 204:** "… for patient rooms … by implementing copper oxide-impregnated self-sanitizing solid surfaces (SSSCus), designers could help mitigate the risk of patient infections without significantly altering the floor plans or other architectural features of healthcare spaces. This study suggests that SSSCus may be a relatively simple, inexpensive, and effective way to combat drug-resistant pathogens over time." // Coding Scheme: **S1:** 'patient rooms', **C1:** 'hygiene/infection control', **C19:** 'cost', **M1:** 'plan layout/organization, **EL1: '**material/details/finishes'

> **KPS 224:** "… within pediatric intensive care units … the authors strongly recommend the use of copper surfaces in multi-bed pediatric settings, especially for bed rails, faucet handles, intravenous poles, workstations, and nurses' pads" // Coding Scheme: **S2:** 'ICU(s) **S7: '**nurse/nursing stations', **S11: '**work areas/stations', **C1:** 'hygiene/infection control', **M5:** single or shared, **EL1: '**material/details/finishes' **EQ2:** 'medical devices', **EQ10:** 'handrail/grab bars'

Within evidence-based knowledge domain, such reasons (i.e. copper material) creates hidden commonalities between individual documents/segments that link what may be normally considered as isolated entities by unexpected and unfamiliar reasons at multi-dimensional levels. This phenomenon is named by this thesis as the formation of 'ontologies' and it is; for example, for the above-quoted KPS documents, defined to be as listed below.

> **Example Ontology** (underlying ontological reason: copper material)

- S / 'Settings': 'patient rooms', 'ICU(s)' 'nurse/nursing stations', 'work areas/stations',
- C / 'Concepts': 'hygiene/infection control', 'cost';
- M / 'Measures': 'plan layout/organization', 'single or shared';
- EL / 'Building elements': 'materials/details/finishes',
- EQ / 'Equipment': 'medical devices', 'handrail/grab bars.

> **Coded commonality:** 'hygiene / infection control' & 'materials / details / finishes'

Here the manifest content of ‘self-sanitizing’ feature of copper material is coded embeddedly under two latent codes: C1: ‘hygiene/infection control’ and EL1: ‘materials/details/finishes’. As such; according to the ongoing coding scheme and analysis methodology, what falls any ontology into the scope of this thesis is only its coded commonality, and it is retrievable and observable only over the spatio-relational layout it provides, and these are named in this thesis ‘ontological structures’ (Figure 6.1).

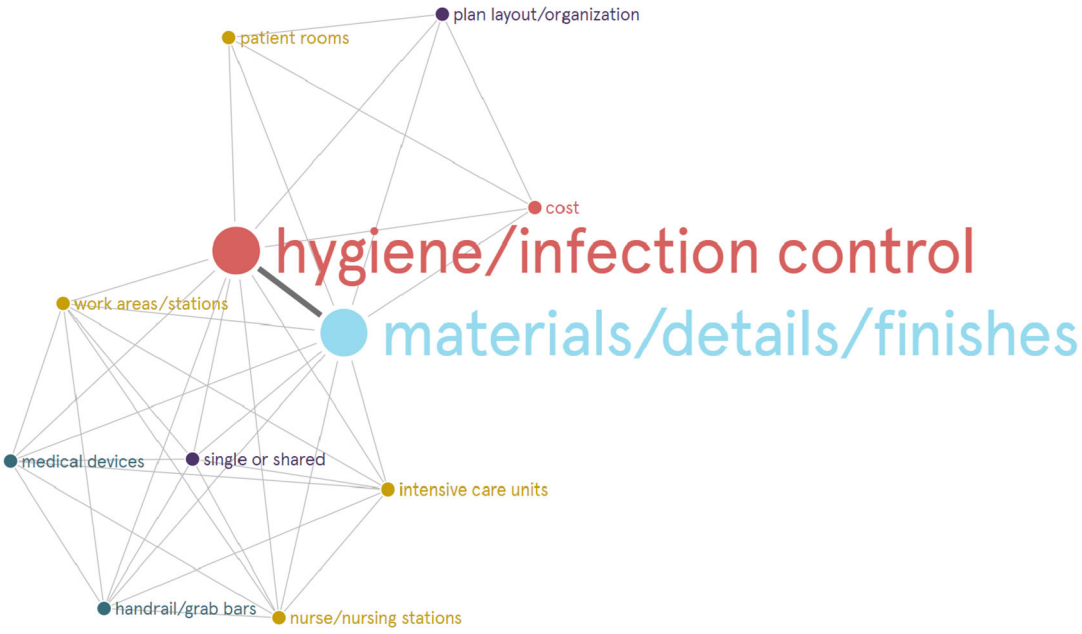


Figure 6.1. An example ‘ontological structure’
(encoded in Graph Commons)

For the analysis of ‘ontological structures’, MAXQDA that is utilized in this thesis is capable of clustering coded data. As displayed in Figure 6.2, overall ‘co-occurrence’ (intersection) scheme of entities is projected on a map layout. The most central entities are isolated and positioned on the peripheries, and the clustering is provided based on the ‘proximity’ of entities within the related layout.

According to the ‘ontological structure’ understanding of this thesis, ‘centrality’ is the key metric in the measurement of spatio-relational properties; and for this, the

layout where entities are positioned should be determined according to their centrality. Additionally, the software has a limitation of providing up to maximum 9 distinct clusters yet the static interface makes closer investigation of inter-relations rather difficult especially for the refinement of complex data sets. For this, this thesis utilizes another tool that will be elaborated in the following section while also effectively referring to MAXQDA for consistency checking.

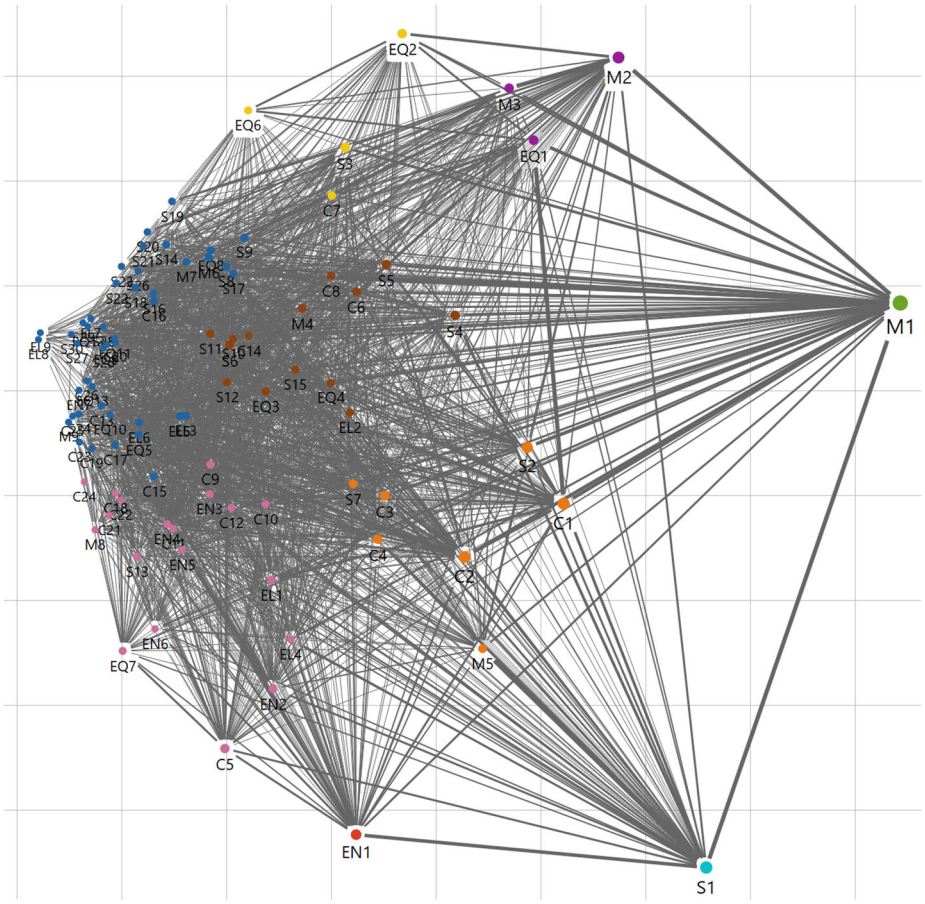


Figure 6.2. An example ‘cluster’ scheme provided by the MAXQDA (both QMaE and KPS segments integrated)

6.2 'DECODING' Relations & Pruning the Data

For the identification of hidden commonalities between entities; namely 'ontologies', this thesis explores structural properties of coded data over an open-source data visualization tool and website named 'Graph Commons'[36]. It aims to empower 'creative and critical' use of complex data networks by 'mapping'[37], 'analyzing', and 'publishing' over a 'network intelligence' KR&R algorithm developed. Overall, its underlying method is identical with MAXQDA as both sharing the tenets of 'neural network-based' KR&R approach through which data is represented as a node & link knowledge graph, and the particular aims are to explore particularly the spatio-relational properties. Compared to MAXQDA, it is fully capable of providing centrality-based data networks by using advanced 'force directed layout' algorithms that weights the encoded data according to its 'scale', 'gravity', and 'threshold' factors.

To initiate 'encoding' data within Graph Commons, the 'centrality' consideration and the 'ontological structure' understanding of the thesis necessitate the definition of the core 'coding category' to start with. Within the overall coding scheme of the thesis, S: 'Settings' (for QMaE documents) and C: 'Concepts' (for KPS documents) are the most central categories to start with. Within the totality of both QMaE and KPS documents, S: 'Settings' are the most central one, as well. For having a comparable ground, the thesis initiates encoding through 'settings' category. As noted, selection of 'settings' is more for statistical reasons, not because it recalls actual physicality or physical plan layouts of health care facilities. Accordingly; for comparison reason, the thesis encodes QMaE and KPS documents independently, and the final projection provided by the tool is displayed in Figure 6.3. These are the

[36] https://graphcommons.com/
[37] What is understood to be meant with 'mapping' is different than the 'mapping' conception provided by its literature, and this thesis accordingly.

early results that are positioned automatically by the tool and according to above-mentioned ‘force’ and ‘gravity’ metrics.

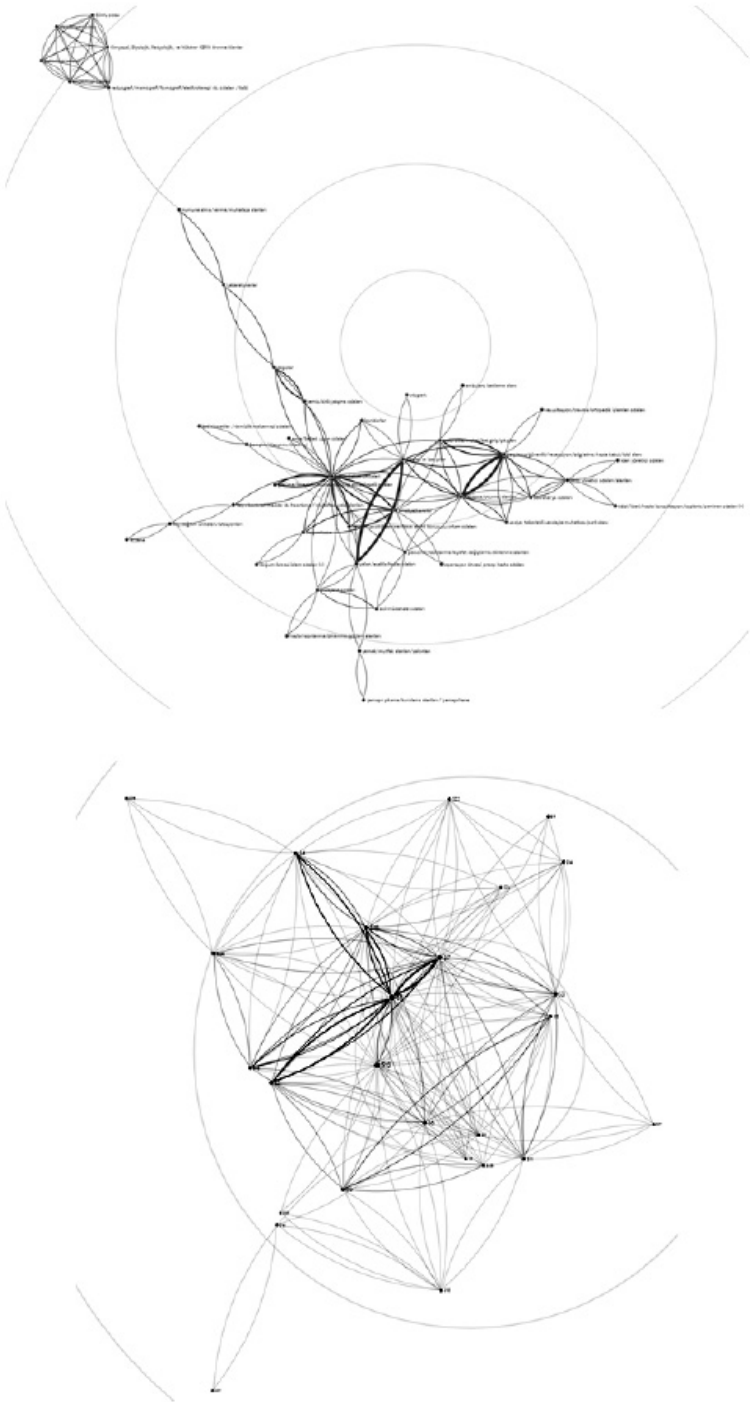


Figure 6.3. ‘Cluster’ schemes of QMaE and KPS documents inquired within S: ‘Settings’ coding category

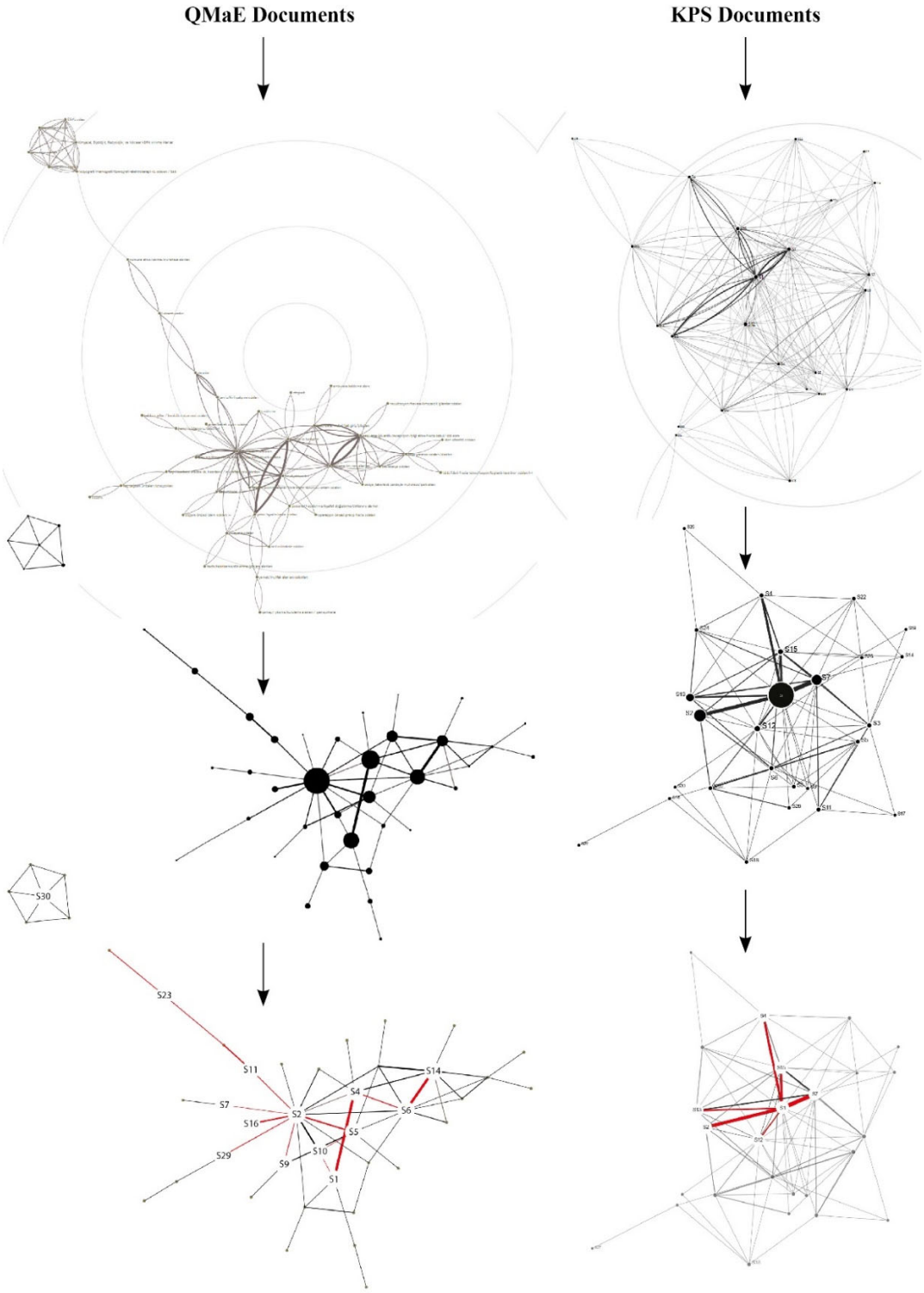


Figure 6.4. Structural layout(s) and ‘pruning’ process followed by the thesis

The above-displayed neural network-based knowledge graphs represent the superimposition of numerous numbers of taxonomies and their branching structure formed at multiple levels. This result the overall projection to be a highly complex multi-dimensional space that needs to be pruned for analysis. This thesis prunes the spatial projection by (1) eliminating the third and subsequent levels of each taxonomy and (2) selecting the most significant one for further analysis. These are achieved by the holistic and trial-and-error consideration of numerical weighting of data by 'frequency' (node size) and 'intersection' (edge thickness) metrics, and spatial (structural) pattern created by the location ('centrality') of significant nodes. The entire process is displayed in Figure 6.3, and the 'perceptibility' of the identified pattern is mainly aimed at.

6.3 'MAPPING' Ontologies & Identification of Structural Cases

From this to onwards, the thesis aimed to question underlying content/context-wise 'reasonability' of the perceived spatial structures. For this, key determinations of the previous chapter were also utilized and referred to.

Accordingly, the thesis interpreted the 'multi-central' nature of the structure on the left as a sign and also confirmation of QMaE documents aiming to cover a broad range of different 'settings'. The thesis further interpreted and named it as an 'syntactic' structure encapsulating 'linearity' inside, and it mainly starts from the least medical spaces (i.e. S14: 'reception/infodesk/patient admission/lobby areas/hallways') and extends toward the most medical ones including S23: 'labs. Although this was a conceptual-physical layout, the displayed actual-physicality of QMaE specifications documents is well grounded in the cognitive mind and memory of the thesis obtained during the reading of QMaE segments. After eliminating the third and subsequent branching levels of each central node, the 'linearity' was intentionally emphasized.

For KPS documents on the right, over emphasis on S1: ‘patient rooms’ by its key metrics including ‘centrality’, ‘frequency’, and ‘intersection’ makes it incomparably the most significant ‘setting’. This results the overall ontological structure of KPS documents having a single-central layout that; when considered together with its second layer branching nodes, indicates an over study of a certain settings cluster intensified and linked mainly in between S1: ‘patient rooms’, S2: ‘ICU’(s), S4: ‘wet spaces’, S7: ‘nurse/nursing stations’, S12: ‘storage rooms/units’, S13: ‘open areas/gardens/greeneries’, and S15: corridors/hallways’. This formation also resulted the thesis in recalling an actual-physicality which is well grounded, as well. As a result, final interpretation of the thesis regarding the two distinct structural cases within S: ‘Settings’ coding category has become:

- QMaE documents perceiving and handling health care buildings more holistically and in building scale,
- KPS documents; on the other hand, perceiving and handling more isolatedly and in departmental scale with a particular attention paid into inpatient units.

For exploring the hidden commonalities in between the two distinct cases, the thesis applied ‘mapping’ approach as another ‘ontology-based’ KR&R method through which ‘decoding’ the encoded map layouts and creating the new representation of especially the abstract relations and properties of the given structural domain are aimed at. By keeping the proportions of coding ‘frequency’ and ‘intersection’ metrics of encoded data, the thesis ‘decoded’ and re-scaled the spatiality of each cases side by side that allowed exploring ontologically common as well as in-between ‘settings’. These settings included: S4: ‘wet spaces’, S1: ‘patient rooms’, S2: ‘ICU(s), and S7: ‘nurse/nursing stations. For now, considered only within S: ‘Settings’ coding category, what makes these settings common is that each has a strong ontological correspondence within both document types. An these displays rather contrasted clusters (i.e. CLS: 3/16, CLS: 7/19) that is rather suitable for comparison purposes. Here before moving into the next stage, the thesis cross-checks the final results with the de-centralized projection provided by MAXDAQ, and it is provided in Figure 6.5.

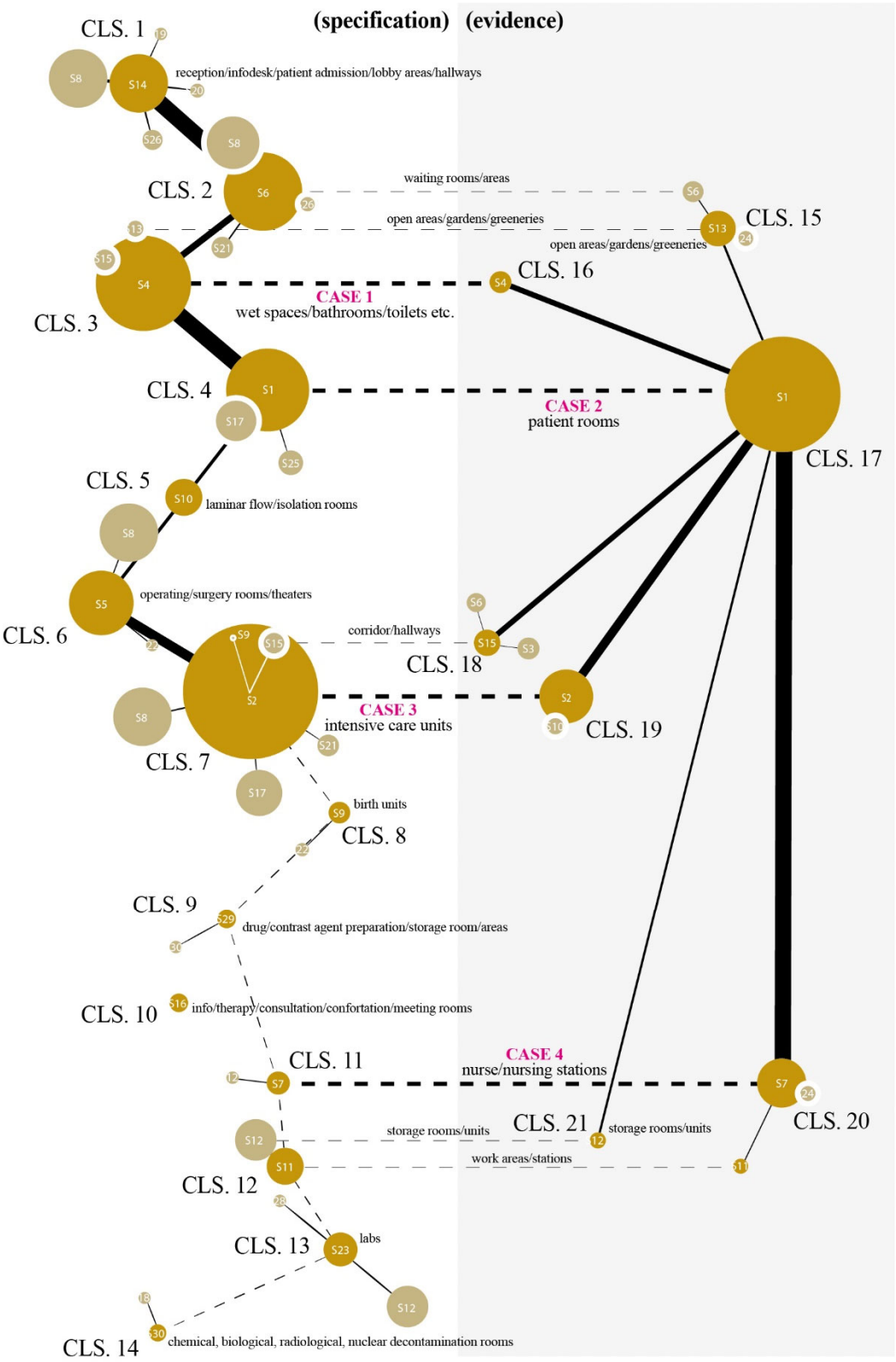


Figure 6.5. ‘Mapping’ and identification of significant S: ‘Settings’ clusters

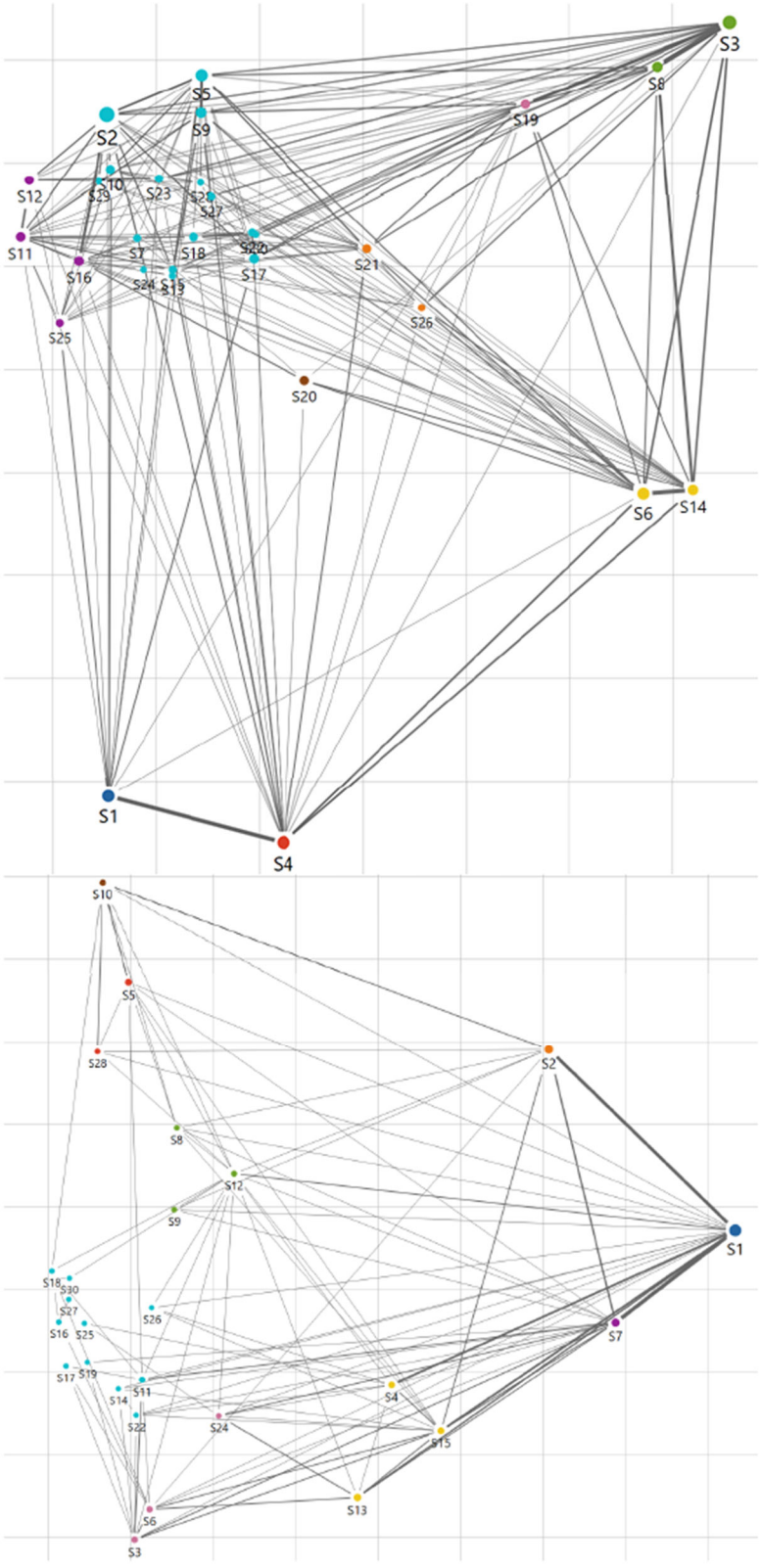


Figure 6.6. Software-based versions of ‘cluster’ layouts

6.4 Final representation of 'Knowledge Domain(s)' under individual ontological structures

According to 'ontology' understanding and conception provided by the thesis, individual clusters should be corresponded with related knowledge domain entities belonging to other coding categories, as well. Having initiated clustering from S: 'Settings', the thesis traces the extension of identified clusters within taxographic spaces; and for this, applies to TAXOGRAPH that were developed in previous chapter. For example, for S4: 'wet spaces' as the core entity of CLS. 4, the thesis cross-compares the evidence and specification taxonomy strings of both (provided in Appendix E) and further identifies significancies of related cluster within other categories (see also p:120). As a result, the thesis constructs individual ontological lists and cases that are provided in Figure 6.7.

Compared to the previously exemplified primitive ontological case created by 'copper material', here the identified ontological cases are actually the most complex and generic ones, having fallen into the scope of this thesis by their underlying structural properties yet reasoned by the togetherness of numerous numbers of uncoded commonalities. Aim of the thesis is to utilize these formations to create even more holistic view and representation of QMaE and KPS documents individually and isolatedly, and each especially under one single dominant and expressive 'ontology' and represented as an 'ontological structure'.

For this, the thesis applies a final 'encoding' process through which the tabulated data in Figure 6.7 is re-introduced to Graph Commons. As the representation of hidden commonalities of CLS. 3/4/7/11, the thesis reached at the structure and centrality-based projection provided in Figure 6.8. It expresses the most evident aspects of the knowledge domain of QMaE specification documents reviewed. The same process results for CLS. 16/17/19/20 in Figure 6.9 as the structural projection of the knowledge domain of KPS documents reviewed. The textual content of the related ontologies is retrieved and provided in Appendix G.

ONTOLOGICAL CASE 1

S4: WET SPACES

CLS. 3 (QMaE Specification Documents)	CLS. 16 (Evidence-based Studies)
patient rooms: S1 waiting rooms/areas: S6 open areas/gardens/greeneries: S13 reception/infodesk/admission/lobby...: S14 corridor/hallways: S15 staff/patient preparation/resting ...: S21	S1: patient rooms S15: corridor/hallways S26: stretcher/wheelchair storage/parking...
hygiene/infection control: C1 privacy/confidentiality: C4 modularity/flexibility/multi-hub: C6 accessibility: C7 teamwork/communication/monitoring: C10 patient-centeredness: C17 waste/hazard management: C20	C2: safety/security C12: falls/injuries C14: ease of mobility/movement C21: choice/control/autonomy of patients
quantity: M3 user profile: M6	M1: plan layout/organization M2: area/size (sqm)
sink/lavatories: EQ1 medical devices: EQ2 storage cabinets: EQ6	EQ8: stretcher/wheel chair EQ10: handrail/grab bars
air quality: EN3	EN5: noise/sound level
lift and elevators: EL7 stairs: EL8 ramps: EL9	EL1: material/details/finishes EL5: ceilings

ONTOLOGICAL CASE 2

S1: PATIENT ROOMS

CLS. 4 (QMaE Specification Documents)	CLS. 17 (Evidence-based Studies)
wet spaces/bathrooms/toilets etc.: S4 laminar flow/isolation rooms: S10 physical examination rooms: S17	S2: ICU(s) S7: nurse/nursing stations S12: storage rooms/units S13: open areas/gardens/greeneries S15: corridor/hallways
safety/security: C2 privacy/confidentiality: C4 modularity/flexibility/multi-hub: C6 spatial/physical/psychological comfort: C11 patient-centeredness C17	C3: visibility/sight/monitoring C5: psychology C10: teamwork/communication/monitor... C12: falls/injuries C21: choice/control/autonomy of patients C22: positive & negative distraction
quantity: M3 user profile: M6 technical features/specs: M7	M5: single or shared M8: aesthetic/visual attractiveness...
medical devices: EQ2 patient beds: EQ4 storage cabinets: EQ6 patient/visitor chairs: EQ11	EQ7: furnishing/artwork/nature view... EQ10: handrail/grab bars
air quality: EN3 temperature: EN4 noise/sound level: EN5	EN2: soundscape
ceilings: EL5	EL1: material/details/finishes

ONTOLOGICAL CASE 3

S2: INTENSIVE CARE UNITS

CLS. 7 (QMaE Specification Documents)	CLS. 19 (Evidence-based Studies)
operating/surgery rooms/theaters: S5 birth units: S9 info/therapy/consultation/confortation: S16 physical examination rooms: S17 chemical, radiological, decontamina...: S30	S1: patient rooms S7: nurse/nursing stations S10: laminar flow/isolation rooms S15: corridor/hallways
privacy/confidentiality: C4 modularity/flexibility/multi-hub: C6 accessibility: C7 spatial/physical/psychological comfort: C11 ease of mobility/movement: C14	C1: hygiene/infection control C2: safety/security C10: teamwork/communication/monitoring C13: design and construction process C15: soundproofing/acoustic C19: cost C24: sleep/circadian entrainment
dimensions: M4 technical features/specs: M7	M5: single or shared
EQ2: medical devices EQ4: patient beds	EQ1: sink/lavatories EQ6: storage cabinets EQ9: continuous power supply modules EQ12: hand dryers/jell dispensers EQ13: curtain/separators
EN4: temperature EN7: humidity	EN5: noise/sound level
walls: EL3 ceilings: EL5	EL1: material/details/finishes EL4: windows

ONTOLOGICAL CASE 4

S7: NURSE/NURSING STATIONS

CLS. 11 (QMaE Specification Documents)	CLS. 20 (Evidence-based Studies)
ICU(s): S2 work areas/stations: S11 storage rooms/units: S12 info/therapy/consultation/confortation: S16 patient preparation/resting/observation: S22 drug/contrast agent preparation/store: S29	S1: patient rooms S13: open areas/gardens/greeneries S15: corridor/hallways S24: social/physical activity/support/entert.
visibility/sight/monitoring: C3 modularity/flexibility/multi-hub: C6 accessibility: C7 foot traffic: C8 teamwork/communication/monitor: C10 soundproofing/acoustic: C15	C1: hygiene/infection control C2: safety/security C4: privacy/confidentiality C5: psychology C12: falls/injuries
quantity: M3	M5: single or shared
sink/lavatories: EQ1 storage cabinets: EQ6	EQ4: patient beds EQ10: handrail/grab bars
	EN1: daylight and lighting EN2: soundscape EN6: exterior/nature view
	EL1: material/details/finishes EL2: door/door openings EL4: windows EL5: ceilings

Figure 6.7. Lists of evident ontological cases

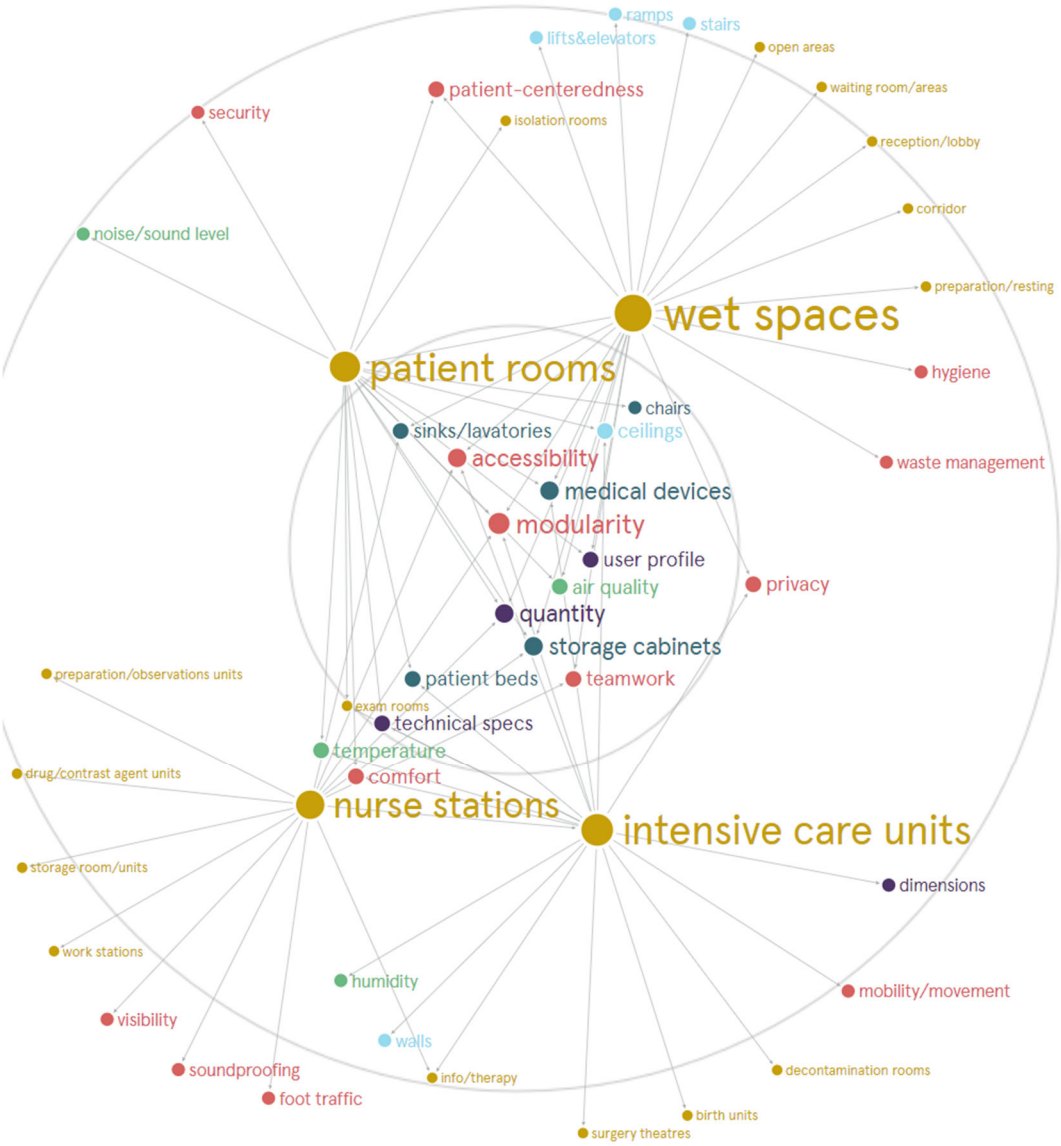


Figure 6.8. Specification base represented as a single ‘ontological structure’

Figure 6.9. Evidence base represented as a single ‘ontological structure’

6.5 Meta-Inferring & 'NARRATION' of Final Results

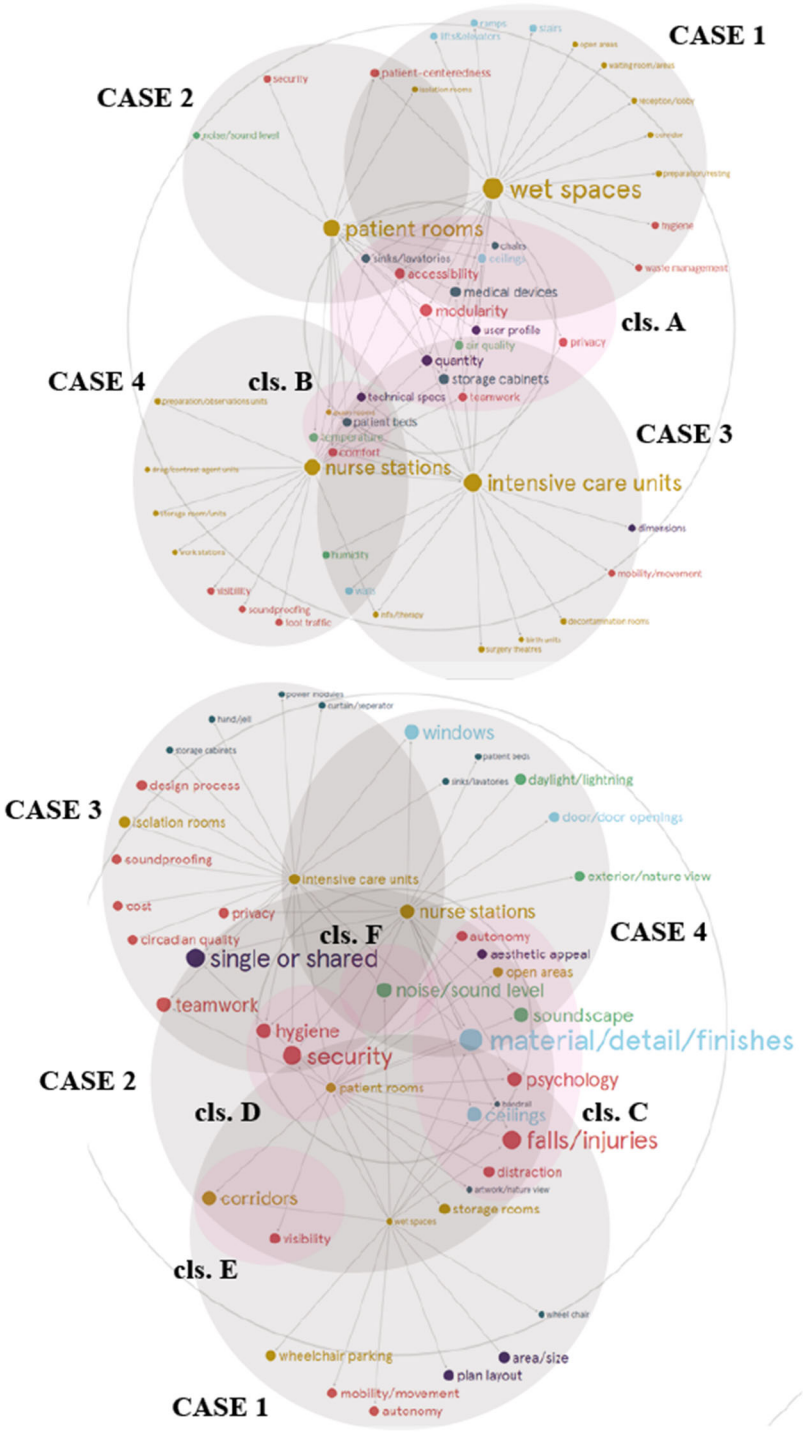


Figure 6.10. 'Decoding' structures into individual clusters, and the scheme of 'comparison'

The thesis makes both (1) case/cluster-wise and (2) structure-wise meta-inferences over the displayed evaluative pictures of the knowledge domain(s) of QMaE specification and KPS documents reviewed. This is the final stage of the thesis where key differences are synthesized and narrated.

Case/cluster-wise

Case 1: 'Wet spaces' including bathrooms and toilets are handled by QMaE specifications together with a broad range of other health care settings. These includes mainly the patient rooms, reception/lobby areas, waiting rooms/areas, open areas, patient preparation and resting units, corridors/hallways and so on. On the other hand, wet spaces are handled by KPS documents together with narrower range of settings including patient rooms, corridor spaces, wheelchair parking/storage areas and so on. Here it can be interpreted that QMaE specifications concentrate more on the wet spaces of common areas and non-medical zones yet KPS documents more of the inpatient rooms and their nearer settings. Here the related coding category of corridors/hallways can be interpreted to be valid as 'corridors' for KPS documents and 'hallways' for QMaE documents. Additionally, same applies 'patient rooms' as 'inpatient rooms' for KPS documents and 'outpatient rooms' for QMaE documents.

Accordingly, the specified concepts for wet spaces are defined by QMaE documents more as waste management, hygiene, patient-centeredness, accessibility, modularity, privacy and so on. Here especially the ones including accessibility and modularity can be interpreted to be referring to those belonging to common areas and non-medical zones. As such, quantity of wet spaces, sinks/lavatories, storage cabinets; and in this regard, consideration of user profile and their access to main circulation elements (ramps, stairs, lifts etc.) are other complementary aspects considered. Air quality is relatedly another dominant theme considered, as well. On the other hand, conceptual aims and grounds of KPS documents intensify more on the safety including falls/injuries, security, mobility/movement, and autonomy of few individuals rather than crowds. Accordingly, materials/details/finishes including

handrail and grab bars are seen and particularly focused on for safety and mobility considerations. Plan layouts, area and size of spaces, additionally height of ceilings are important measures to be concentrated on. Finally, noise/sound level is considered more relatedly than the air quality.

Case 2: 'Patient rooms' are handled by QMaE specifications together with a narrower range of other settings and these include: physical examination rooms, laminar flow and isolation rooms, wet spaces and so on. On the other hand, patient rooms are handled by KPS documents with a broader range of other settings including ICU(s), nurse/nursing stations, open areas, storage rooms/units, corridor/hallway spaces and so on. Here it can be interpreted that QMaE specifications handle patient rooms more isolatedly and especially in medical means yet KPS documents more holistically including and referring to both medical and non-medical means.

Accordingly, modularity, social/physical/psychological/spatial comfort, safety and security, as well as patient-centeredness are the key concepts prioritized by QMaE documents. And these are considered together with key environmental variables of medical zones including temperature and air quality, yet noise/sound level especially for comfort. Patient beds and medical devices' technical specifications and features are aimed to be defined, and user profile is particularly considered. Heights of ceilings are specified, as well as the example plan layouts provided. On the other hand, conceptual aims and grounds of KPS documents were intensified around whether it is planned to have single or shared layout. These included psychology, positive/negative distractions, autonomy of patients that can be interpreted as the support-oriented considerations while teamwork and communication, falls and injuries, visibility are more related with the safety-oriented domain of especially medical zones. Here the key concept of 'soundscape' is used instead of 'noise/sound level'. An additional attention is paid to artwork and nature views. And many of these concepts and considerations are suggested at materials/details/furnishing scales.

Case 3: Intensive care units (ICUs) are handled by QMaE documents together with a broader range of settings including decontamination units, birth units, surgery theater, info-therapy and confortation rooms, nurse stations, physical examination rooms and so on. On the other hand, KPS documents handles ICU(s) together with a narrower range of settings including patient rooms, laminar flow and isolation rooms, nurse/nursing stations and so on. Here it can be interpreted that QMaE documents aims to considers inter-departmental links between ICU(s) and others yet KPS documents consider again more isolatedly especially intensified more as impatient units.

Accordingly, QMaE documents handles ICU(s) quite in parallel with 'patient rooms' considering both in medical means. On the other hand, KPS documents' handing of ICU(s) differs from its 'patient room' understanding and conceptualization. Accordingly, ICU(s)'s conceptual grounds are specified more on the aspects including hygiene, teamwork and communication, circadian quality, cost, soundproofing, their designing process and so on. These are considered together with noise and sound level, considered at materials/details/furnishing scale. Single-or-shared(ness) and its relation with windows is mostly considered either by positive or negative means.

Case 4: 'Nurse/nursing stations' are handled by QMaE documents especially and particularly with ICU(s). Its relation with other settings including info-therapy and confortation rooms, other work stations, storage rooms/units, drug/contrast agent preparation and storage units, patient resting and preparation rooms and units and so on are additionally considered. KPS documents; on the other hand, handle nurse/nursing stations together with both ICU(s) and patient rooms.

Accordingly, here the common concepts of teamwork and communication, modularity, and accessibility are considered by QMaE documents together with more specific concepts (within QMaE documents) including visibility, foot traffic, soundproofing, and so on. Here the quantity measure of stations or other equipment such as sinks and lavatories or storage cabinets are particularly referred by. There is

no significance emphasis on environmental variables or building elements. KPS documents; on the other hand, considers nurse/nursing stations with a broader range of concepts including privacy, hygiene, security, psychology, falls and injuries and so on. Materials and finishes, windows, doors and door openings, ceilings, namely the building elements are considered together with environmental variables including daylight and lightning, soundscape, exterior view and nature, and so on.

Structure-Wise

For comparison reasons, the coded commonality between the two structural cases of QMaE and KPS documents was identified and established by the thesis as the inter-relation between S: 'Settings': 'wet spaces', 'patient rooms', 'ICU(s), and nurse/nursing stations.

Building onto and inferring from this commonality, structural nature of QMaE documents is interpreted by the thesis as **'settings-based'** meaning that specifications predominantly seek for 'syntactic' spatial configurations and layouts. While doing so, QMaE documents approaches the settings-wise commonalities from a rather **'holistic'** perspective aiming to pay competing attentions to each settings-based cluster. On the other hand, QMaE specifications' approach to health care environments is identified and described by the thesis as **'monolithic'** meaning that spatial phenomena are handled repeatedly and commonly for example; (cls. A/B): accessibility, modularity, teamwork and communication, comfort that are altogether considered mainly by quantity, user profile, technical specifications and features, air quality considerations of settings, as well as in some instances equipment (patient beds, storage cabinets and so).

Structural nature of KPS documents; on the other hand, is interpreted by the thesis as **'concept-based'** meaning that evidence-based studies predominantly seek for the proper, related, and in-place conceptual grounds depending on the peculiarities of spatial and operational problems. This results evidence-based studies in providing **'isolated'** solutions, resulting also in atomization and having a **'polylithic'** approach consisting of; for example, (cls. D): hygiene and security, (cls. E): corridors and

visibility, (cls. F): noise/sound level, and so on. While doing so, the thesis further interprets that evidence-based studies over-study certain health care environments while ignoring or paying less attention to the totality of health care physical environments. For this, design implications provided by evidence-based studies' concentration intensify more on impatient units, lacks implications regarding plan layout and organization overall health care building design layouts, or finally includes implications only at the scale of materials, details, and finishes (cls. C) and so on.

CHAPTER 7

CONCLUSION

This thesis inquired into the very notion of EBD, and aimed to deepen its **understanding**. It required further inquiries into the **realization**, **application**, and **evaluation** of its knowledge base. Following the preliminary understanding obtained during early stages, the thesis deemed EBD notion having a rather dynamic contextual environment that is grounded on a highly ambivalent discursive field. As such, the thesis defined disclosion of EBD as an overly complex process that necessitated an experimentally plural, sequentially exploratory, and convergently parallel research approach applied within an integrated and descriptive conceptual framework. Accordingly in the end, particular knowledge produced by the thesis has become multi-leveled and distributed along various stages. These included to be addressing; in order with, – (1) conceptual, – (2) methodical, – (3) case-wise, – (4) methodological, – (5) analytical, – (6) practical, – (7) evaluative aspects of EBD field. Entire research process carried out and documented is named by the thesis as an 'ontological inquiry' into EBD notion and its knowledge base. As displayed in Figure 7.1, totality of these altogether led to an extended understanding of EBD notion, and it allowed for further ideation about evidence-based design knowledge's journey from its production to its dissemination, utilization, and integration for the design quality of health care physical environments.

Through conclusive final remarks provided, this chapter's aim is to further support ideation and discussion of EBD notion that can be described to be an open-ended process involving stakeholders belonging to design or non-design professional backgrounds, from within or outside the health care field, as well as in national and international scales.

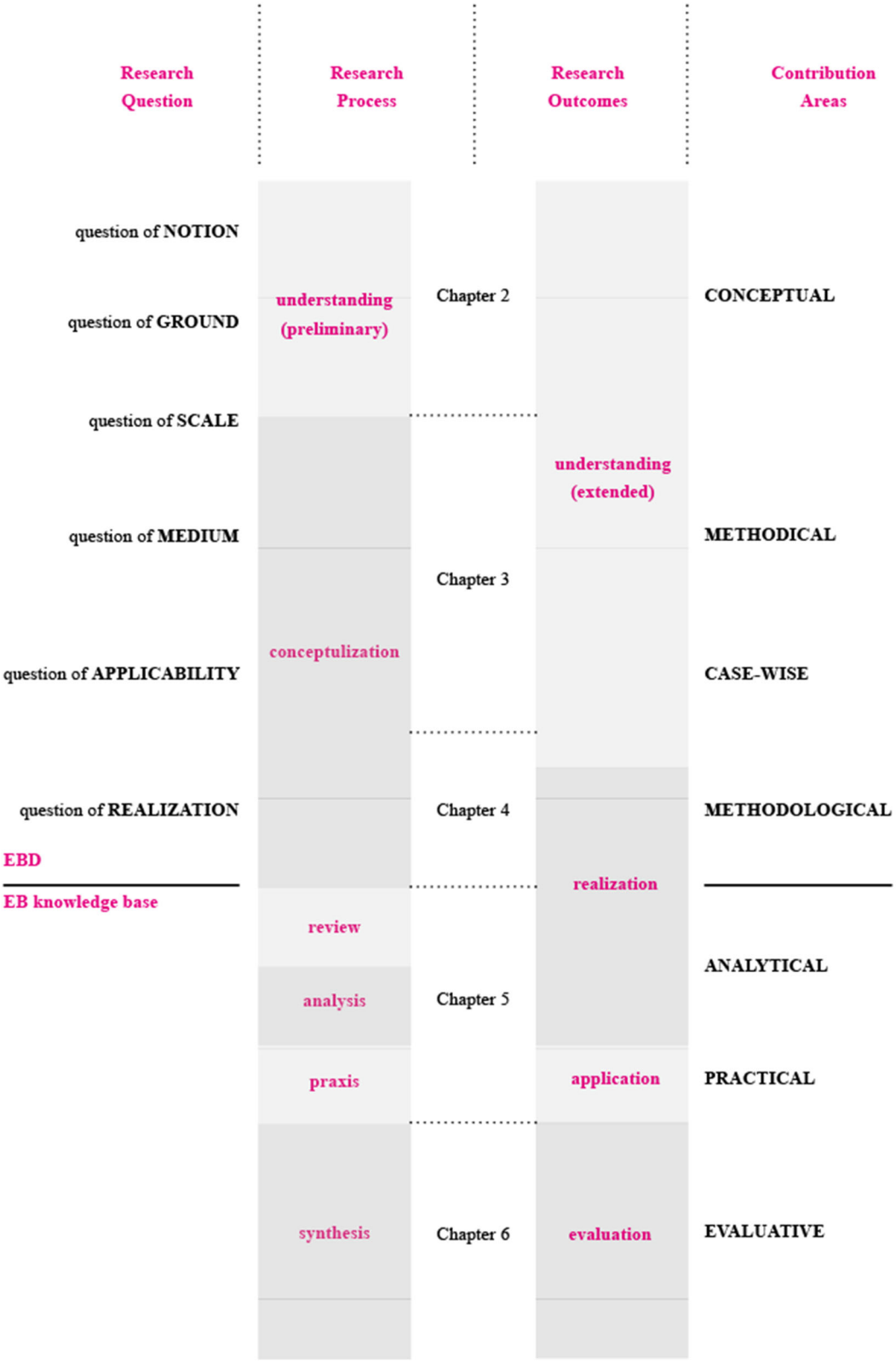


Figure 7.1. Definition of the contribution areas of the thesis

Conceptual

In relation to the question of EBD as a **NOTION**; the thesis explored and suggested possibility of multiple ways of describing and studying it. These included EBD as a 'design practice model', EBD as a 'knowledge utilization model', and EBD as a 'quality management and evaluation' (QMaE) model. In early stages, the thesis studied these under two contextual categories and these were disclosed as 'emerged' (chapter 2 / design & knowledge) and 'emerging' (chapter 3 / QMaE) contexts of EBD field. Building onto these; and after reviewing the global pandemic period developments, later stages of the thesis defined and intensified its main concentration area on its 're-emerging' (Chapter 4 and beyond) context that handled the phenomenon within an integrated philosophical and methodical perspective.

In Chapter 2, the thesis disclosed early conceptions provided in its emerged context to be implying a mode of scientific design practice through which health care architects were shown as having the primary responsibility of ensuring the quality of health care physical environments. For this, the thesis deemed EBD literature suffering mainly from lacking extended reference on how it can be effectively and respectfully applied within situated methods and knowledge utilization processes of an architectural designing process. During the continuation of Chapter 2, the thesis critically questioned the possible **GROUND** of demanded 'robusticity' and 'rigorousity', namely the 'scientificity' conceptions that were put forward within its emerged context. For this, the thesis framed an expanded inquiry into 'design studies and 'design research' fields of architectural literature. The thesis disclosed that methodical aspects of design is dependent on underlying and required knowledge base, its types, its production and utilization contexts and purposes. As part of this inquiry, the thesis further refined its EBD understanding as referring to a peculiar process of 'knowledge utilization', and it brought the thesis into the question of its **SCALE**. It necessitated another expanded literature review and grounding of EBD in relation to 'knowledge translation/utilization' theme that had been a dominant study area in social sciences since late 20th century.

The thesis explored various scales of knowledge utilization that span from its 'scientist-practitioners' conception to 'embedded research' that aims knowledge utilization more at systems level. Accordingly, the thesis deemed EBP culture to be limitedly benefiting from the existing grounds of the field where it belongs to, and this results in over-pressurizing on individual professionals. For EBD in particular, the thesis further deemed EBD's ungrounded pressure on health care architects resulting in rather more intense impracticalities that are rather difficult yet non-realistic to deal with, especially under the grounds and positivist conception provided in its emerged context.

During the entire inquiry process, the thesis displayed that innovation that is aimed to be achieved through re-explicitizing health care architects' design knowledge is actually trying to be achieved paradoxically by invoking the far past of pre-specification period of HBD field. On the other hand, the thesis deemed its nearer past an ignored field of study especially by means of EBD field's lacking required attention to the role of HBD specifications, and the 'system approach' according to which health care architects and design teams have been required to comply and practice since decades. Here the entire process contributed to the process of having a common conceptual ground between the 'system approach' of 1950s (specific to HBD) and 'embedded research' approach of late 20th century (generic to social sciences). And this further contributed to the process of handling EBD notion as an 'embedded research' that needed to be handled more as a system-wide phenomenon. This common ground allowed also handling EBD in relation to collective health care quality efforts of overall health care industry as the main underlying rationale behind the emergence of EBD notion; hence further contributing its reinforcement as a QMaE model.

Methodical

In parallel with handling EBD more as a system-wide QMaE model, Chapter 3 questioned also the **MEDIUM** that is required for the desired knowledge translation and utilization. For addressing this question, the thesis reviewed ongoing knowledge

translation and utilization mediums that diversely span from systematic review and meta-analyses to web-based knowledge repositories and excel-based EBD tool and toolkit(s). During this inquiry, the thesis realized that majority of these mediums lack effective KR&R methods, yet their underlying evaluative background is not often up-to-date. Hence; compared to their early periods, the thesis realized that majority of them are today out of use.

Despite their KR&R limitations, the thesis paid a particular significance to UK's EBD tool and toolkit(s) especially for their particular aim of functioning in collaboration with the existing specification network of UK's health care system. By further digging from this aspect, the thesis realized that collective quality efforts of overall health care industry diffuse also into existing specification networks of healthcare that results in intensified demands on 'evidence-based' specification networks. As part of these efforts, traditionally existing HBD specification networks are aimed to be supported with establishment of 'performance-based' specifications (QMaE specifications) that aim to propose quality interventions within a less prescriptive yet more outcome-focused language and format. The thesis displayed that more recent literature of EBD field interprets all these developments as a suitable act for overall principles and intentions of EBD, yet having more potential for addressing also the later stages of design including its evaluation and accreditation. The thesis deemed that such an approach can move EBD from being a temporary concept that was put forward during the hospital construction boom period of the industry toward a permanent concept envisioning also their reuse.

Case-wise

For building more on this potential; in the continuation of chapter 3, the thesis questioned practical **APPLICABILITY** of handling EBD especially in health care contexts of countries that are less familiar with EBD notion. For this, the thesis provided knowledge about the case of Turkish healthcare, and deemed it as a highly significant case that can allow for further reinforcement of system-wide understanding and application of EBD notion. And the thesis provided this

knowledge as a two-way comparison to international precedents and progressed contexts of EBD.

Accordingly; for disclosing the rich context of Turkish healthcare, the thesis reviewed a broad range and types of documents that frequently reported health care architects' over-reliance on specifications yet not preferring to have a direct engagement with evidence-based studies in front. In this regard, the thesis deemed Turkish healthcare a highly counter case when comparing to the US as it is the originating context of the emerged context of EBD notion. On the other hand, Turkish healthcare was deemed and introduced by the thesis as also a rather informative and symptomatic case that aims to apply an EBD conception more at systems level despite not naming it as EBD. In this regard, Turkey's recent efforts for establishing evidence-based QMaE specification networks was deemed by this thesis as an analogous act and effort with the case of UK. Beyond their shared tenets; on the other hand, the thesis also differentiated two cases and context (UK and Turkey) especially by means of nature of major problems faced during the establishment process of QMaE networks. For disclosing these differences, the thesis reviewed accounts provided by the authorities who are responsible for their establishment.

In UK case, the thesis displayed that major problem is described by UK authorities as the problem of knowledge difference occurring between evidence-based and non-evidence-based specifications. This problem is mainly handled by the UK by collaborating with architectural schools and EBD research groups who are commissioned to review, appraise, and link findings of evidence-based studies in relation to existing specification network of the country. While doing so, the problem is handled by the related research groups more as an evaluative research task, named and realized as EBD tool and toolkit(s); and as noted before, made practical with limited KR&R capabilities. By contrast; in Turkish context, major problem occurring for the integration of evidence-based studies in Turkish specification network was explored by the thesis to be more profoundly caused by a communication and perception gap occurring between health care building design

and research communities in Turkey and the authorities. This problem was then named by the thesis more as a 'knowledge gap' caused by some ontological reasons. Different also from being an evaluative task, the thesis defined and handled this problem as the problem and question of **REALIZATION** of EBD's knowledge base and its differentiated perception and handling. For this, the thesis needed advanced KR&R methods that allowed also developing inquiries into the practicality considerations of related and desired mediums.

Methodological

For the realization of knowledge gap areas occurring in Turkish context; in Chapter 4, the thesis developed an integrated 'ontology-based' EBD conception, and displayed it as a precedent methodology of knowledge-based evaluation and envisioning an applicable tool scenario. In doing so, the thesis re-visited the philosophical and methodical grounds of 'ontology' conception, and aimed to further reinforce links in between.

In philosophical means, the thesis applied to existing theoretical frameworks of 'ontology' concept to demarcate positivist view of science from its post-positivist alternatives. Accordingly, the thesis deepened its understanding of 'ontology' as the pre-condition of 'epistemology' into which EBD notion's emerged context had been mainly deemed to be stuck. Building onto this perspective, the thesis traced also the most recent and global pandemic period developments in EBD field that intensifies more on the 'ontological' underpinnings of EBD notion, hence providing the ground for an 'ontology-based', as well as post-positivist conception of EBD. 'Ontology-based' conception was also referred by the thesis in parallel with the 'critical realist' readings of EBD existing within its recent literature. Accordingly, it was utilized also to mean the differentiated underlying worldviews, mindsets, and belief-systems that provided the ground for the explanation of knowledge domain incompatibilities including the one in Turkish QMaE specification networks. In this regard; and beyond the scope of EBD, the thesis's ontology-based inquiry can also be displayed

to be framing a peculiar view into the demarcation problem, and its understanding and observation in situ.

By developing 'ontology-based' EBD conception, one of another intended contributions of the thesis has been the reinforcement of its practical reflections during the realization of EBD's knowledge base from a more effective and applicable KR&R perspective. Accordingly, the thesis applied to provide a common ground between various post-positivist research methods and methodologies needing the social phenomena objectified for analysis. These included particularly the ones adopting 'coding' approach for the analysis of textual content as the empirical objects. The thesis explored the various types of 'coding' approaches yet provided a teleological ground for its subsequent stages that may be applied both isolatedly and holistically. These included 'encoding' approaches of computer sciences and 'decoding' approaches of social and creative fields. The thesis referred and applied to those holistically; and formulated under an integrated coding-encoding-decoding trilogy.

While doing so, the thesis aimed also to test and augment the knowledge domain representation and visualization methods of existing 'coding' approaches. For this, the thesis explored the potentials and limitations of two distinct visualization methods including 'modelling' and 'mapping' in a comparative and descriptive manner. Building onto its coding-encoding-decoding methodology, the thesis disclosed their complementary and integrated adoption rather effective approach especially by means of consistency and validity considerations of mixed-method studies. In the end, the thesis signified its methodology as a peculiar k-gap (knowledge domain analysis) methodology that can contribute to the process of designing various other research inquiries that may require a mixed-method approach. Additionally and lastly, the thesis's methodological approach can also envision knowledge management and knowledge-based performance evaluation of various other fields during their involvement in QMaE studies. For this, the thesis developed three conceptual metrics and these included (1) 'inclusion', (2) 'coverage'

and (3) ‘compatibility’ capabilities of QMaE that can be investigated in relation to knowledge requirements of the any related field.

Analytical

Having disclosed EBD notion more as an ‘embedded research’ that needs to be ontologically realized; from Chapter 5 to onwards, the thesis demonstrated its ‘ontology-based’ conception and methodology during/for comparing and contrasting knowledge domains of Turkish QMaE specifications and evidence-based studies. Accordingly to begin with, Chapter 5 explored possibilities of reducing and handling their design implications to/under identical lengths, formats, and propositional languages. For this, ‘design implication’ sections of KPS documents provided by CHD’s knowledge repository allowed for converging evidence-based studies to QMaE specifications, hence helped in having a commensurable ground for comparison.

As part of its qualitative ‘coding’ scheme, the thesis applied an extended segmentation process of the documents under investigation. For labeling and coding each segment, the thesis considered situated knowledge domain filtering and scoping approaches of existing mediums of EBD field, and automated compliance checking (of specification) studies of computer sciences. These included; for example, classification of themes by their relevant performance outcomes, related design aspects, settings, certain environmental variables, subjected user profile, and so on.

During this consideration, existing methods and viewpoints provided the main encouragement and support for the thesis; however, the thesis deemed majority of them to be developed more for hypothetical purposes rather than actual practicality in situ. In the end, the thesis further deemed that existing conceptual labelings are rather limited for reflecting multi-dimensional space of EBD’s knowledge domain, including the ones displayed in the user interface of CHD’s knowledge repository. As such; instead of adopting a top-down approach and grounding on existing conceptual labelings, the thesis adopted a bottom-approach. Following its qualitative coding phase, the thesis tabulated a broader range of codes and coding categories

that can lead to more advanced knowledge domain searching, filtering, analysis, as well as representation tools and methods.

Practical (Semantic/Taxograph)

During its quantitative 'encoding' stage; in the continuation of Chapter 5, the thesis aimed to provide a preliminary understanding of numerical significancies and 'semantic' features and structures of raw data obtained in coding phase. For this, the thesis started with developing metrics that reflected on coding 'frequency', 'intersection', and 'centrality' ratios of coded concepts and categories. Based on these metrics, the thesis compared and contrasted QMaE documents and evidence-based studies, and tabulated the final results. Findings obtained during this stage; later on, were elaborated and further utilized during the evaluation stage (next stage / Chapter 6) especially by means of consistency checking. More signified than their analytical implications; during the entire process, the thesis developed inquiries into rich methodical environment of existing knowledge domain 'modelling' studies belonging to the realms of AI and computer sciences. And the thesis interpreted and weighed them from EBD perspective.

Accordingly, the thesis deemed a quantitative 'modelling' approach a highly effective method that can fulfill the KR&R needs of EBD field. Building more on this potential, the thesis developed an algorithm (Taxograph) that allowed for visual representation of knowledge domains in a comparatively integrated framework. The algorithm was designed to function as a single-layered vector space, reflecting taxonomic definition of two distinct knowledge domains, and it further envisioned a multi-layered knowledge utilization scenario for a broad range of knowledge consumers spanning from health care architects as individual practitioners to multidisciplinary design teams, health care organizations and authorities, and so on. While doing so, the thesis also provided further improvement scenarios and viewpoints regarding its limitations. This included primarily the augmentation of the algorithm as to function as a multi-dimensional space and include the ontological

definition of the data. For this, the thesis displayed neural network-based KR&R methods as the main address that can be visited by future studies.

Evaluative (Spatial/Ontograph)

During its quantitative 'decoding' stage; in Chapter 6, the thesis aimed to provide a refined understanding of two distinct knowledge domains. Building more onto the previous stage, the thesis prioritized representation and final evaluation of 'spatio-conceptual' features and structures of coded raw data. For this, the thesis developed inquiries into qualitative 'mapping' approach, contrasted it with the 'modelling' approach, and disclosed it as a highly effective complementary method of quantitative data analysis, reasoning, and representation. Through the 'mapping' process carried out, in the end, the thesis provided a spatio-conceptual projection of EBD's investigated knowledge domain(s), developed knowledge about its spatial and structural properties, and described them under few descriptive concepts. These concepts were further referred to provide a two-way comparison of knowledge-based capabilities of QMaE specifications and evidence-based studies.

Accordingly, the thesis disclosed 'inclusion' capabilities of QMaE specification network of Turkish healthcare to be rather limited especially within the 'evaluation' and 'accreditation' specification documents. This was identified the reason to be mainly caused by over-broad nature and content of the documents that are aiming to be concentrating on every quality aspect of health care yet losing their specificity on particular aspects including the design quality of health care physical environments. 'Coverage' capabilities of QMaE specification networks were identified again to be rather limited for their 'monolithic' consideration of health care physical environments. Analogously, 'compatibility' metric was considered and handled by the thesis as a two-way comparison. Comparing to the **'monolithic'**, **'holistic'**, and **'settings-based'** approach of QMaE specifications, design implications of evidence-based studies were identified to be **'polylithic'**, **'isolated'** and more specific, as well as more **'concept-based'** that all these together responds well to the knowledge gap areas of QMaE specifications. However, the thesis also further indicated that

evidence-based studies lack a holistic view of health care physical environments, and over-studying certain phenomena.

BIBLIOGRAPHY

Acar, Y. (2017). Atlan of Urban Design: Textual Analysis and Mapping of Production of Knowledge in Turkish Context (Doctoral dissertation, Middle East Technical University).

Agartan, T. I. (2015). Explaining large-scale policy change in the Turkish health care system: Ideas, institutions, and political actors. Journal of Health Politics, Policy and Law, 40(5), 971-999.

Akbulut, Y., Esatoglu, A. E., & Yildirim, T. (2010). Managerial roles of physicians in the Turkish healthcare system: Current situation and future challenges. Journal of Health Management, 12(4), 539-551.

Aközer, E. (1989). A framework for understanding" modernism" in architecture, and architecture as a field of knowledge. (Doctoral dissertation, Middle East Technical University).

Alfonsi, E., Capolongo, S., & Buffoli, M. (2014). Evidence based design and healthcare: an unconventional approach to hospital design. Ann Ig, 26(2), 137-43.

Altman I. & Rogoff B. (1987). World Views in Psychology: Trait, Interactional, Organismic, and Transactional Perspectives. In Handbook of Environmental Psychology. New York Academic Press. Pp. 7-40.

Anderson, D. C. (2019). Bricks and Morals—Hospital Buildings, Do No Harm. Journal of general internal medicine, 34(2), 312-316.

Antonovsky, A. (1979). Health, stress, and coping. San Francisco: Jossey-Bass.

Aravind, M., & Chung, K. C. (2010). Evidence-based medicine and hospital reform: Tracing origins back to Florence Nightingale. Plastic and reconstructive surgery, 125(1), 403-409.

Archer, M. S. (1995). Realist social theory: The morphogenetic approach. Cambridge university press.

ASQ: American Society for Quality. What is Quality Management System (QMS)? Accessed August 19, 2020 (https://asq.org/quality-resources/quality-management-system)

Assarroudi, A., Heshmati Nabavi, F., Armat, M. R., Ebadi, A., & Vaismoradi, M. (2018). Directed qualitative content analysis: the description and elaboration of its underpinning methods and data analysis process. Journal of Research in Nursing, 23(1), 42-55.

Avsar, T. S., Erdem, R., & Akkas, E. (2017). Evaluation of the healthcare transformation programme in Turkey as a strategy for better health. Journal of International Health Sciences and Management, 3(4), 11-19.

Aydın, D., & Sungur, M. (2018). Accessibility, Orientation and Scenery as Natural and Physical Environmental Factors in Hospital Design Case of Konya Hospitals. Journal of Fine Arts, 1(2), 24–37.

Basa, I. (2009). Environmental discourse of architecture. International Journal of Environmental Studies, 66(2), 271-279.

Baumbusch, J. L., Kirkham, S. R., Khan, K. B., McDonald, H., Semeniuk, P., Tan, E., & Anderson, J. M. (2008). Pursuing common agendas: a collaborative model for knowledge translation between research and practice in clinical settings. Research in nursing & health, 31(2), 130-140.

Becker, C. M., Glascoff, M. A., & Felts, W. M. (2010). Salutogenesis 30 Years Later: Where Do We Go from here?. International Electronic Journal of Health Education, 13, 25-32.

Becker, F., & Carthey, J. (2007). Evidence-based design: Key issues in a collaborative process. Proceedings of the W, 92, 23-26.

Becker, F., & Parsons, K. S. (2007). Hospital facilities and the role of evidence-based design. Journal of Facilities management. 5(4), 263-74

Berber, Ö. (2001). An Essay Of A Study On Architectural Knowledge. (MSc Thesis, Istanbul Technical University).

Berberoğlu, Ö. (2010). Perception, Boundary, Personal Space Concepts And Hospital Design. (MSc Thesis, Istanbul Technical University).

Bernhardt, J., Lipson-Smith, R., Davis, A., White, M., Zeeman, H., Pitt, N., ... & Elf, M. (2021). Why hospital design matters: A narrative review of built environments research relevant to stroke care. International Journal of Stroke, 17474930211042485.

Bero, L. A., Grilli, R., Grimshaw, J. M., Harvey, E., Oxman, A. D., & Thomson, M. A. (1998). Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. Bmj, 317(7156), 465-468.

Berwick, D. M. (2009). What 'patient-centered' should mean: confessions of an extremist: A seasoned clinician and expert fears the loss of his humanity if he should become a patient. Health affairs, 28(Suppl1), w555-w565.

Bhaskar, R. (1975). A realist theory of science. Leeds Book, Leeds, UK.

Bhatt, M., Hois, J., & Kutz, O. (2012). Ontological modelling of form and function for architectural design. Applied Ontology, 7(3), 233-267.

Biket, A. P. (2012). Pediatric Intensive Care Unit Design Guide and Design Assistance Model (Ph.D. Thesis, Yıldız Technical University)

Bodenreider, O., Smith, B., & Burgun, A. (2004). The ontology-epistemology divide: A case study in medical terminology. In Formal ontology in information systems: proceedings of the... International Conference. FOIS (Conference) (Vol. 2004, p. 185). NIH Public Access.

Brambilla, A., Rebecchi, A., & Capolongo, S. (2019). Evidence based hospital design. A literature review of the recent publications about the EBD impact of built environment on hospital occupants' and organizational outcomes.

Brown, C. E., & Ecoff, L. (2011). A systematic approach to the inclusion of evidence in healthcare design. HERD: Health Environments Research & Design Journal, 4(2), 7-16.

Capolongo, S., Gola, M., Brambilla, A., Morganti, A., Mosca, E. I., & Barach, P. (2020). COVID-19 and Healthcare facilities: A decalogue of design strategies for resilient hospitals. Acta Bio Medica: Atenei Parmensis, 91(9-S), 50.

Caruth, G. D. (2013). Demystifying mixed methods research design: A review of the literature. Online Submission, 3(2), 112-122.

Charlton, B. G., & Miles, A. (1998). The rise and fall of EBM. QJM: monthly journal of the Association of Physicians, 91(5), 371-374.

CHD: The Center for Health Design. About Us. Accessed Sept. 2, 2020 (https://www.healthdesign.org/about-us).

Chen, B., Zhang, C., & Sharples, S. (2016). BIM-based Design Strategies for Improving the Overall Quality of Healthcare Environment (Ongoing Research Project Grant RDF-15-01-19). XJTLU Research Development.

Chen, X., Jia, S., & Xiang, Y. (2020). A review: Knowledge reasoning over knowledge graph. Expert Systems with Applications, 141, 112948.

Cho, J. Y., & Lee, E. H. (2014). Reducing confusion about grounded theory and qualitative content analysis: Similarities and differences. Qualitative Report, 19(32).

Chong, G. H., Brandt, R., & Martin, W. M. (2010). Design informed: Driving innovation with evidence-based design. John Wiley & Sons.

Çıraklı, Ü., Gözlü, M., & Gözlü, K. (2014). Evaluation Of the Perceived Service Quality in Healthcare Organizations: A Study on Inpatients of Two Hospitals in Yozgat. MoH: Journal of Quality and Performance in Health, 7(1), 61-82.

Clarke, J. (2011). What is a systematic review?. Evidence-based nursing, 14(3), 64-64.

Cochrane, A. L. (1972). Effectiveness and efficiency: random reflections on health services. Nuffield Provincial Hospitals Trust.

Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. Review of research in education, 24(1), 249-305.

Codinhoto, R., Platten, B., Tzortzopoulos, P., & Kagioglou, M. (2010). Supporting evidence-based design. Improving healthcare through built environment infrastructure, 151-165.

Codinhoto, R., Tzortzopoulos, P., & Kagioglou, M. (2007). Effects of the built environment on health outcomes: Challenges in building the evidence-base. In 4th International SCRI Symposium. 343-357

Codinhoto, R., Tzortzopoulos, P., Kagioglou, M., Aouad, G. and Cooper, R. (2009). The impacts of the built environment on health outcomes. Facilities. 27(3/4), 138-151.

Collins, C., & Green, A. (1994). Decentralization and primary health care: some negative implications in developing countries. International journal of health services, 24(3), 459-475.

Cook, D. J., Greengold, N. L., Ellrodt, A. G., & Weingarten, S. R. (1997). The relation between systematic reviews and practice guidelines. Annals of internal medicine, 127(3), 210-216.

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. Qualitative sociology, 13(1), 3-21.

Crampton, J. W. (2009). Being ontological: Response to "postructuralism and GIS: Is there a 'disconnect'?". Environment and Planning D: Society and Space, 27(4), 603-608.

Crampton, J. W. (2011). Mapping: A critical introduction to cartography and GIS. John Wiley & Sons.

Crampton, J. W., & Krygier, J. (2018). An introduction to critical cartography. ACME: An International E-Journal for Critical Geographies, 4 (1), 11-33.

Crocker, S. (2021). A call for intersectional healthcare design research. HERD: Health Environments Research & Design Journal, 14(1), 273-277.

Cross, N. (2001). Designerly ways of knowing: Design discipline versus design science. Design issues, 17(3), 49-55.

Davidson, J. E. (2017). Organizing the evidence for healthcare design projects. HERD: Health Environments Research & Design Journal, 10(2), 13-22.

Davies, H., Nutley, S., & Walter, I. (2010). Using evidence: how social research could be better used to improve public service performance. Connecting knowledge and performance in public services: From knowing to doing, 199-225.

Deleuze, G., & Guattari, F. (1988). A thousand plateaus: Capitalism and schizophrenia. Bloomsbury Publishing.

Downe-Wamboldt, B. (1992). Content analysis: method, applications, and issues. Health care for women international, 13(3), 313-321.

Duffy, F., & Hutton, L. (2004). Architectural knowledge: the idea of a profession. Taylor & Francis.

Durmisevic, S., & Ciftcioglu, Ö. (2007) A neural-tree knowledge model for the assessment of building's transformation. In L. Bragança, M. Pinheiro, S. Jalali, R. Mateus, R. Amoêda, & M. C. Guedes (Eds.), Sustainable construction, materials and practices: Challenge of the industry for the new millennium. September 12–14, 2007, SB07 Part 1, Lisbon, Portugal.

Durmisevic, S., & Ciftcioglu, Ö. (2010). Knowledge modeling tool for evidence-based design. HERD: Health Environments Research & Design Journal, 3(3), 101-123.

Edelstein, E. A. (2008). Searching for evidence. HERD: Health Environments Research & Design Journal, 1(4), 95-110.

Elden, S. (1998). Mapping the Present: Space and History in the Work of Friedrich Nietzsche, Martin Heidegger and Michel Foucault. (Doctoral dissertation, Brunel University)

Epstein, R. M., & Street, R. L. (2011). The values and value of patient-centered care. Annals of Family Medicine 9(2), 100-3.

Ergenoğlu, A. S., & Aytuğ, A. (2007). Examination Of Changing Paradigms And Healing Hospital Concept In Healthcare Facilities With Regard To Architectural Design. Megaron, 2(1), 44.

Ergenoğlu, A. S., & Tanrıtanır, A. (2013). Evaluation of Architectural Spatial Quality in Patients' Rooms in the Context of User Satisfaction in General Hospitals: a Case study in Gaziantep. Megaron, 8(2), 61-63.

Fay, L., Cai, H., & Real, K. (2019). A systematic literature review of empirical studies on decentralized nursing stations. HERD: Health Environments Research & Design Journal, 12(1), 44-68.

Ferlie, E. B., & Shortell, S. M. (2001). Improving the quality of health care in the United Kingdom and the United States: a framework for change. The Milbank Quarterly, 79(2), 281-315.

Forty, A. (ed.) (2003). The modern hospital in England and France: the social and medical uses of architecture. In Buildings and society (pp. 39-57). Routledge.

Francis, S., Glanville, R., Noble, A., & Scher, P. (1999). 50 YEARS OF IDEAS in health care buildings. London: Nuffield Trust.

Gadamer, H. (1975). Truth and Method. Newyork. The Seabury Press

Gayathri, R., & Uma, V. (2018). Ontology based knowledge representation technique, domain modeling languages and planners for robotic path planning: A survey. ICT Express, 4(2), 69-74.

Gerhardt, U. (1989). Ideas about illness: An intellectual and political history of medical sociology. Macmillan International Higher Education.

Gesler, W., Bell, M., Curtis, S., Hubbard, P., & Francis, S. (2004). Therapy by design: evaluating the UK hospital building program. Health & place, 10(2), 117-128.

Gharaveis, A., Hamilton, D. K., & Pati, D. (2018). The impact of environmental design on teamwork and communication in healthcare facilities: a systematic literature review. HERD: Health Environments Research & Design Journal, 11(1), 119-137.

Glaser, B., & Strauss, A. (1967). The discovery of grounded theory: Strategies for qualitative research. London, UK: Weidenfeld & Nicholson.

Glaser, E. M. (1976). Putting Knowledge To Use: A Distillation of the Literature Regarding Knowledge Transfer & Change. Los Angeles, California: Human Interaction Research Institute.

Goertz, G., & Mahoney, J. (2012). Concepts and measurement: Ontology and epistemology. Social Science Information, 51(2), 205-216.

Greenhalgh, T. (2020). Will COVID-19 be evidence-based medicine's nemesis?. PLoS Medicine. 17(6). (https://doi.org/10.1371/journal.pmed.1003266)

Greenhalgh, T., Thorne, S., & Malterud, K. (2018). Time to challenge the spurious hierarchy of systematic over narrative reviews?. European journal of clinical investigation, 48(6).

Greenhalgh, Trisha, and Chrysanthi Papoutsi. "Studying complexity in health services research: desperately seeking an overdue paradigm shift." (2018): 1-6.

Groat, L., & Wang, D. (2002). Architectural research methods. New York, NY: Wiley & Sons.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. Handbook of qualitative research, 2(163-194).

Güç, B., Gençel, Z., & Karadayı, A. (2013). Understanding the Language of Hospital Design in the Context of Space, Perception and Cognition: The Case of SDU Hospital. Suleyman Demirel University Journal of Natural and Applied Science, 17(1), 133–146.

Guyatt, G., Cairns, J., Churchill, D., Cook, D., Haynes, B., Hirsh, J., ... & Tugwell, P. (1992). Evidence-based medicine: a new approach to teaching the practice of medicine. Jama, 268(17), 2420-2425.

Habermas, J., (1984). The Theory of Communicative Action. Vol I: Reason and the Rationalization of Society. Boston: Beacon Press

Hadi, K., Du Bose, J. R., & Choi, Y. S. (2019). The effect of light on sleep and sleep-related physiological factors among patients in healthcare facilities: a systematic review. HERD: Health Environments Research & Design Journal, 12(4), 116-141.

Hall, S., Oldfield, P., Mullins, B. J., Pollard, B., & Criado-Perez, C. (2017). Evidence based practice for the built environment: Can systematic reviews close the research-practice gap? Procedia engineering, 180, 912-924.

Hamilton, D. K. (2003). The Four Levels of Evidence-Based Practice. Healthcare Design Magazine. Accessed May 9, 2017 https://healthcaredesignmagazine.com/architecture/four-levels-evidence-based-practice/)

Hamilton, D. K. (2009). Evidence, Decisions, Guidelines, and Standards. HERD: Health Environments Research & Design Journal, 2(3), 51–55

Hamilton, D. K. (2010). Reflecting on Three Decades of Practice: Where's the Rigor? HERD: Health Environments Research & Design Journal. 4(1), 89-94

Hamilton, D. K., & Watkins, D. H. (2009). Evidence-based design for multiple building types. John Wiley & Sons.

Harari, E. (2001). Whose evidence? Lessons from the philosophy of science and the epistemology of medicine. Australian & New Zealand Journal of Psychiatry, 35(6), 724-730.

Harley, J. B., Woodward, D., Edney, M. H., Pedley, M. S., & Monmonier, M. S. (Eds.). (1987). The history of cartography (Vol. 1, p. 622). Chicago: University of Chicago Press.

Harvey, G., & Kitson, A. (2015). Implementing evidence-based practice in healthcare. Taylor & Francis.

Haynes, R. B. (2002). What kind of evidence is it that Evidence-Based Medicine advocates want health care providers and consumers to pay attention to?. BMC health services research, 2(1), 1-7.

Heidegger, M. (1967). Being and Time. Blackwell Oxford & Cambridge

Hekman, S. (1983). From epistemology to ontology: Gadamer's hermeneutics and Wittgensteinian social science. Human Studies, 6(1), 205-224.

Hignett, S., & Lu, J. (2009). An investigation of the use of health building notes by UK healthcare building designers. Applied Ergonomics, 40(4), 608-616.

Hind, S., Perkins, C., Gekker, A., Evans, D., Lammes, S., & Wilmott, C. (2018). Time for mapping: Cartographic temporalities (p. 288). Manchester University Press.

Horton, R., & Lo, S. (2013). Turkey's democratic transition to universal health coverage. The Lancet, 382(9886), 3.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. Qualitative health research, 15(9), 1277-1288.

Hughes, J. (2000). The “Matchbox on a Muffin”: the design of hospitals in the early NHS. Medical History, 44(1), 21-56.

Ilal, S. M., & Günaydın, H. M. (2017). Computer representation of building codes for automated compliance checking. Automation in Construction, 82, 43-58.

IOM: Institute of Medicine. (2000). To Err Is Human: Building a Safer Health System. Washington, D.C.: National Academy Press.

IOM: Institute of Medicine. (2001). Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, D.C.: National Academy Press.

ISO: International Organisation for Standardization. (ISO9000:2015) Quality management systems: Fundamentals and vocabulary. Accessed August 21, 2020. (https://www.iso.org/obp/ui/#iso:std:iso:9000:ed-4:v1:en)

Jacobson, N., Butterill, D., & Goering, P. (2003). Development of a framework for knowledge translation: understanding user context. Journal of health services research & policy, 8(2), 94-99.

Jiang, S., & Verderber, S. (2017). On the planning and design of hospital circulation zones: a review of the evidence-based literature. HERD: Health Environments Research & Design Journal, 10(2), 124-146.

Jones, J. C. (1992). Design methods. John Wiley & Sons.

Jones, W. J. (2004). Renewal by earthquake: Designing 21st century hospitals in response to California's seismic safety legislation. California HealthCare Foundation

Joseph, A., & Kirk Hamilton, D. (2008). The Pebble Projects: coordinated evidence-based case studies. Building Research & Information, 36(2), 129-145.

Junior, E. D. D. A., & de Lima Paula, F. (2008). The prevention of falls under the aspect of health promotion. Fitness & Performance Journal (Online Edition), 7(2), 123-129.

Kaijanaho, A. J. (2014). The extent of empirical evidence that could inform evidence-based design of programming languages: A systematic mapping study. Jyväskylä licentiate theses in computing, (18).

Kalaja, R., Myshketa, R., & Scalera, F. (2016). Service quality assessment in health care sector: the case of Durres public hospital. Procedia-Social and Behavioral Sciences, 235, 557-565.

Kasalı, A. (2013). An Ethnographic Study Of The Role Of Evidence In Problem-Solving Practices Of Healthcare Facilities Design Teams. (Doctoral dissertation, Georgia Institute of Technology).

Kasalı, A., & Nersessian, N. J. (2017). Grounding Evidence in Design: Framing Next Practices. The Design Journal, 20(sup1), 4387-4397.

Kibiswa, N. K. (2019). Directed qualitative content analysis (DQlCA): A tool for conflict analysis. The Qualitative Report, 24(8), 2059-2079.

Kolehmainen-Aitken, R. L. (1998). Decentralization and human resources: implications and impact. Human Resources for Health Development Journal, 2(1), 1-29.

Konys, A. (2018). An ontology-based knowledge modelling for a sustainability assessment domain. Sustainability, 10(2), 300.

Kruger, C., & Cross, N. (2006). Solution driven versus problem driven design: strategies and outcomes. Design Studies, 27(5), 527-548.

Landry, R., Amara, N., & Lamari, M. (2001). Climbing the ladder of research utilization: Evidence from social science research. Science Communication, 22(4), 396-422.

Laursen, J., Danielsen, A., & Rosenberg, J. (2014). Effects of environmental design on patient outcome: a systematic review. HERD: Health Environments Research & Design Journal, 7(4), 108-119.

Lawson, B. (2010). Healing architecture. Arts & Health, 2(2), 95-108.

Lawson, B., Bassanino, M., Phiri, M., & Worthington, J. (2003). Intentions, practices and aspirations: Understanding learning in design. Design Studies, 24(4), 327-339.

Leszczynski, A. (2009). Poststructuralism and GIS: Is there a 'disconnect'?. Environment and Planning D: Society and Space, 27(4), 581-602.

Li, Y. (2010). The Third Methodology Movement: Probe and Analysis of the 60 years' Development of Mixed Approach [J]. Journal of Educational Studies, 3.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. Sage Publications.

Lincoln, Y. S., & Guba, E. G. (2013). The constructivist credo. Left coast press.

Lindahl, Göran, Michael Phiri, Grant Mills, M. Strid, and Andrew D. F. Price. (2010). Quality Innovation and Evidence in Healthcare Physical Environments in England and Sweden: Establishing a Collaborative Roadmap. HaCIRIC International Conference 2010.

Lorusso, L., Lee, J. H., & Worden, E. A. (2021). Design Thinking for Healthcare: Transliterating the Creative Problem-Solving Method into Architectural Practice. HERD: Health Environments Research & Design Journal, 14(2), 16-29.

Lundin, S. (2015). Healing architecture: Evidence, intuition, dialogue. Chalmers Tekniska Hogskola (Sweden).

Lupton, D. (1997). Foucault and the medicalisation critique. Foucault, health and medicine, 94-110.

Lyon, C. (2017). Humanist principles, sustainable design and salutogenics: A new form of healthcare architecture. Architectural Design, 87(2), 56-65.

Macquarrie, Oxford: Blackwell, 1962.Acierno, M., Cursi, S., Simeone, D., & Fiorani, D. (2017). Architectural heritage knowledge modelling: An ontology-based framework for conservation process. Journal of Cultural Heritage, 24, 124-133.

Malkin, J. (2008). A visual reference for evidence-based design. CHD: Center for Health Design.

Malone, E. B., & Dellinger, B. A. (2011). Furniture design features and healthcare outcomes. Concord, CA: The Center for Health Design.

Marcheschi, E., Sigurjónsson, A., Ulrich, R. S., & Elf, M. (2019). The physical environment and its effect on health outcomes—A systematic review. In Architecture Research Care & Health (ARCH19) Conference 'Building for Better Health', June (pp. 12-14).

Martin, C. S. (2009). The challenge of integrating evidence-based design. HERD: Health Environments Research & Design Journal, 2(3), 29-50.

Martin, C., & Guerin, D. (2006). Using research to inform design solutions. Journal of Facilities Management. 4(3), 167-180.

Martin, C., & Guerin, D. (2007). Integrating the use of research into the design process experience. IDEC, 30(1), 57-67.

McCullough, C. S. (Ed.). (2010). Evidence-based design for healthcare facilities. Sigma Theta Tau.

Mills, G. R., Phiri, M., Erskine, J., & Price, A. D. (2015). Rethinking healthcare building design quality: an evidence-based strategy. Building Research & Information, 43(4), 499-515.

MoH: Ministry of Health of Turkey. (2010). Türkiye Sağlık Yapıları Asgari Tasarım Standartları // A guidance for Minimum Design Standards for Health Care Buildings in Turkey.

MoH: Ministry of Health of Turkey. (2012). Türkiye Sağlıkta Dönüşüm Proğramı Değerlendirme Raporu // Turkey Health Transformation Program Assessment Report (2003-2011).

MoH: Ministry of Health of Turkey. (2015). Standart Development Algorithm in Standards of Accreditation in Health: Hospital Kit. (V. 1).

MoH: Ministry of Health of Turkey. (2017). Standards for Accreditation in Health: Standard Development Guide. TUSEB / Department of Quality and Accreditation in Health.

MoH: Ministry of Health of Turkey. (2018). Standards of Accreditation in Health: Hospital Kit. (V. 2).

MoH: Ministry of Health of Turkey. (2020). Sağlıkta Kalite Standartları: Hastane // Standards of Quality of Health: Hospital Kit. (V. 6).

Mohan, J. (2002). Planning, markets and hospitals. Routledge.

Moore, K. D., & Geboy, L. (2010). The question of evidence: current worldviews in environmental design research and practice. Arq: Architectural Research Quarterly, 14(2), 105-114.

Nelson, C., West, T., & Goodman, C. (2005). The hospital-built environment: what role might funders of health services research play. Rockville, MD: Agency for Healthcare Research and Quality.

Nutley, S., Jung, T., & Walter, I. (2008). The many forms of research-informed practice: a framework for mapping diversity. Cambridge Journal of Education, 38(1), 53-71.

Owen, J. A. (2008). Naturalistic inquiry. In Given, L. M. (Ed.), The SAGE encyclopedia of qualitative research methods (pp. 548–551). Thousand Oaks, CA: SAGE.

Packer, M. J., & Goicoechea, J. (2000). Sociocultural and constructivist theories of learning: Ontology, not just epistemology. Educational psychologist, 35(4), 227-241.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. Journal of marketing, 49(4), 41-50.

Peavey, E., & Vander Wyst, K. B. (2017). Evidence-based design and research-informed design: What's the difference? Conceptual definitions and comparative analysis. HERD: Health Environments Research & Design Journal, 10(5), 143-156.

Perkins, C. (2003). Cartography: mapping theory. Progress in human geography, 27(3), 341-351.

Pevsner, N. (1976). A history of building types (Vol. 257). London: Thames and Hudson.

Phiri, M. (2014). Design tools for evidence-based healthcare design. Routledge.

Phiri, M., & Chen, B. (2014). Sustainability and evidence-based design in the healthcare estate. Springer Berlin Heidelberg.

Pidgeon, N. F., Turner, B. A., & Blockley, D. I. (1991). The use of grounded theory for conceptual analysis in knowledge elicitation. International journal of Man-machine studies, 35(2), 151-173.

Price, A. D. F., & Lu, J. (2013). Impact of hospital space standardization on patient health and safety. Architectural Engineering and Design Management, 9(1), 49-61.

Quan, X., Joseph, A., & Nanda, U. (2017). Developing evidence-based tools for designing and evaluating hospital inpatient rooms. Journal of Interior Design, 42(1), 19-38.

Rashid, M. (2013). The question of knowledge in evidence-based design for healthcare facilities: Limitations and suggestions. HERD: Health Environments Research & Design Journal, 6(4), 101-126.

Reid, W. J. (1994). The empirical practice movement. Social Service Review, 68(2), 165-184.

Reitman, W. R. (1964). Heuristic decision procedures, open constraints, and the structure of ill-defined problems. Human judgments and optimality, 282-315.

Resnik, D. B. (2000). A pragmatic approach to the demarcation problem. Studies in History and Philosophy of Science Part A, 31(2), 249-267.

Reynolds, A. (2009). Patient-centered care. Radiologic Technology, 81(2), 133-147.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy sciences, 4(2), 155-169.

Roberts, J. P., Fisher, T. R., Trowbridge, M. J., & Bent, C. (2016, March). A design thinking framework for healthcare management and innovation. In Healthcare (Vol. 4, No. 1, pp. 11-14). Elsevier.

Rogers, Everett M. 1983. Diffusion of Innovations. 3rd ed. [1. New York, London: Free Press].

Rooney, A. L., & Van Ostenberg, P. R. (1999). Licensure, accreditation, and certification: approaches to health services quality. Center for Human Services, Quality Assurance Project.

Rožanec, J. M., Novalija, I., Zajec, D. P., Kenda, K., & Mladenić, D. (2021). Knowledge Modelling and Active Learning in Manufacturing. arXiv:2107.02298.

Rutter, H., Savona, N., Glonti, K., Bibby, J., Cummins, S., Finegood, D. T., ... & White, M. (2017). The need for a complex systems model of evidence for public health. The lancet, 390(10112), 2602-2604.

Sackett, D. L., Rosenberg, W. M., Gray, J. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't.

Sailer, K., Budgen, A., Lonsdale, N., Turner, A., & Penn, A. (2008). Evidence-based design: Theoretical and practical reflections of an emerging approach in office architecture.

Saltman, R. B., & Figueras, J. (1998). Analyzing The Evidence On European Health Care Reforms: Experience in western European health care systems suggests lessons for reform in the United States, according to a major international comparison by the World Health Organization. Health affairs, 17(2), 85-108.

Sandal, L. F., Thorlund, J. B., Moore, A. J., Ulrich, R. S., Dieppe, P. A., & Roos, E. M. (2019). Room for improvement: a randomised controlled trial with nested qualitative interviews on space, place and treatment delivery. British journal of sports medicine, 53(6), 359-367.

Schreiber, C., & Carley, K. (2004). Going beyond the data: Empirical validation leading to grounded theory. Computational & Mathematical Organization Theory, 10(2), 155-164.

Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. English language teaching, 5(9), 9-16.

Sehon, S. R., & Stanley, D. E. (2003). A philosophical analysis of the evidence-based medicine debate. BMC health services research, 3(1), 1-10.

Sen, K., & Koivusalo, M. (1998). Health care reforms and developing countries—a critical overview. The International journal of health planning and management, 13(3), 199-215.

Şensoy, A. (2015). Hastane Yapıları: Uzmanlık Gerektiren Komplike Binalar // Health Care Buildings: Complex Buildings Requiring Specialism. Web Interview Accessed Sept. 12, 2020. (https://www.ekoyapidergisi.org/972-hastane-yapilari-uzmanlik-gerektiren-komplike-binalar.html)

Shoemaker, L. K., Kazley, A. S., & White, A. (2010). Making the case for evidence-based design in healthcare: a descriptive case study of organizational decision making. HERD: Health Environments Research & Design Journal, 4(1), 56-88.

Sioofy Khoojine, N. (2020). Evaluation of the architects' concern of the accessibility in intensive care units referring to evidence-based design. (Doctoral Thesis, Middle East Technical University).

Stankos, M., & Schwarz, B. (2007). Evidence-based design in healthcare: A theoretical dilemma. Interdisciplinary Design and Research e-Journal, 1(1), 1-15.

Stichler, J. F. (2007). Using evidence-based design to improve outcomes. JONA: The Journal of Nursing Administration, 37(1), 1-4.

Stichler, J. F., & Hamilton, D. K. (2008). Evidence-Based Design: What is It? HERD: Health Environments Research & Design Journal, 1(2), 3–4.

Sun, Y. (2017). Coding of Data. In Allen, M. (Ed.), The SAGE encyclopedia of communication research methods. Sage Publications, 148-151.

Taylor, E., & Hignett, S. (2016). The SCOPE of hospital falls: a systematic mixed studies review. HERD: Health Environments Research & Design Journal, 9(4), 86-109.

Thyer, B. A., & Myers, L. L. (2011). The quest for evidence-based practice: A view from the United States. Journal of Social Work, 11(1), 8-25.

Till, J. (2008). Three myths and one model. Building Materials (Dublin), (17), 4-10.

TMMOB: Chamber of Architects of Turkey / Adana Branch. (2015). Sağlık Yapıları // Health Care Buildings. Güney Mimarlık (vol.18).

TMMOB: Chamber of Architects of Turkey / Ankara Branch. (2019). İlişkisel Bir Eylem Olarak Haritalama // Mapping as a Relational Act (vol.42).

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. British journal of management, 14(3), 207-222.

Tufte, E. R. (2006). Beautiful evidence. Cheshire, CT: Graphics Press.

Turchi, P. (2004). Maps of the Imagination: The Writer as Cartographer. San Antonio, Trinity University Press

Ulrich, R. S., Berry, L. L., Quan, X., & Parish, J. T. (2010). A conceptual framework for the domain of evidence-based design. HERD: Health Environments Research & Design Journal, 4(1), 95-114.

Ulrich, R. S., Zimring, C., Joseph, A., & Choudhary, R. (2004). The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity. Concord, CA: The Center for Health Design, 311.

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H. B., Choi, Y. S., ... & Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. HERD: Health Environments Research & Design Journal, 1(3), 61-125.

Urban, R. J. (2009). Blending Grounded Theory and Ontology Development Methods.

Van Rees, R. (2003). Clarity in the usage of the terms ontology, taxonomy and classification. CIB REPORT, 284(432), 1-8.

Venkatesh, V., Brown, S. A., & Bala, H. (2013). Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. MIS quarterly, 21-54.

Viets, E. (2009). Lessons from evidence-based medicine: what healthcare designers can learn from the medical field. HERD: Health Environments Research & Design Journal, 2(2), 73-87.

Viets-Schmitz, E., & Anderson, D. (2011). Bridging the gap: multidisciplinary collaboration in medicine and architecture. University of Toronto Medical Journal, 88(3), 129-134.

Walsh, D., & Evans, K. (2014). Critical realism: An important theoretical perspective for midwifery research. Midwifery, 30(1), e1-e6.

Wanigarathna N, Price ADF and Austin SA (2013) Improvement opportunities for evidence-based design: an application of a critical realist's perspective. Proceeding 29th Annual ARCOM Conference, 2-4

Wanigarathna, N. (2014). Evidence-based design for healthcare buildings in England and Wales (Doctoral dissertation, Loughborough University).

Wanigarathna, N., Austin, S., Price, A., & Mills, G. R.. (2011). Does evidence based design for healthcare built environments limit creativity? Loughborough University.

Wanigarathna, N., Sherratt, F., Price, A., & Austin, S. (2016). Healthcare designers' use of prescriptive and performance-based approaches. Architectural Engineering and Design Management, 12(6), 427-441.

Wanigarathna, N., Sherratt, F., Price, A.D.F. and Austin, S. (2021). Sources and flow of healthcare built environment design evidence. Built Environment Project and Asset Management. https://doi.org/10.1108/BEPAM-08-2020-0144

Weiss, C. H. (1979). The many meanings of research utilization. Public administration review, 39(5), 426-431.

Wendt, C., Frisina, L., & Rothgang, H. (2009). Healthcare system types: a conceptual framework for comparison. Social Policy & Administration, 43(1), 70-90.

White, F. (2015). Primary health care and public health: foundations of universal health systems. Medical Principles and Practice, 24(2), 103-116.

WHO: Word Health Organization. (2012). Successful Health System Reforms: The case of Turkey. World Health Organization. Regional Office for Europe, Copenhagen, Denmark.

WHO: World Health Organization. (2002). World Health Report-Reducing Risks, Promoting Healthy Life. Geneva, Switzerland.

WHO: World Health Organization. (2008). Guidance on developing quality and safety strategies with a health system approach. Guidance on developing quality and safety strategies with a health system approach. Geneva, Switzerland.

WHO: World Health Organization. (2010). The world health report: health systems financing: the path to universal coverage: executive summary. Geneva, Switzerland.

WHO: World Health Organization. (2015). World health statistics 2015. World Health Organization. Geneva, Switzerland.

WHO: World Health Organization. Constitution of WHO: Principles. Accessed May 2, 2019 (https://www.who.int/about/mission/en/).

WHO: World Health Organization. Health Systems Glossary. Accessed August 26, 2020 (https://www.who.int/healthsystems/Glossary_January2011.pdf).

WHO: World Health Organization. What is quality of care and why it is important. Accessed August 26, 2020. (https://www.who.int/healthsystems/Glossary_January2011.pdf)

Wildemuth, B. M. (1993). Post-positivist research: two examples of methodological pluralism. The Library Quarterly, 63(4), 450-468.

Wright, L. (2012). Architectural knowledge: the way that architects know and use knowledge embedded in design (Doctoral dissertation, RMIT University).

Yilmaz, V. (2017). The politics of healthcare reform in Turkey. Springer.

Yimin, J. (2009). Mixed methods research as “the third methodological movement”. Zhejiang Social Sciences, 10, 27-39.

Yuen, H. K., & Richards, T. J. (1994). Knowledge representation for grounded theory construction in qualitative data analysis. Journal of Mathematical Sociology, 19(4), 279-298.

Zhang, Y., Tzortzopoulos, P., & Kagioglou, M. (2017). How evidence-based design supports better value generation for end-users. 25th Annual Conference of the International Group for Lean Construction, Heraklion, Greece.

Zhang, Y., Tzortzopoulos, P., & Kagioglou, M. (2019). Healing built-environment effects on health outcomes: Environment–occupant–health framework. Building research & information, 47(6), 747-766.

Zhang, Y., Tzortzopoulos, P., & Kagioglou, M. (2019). Healing built-environment effects on health outcomes: Environment–occupant–health framework. Building research & information, 47(6), 747-766.

Zhou, Y. (2014). Healthcare facility research and design. Frontiers of Architectural Research, 3(3), 227-227.

Zimring, C., & Bosch, S. (2008). Building the evidence base for evidence-based design: editors' introduction. 40(2), 147-150.

Zimring, C., Augenbroe, G. L., Malone, E. B., & Sadler, B. L. (2008). Implementing healthcare excellence: The vital role of the CEO in evidence-based design. HERD: Health Environments Research & Design Journal, 1(3), 7-21.

Zwart, J.V.D. (2021). Building for Better Health: Reflections on Architecture Research for Care and Health. HERD: Health Environments Research & Design Journal. 14(1): 12-18.

APPENDICES

A. Reference list of evidence-based studies coded

KPS 1: Berry, L. L., & Parish, J. T. (2008). The impact of facility improvements on hospital nurses. HERD: Health Environments Research & Design Journal, 1(2), 5-13.

KPS 2: Capodaglio, E. M. (2014). Hospital bathroom ergonomics: safety, usability and accessibility issues. Clinical Nursing Studies, 2, 1-11.

KPS 3: Spritzer, S. D., Riordan, K. C., Berry, J., Corbett, B. M., Gerke, J. K., Hoerth, M. T., ... & Noe, K. H. (2015). Fall prevention and bathroom safety in the epilepsy monitoring unit. Epilepsy & Behavior, 48, 75-78.

KPS 4: Sadatsafavi, H., Walewski, J., & Shepley, M. M. (2015). Factors influencing evaluation of patient areas, work spaces, and staff areas by healthcare professionals. Indoor and Built Environment, 24(4), 439-456.

KPS 5: Valdez, R. S., McGuire, K. M., & Rivera, A. J. (2017). Qualitative ergonomics/human factors research in health care: Current state and future directions. Applied Ergonomics, 62, 43-71.

KPS 6: Garg, A., & Kapellusch, J. M. (2012). Long-term efficacy of an ergonomics program that includes patient-handling devices on reducing musculoskeletal injuries to nursing personnel. Human factors, 54(4), 608-625.

KPS 7: Pati, D., Harvey Jr, T. E., & Barach, P. (2008). Relationships between exterior views and nurse stress: An exploratory examination. HERD: Health Environments Research & Design Journal, 1(2), 27-38.

KPS 8: Lo Verso, V. R., Caffaro, F., & Aghemo, C. (2016). Luminous environment in healthcare buildings for user satisfaction and comfort: An objective and subjective field study. Indoor and Built Environment, 25(5), 809-825.

KPS 9: Holder, M., & Berndt, A. (2011). The effect of changes in servicescape and service quality perceptions in a maternity unit. International journal of health care quality assurance.

KPS 10: Collier, L., & Jakob, A. (2017). The multisensory environment (MSE) in dementia care: examining its role and quality from a user perspective. HERD: Health Environments Research & Design Journal, 10(5), 39-51.

KPS 11: Bayramzadeh, S., Joseph, A., San, D., Khoshkenar, A., Taaffe, K., Jafarifiroozabadi, R., ... & RIPCHD. OR Study Group. (2018). The impact of operating room layout on circulating nurse's work patterns and flow disruptions: a behavioral mapping study. HERD: Health Environments Research & Design Journal, 11(3), 124-138.

KPS 12: Luetz, A., Weiss, B., Penzel, T., Fietze, I., Glos, M., Wernecke, K. D., ... & Spies, C. (2016). Feasibility of noise reduction by a modification in ICU environment. Physiological measurement, 37(7), 1041.

KPS 13: Liu, W., Manias, E., & Gerdtz, M. (2014). The effects of physical environments in medical wards on medication communication processes affecting patient safety. Health & place, 26, 188-198.

KPS 14: Palmer, G., Abernathy III, J. H., Swinton, G., Allison, D., Greenstein, J., Shappell, S., ... & Reeves, S. T. (2013). Realizing improved patient care through human-centered operating room design: a human factors methodology for observing flow disruptions in the cardiothoracic operating room. Anesthesiology, 119(5), 1066-1077.

KPS 15: Urbanoski, K. A., Mulsant, B. H., Novotna, G., Ehtesham, S., & Rush, B. R. (2013). Does the redesign of a psychiatric inpatient unit change the treatment process and outcomes?. Psychiatric Services, 64(8), 804-807.

KPS 16: Colligan, L., Guerlain, S., Steck, S. E., & Hoke, T. R. (2012). Designing for distractions: a human factors approach to decreasing interruptions at a centralised medication station. BMJ quality & safety, 21(11), 939-947.

KPS 17: Varu, V. N., Greenberg, J. I., & Lee, J. T. (2013). Improved efficiency and safety for EVAR with utilization of a hybrid room. European Journal of Vascular and Endovascular Surgery, 46(6), 675-679.

KPS 18: Watkins, N., Kobelja, M., Peavey, E., Thomas, S., & Lyon, J. (2011). An evaluation of operating room safety and efficiency: Pilot utilization of a structured focus group format and three-dimensional video mock-up to inform design decision making. HERD: Health Environments Research & Design Journal, 5(1), 6-22.

KPS 19: Ahamed, M. F., Campbell, D., Horan, S., & Rosen, O. (2018). Noise reduction in the neonatal intensive care unit: A quality improvement initiative. American Journal of Medical Quality, 33(2), 177-184.

KPS 20: Lake, E. T., Hallowell, S. G., Kutney-Lee, A., Hatfield, L. A., Del Guidice, M., Boxer, B., ... & Aiken, L. H. (2016). Higher quality of care and patient safety associated with better NICU work environments. Journal of nursing care quality, 31(1), 24.

KPS 21: Dean, M., Gill, R., & Barbour, J. B. (2016). "Let's sit forward": investigating interprofessional communication, collaboration, professional roles, and physical space at EmergiCare. Health Communication, 31(12), 1506-1516.

KPS 22: Manganelli, J., Threatt, A., Brooks, J. O., Smolentzov, L., Mossey, M., Healy, S., ... & Green, K. (2013). Examination of overbed tables: Healthcare provider and user preferences. HERD: Health Environments Research & Design Journal, 6(3), 9-29.

KPS 23: Andrade, C., Lima, M. L., Fornara, F., & Bonaiuto, M. (2012). Users' views of hospital environmental quality: validation of the perceived hospital environment quality indicators (PHEQIs). Journal of environmental psychology, 32(2), 97-111.

KPS 24: Hua, Y., Becker, F., Wurmser, T., Bliss-Holtz, J., & Hedges, C. (2012). Effects of nursing unit spatial layout on nursing team communication patterns, quality of care, and patient safety. HERD: Health Environments Research & Design Journal, 6(1), 8-38.

KPS 25: Sherman-Bien, S. A., Malcarne, V. L., Roesch, S., Varni, J. W., & Katz, E. R. (2011). Quantifying the relationship among hospital design, satisfaction, and psychosocial functioning in a pediatric hematology oncology inpatient unit. HERD: Health Environments Research & Design Journal, 4(4), 34-59.

KPS 26: Isaac, T., Zaslavsky, A. M., Cleary, P. D., & Landon, B. E. (2010). The relationship between patients' perception of care and measures of hospital quality and safety. Health services research, 45(4), 1024-1040.

KPS 27: Becker, F., Sweeney, B., & Parsons, K. (2008). Ambulatory facility design and patients' perceptions of healthcare quality. HERD: Health Environments Research & Design Journal, 1(4), 35-54.

KPS 28: Nyrud, A. Q., Bringslimark, T., & Bysheim, K. (2014). Benefits from wood interior in a hospital room: a preference study. Architectural Science Review, 57(2), 125-131.

KPS 29: Sadatsafavai, H. Sadatsafavi, H., Walewski, J., & Taborn II, M.(2014). Comparison of a Sample of Green Hospitals with Non-Green Hospitals With Respects to Operating Expenses And Patient Revenue. Journal of Green Building Vol. 9, No. 2.

KPS 30: Chambers, M., & Bowman, K. L. (2011). Finishes and furnishings: Considerations for critical care environments. Critical Care Nursing Quarterly, 34(4), 317-331.

KPS 31: Burpee, H., & McDade, E. (2014). Comparative analysis of hospital energy use: Pacific Northwest and Scandinavia. HERD: Health Environments Research & Design Journal, 8(1), 20-44.

KPS 32: Daemen, E. M. L., Flinsenberg, I. C. M., Van Loenen, E. J., Cuppen, R. P. G., & Rajae-Joordens, R. J. E. (2014). Adaptable healing patient room for stroke patients. Methods of Information in Medicine, 53(05), 406-415.

KPS 33: McDowell, A. L., & Huang, Y. L. (2012). Selecting a pharmacy layout design using a weighted scoring system. American Journal of Health-System Pharmacy, 69(9), 796-804.

KPS 34: Malcolm, H. A. (2005). Does privacy matter? Former patients discuss their perceptions of privacy in shared hospital rooms. Nursing ethics, 12(2), 156-166.

KPS 35: Whitehead, C. C., Polsky, R. H., Crookshank, C., & Fik, E. (1984). Objective and subjective evaluation of psychiatric ward redesign. The American Journal of Psychiatry.

KPS 36: Lee, S., Dazkir, S. S., Paik, H. S., & Coskun, A. (2014). Comprehensibility of universal healthcare symbols for wayfinding in healthcare facilities. Applied ergonomics, 45(4), 878-885.

KPS 37: Choi, J. H., Beltran, L. O., & Kim, H. S. (2012). Impacts of indoor daylight environments on patient average length of stay (ALOS) in a healthcare facility. Building and environment, 50, 65-75.

KPS 38: Choi, Y. S., & Bosch, S. J. (2013). Environmental affordances: designing for family presence and involvement in patient care. HERD: Health Environments Research & Design Journal, 6(4), 53-75.

KPS 39: Joarder, A. R., & Price, A. D. F. (2013). Impact of daylight illumination on reducing patient length of stay in hospital after coronary artery bypass graft surgery. Lighting Research & Technology, 45(4), 435-449.

KPS 40: Erbino, C., Toccolini, A., Vagge, I., & Ferrario, P. S. (2015). Guidelines for the design of a healing garden for the rehabilitation of psychiatric patients. Journal of Agricultural Engineering, 46(2), 43-51.

KPS 41: Mayampurath, A., Ward, C., Fahrenbach, J., LaFond, C., Howell, M., & Churpek, M. M. (2019). Association between room location and adverse outcomes in hospitalized patients. HERD: Health Environments Research & Design Journal, 12(2), 21-29.

KPS 42: Vaccari, M., Montasser, W., Tudor, T., & Leone, L. (2017). Environmental audits and process flow mapping to assess management of solid waste and wastewater from a healthcare facility: an Italian case study. Environmental monitoring and assessment, 189(5), 1-12.

KPS 43: Bonuel, N. (2018). Acuity-adaptable patient room from the patient's perspective. Journal of Nursing Education and Practice, 8(5), 38-43.

KPS 44: Sadler, B. L., Berry, L. L., Guenther, R., Hamilton, D. K., Hessler, F. A., Merritt, C., & Parker, D. (2011). Fable hospital 2.0: the business case for building better health care facilities. Hastings Center Report, 41(1), 13-23.

KPS 45: Ulrich, R. S., & Zhu, X. (2007). Medical complications of intra-hospital patient transports: Implications for architectural design and research. HERD: Health Environments Research & Design Journal, 1(1), 31-43.

KPS 46: Joseph, A., Wingler, D., & Zamani, Z. (2017). Balancing the human touch with the need for integrating technology in ambulatory surgical environments: Barriers and facilitators to nursing work and care team interactions. Journal of Interior Design, 42(1), 39-65.

KPS 47: Johnson, O., Youkee, D., Brown, C. S., Lado, M., Wurie, A., Bash-Taqi, D., ... & Kargbo, B. (2016). Ebola holding units at government hospitals in Sierra Leone: evidence for a flexible and effective model for safe isolation, early treatment initiation, hospital safety and health system functioning. BMJ global health, 1(1), e000030.

KPS 48: Rinkoo, A. V., Singh, S. P., Mishra, S., Vashishta, G., Chandra, H., & Singh, P. K. (2015). Does effective designing of operation theaters contribute towards staff satisfaction: A cross-sectional study. Facilities.

KPS 49: McGrath, J., LeGare, A., Hermanson, L., & Repplinger, M. D. (2015). The impact of a flexible care area on throughput measures in an academic emergency department. Journal of Emergency Nursing, 41(6), 503-509.

KPS 50: Browall, M., Koinberg, I., Falk, H., & Wijk, H. (2013). Patients' experience of important factors in the healthcare environment in oncology care. International journal of qualitative studies on health and well-being, 8(1), 20870.

KPS 51: Dortland, M. V. R., Dewulf, G., & Voordijk, H. (2013). Project coalitions in healthcare construction projects and the application of real options: an exploratory survey. HERD: Health Environments Research & Design Journal, 7(1), 14-36.

KPS 52: Traversari, R., Goedhart, R., & Schraagen, J. M. (2013). Process simulation during the design process makes the difference: Process simulations applied to a traditional design. HERD: Health Environments Research & Design Journal, 6(2), 58-76.

KPS 53: Holmdahl, T., & Lanbeck, P. (2013). Design for the post-antibiotic era: Experiences from a new building for infectious diseases in Malmö, Sweden. HERD: Health Environments Research & Design Journal, 6(4), 27-52.

KPS 54: Pati, D., Evans, J., Harvey Jr, T. E., & Bazuin, D. (2012). Factors impeding flexible inpatient unit design. HERD: Health Environments Research & Design Journal, 6(1), 83-103.

KPS 55: Gulwadi, G. B., Joseph, A., & Keller, A. B. (2009). Exploring the impact of the physical environment on patient outcomes in ambulatory care settings. HERD: Health Environments Research & Design Journal, 2(2), 21-41.

KPS 56: Harris, D. (2016). Surface finish materials: Considerations for the neonatal intensive care unit (NICU). Newborn and Infant Nursing Reviews, 16(4), 203-207.

KPS 57: Kim, D., Lee, J. H., & Ha, M. (2014). Exploring perceptions of designers and medical staff in South Korea about design elements for the elder-friendly hospital. Journal of Interior Design, 39(4), 15-32.

KPS 58: Abraham, S. (2016). Managing patient falls in psychiatric inpatient units: Part 2. The Health Care Manager, 35(2), 121-133.

KPS 59: Pasquier, P., Ficko, C., Mérens, A., & Dubost, C. (2015). Preparing an ICU room to welcome a critically ill patient with Ebola virus disease. Intensive care medicine, 41(1), 118-119.

KPS 60: Sugalski, G., Murano, T., Fox, A., & Rosania, A. (2015). Development and use of mobile containment units for the evaluation and treatment of potential Ebola virus disease patients in a United States hospital. Academic Emergency Medicine, 22(5), 616-622.

KPS 61: Lowe, J. J., Olinger, P. L., Gibbs, S. G., Rengarajan, K., Beam, E. L., Boulter, K. C., ... & Ribner, B. S. (2015). Environmental infection control considerations for Ebola. American Journal of Infection Control, 43(7), 747-749.

KPS 62: Algase, D. L., Antonakos, C., Beattie, E., Beel-Bates, C., & Song, J. A. (2011). Estimates of crowding in long-term care: comparing two approaches. HERD: Health Environments Research & Design Journal, 4(2), 61-74.

KPS 63: Hamilton, D. K., Swoboda, S. M., Lee, J. T., & Anderson, D. C. (2018). Decentralization: The corridor is the problem, not the alcove. Critical Care Nursing Quarterly, 41(1), 3-9.

KPS 64: Keys, Y., & Stichler, J. F. (2018). Safety and security concerns of nurses working in the intensive care unit. Critical care nursing quarterly, 41(1), 68-75.

KPS 65: Joseph, A., Bayramzadeh, S., Zamani, Z., & Rostenberg, B. (2018). Safety, performance, and satisfaction outcomes in the operating room: a literature review. HERD: Health Environments Research & Design Journal, 11(2), 137-150.

KPS 66: Naccarella, L., Raggatt, M., & Redley, B. (2019). The influence of spatial design on team communication in hospital emergency departments. HERD: Health Environments Research & Design Journal, 12(2), 100-115.

KPS 67: Rodrigues, R., Coelho, R., & Tavares, J. M. R. (2019). Healthcare signage design: a review on recommendations for effective signing systems. HERD: Health Environments Research & Design Journal, 12(3), 45-65.

KPS 68: Patterson, E. S., Sanders, E. B. N., Sommerich, C. M., Lavender, S. A., Li, J., & Evans, K. D. (2017). Meeting patient expectations during hospitalization: A grounded theoretical analysis of patient-centered room elements. HERD: Health Environments Research & Design Journal, 10(5), 95-110.

KPS 69: Fay, L., Carll-White, A., Schadler, A., Isaacs, K. B., & Real, K. (2017). Shifting landscapes: The impact of centralized and decentralized nursing station models on the efficiency of care. HERD: Health Environments Research & Design Journal, 10(5), 80-94.

KPS 70: Donetto, S., Penfold, C., Anderson, J., Robert, G., & Maben, J. (2017). Nursing work and sensory experiences of hospital design: A before and after qualitative study following a move to all-single room inpatient accommodation. Health & place, 46, 121-129.

KPS 71: Leccese, F., Salvadori, G., Montagnani, C., Ciconi, A., & Rocca, M. (2017). Lighting assessment of ergonomic workstation for radio diagnostic reporting. International Journal of Industrial Ergonomics, 57, 42-54.

KPS 72: González-Martínez, E., Bangerter, A., & Lê Van, K. (2017). Building Situation Awareness on the Move: Staff Monitoring Behavior in Clinic Corridors. Qualitative Health Research, 27(14), 2244-2257.

KPS 73: McNeil, S. J., & Tapp, L. S. (2016). The design and initial evaluation of visual cues in carpets to assist walking. The Journal of The Textile Institute, 107(3), 376-385.

KPS 74: Deyneko, A., Cordeiro, F., Berlin, L., Ben-David, D., Perna, S., & Longtin, Y. (2016). Impact of sink location on hand hygiene compliance after care of patients with Clostridium difficile infection: a cross-sectional study. BMC infectious diseases, 16(1), 1-7.

KPS 75: MacAllister, L., Zimring, C., & Ryherd, E. (2016). Environmental variables that influence patient satisfaction: A review of the literature. HERD: Health Environments Research & Design Journal, 10(1), 155-169.

KPS 76: Maben, J., Griffiths, P., Penfold, C., Simon, M., Anderson, J. E., Robert, G., ... & Barlow, J. (2016). One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. BMJ quality & safety, 25(4), 241-256.

KPS 77: Bonett, J. (2015). Ceiling art in a radiation therapy department: its effect on patient treatment experience. Journal of medical radiation sciences, 62(3), 192-197.

KPS 78: Cure, L., & Van Enk, R. (2015). Effect of hand sanitizer location on hand hygiene compliance. American journal of infection control, 43(9), 917-921.

KPS 79: Bengtsson, A., & Grahn, P. (2014). Outdoor environments in healthcare settings: A quality evaluation tool for use in designing healthcare gardens. Urban forestry & urban greening, 13(4), 878-891.

KPS 80: Pettit, N. R., Wood, T., Lieber, M., & O'mara, M. S. (2014). Intensive care unit design and mortality in trauma patients. Journal of Surgical Research, 190(2), 640-646.

KPS 81: Hor, S. Y., Iedema, R., & Manias, E. (2014). Creating spaces in intensive care for safe communication: a video-reflexive ethnographic study. BMJ Quality & Safety, 23(12), 1007-1013.

KPS 82: Cloutman-Green, E., Kalaycioglu, O., Wojani, H., Hartley, J. C., Guillas, S., Malone, D., ... & Klein, N. (2014). The important role of sink location in handwashing compliance and microbial sink contamination. American journal of infection control, 42(5), 554-555.

KPS 83: Hardin, S. R., Dienemann, J., Rudisill, P., & Mills, K. K. (2013). Inpatient Fall Prevention. Journal of patient safety, 9(1), 29-35.

KPS 84: Wagenfeld, A., Roy-Fisher, C., & Mitchell, C. (2013). Collaborative design: outdoor environments for veterans with PTSD. Facilities.

KPS 85: Curtis, S., Gesler, W., Wood, V., Spencer, I., Mason, J., Close, H., & Reilly, J. (2013). Compassionate containment? Balancing technical safety and therapy in the design of psychiatric wards. Social Science & Medicine, 97, 201-209.

KPS 86: Boog, M.C., Erasmus, V., de Gaaf, J.M., van Beeck, E.A.H.E., Melles, M, & van Beeck, E.F. (2013). Patients and their families weigh in on evidence-based hospital design. Critical Care Nurse, 32(1), e1-e10.

KPS 87: Cone, S. K., Short, S., & Gutcher, G. (2010). From "baby barn" to the "single family room designed NICU": a report of staff perceptions one year post occupancy. Newborn and Infant Nursing Reviews, 10(2), 97-103.

KPS 88: Leaf, D. E., Homel, P., & Factor, P. H. (2010). Relationship between ICU design and mortality. Chest, 137(5), 1022-1027.

KPS 89: Almquist, J. R., Kelly, C., Bromberg, J., Bryant, S. C., Christianson, T. J., & Montori, V. M. (2009). Consultation room design and the clinical encounter: the space and interaction randomized trial. HERD: Health Environments Research & Design Journal, 3(1), 41-78.

KPS 90: Andes, M., & Shattell, M. M. (2006). An exploration of the meanings of space and place in acute psychiatric care. Issues in Mental Health Nursing, 27(6), 699-707.

KPS 91: Pati, D., Lee, J., Mihandoust, S., Kazem-Zadeh, M., & Oh, Y. (2018). Top five physical design factors contributing to fall initiation. HERD: Health Environments Research & Design Journal, 11(4), 50-64.

KPS 92: Weerasuriya, R., Henderson-Wilson, C., & Townsend, M. (2019). Accessing green spaces within a healthcare setting: A mixed studies review of barriers and facilitators. HERD: Health Environments Research & Design Journal, 12(3), 119-140.

KPS 93: Colley, J., Zeeman, H., & Kendall, E. (2018). "Everything Happens in the Hallways": Exploring User Activity in the Corridors at Two Rehabilitation Units. HERD: Health Environments Research & Design Journal, 11(2), 163-176.

KPS 94: Zijlstra, E., Hagedoorn, M., Krijnen, W. P., van der Schans, C. P., & Mobach, M. P. (2016). Route complexity and simulated physical ageing negatively influence wayfinding. Applied ergonomics, 56, 62-67.

KPS 95: Rao, R. R. (2016). Ergonomical aspects of anaesthetic practice. Indian Journal of anaesthesia, 60(5), 306.

KPS 96: Pati, D., Pati, S., & Harvey Jr, T. E. (2016). Security implications of physical design attributes in the emergency department. HERD: Health Environments Research & Design Journal, 9(4), 50-63.

KPS 97: Farrehi, P. M., Nallamothu, B. K., & Navvab, M. (2016). Reducing hospital noise with sound acoustic panels and diffusion: a controlled study. BMJ quality & safety, 25(8), 644-646.

KPS 98: Burton, J. H., Young, J., & Bernier, C. A. (2014). The geriatric ED: structure, patient care, and considerations for the emergency department geriatric unit. International Journal of Gerontology, 8(2), 56-59.

KPS 99: Copeland, D., & Chambers, M. (2017). Effects of unit design on acute care nurses' walking distances, energy expenditure, and job satisfaction: A pre–post relocation study. HERD: Health Environments Research & Design Journal, 10(4), 22-36.

KPS 100: Gum, L. F., Prideaux, D., Sweet, L., & Greenhill, J. (2012). From the nurses' station to the health team hub: how can design promote interprofessional collaboration?. Journal of interprofessional care, 26(1), 21-27.

KPS 101: Parker, C., Barnes, S., McKee, K., Morgan, K., Torrington, J., & Tregenza, P. (2004). Quality of life and building design in residential and nursing homes for older people. Ageing & Society, 24(6), 941-962.

KPS 102: Gurses, A. P., Martinez, E. A., Bauer, L., Kim, G., Lubomski, L. H., Marsteller, J. A., ... & Thompson, D. (2012). Using human factors engineering to improve patient safety in the cardiovascular operating room. Work, 41(Supplement 1), 1801-1804.

KPS 103: Slatyer, S., Pienaar, C., Williams, A. M., Proctor, K., & Hewitt, L. (2015). Finding privacy from a public death: A qualitative exploration of how a dedicated space for end-of-life care in an acute hospital impacts on dying patients and their families. Journal of clinical nursing, 24(15-16), 2164-2174.

KPS 104: Trudel, C., Cobb, S., Momtahan, K., Brintnell, J., & Mitchell, A. (2018). Human factors considerations in designing for infection prevention and control in neonatal care–findings from a pre-design inquiry. Ergonomics, 61(1), 169-184.

KPS 105: Wallingford Jr, G., Joshi, N., Callagy, P., Stone, J., Brown, I., & Shen, S. (2018). Introduction of a horizontal and vertical split flow model of emergency department patients as a response to overcrowding. Journal of Emergency Nursing, 44(4), 345-352.

KPS 106: Crawford, K., Morphet, J., Jones, T., Innes, K., Griffiths, D., & Williams, A. (2014). Initiatives to reduce overcrowding and access block in Australian emergency departments: a literature review. Collegian, 21(4), 359-366.

KPS 107: Poulin, M. F., Appis, A., Purim-Shem-Tov, Y., Schaer, G. L., & Snell, J. (2015). Impact of a novel interventional platform and hospital design on the door-to-balloon time in patients presenting with ST-segment elevation myocardial infarction. Critical pathways in cardiology, 14(1), 39-43.

KPS 108: Loo, V. G. (2015). Environmental interventions to control Clostridium difficile. Infectious Disease Clinics, 29(1), 83-91.

KPS 109: Karpanen, T. J., Casey, A. L., Lambert, P. A., Cookson, B. D., Nightingale, P., Miruszenko, L., & Elliott, T. S. (2012). The antimicrobial efficacy of copper alloy furnishing in the clinical environment: a crossover study. Infection Control & Hospital Epidemiology, 33(1), 3-9.

KPS 110: Teltsch, D. Y., Hanley, J., Loo, V., Goldberg, P., Gursahaney, A., & Buckeridge, D. L. (2011). Infection acquisition following intensive care unit room privatization. Archives of internal medicine, 171(1), 32-38.

KPS 111: Alzoubi, H. H., & Al-Rqaibat, S. M. (2015). The effect of hospital design on indoor daylight quality in children section in King Abdullah University Hospital, Jordan. Sustainable Cities and Society, 14, 449-455.

KPS 112: Campos-Andrade, C., Hernández-Fernaud, E., & Lima, M. L. (2013). A better physical environment in the workplace means higher well-being? A study with healthcare professionals. Psyecology, 4(1), 89-110.

KPS 113: Zamani, Z., & Harper, E. C. (2019). Exploring the effects of clinical exam room design on communication, technology interaction, and satisfaction. HERD: Health Environments Research & Design Journal, 12(4), 99-115.

KPS 114: Sundberg, F., Olausson, S., Fridh, I., & Lindahl, B. (2017). Nursing staff's experiences of working in an evidence-based designed ICU patient room—An interview study. Intensive and Critical Care Nursing, 43, 75-80.

KPS 115: Shepley, M. M., Rybkowski, Z., Aliber, J., & Lange, C. (2012). Ambulatory infusion suite: pre-and post-occupancy evaluation. Building Research & Information, 40(6), 700-712.

KPS 116: Verceles, A. C., Liu, X., Terrin, M. L., Scharf, S. M., Shanholtz, C., Harris, A., ... & Netzer, G. (2013). Ambient light levels and critical care outcomes. Journal of critical care, 28(1), 110-e1.

KPS 117: Engineer, A., Sternberg, E. M., & Najafi, B. (2018). Designing interiors to mitigate physical and cognitive deficits related to aging and to promote longevity in older adults: a review. Gerontology, 64(6), 612-622.

KPS 118: Garrett, J. S., Berry, C., Wong, H., Qin, H., & Kline, J. A. (2018). The effect of vertical split-flow patient management on emergency department throughput and efficiency. The American Journal of Emergency Medicine, 36(9), 1581-1584.

KPS 119: Fay, L., Carll-White, A., & Real, K. (2018). Emergency nurses' perceptions of efficiency and design: Examining ED structure, process, and outcomes. Journal of emergency nursing, 44(3), 274-279.

KPS 120: Quan, X., Joseph, A., Nanda, U., Moyano-Smith, O., Kanakri, S., Ancheta, C., & Loveless, E. A. (2016). Improving pediatric radiography patient stress, mood, and parental satisfaction through positive environmental distractions: A randomized control trial. Journal of pediatric nursing, 31(1), e11-e22.

KPS 121: Campion, N., Thiel, C. L., Focareta, J., & Bilec, M. M. (2016). Understanding green building design and healthcare outcomes: Evidence-based design analysis of an oncology unit. Journal of Architectural Engineering, 22(3), 04016009.

KPS 122: Csipke, E., Papoulias, C., Vitoratou, S., Williams, P., Rose, D., & Wykes, T. (2016). Design in mind: eliciting service user and frontline staff perspectives on psychiatric ward design through participatory methods. Journal of Mental Health, 25(2), 114-121.

KPS 123: Smith, I. (2016). The participative design of an endoscopy facility using lean 3p. BMJ Open Quality, 5(1), u208920-w3611.

KPS 124: Siddiqui, Z. K., Zuccarelli, R., Durkin, N., Wu, A. W., & Brotman, D. J. (2015). Changes in patient satisfaction related to hospital renovation: experience with a new clinical building. Journal of hospital medicine, 10(3), 165-171.

KPS 125: Kane, M., Chui, K., Rimicci, J., Callagy, P., Hereford, J., Shen, S., ... & Pickham, D. (2015). Lean manufacturing improves emergency department throughput and patient satisfaction. The Journal Of Nursing Administration, 45(9), 429-434.

KPS 126: Djukic, M., Kovner, C. T., Brewer, C. S., Fatehi, F., & Greene, W. H. (2014). Exploring direct and indirect influences of physical work environment on job satisfaction for early-career registered nurses employed in hospitals. Research in nursing & health, 37(4), 312-325.

KPS 127: Jongerden, I. P., Slooter, A. J., Peelen, L. M., Wessels, H., Ram, C. M., Kesecioglu, J., ... & van Dijk, D. (2013). Effect of intensive care environment on family and patient satisfaction: a before–after study. Intensive care medicine, 39(9), 1626-1634.

KPS 128: Dianat, I., Sedghi, A., Bagherzade, J., Jafarabadi, M. A., & Stedmon, A. W. (2013). Objective and subjective assessments of lighting in a hospital setting: implications for health, safety and performance. Ergonomics, 56(10), 1535-1545.

KPS 129: Sheehan, B., Burton, E., Wood, S., Stride, C., Henderson, E., & Wearn, E. (2013). Evaluating the built environment in inpatient psychiatric wards. Psychiatric Services, 64(8), 789-795.

KPS 130: Quan, X., Joseph, A., & Ensign, J. C. (2012). Impact of imaging room environment: Staff job stress and satisfaction, patient satisfaction, and willingness to recommend. HERD: Health Environments Research & Design Journal, 5(2), 61-79.

KPS 131: Kotzer, A. M., Zacharakis, S. K., Raynolds, M., & Buenning, F. (2011). Evaluation of the built environment: staff and family satisfaction pre-and post-occupancy of the Children's Hospital. HERD: Health Environments Research & Design Journal, 4(4), 60-78.

KPS 132: Short, A. E., Ahern, N., Holdgate, A., Morris, J., & Sidhu, B. (2010). Using music to reduce noise stress for patients in the emergency department: a pilot study. Music and Medicine, 2(4), 201-207.

KPS 133: Cruise, C. J., Chung, F., Yogendran, S., & Little, D. A. (1997). Music increases satisfaction in elderly outpatients undergoing cataract surgery. Canadian Journal of Anaesthesia, 44(1), 43-48.

KPS 134: Cartland, J., Ruch-Ross, H. S., Carr, L., Hall, A., Olsen, R., Rosendale, E., & Ruohonen, S. (2018). The role of hospital design in reducing anxiety for pediatric patients. HERD: Health Environments Research & Design Journal, 11(3), 66-79.

KPS 135: Munch, M., Schmieder, M., Bieler, K., Goldbach, R., Fuhrmann, T., Zumstein, N., ... & Cajochen, C. (2017). Bright light delights: Effects of daily light exposure on emotions, restactivity cycles, sleep and melatonin secretion in severely demented patients. Current Alzheimer Research, 14(10), 1063-1075.

KPS 136: Wahnschaffe, A., Nowozin, C., Haedel, S., Rath, A., Appelhof, S., Münch, M., & Kunz, D. (2017). Implementation of dynamic lighting in a nursing home: impact on agitation but not on rest-activity patterns. Current Alzheimer Research, 14(10), 1076-1083.

KPS 137: Short, E. J., Reay, S., & Gilderdale, P. (2017). Wayfinding for health seeking: Exploring how hospital wayfinding can employ communication design to improve the outpatient experience. The Design Journal, 20(sup1), S2551-S2568.

KPS 138: Huber, C. G., Schneeberger, A. R., Kowalinski, E., Fröhlich, D., von Felten, S., Walter, M., ... & Lang, U. E. (2016). Suicide risk and absconding in psychiatric hospitals with and without open door policies: a 15 year, observational study. The Lancet Psychiatry, 3(9), 842-849.

KPS 139: Watts, G., Khan, A., & Pheasant, R. (2016). Influence of soundscape and interior design on anxiety and perceived tranquillity of patients in a healthcare setting. Applied Acoustics, 104, 135-141.

KPS 140: Engwall, M., Fridh, I., Johansson, L., Bergbom, I., & Lindahl, B. (2015). Lighting, sleep and circadian rhythm: An intervention study in the intensive care unit. Intensive and Critical Care Nursing, 31(6), 325-335.

KPS 141: Andrade, C. C., & Devlin, A. S. (2015). Stress reduction in the hospital room: Applying Ulrich's theory of supportive design. Journal of environmental psychology, 41, 125-134.

KPS 142: Jenkins, O., Dye, S., & Foy, C. (2015). A study of agitation, conflict and containment in association with change in ward physical environment. Journal of Psychiatric Intensive Care, 11(1), 27-35.

KPS 143: Mackrill, J., Jennings, P., & Cain, R. (2014). Exploring positive hospital ward soundscape interventions. Applied ergonomics, 45(6), 1454-1460.

KPS 144: Lin, B. Y. J., Lin, Y. K., Juan, C. W., Lee, S., & Lin, C. C. (2013). Moderating role of interior amenities on hospital medical directors' patient-related work stresses. HERD: Health Environments Research & Design Journal, 6(2), 77-92.

KPS 145: Goto, S., Park, B. J., Tsunetsugu, Y., Herrup, K., & Miyazaki, Y. (2013). The effect of garden designs on mood and heart output in older adults residing in an assisted living facility. HERD: Health Environments Research & Design Journal, 6(2), 27-42.

KPS 146: Vogel, W. V., Olmos, R. A. V., Tijs, T. J., Gillies, M. F., van Elswijk, G., & Vogt, J. (2012). Intervention to lower anxiety of 18F-FDG PET/CT patients by use of audiovisual imagery during the uptake phase before imaging. Journal of Nuclear Medicine Technology, 40(2), 92-98.

KPS 147: Nanda, U., Zhu, X., & Jansen, B. H. (2012). Image and emotion: from outcomes to brain behavior. HERD: Health Environments Research & Design Journal, 5(4), 40-59.

KPS 148: Nanda, U., Eisen, S., Zadeh, R. S., & Owen, D. (2011). Effect of visual art on patient anxiety and agitation in a mental health facility and implications for the business case. Journal of psychiatric and mental health nursing, 18(5), 386-393.

KPS 149: Pati, D., & Nanda, U. (2011). Influence of positive distractions on children in two clinic waiting areas. HERD: Health Environments Research & Design Journal, 4(3), 124-140.

KPS 150: Foureur, M., Davis, D., Fenwick, J., Leap, N., Iedema, R., Forbes, I., & Homer, C. S. (2010). The relationship between birth unit design and safe, satisfying birth: Developing a hypothetical model. Midwifery, 26(5), 520-525.

KPS 151: Gharaveis, A., & Kazem-Zadeh, M. (2018). The role of environmental design in cancer prevention, diagnosis, treatment, and survivorship: a systematic literature review. HERD: Health Environments Research & Design Journal, 11(4), 18-32.

KPS 152: Knight, S., & Singh, I. (2016). Profile of inpatient falls in patients with dementia: A prospective comparative study between 100% single rooms and traditional multibedded wards. Journal of Clinical Gerontology and Geriatrics, 7(3), 87-92

KPS 153: Edvardsson, D., Sandman, P. O., & Rasmussen, B. (2006). Caring or uncaring–meanings of being in an oncology environment. Journal of Advanced Nursing, 55(2), 188-197.

KPS 154: McLaughlan, R. (2018). Psychosocially supportive design: The case for greater attention to social space within the pediatric hospital. HERD: Health Environments Research & Design Journal, 11(2), 151-162.

KPS 155: Timmermann, C., Uhrenfeldt, L., & Birkelund, R. (2015). Room for caring: patients' experiences of well-being, relief and hope during serious illness. Scandinavian journal of caring sciences, 29(3), 426-434.

KPS 156: Iyendo, T. O. (2017). Sound as a supportive design intervention for improving health care experience in the clinical ecosystem: A qualitative study. Complementary therapies in clinical practice, 29, 58-96.

KPS 157: Brown, J., Fawzi, W., Shah, A., Joyce, M., Holt, G., McCarthy, C., ... & Solomon-Ayeh, K. (2016). Low stimulus environments: reducing noise levels in continuing care. BMJ Open Quality, 5(1), u207447-w4214.

KPS 158: Fakhry, M., Hanna, G. B., Anderson, O., Holmes, A., & Nathwani, D. (2012). Effectiveness of an audible reminder on hand hygiene adherence. American journal of infection control, 40(4), 320-323.

KPS 159: Johansson, L., Lindahl, B., Knutsson, S., Ögren, M., Waye, K. P., & Ringdal, M. (2018). Evaluation of a sound environment intervention in an ICU: a feasibility study. Australian Critical Care, 31(2), 59-70.

KPS 160: Jerlehag, C., Lee, P. J., Park, S. H., Jones, T., & Carroll, N. (2018). Acoustic environments of patient room in a typical geriatric ward. Applied Acoustics, 133, 186-193.

KPS 161: Pyrke, R. J., McKinnon, M. C., McNeely, H. E., Ahern, C., Langstaff, K. L., & Bieling, P. J. (2017). Evidence-based design features improve sleep quality among psychiatric inpatients. HERD: Health Environments Research & Design Journal, 10(5), 52-63.

KPS 162: McNeer, R. R., Bennett, C. L., Horn, D. B., & Dudaryk, R. (2017). Factors affecting acoustics and speech intelligibility in the operating room: size matters. Anesthesia and analgesia, 124(6), 1978

KPS 163: Sato, H., Morimoto, M., Ohtani, S., Hoshino, Y., & Sato, H. (2017). Subjective evaluation of speech privacy at consulting rooms in hospitals: Relationship between feeling evoked by overhearing speech and word intelligibility score. Applied Acoustics, 124, 38-47.

KPS 164: Zhang, M., Zhang, X., Chen, F., Dong, B., Chen, A., & Zheng, D. (2017). Effects of room environment and nursing experience on clinical blood pressure measurement: an observational study. Blood pressure monitoring, 22(2), 79-85

KPS 165: Ramm, K., Mannix, T., Parry, Y., & Gaffney, M. P. (2017). A comparison of sound levels in open plan versus pods in a neonatal intensive care unit. HERD: Health Environments Research & Design Journal, 10(3), 30-39.

KPS 166: Boyko, Y., Jennum, P., Nikolic, M., Holst, R., Oerding, H., & Toft, P. (2017). Sleep in intensive care unit: the role of environment. Journal of critical care, 37, 99-105.

KPS 167: Pope, D. S., & Miller-Klein, E. T. (2016). Acoustic assessment of speech privacy curtains in two nursing units. Noise & health, 18(80), 26.

KPS 168: DuBose, J. R., & Hadi, K. (2016). Improving inpatient environments to support patient sleep. International Journal for Quality in Health Care, 28(5), 540-553.

KPS 169: Park, M., Kohlrausch, A., de Bruijn, W., de Jager, P., & Simons, K. (2014). Analysis of the soundscape in an intensive care unit based on the annotation of an audio recording. The Journal of the Acoustical Society of America, 135(4), 1875-1886.

KPS 170: Chen, H. L., Chen, C. H., Wu, C. C., Huang, H. J., Wang, T. M., & Hsu, C. C. (2009). The influence of neonatal intensive care unit design on sound level. Pediatrics & Neonatology, 50(6), 270-274.

KPS 171: Aries, M. B., Aarts, M. P., & van Hoof, J. (2015). Daylight and health: A review of the evidence and consequences for the built environment. Lighting Research & Technology, 47(1), 6-27.

KPS 172: Ramos, T., Dedesko, S., Siegel, J. A., Gilbert, J. A., & Stephens, B. (2015). Spatial and temporal variations in indoor environmental conditions, human occupancy, and operational characteristics in a new hospital building. PLoS One, 10(3), e0118207.

KPS 173: Wahnschaffe, A., Nowozin, C., Rath, A., Floessner, T., Appelhoff, S., Münch, M., & Kunz, D. (2017). Night-time activity forecast by season and weather in a longitudinal design–natural light effects on three years' rest-activity cycles in nursing home residents with dementia. International Psychogeriatrics, 29(12), 2071-2080

KPS 174: Chaudhury, H., Cooke, H. A., Cowie, H., & Razaghi, L. (2018). The influence of the physical environment on residents with dementia in long-term care settings: A review of the empirical literature. The Gerontologist, 58(5), e325-e337.

KPS 175: Chiu, W. C., Chang, P. S., Hsieh, C. F., Chao, C. M., & Lai, C. C. (2018). The impact of windows on the outcomes of medical intensive care unit patients. International Journal of Gerontology, 12(1), 67-70.

KPS 176: Ferri, M., Zygun, D. A., Harrison, A., & Stelfox, H. T. (2015). Evidence-based design in an intensive care unit: End-user perceptions. BMC anesthesiology, 15(1), 1-9

KPS 177: Moatari-Kazerouni, A., Chinniah, Y., & Agard, B. (2015). Integration of occupational health and safety in the facility layout planning, part II: design of the kitchen of a hospital. International journal of production research, 53(11), 3228-3242.

KPS 178: Sadrizadeh, S., Tammelin, A., Nielsen, P. V., & Holmberg, S. (2014). Does a mobile laminar airflow screen reduce bacterial contamination in the operating room? A numerical study using computational fluid dynamics technique. Patient Safety in Surgery, 8(1), 1-6.

KPS 179: Yi, L., & Seo, H. B. (2012). The effect of hospital unit layout on nurse walking behavior. HERD: Health Environments Research & Design Journal, 6(1), 66-82.

KPS 180: Hota, S., Hirji, Z., Stockton, K., Lemieux, C., Dedier, H., Wolfaardt, G., & Gardam, M. A. (2009). Outbreak of multidrug-resistant Pseudomonas aeruginosa colonization and infection secondary to imperfect intensive care unit room design. Infection Control & Hospital Epidemiology, 30(1), 25-33.

KPS 181: Gurascio-Howard, L., & Malloch, K. (2007). Centralized and decentralized nurse station design: An examination of caregiver communication, work activities, and technology. HERD: Health Environments Research & Design Journal, 1(1), 44-57.

KPS 182: Lippert, S. (1971). Travel in nursing units. Human factors, 13(3), 269-282.

KPS 183: Thompson, T. S., & Heflin, L. (2011). Lactation space design: supporting evidence-based practice and the baby-friendly hospital initiative. HERD: Health Environments Research & Design Journal, 4(3), 101-109.

KPS 184: Kembel, S. W., Meadow, J. F., O'Connor, T. K., Mhuireach, G., Northcutt, D., Kline, J., ... & Green, J. L. (2014). Architectural design drives the biogeography of indoor bacterial communities. PloS one, 9(1), e87093.

KPS 185: Mousavi, E. S., & Grosskopf, K. R. (2016). Secondary exposure risks to patients in an airborne isolation room: Implications for anteroom design. Building and Environment, 104, 131-137.

KPS 186: Chen, Y. C., Lin, C. F., Rehn, Y. J. F., Chen, J. C., Chen, P. Y., Chen, C. H., ... & Huang, F. L. (2017). Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period. Journal of the Chinese Medical Association, 80(7), 427-431

KPS 187: Taaffe, K., Lee, B., Ferrand, Y., Fredendall, L., San, D., Salgado, C., ... & Reeves, S. (2018). The influence of traffic, area location, and other factors on operating room microbial load. infection control & hospital epidemiology, 39(4), 391-397.

KPS 188: Huesca-Espitia, L. D. C., Aslanzadeh, J., Feinn, R., Joseph, G., Murray, T. S., & Setlow, P. (2018). Deposition of bacteria and bacterial spores by bathroom hot-air hand dryers. Applied and Environmental Microbiology, 84(8), e00044-18.

KPS 189: Plamann, J. M., Zedreck-Gonzalez, J., & Fennimore, L. (2018). Creation of an Adult Observation Unit. Journal of Nursing Care Quality, 33(1), 72-78.

KPS 190: Hignett, S., & Lu, J. (2010). Space to care and treat safely in acute hospitals: recommendations from 1866 to 2008. Applied ergonomics, 41(5), 666-673.

KPS 191: Singh, S., Fletcher, K. E., Pandl, G. J., Schapira, M. M., Nattinger, A. B., Biblo, L. A., & Whittle, J. (2011). It's the writing on the wall: whiteboards improve inpatient satisfaction with provider communication. American Journal of Medical Quality, 26(2), 127-131.

KPS 192: Birnbach, D. J., Nevo, I., Barnes, S., Fitzpatrick, M., Rosen, L. F., Everett-Thomas, R., ... & Arheart, K. L. (2012). Do hospital visitors wash their hands? Assessing the use of alcohol-based hand sanitizer in a hospital lobby. American journal of infection control, 40(4), 340-343.

KPS 193: King, M. F., Noakes, C. J., & Sleigh, P. A. (2015). Modeling environmental contamination in hospital single-and four-bed rooms. Indoor Air, 25(6), 694-707.

KPS 194: VanSteelandt, A., Conly, J., Ghali, W., & Mather, C. (2015). Implications of design on infection prevention and control practice in a novel hospital unit: the Medical Ward of the 21st Century. Anthropology & medicine, 22(2), 149-161

KPS 195: Carter, E. J., Wyer, P., Giglio, J., Jia, H., Nelson, G., Kauari, V. E., & Larson, E. L. (2016). Environmental factors and their association with emergency department hand hygiene compliance: an observational study. BMJ quality & safety, 25(5), 372-378.

KPS 196: Neo, J. R. J., & Sagha-Zadeh, R. (2017). The influence of spatial configuration on the frequency of use of hand sanitizing stations in health care environments. American journal of infection control, 45(6), 615-619.

KPS 197: Bayramzadeh, S., Portillo, M., & Carmel-Gilfilen, C. (2019). Understanding design vulnerabilities in the physical environment relating to patient fall patterns in a psychiatric hospital: seven years of sentinel events. Journal of the American Psychiatric Nurses Association, 25(2), 134-145.

KPS 198: Tzeng, H. M. (2011). Triangulating the extrinsic risk factors for inpatient falls from the fall incident reports and nurse's and patient's perspectives. Applied Nursing Research, 24(3), 161-170.

KPS 199: Wahr, J. A., Prager, R. L., Abernathy Iii, J. H., Martinez, E. A., Salas, E., Seifert, P. C., ... & Nussmeier, N. A. (2013). Patient safety in the cardiac operating room: human factors and teamwork: a scientific statement from the American Heart Association. Circulation, 128(10), 1139-1169.

KPS 200: Hammond, A., Foureur, M., & Homer, C. S. (2014). The hardware and software implications of hospital birth room design: A midwifery perspective. Midwifery, 30(7), 825-830.

KPS 201: Harris, D. D. (2014). Return on Investment of a LEED platinum hospital: the influence of healthcare facility environments on healthcare employees and organizational effectiveness. Journal of Hospital Administration, 3(6), 37.

KPS 202: Iddon, C. R., Mills, T. C., Giridharan, R., & Lomas, K. J. (2015). The influence of hospital ward design on resilience to heat waves: an exploration using distributed lag models. Energy and Buildings, 86, 573-588.

KPS 203: Rismanchian, F., & Lee, Y. H. (2017). Process mining–based method of designing and optimizing the layouts of emergency departments in hospitals. HERD: Health Environments Research & Design Journal, 10(4), 105-120.

KPS 204: Coppin, J. D., Villamaria, F. C., Williams, M. D., Copeland, L. A., Zeber, J. E., & Jinadatha, C. (2017). Self-sanitizing copper-impregnated surfaces for bioburden reduction in patient rooms. American journal of infection control, 45(6), 692-694.

KPS 205: Patel, M. R., Vichich, J., Lang, I., Lin, J., & Zheng, K. (2017). Developing an evidence base of best practices for integrating computerized systems into the exam room: a systematic review. Journal of the American Medical Informatics Association, 24(e1), e207-e215.

KPS 206: Benitez, G. B., Fogliatto, F. S., Cardoso, R. B., Torres, F. S., Faccin, C. S., & Dora, J. M. (2018). Systematic layout planning of a radiology reporting area to optimize radiologists' performance. Journal of digital imaging, 31(2), 193-200.

KPS 207: Mobley, C., Leigh, K., & Malinin, L. (2017). Examining relationships between physical environments and behaviors of residents with dementia in a retrofit special care unit. Journal of Interior Design, 42(2), 49-69.

KPS 208: Tao, Y., Gou, Z., Lau, S. S. Y., Lu, Y., & Fu, J. (2018). Legibility of floor plans and wayfinding satisfaction of residents in Care and Attention homes in Hong Kong. Australasian journal on ageing, 37(4), E139-E143.

KPS 209: Haywood, A., Barnes, S., Marsh, H., & Parker, S. G. (2018). Does the design of settings where acute care is delivered meet the needs of older people? Perspectives of patients, family carers, and staff. HERD: Health Environments Research & Design Journal, 11(2), 177-188.

KPS 210: Denham, M. E., Bushehri, Y., & Lim, L. (2018). Through the eyes of the user: evaluating neonatal intensive care unit design. HERD: Health Environments Research & Design Journal, 11(3), 49-65.

KPS 211: Zhang, Y., Soroken, L., Laccetti, M., De Castillero, E. R., & Konadu, A. (2015). Centralized to hybrid nurse station: Communication and teamwork among nursing staff. Journal of Nursing Education and Practice, 5(12), 34.

KPS 212: Stackelroth, J., Sinnott, M., & Shaban, R. Z. (2015). Hesitation and error: Does product placement in an emergency department influence hand hygiene performance?. American journal of infection control, 43(9), 913-916.

KPS 213: Şimşek, E. M., Grassie, S. S., Emre, C., & GEVREK, S. Ç. (2017). Relationship between environmental conditions and nosocomial infection rates in intensive care unit. Medical Journal of Islamic World Academy of Sciences, 25(1), 15-18.

KPS 214: Pati, D., Valipoor, S., Cloutier, A., Yang, J., Freier, P., Harvey, T. E., & Lee, J. (2021). Physical design factors contributing to patient falls. Journal of patient safety, 17(3), e135-e142.

KPS 215: Gilkeson, C. A., Camargo-Valero, M. A., Pickin, L. E., & Noakes, C. J. (2013). Measurement of ventilation and airborne infection risk in large naturally ventilated hospital wards. Building and environment, 65, 35-48.

KPS 216: Figueiro, M. G., Sahin, L., Wood, B., & Plitnick, B. (2016). Light at night and measures of alertness and performance: implications for shift workers. Biological research for nursing, 18(1), 90-100.

KPS 217: Maleetipwan-Mattsson, P., Laike, T., & Johansson, M. (2016). Factors affecting optimal lighting use in shared hospital environments: A case-study. Building and Environment, 96, 260-269.

KPS 218: Redd, W. H., Valdimarsdottir, H., Wu, L., Winkel, G., Byrne, E. E., Beltre, M. A., ... & Ancoli-Israel, S. (2014). Systematic light exposure in the treatment of cancer-related fatigue: a preliminary study. Psycho-oncology, 23(12), 1431.

KPS 219: Smith, M. R., & Eastman, C. I. (2012). Shift work: health, performance and safety problems, traditional countermeasures, and innovative management strategies to reduce circadian misalignment. Nature and science of sleep, 4, 111.

KPS 220: Sadatsafavi, H., Niknejad, B., Zadeh, R., & Sadatsafavi, M. (2016). Do cost savings from reductions in nosocomial infections justify additional costs of single-bed rooms in intensive care units? A simulation case study. Journal of critical care, 31(1), 194-200.

KPS 221: Chrysikou, E. (2013). Accessibility for mental healthcare. Facilities. 31(9/10), 418-426.

KPS 222: Gimelli, A., Muccillo, M., & Sannino, R. (2017). Optimal design of modular cogeneration plants for hospital facilities and robustness evaluation of the results. Energy Conversion and Management, 134, 20-31.

KPS 223: Cammarano, S., Pellegrino, A., Lo Verso, V. R. M., & Aghemo, C. (2015). Assessment of daylight in rooms with different architectural features. Building Research & Information, 43(2), 222-237.

KPS 224: Schmidt, M. G., von Dessauer, B., Benavente, C., Benadof, D., Cifuentes, P., Elgueta, A., ... & Navarrete, M. S. (2016). Copper surfaces are associated with significantly lower concentrations of bacteria on selected surfaces within a pediatric intensive care unit. American journal of infection control, 44(2), 203-209.

KPS 225: Morales, E., Gamache, S., Routhier, F., Rousseau, J., & Doyle, O. (2018). Pilot study to measure wheelchair users' space requirements in the bathroom. Journal of Enabling Technologies.

KPS 226: Poon, E. G., Cina, J. L., Churchill, W., Patel, N., Featherstone, E., Rothschild, J. M., ... & Gandhi, T. K. (2006). Medication dispensing errors and potential adverse drug events before and after implementing bar code technology in the pharmacy. Annals of internal medicine, 145(6), 426-434.

KPS 227: Sandal, L. F., Thorlund, J. B., Moore, A. J., Ulrich, R. S., Dieppe, P. A., & Roos, E. M. (2017). Room for improvement: a randomised controlled trial with nested qualitative interviews on space, place and treatment delivery. British Journal of Sports Medicine, 53(6), 359-367.

KPS 228: Merchant, S., O'Connor, M., & Halkett, G. (2015). Time, space and technology in radiotherapy departments: how do these factors impact on patients' experiences of radiotherapy?. European journal of cancer care, 26(2), e12354.

KPS 229: White, B. A., Chang, Y., Grabowski, B. G., & Brown, D. F. (2014). Using lean-based systems engineering to increase capacity in the emergency department. Western Journal of Emergency Medicine, 15(7), 770.

KPS 230: Hicks, C., McGovern, T., Prior, G., & Smith, I. (2015). Applying lean principles to the design of healthcare facilities. International Journal of Production Economics, 170, 677-686.

KPS 231: Nijman, H., Bowers, L., Haglund, K., MUIR-COCHRANE, E., Simpson, A., & Van der Merwe, M. (2011). Door locking and exit security measures on acute psychiatric admission wards. Journal of Psychiatric and Mental Health Nursing, 18(7), 614-621.

KPS 232: Wang, Z., & Pukszta, M. (2017). Patient needs and environments for cancer infusion treatment. Journal of Interior Design, 42(2), 13-25.

KPS 233: Bukh, G., Tommerup, A. M. M., & Madsen, O. R. (2015). Impact of healthcare design on patients' perception of a rheumatology outpatient infusion room: an interventional pilot study. Clinical rheumatology, 34(7), 1249-1254.

KPS 234: Ono, H., Taguchi, T., Kido, Y., Fujino, Y., & Doki, Y. (2011). The usefulness of bright light therapy for patients after oesophagectomy. Intensive and Critical Care Nursing, 27(3), 158-166.

KPS 235: Shepley, M. M., Watson, A., Pitts, F., Garrity, A., Spelman, E., Fronsman, A., & Kelkar, J. (2017). Mental and behavioral health settings: Importance & effectiveness of environmental qualities & features as perceived by staff. Journal of Environmental Psychology, 50, 37-50.

KPS 236: Bayramzadeh, S. (2017). An assessment of levels of safety in psychiatric units. HERD: Health Environments Research & Design Journal, 10(2), 66-80.

KPS 237: Barnes, S. (2006). Space, choice and control, and quality of life in care settings for older people. Environment and behavior, 38(5), 589-604.

KPS 238: Islam, F., & Rashid, M. (2018). Evaluating Nurses' Perception of Patient Safety Design Features in Intensive Care Units. Critical Care Nursing Quarterly, 41(1), 10-28.

KPS 239: Shi, Z., Qian, H., Zheng, X., Lv, Z., Li, Y., Liu, L., & Nielsen, P. V. (2018). Seasonal variation of window opening behaviors in two naturally ventilated hospital wards. Building and Environment, 130, 85-93.

KPS 240: Becher, R., Øvrevik, J., Schwarze, P. E., Nilsen, S., Hongslo, J. K., & Bakke, J. V. (2018). Do carpets impair indoor air quality and cause adverse health outcomes: A review. International journal of environmental research and public health, 15(2), 184.

KPS 241: Perez, P., Holloway, J., Ehrenfeld, L., Cohen, S., Cunningham, L., Miley, G. B., & Hollenbeck, B. L. (2018). Door openings in the operating room are associated with increased environmental contamination. American journal of infection control, 46(8), 954-956.

KPS 242: O'Neill, L., Park, S. H., & Rosinia, F. (2018). The role of the built environment and private rooms for reducing central line-associated bloodstream infections. Plos one, 13(7), e0201002.

KPS 243: Parkes, L. O., & Hota, S. S. (2018). Sink-related outbreaks and mitigation strategies in healthcare facilities. Current Infectious Disease Reports, 20(10), 1-14.

KPS 244: Lygum, V. L., Poulsen, D. V., Djernis, D., Djernis, H. G., Sidenius, U., & Stigsdotter, U. K. (2019). Post-occupancy evaluation of a crisis shelter garden and application of findings through the use of a participatory design process. HERD: Health Environments Research & Design Journal, 12(3), 153-167.

KPS 245: Kelly, R., Brown, D., McCance, T., & Boomer, C. (2018). The experience of person-centred practice in a 100% single-room environment in acute care settings—A narrative literature review. Journal of Clinical Nursing, 28(13-14), 2369-2385.

KPS 246: Acosta, I., Leslie, R. P., & Figueiro, M. G. (2015). Analysis of circadian stimulus allowed by daylighting in hospital rooms. Lighting research & technology, 49(1), 49-61.

KPS 247: Lachance, C. C., Jurkowski, M. P., Dymarz, A. C., Robinovitch, S. N., Feldman, F., Laing, A. C., & Mackey, D. C. (2017). Compliant flooring to prevent fall-related injuries in older adults: A scoping review of biomechanical efficacy, clinical effectiveness, cost-effectiveness, and workplace safety. PLoS one, 12(2), e0171652.

KPS 248: Kalantari, S., & Snell, R. (2017). Post-occupancy evaluation of a mental healthcare facility based on staff perceptions of design innovations. HERD: Health Environments Research & Design Journal, 10(4), 121-135.

KPS 249: Weinberger, N., Butler, A. G., McGee, B., Schumacher, P. A., & Brown, R. L. (2017). Child life specialists' evaluation of hospital playroom design: A mixed method inquiry. Journal of Interior Design, 42(2), 71-91.

KPS 250: Giménez, M. C., Geerdinck, L. M., Versteylen, M., Leffers, P., Meekes, G. J., Herremans, H., ... & Schlangen, L. J. (2017). Patient room lighting influences on sleep, appraisal and mood in hospitalized people. Journal of sleep research, 26(2), 236-246.

KPS 251: Souli, M., Antoniadou, A., Katsarolis, I., Mavrou, I., Paramythiotou, E., Papadomichelakis, E., ... & Armaganidis, A. (2017). Reduction of environmental contamination with multidrug-resistant bacteria by copper-alloy coating of surfaces in a highly endemic setting. infection control & hospital epidemiology, 38(7), 765-771.

KPS 252: Reeve, A., Nieberler-Walker, K., & Desha, C. (2017). Healing gardens in children's hospitals: Reflections on benefits, preferences and design from visitors' books. Urban forestry & urban greening, 26, 48-56.

KPS 253: Gormley, T., Markel, T. A., Jones III, H. W., Wagner, J., Greeley, D., Clarke, J. H., ... & Ostojic, J. (2017). Methodology for analyzing environmental quality indicators in a dynamic operating room environment. American Journal of Infection Control, 45(4), 354-359.

KPS 254: Đukanović, Z., Marić, J., & Giofrè, F. (2017). Evaluation of hospital outdoor spaces through users' participation analysis. Facta Universitatis, Series: Architecture and Civil Engineering, 15(1), 73-84.

KPS 255: Anåker, A., von Koch, L., Sjöstrand, C., Bernhardt, J., & Elf, M. (2017). A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction—The significance of the built environment. PLoS One, 12(7), e0177477.

KPS 256: Wessman, B. T., Sona, C., & Schallom, M. (2017). A novel ICU Hand-Over tool: the glass door of the patient room. Journal of Intensive Care Medicine, 32(8), 514-519.

KPS 257: Halaby, T., Al Naiemi, N., Beishuizen, B., Verkooijen, R., Ferreira, J. A., & Klont, R. (2017). Impact of single room design on the spread of multi-drug resistant bacteria in an intensive care unit. Antimicrobial Resistance & Infection Control, 6(1), 1-10.

KPS 258: Real, K., Bardach, S. H., & Bardach, D. R. (2017). The role of the built environment: How decentralized nurse stations shape communication, patient care processes, and patient outcomes. Health communication, 32(12), 1557-1570.

KPS 259: Rehn, J., & Schuster, K. (2017). Clinic design as placebo—using design to promote healing and support treatments. Behavioral Sciences, 7(4), 77.

KPS 260: Sidenius, U., Karlsson Nyed, P., Linn Lygum, V., & K Stigsdotter, U. (2017). A diagnostic post-occupancy evaluation of the Nacadia® therapy garden. International Journal of Environmental Research and Public Health, 14(8), 882.

KPS 261: Pilmis, B., Thepot-Seegers, V., Angebault, C., Weiss, E., Alaabouche, I., Bougnoux, M. E., & Zahar, J. R. (2017). Could we predict airborne Aspergillus contamination during construction work?. American Journal of Infection Control, 45(1), 39-41.

KPS 262: Mazur, L. M., Johnson, K., Pooya, P., Chadwick, J., & McCreery, J. (2017). Integrating lean exploration loops into healthcare facility design: programming phase. HERD: Health Environments Research & Design Journal, 10(3), 116-130.

KPS 263: Curtis, P., & Northcott, A. (2016). The impact of single and shared rooms on family-centred care in children's hospitals. Journal of Clinical Nursing, 26(11-12), 1584-1596.

KPS 264: Alsved, M., Civilis, A., Ekolind, P., Tammelin, A., Andersson, A. E., Jakobsson, J., ... & Löndahl, J. (2017). Temperature-controlled airflow ventilation in operating rooms compared with laminar airflow and turbulent mixed airflow. Journal of Hospital Infection, 98(2), 181-190.

KPS 265: Lax, S., Smith, D., Sangwan, N., Handley, K., Larsen, P., Richardson, M., ... & Gilbert, J. A. (2017). Colonization and succession of hospital-associated microbiota. Science translational medicine, 9(391).

KPS 266: Parvizi, J., Barnes, S., Shohat, N., & Edmiston Jr, C. E. (2017). Environment of care: Is it time to reassess microbial contamination of the operating room air as a risk factor for surgical site infection in total joint arthroplasty?. American journal of infection control, 45(11), 1267-1272.

KPS 267: Maben, J., Simon, M., Murrells, T., & Griffiths, P. (2016). Is single room hospital accommodation associated with differences in healthcare-associated infection, falls, pressure ulcers or medication errors? A natural experiment with non-equivalent controls. Journal of health services research & policy, 21(3), 147-155.

KPS 268: Hobbs, M. A., Robinson, S., Neyens, D. M., & Steed, C. (2016). Visitor characteristics and alcohol-based hand sanitizer dispenser locations at the hospital entrance: Effect on visitor use rates. American Journal of Infection Control, 44(3), 258-262.

KPS 269: Garibaldi, B. T., Kelen, G. D., Brower, R. G., Bova, G., Ernst, N., Reimers, M., ... & Maragakis, L. L. (2016). The creation of a biocontainment unit at a tertiary care hospital. The Johns Hopkins medicine experience. Annals of the American Thoracic Society, 13(5), 600-608.

KPS 270: Devlin, A. S., Andrade, C. C., & Carvalho, D. (2016). Qualities of inpatient hospital rooms: patients' perspectives. HERD: Health Environments Research & Design Journal, 9(3), 190-211.

KPS 271: Sherif, A., Sabry, H., Wagdy, A., Mashaly, I., & Arafa, R. (2016). Shaping the slats of hospital patient room window blinds for daylighting and external view under desert clear skies. Solar Energy, 133, 1-13.

KPS 272: Rashidi, B., Li, A., Patel, R., Harmsen, I. E., Sabri, E., Kyeremanteng, K., & D'Egidio, G. (2016). Effectiveness of an extended period of flashing lights and strategic signage to increase the salience of alcohol-gel dispensers for improving hand hygiene compliance. American Journal of Infection Control, 44(7), 782-785.

KPS 273: Sadatsafavi, H., & Shepley, M. M. (2016). Performance evaluation of 32 LEED hospitals on operation costs. Procedia Engineering, 145, 1234-1241.

KPS 274: Golbazi, M., & Aktas, C. B. (2016). Analysis of credits earned by LEED healthcare certified facilities. Procedia Engineering, 145, 203-210.

KPS 275: Shepley, M. M., Watson, A., Pitts, F., Garrity, A., Spelman, E., Kelkar, J., & Fronsman, A. (2016). Mental and behavioral health environments: critical considerations for facility design. General Hospital Psychiatry, 42, 15-21.

KPS 276: Loomans, M. G. L. C., De Visser, I. M., Loogman, J. G. H., & Kort, H. S. (2016). Alternative ventilation system for operating theaters: Parameter study and full-scale assessment of the performance of a local ventilation system. Building and Environment, 102, 26-38.

KPS 277: Kalliomäki, P., Saarinen, P., Tang, J. W., & Koskela, H. (2016). Airflow patterns through single hinged and sliding doors in hospital isolation rooms–Effect of ventilation, flow differential and passage. Building and Environment, 107, 154-168.

KPS 278: Motzek, T., Bueter, K., & Marquardt, G. (2016). Investigation of eligible picture categories for use as environmental cues in dementia-sensitive environments. HERD: Health Environments Research & Design Journal, 10(4), 64-73.

KPS 279: Lu, Y., Cai, H., & Bosch, S. J. (2016). Key spatial factors influencing the perceived privacy in nursing units: An exploration study with eight nursing units in Hong Kong. HERD: Health Environments Research & Design Journal, 10(4), 37-48.

KPS 280: Er, C. Y., & Shukor, S. F. A. (2016). Healing gardens for the elderly: a review of design guidelines and the comparisons with the existing senior outdoor survey (sos) tool. Alam Cipta, 9(2), 19-25.

KPS 281: Keys, Y., Silverman, S. R., & Evans, J. (2016). Identification of tools and techniques to enhance interdisciplinary collaboration during design and construction projects. HERD: Health Environments Research & Design Journal, 10(5), 28-38.

KPS 282: Bivolarova, M. P., Melikov, A. K., Mizutani, C., Kajiwara, K., & Bolashikov, Z. D. (2016). Bed-integrated local exhaust ventilation system combined with local air cleaning for improved IAQ in hospital patient rooms. Building and Environment, 100, 10-18.

KPS 283: Knauert, M., Jeon, S., Murphy, T. E., Yaggi, H. K., Pisani, M. A., & Redeker, N. S. (2016). Comparing average levels and peak occurrence of overnight sound in the medical intensive care unit on A-weighted and C-weighted decibel scales. Journal of critical care, 36, 1-7.

KPS 284: Alharbi, S. A., Salmen, S. H., Chinnathambi, A., Alharbi, N. S., Zayed, M. E., Al-Johny, B. O., & Wainwright, M. (2016). Assessment of the bacterial contamination of hand air dryer in washrooms. Saudi journal of biological sciences, 23(2), 268-271.

KPS 285: Sifri, C. D., Burke, G. H., & Enfield, K. B. (2016). Reduced health care-associated infections in an acute care community hospital using a combination of self-disinfecting copper-impregnated composite hard surfaces and linens. American Journal of Infection Control, 44(12), 1565-1571.

KPS 286: Kimmitt, P. T., & Redway, K. F. (2016). Evaluation of the potential for virus dispersal during hand drying: a comparison of three methods. Journal of Applied Microbiology, 120(2), 478-486.

KPS 287: McCarthy, S., O'Raghallaigh, P., Woodworth, S., Lim, Y. L., Kenny, L. C., & Adam, F. (2016). An integrated patient journey mapping tool for embedding quality in healthcare service reform. Journal of Decision Systems, 25(sup1), 354-368.

KPS 288: Kamnetz, S., Marquez, B., Aeschlimann, R., & Pandhi, N. (2015). Are waiting rooms passé: A pilot study of patient self-rooming. The Journal of ambulatory care management, 38(1), 25.

KPS 289: Wood, V. J., Gesler, W., Curtis, S. E., Spencer, I. H., Close, H. J., Mason, J., & Reilly, J. G. (2015). 'Therapeutic landscapes' and the importance of nostalgia, solastalgia, salvage and abandonment for psychiatric hospital design. Health & place, 33, 83-89.

KPS 290: Harris, D. D., & Fitzgerald, L. (2015). A life-cycle cost analysis for flooring materials for healthcare facilities. Journal of Hospital Administration, 4(4), 92.

KPS 291: White, M. J., Thornton, J. S., Hawkes, D. J., Hill, D. L., Kitchen, N., Mancini, L., ... & Keevil, S. F. (2015). Design, Operation, and Safety of Single-Room Interventional MRI Suites: Practical Experience From Two Centers. Journal of magnetic resonance imaging, 41(1), 34-43.

KPS 292: Kol, E., Aydın, P., & Dursun, O. (2015). The effectiveness of environmental strategies on noise reduction in a pediatric intensive care unit: creation of single-patient bedrooms and reducing noise sources. Journal for Specialists in Pediatric nursing, 20(3), 210-217.

KPS 293: Singh, I., Okeke, J., & Edwards, C. (2015). Outcome of in-patient falls in hospitals with 100% single rooms and multi-bedded wards. Age and ageing, 44(6), 1032-1035.

KPS 294: Brown, B., Rutherford, P., & Crawford, P. (2015). The role of noise in clinical environments with particular reference to mental health care: A narrative review. International journal of nursing studies, 52(9), 1514-1524.

KPS 295: Joseph, A., Choi, Y. S., & Quan, X. (2015). Impact of the physical environment of residential health, care, and support facilities (RHCSF) on staff and residents: A systematic review of the literature. Environment and Behavior, 48(10), 1203-1241.

KPS 296: Julian, S., Burnham, C. A. D., Sellenriek, P., Shannon, W. D., Hamvas, A., Tarr, P. I., & Warner, B. B. (2015). Impact of neonatal intensive care bed configuration on rates of late-onset bacterial sepsis and methicillin-resistant Staphylococcus aureus colonization. infection control & hospital epidemiology, 36(10), 1173-1182.

KPS 297: Ajiboye, F., Dong, F., Moore, J., Kallail, K. J., & Baughman, A. (2015). Effects of revised consultation room design on patient–physician communication. HERD: Health Environments Research & Design Journal, 8(2), 8-17.

KPS 298: Andersen, M. (2015). Unweaving the human response in daylighting design. Building and Environment, 91, 101-117.

KPS 299: Donald, F., Duff, C., Lee, S., Kroschel, J., & Kulkarni, J. (2015). Consumer perspectives on the therapeutic value of a psychiatric environment. Journal of Mental Health, 24(2), 63-67.

KPS 300: Carayon, P., Kianfar, S., Li, Y., Xie, A., Alyousef, B., & Wooldridge, A. (2015). A systematic review of mixed methods research on human factors and ergonomics in health care. Applied ergonomics, 51, 291-321.

KPS 301: Oliveira, L., Gomes, C., Nicolau, L. B., Ferreira, L., & Ferreira, R. (2015). Environment in pediatric wards: light, sound, and temperature. Sleep medicine, 16(9), 1041-1048.

KPS 302: Verani, M., Bigazzi, R., & Carducci, A. (2014). Viral contamination of aerosol and surfaces through toilet use in health care and other settings. American journal of infection control, 42(7), 758-762.

KPS 303: D'Arcy, N., Cloutman-Green, E., Klein, N., & Spratt, D. A. (2013). Environmental viral contamination in a pediatric hospital outpatient waiting area: implications for infection control. American journal of infection control, 42(8), 856-860.

KPS 304: Szymczak, S. E., & Shellhaas, R. A. (2014). Impact of NICU design on environmental noise. Journal of Neonatal Nursing, 20(2), 77-81.

KPS 305: Sadrizadeh, S., Holmberg, S., & Tammelin, A. (2014). A numerical investigation of vertical and horizontal laminar airflow ventilation in an operating room. Building and Environment, 82, 517-525.

KPS 306: Fornwalt, L., & Riddell, B. (2014). Implementation of innovative pulsed xenon ultraviolet (PX-UV) environmental cleaning in an acute care hospital. Risk Management and Healthcare Policy, 7, 25.

KPS 307: Fontana, L., & Quintino, A. (2014). Experimental analysis of the transport of airborne contaminants between adjacent rooms at different pressure due to the door opening. Building and environment, 81, 81-91.

KPS 308: O'Hara, S. (2014). Planning intensive care unit design using computer simulation modeling: optimizing integration of clinical, operational, and architectural requirements. Critical Care Nursing Quarterly, 37(1), 67-82.

KPS 309: Campbell, C., Kramer, C., Kelsey, S., & King, W. J. (2013. Identification of EMR Hardware and Space Design Requirements using Human Factors Analyses. In Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care (Vol. 3, No. 1, pp. 50-57). Sage CA: Los Angeles, CA: SAGE Publications.

KPS 310: Hang, J., Li, Y., & Jin, R. (2014). The influence of human walking on the flow and airborne transmission in a six-bed isolation room: tracer gas simulation. Building and Environment, 77, 119-134.

KPS 311: Broadbent, M., Moxham, L., & Dwyer, T. (2014). Implications of the emergency department triage environment on triage practice for clients with a mental illness at triage in an Australian context. Australasian Emergency Nursing Journal, 17(1), 23-29.

KPS 312: Larsen, L. S., Larsen, B. H., & Birkelund, R. (2014). A companionship between strangers–the hospital environment as a challenge in patient–patient interaction in oncology wards. Journal of advanced nursing, 70(2), 395-404.

KPS 313: Thiel, C. L., Needy, K. L., Ries, R., Hupp, D., & Bilec, M. M. (2014). Building design and performance: A comparative longitudinal assessment of a Children's hospital. Building and Environment, 78, 130-136.

KPS 314: Lazary, A., Weinberg, I., Vatine, J. J., Jefidoff, A., Bardenstein, R., Borkow, G., & Ohana, N. (2014). Reduction of healthcare-associated infections in a long-term care brain injury ward by replacing regular linens with biocidal copper oxide impregnated linens. International Journal of Infectious Diseases, 24, 23-29.

KPS 315: Baron, J. L., Peters, T., Shafer, R., MacMurray, B., & Stout, J. E. (2014). Field evaluation of a new point-of-use faucet filter for preventing exposure to Legionella and other waterborne pathogens in health care facilities. American journal of infection control, 42(11), 1193-1196.

KPS 316: Lambert, V., Coad, J., Hicks, P., & Glacken, M. (2014). Young children's perspectives of ideal physical design features for hospital-built environments. Journal of Child Health Care, 18(1), 57-71.

KPS 317: Van Der Ploeg, E. S., & O'Connor, D. W. (2014). Methodological challenges in studies of bright light therapy to treat sleep disorders in nursing home residents with dementia. Psychiatry and clinical Neurosciences, 68(11), 777-784.

KPS 318: Tamimi, A. H., Carlino, S., & Gerba, C. P. (2014). Long-term efficacy of a self-disinfecting coating in an intensive care unit. American journal of infection control, 42(11), 1178-1181.

KPS 319: Perkins, N. H. (2013). Including patients, staff and visitors in the design of the psychiatric milieu: notes from the field. Facilities.

KPS 320: Swanson, J. R., Peters, C., & Lee, B. H. (2013). NICU redesign from open ward to private room: a longitudinal study of parent and staff perceptions. Journal of Perinatology, 33(6), 466-469.

KPS 321: Way, T. J., Long, A., Weihing, J., Ritchie, R., Jones, R., Bush, M., & Shinn, J. B. (2015). Effect of noise on auditory processing in the operating room. Journal of the American College of Surgeons, 216(5), 933-938.

KPS 322: Weber, D. J., Anderson, D., & Rutala, W. A. (2013). The role of the surface environment in healthcare-associated infections. Current opinion in infectious diseases, 26(4), 338-344.

KPS 323: Van der Schaaf, P. S., Dusseldorp, E., Keuning, F. M., Janssen, W. A., & Noorthoorn, E. O. (2013). Impact of the physical environment of psychiatric wards on the use of seclusion. The British Journal of Psychiatry, 202(2), 142-149.

KPS 324: Conroy, S. P., Ansari, K., Williams, M., Laithwaite, E., Teasdale, B., Dawson, J., ... & Banerjee, J. (2014). A controlled evaluation of comprehensive geriatric assessment in the emergency department: the 'Emergency Frailty Unit'. Age and ageing, 43(1), 109-114.

KPS 325: Cervantes, H. I., Álvarez, J. A., Muñoz, J. M., Arreguín, V., Mosqueda, J. L., & Macías, A. E. (2013). Antimicrobial activity of copper against organisms in aqueous solution: a case for copper-based water pipelines in hospitals?. American Journal of Infection Control, 41(12), e115-e118.

KPS 326: Fredj, N., Kolar, J. S., Prichard, D. M., & Burleigh, T. D. (2013). Study of relative color stability and corrosion resistance of commercial copper alloys exposed to hand contact and synthetic hand sweat. Corrosion science, 76, 415-423.

KPS 327: FitzGerald, G., Moore, G., & Wilson, A. P. R. (2013). Hand hygiene after touching a patient's surroundings: the opportunities most commonly missed. Journal of Hospital Infection, 84(1), 27-31.

KPS 328: Golembiewski, J. (2013). Lost in space: The place of the architectural milieu in the aetiology and treatment of schizophrenia. Facilities.

KPS 329: Azimi, P., & Stephens, B. (2013). HVAC filtration for controlling infectious airborne disease transmission in indoor environments: Predicting risk reductions and operational costs. Building and environment, 70, 150-160.

KPS 330: Salgado, C. D., Sepkowitz, K. A., John, J. F., Cantey, J. R., Attaway, H. H., Freeman, K. D., ... & Schmidt, M. G. (2013). Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care unit. Infection Control & Hospital Epidemiology, 34(5), 479-486.

KPS 331: Tang, J. W., Nicolle, A., Pantelic, J., Klettner, C. A., Su, R., Kalliomaki, P., ... & Tham, K. W. (2013). Different types of door-opening motions as contributing factors to containment failures in hospital isolation rooms. PloS one, 8(6), e66663.

KPS 332: Pasha, S. (2013). Barriers to garden visitation in children's hospitals. HERD: Health Environments Research & Design Journal, 6(4), 76-96.

KPS 333: Pineda, R. G., Stransky, K. E., Rogers, C., Duncan, M. H., Smith, G. C., Neil, J., & Inder, T. (2012). The single-patient room in the NICU: maternal and family effects. Journal of Perinatology, 32(7), 545-551.

KPS 334: Huisman, E. R., Morales, E., van Hoof, J., & Kort, H. S. (2012). Healing environment: A review of the impact of physical environmental factors on users. Building and environment, 58, 70-80.

KPS 335: Mourshed, M., & Zhao, Y. (2012). Healthcare providers' perception of design factors related to physical environments in hospitals. Journal of Environmental Psychology, 32(4), 362-370.

KPS 336: Trochelman, K., Albert, N., Spence, J., Murray, T., & Slifcak, E. (2012). Patients and their families weigh in on evidence-based hospital design. Critical Care Nurse, 32(1), e1-e10.

KPS 337: Shepley, M. M., Gerbi, R. P., Watson, A. E., Imgrund, S., & Sagha-Zadeh, R. (2012). The impact of daylight and views on ICU patients and staff. HERD: Health Environments Research & Design Journal, 5(2), 46-60.

KPS 338: Baugh, C. W., Venkatesh, A. K., & Bohan, J. S. (2011). Emergency department observation units: a clinical and financial benefit for hospitals. Health care management review, 36(1), 28-37.

KPS 339: Lavy, S., & Dixit, M. K. (2012). Wall finish selection in hospital design: a survey of facility managers. HERD: Health Environments Research & Design Journal, 5(2), 80-98.

KPS 340: Rodriguez, M., Ford, D., & Adams, S. (2011). Does proper design of an intensive care unit affect compliance with isolation practices?. Critical care nursing quarterly, 34(1), 36-45.

KPS 341: Heddema, E. R., & van Benthem, B. H. (2011). Decline in incidence of Clostridium difficile infection after relocation to a new hospital building with single rooms. The Journal of hospital infection, 79(1), 93-94.

KPS 342: Guarascio-Howard, L. (2011). Examination of wireless technology to improve nurse communication, response time to bed alarms, and patient safety. HERD: Health Environments Research & Design Journal, 4(2), 109-120.

KPS 343: Marquardt, G. (2011). Wayfinding for people with dementia: a review of the role of architectural design. HERD: Health Environments Research & Design Journal, 4(2), 75-90.

KPS 344: Lorenz, S. G., & Dreher, H. M. (2011). Hospital room design and health outcomes of the aging adult. HERD: Health Environments Research & Design Journal, 4(2), 23-35.

KPS 345: Carr, V. L., Sangiorgi, D., Büscher, M., Junginger, S., & Cooper, R. (2011). Integrating evidence-based design and experience-based approaches in healthcare service design. HERD: Health Environments Research & Design Journal, 4(4), 12-33.

KPS 346: Covinsky, K. E., Pierluissi, E., & Johnston, C. B. (2011). Hospitalization-associated disability:“She was probably able to ambulate, but I’m not sure”. Jama, 306(16), 1782-1793.

KPS 347: Rizzo, P., Rea, M., & White, R. (2010). Lighting for today's neonatal intensive care unit. Newborn and Infant Nursing Reviews, 10(2), 107-113.

KPS 348: Alzoubi, H., & Bataineh, R. F. (2010). Pre-versus post-occupancy evaluation of daylight quality in hospitals. Building and Environment, 45(12), 2652-2665.

KPS 349: Verbeek, H., Zwakhalen, S. M., van Rossum, E., Ambergen, T., Kempen, G. I., & Hamers, J. P. (2010). Dementia care redesigned: Effects of small-scale living facilities on residents, their family caregivers, and staff. Journal of the American Medical Directors Association, 11(9), 662-670.

KPS 350: Auger, C., Demers, L., Gélinas, I., Miller, W. C., Jutai, J. W., & Noreau, L. (2010). Life-space mobility of middle-aged and older adults at various stages of usage of power mobility devices. Archives of physical medicine and rehabilitation, 91(5), 765-773.

KPS 351: Casey, D., Murphy, K., Ni Leime, A., Larkin, P., Payne, S., Froggatt, K. A., & O'Shea, E. (2011). Dying well: factors that influence the provision of good end-of-life care for older people in acute and long-stay care settings in Ireland. Journal of Clinical Nursing, 20(13-14), 1824-1833.

KPS 352: Vincent, E., Battisto, D., Grimes, L., & McCubbin, J. (2010). The effects of nature images on pain in a simulated hospital patient room. HERD: Health Environments Research & Design Journal, 3(3), 42-55.

KPS 353: Fink, N., Pak, R., & Battisto, D. (2010). Developing a usability evaluation tool to assess the patient room bathroom. HERD: Health Environments Research & Design Journal, 3(3), 22-41.

KPS 354: Haq, S., & Pati, D. (2010). The research-design interaction: Lessons learned from an evidence-based design studio. HERD: Health Environments Research & Design Journal, 3(4), 75-92.

KPS 355: Nollert, G., & Wich, S. (2008, December). Planning a Cardiovascular Hybrid Operating Room: the Technical. In The heart surgery forum (Vol. 2009, p. 1033).

KPS 356: Lu, J., & Hignett, S. (2009). Using task analysis in healthcare design to improve clinical efficiency. HERD: Health Environments Research & Design Journal, 2(2), 60-69.

KPS 357: Hendrich, A., Chow, M. P., Bafna, S., Choudhary, R., Heo, Y., & Skierczynski, B. A. (2009). Unit-related factors that affect nursing time with patients: Spatial analysis of the time and motion study. HERD: Health Environments Research & Design Journal, 2(2), 5-20.

KPS 358: Pati, D., Harvey Jr, T. E., Reyers, E., Evans, J., Waggener, L., Serrano, M., ... & Nagle, T. (2009). A multidimensional framework for assessing patient room configurations. HERD: Health Environments Research & Design Journal, 2(2), 88-111.

KPS 359: Chen, Y. M. (2007). Perceived barriers to physical activity among older adults residing in long-term care institutions. Journal of clinical nursing, 19(3-4), 432-439.

KPS 360: Naderi, J. R., & Shin, W. H. (2008). Humane design for hospital landscapes: A case study in landscape architecture of a healing garden for nurses. HERD: Health Environments Research & Design Journal, 2(1), 82-119.

KPS 361: Daykin, N., Byrne, E., Soteriou, T., & O'Connor, S. (2008). The impact of art, design and environment in mental healthcare: a systematic review of the literature. Journal of the Royal Society for the Promotion of Health, 128(2), 85-94.

KPS 362: Brandt, C., Hott, U., Sohr, D., Daschner, F., Gastmeier, P., & Rüden, H. (2008). Operating room ventilation with laminar airflow shows no protective effect on the surgical site infection rate in orthopedic and abdominal surgery. Annals of surgery, 248(5), 695-700.

KPS 363: Gutierrez, F., & Smith, K. (2008). Reducing falls in a definitive observation unit: an evidence-based practice institute consortium project. Critical care nursing quarterly, 31(2), 127-139.

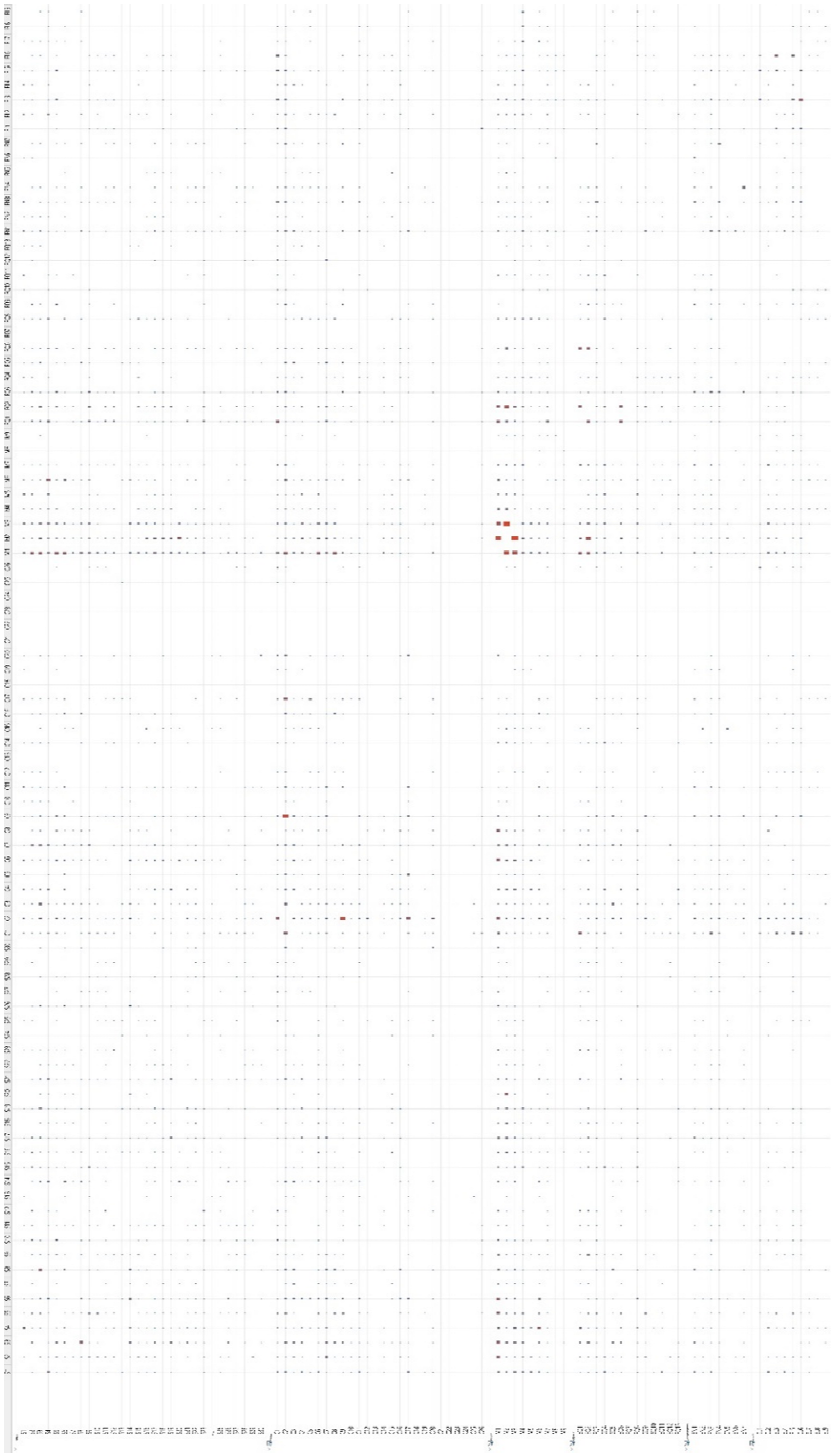
KPS 364: Watkins, N., Myers, D., & Villasante, R. (2008). Mock-ups as "interactive laboratories": Mixed methods research using inpatient unit room mock-ups. HERD: Health Environments Research & Design Journal, 2(1), 66-81.

KPS 365: Rabig, J., Thomas, W., Kane, R. A., Cutler, L. J., & McAlilly, S. (2006). Radical redesign of nursing homes: applying the green house concept in Tupelo, Mississippi. The Gerontologist, 46(4), 533-539.

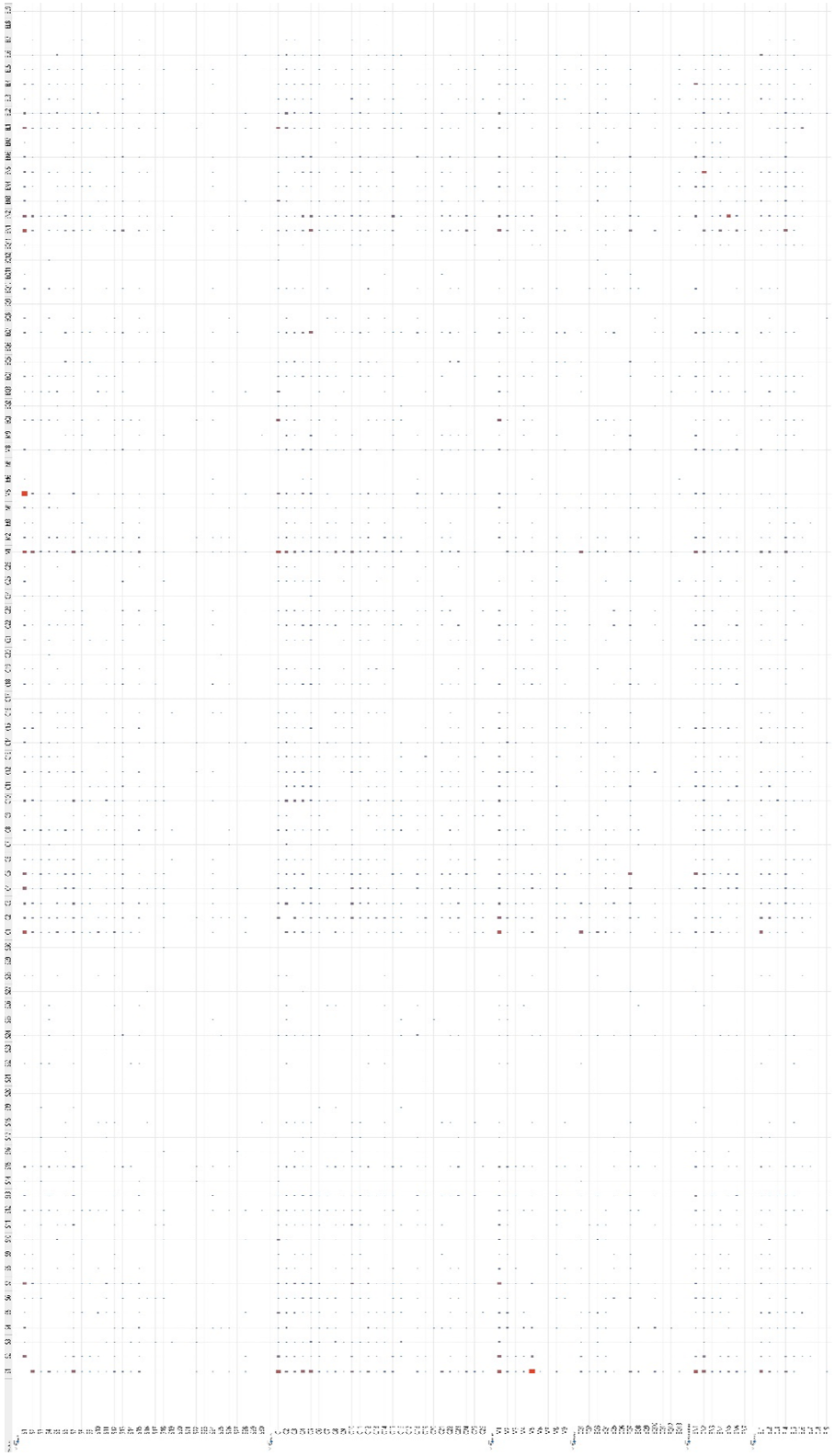
KPS 366: Sandberg, W. S., Daily, B., Egan, M., Stahl, J. E., Goldman, J. M., Wiklund, R. A., & Rattner, D. (2005). Deliberate perioperative systems design improves operating room throughput. The Journal of the American Society of Anesthesiologists, 103(2), 406-418

B. Numerical data

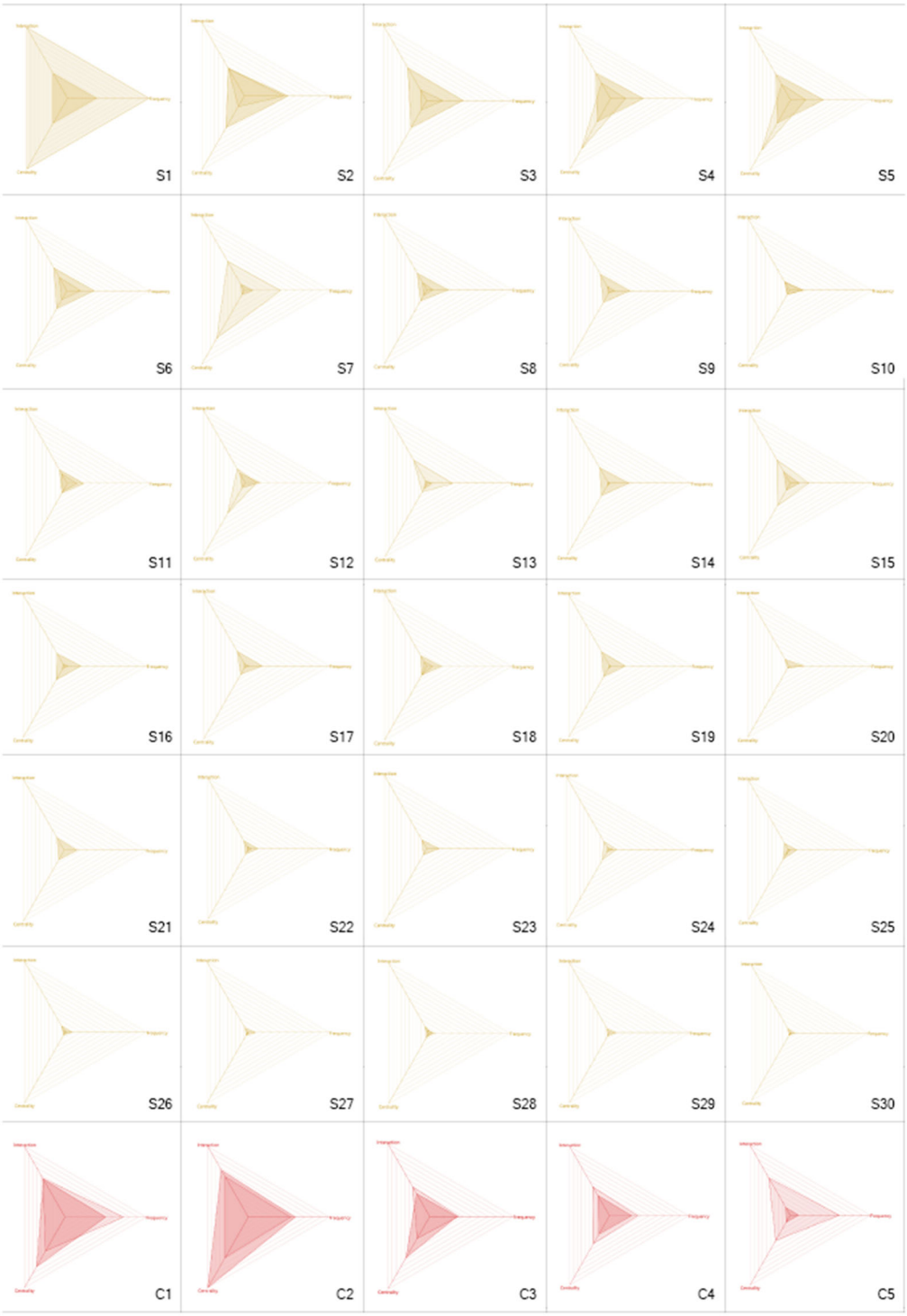
(for specification documents coded)

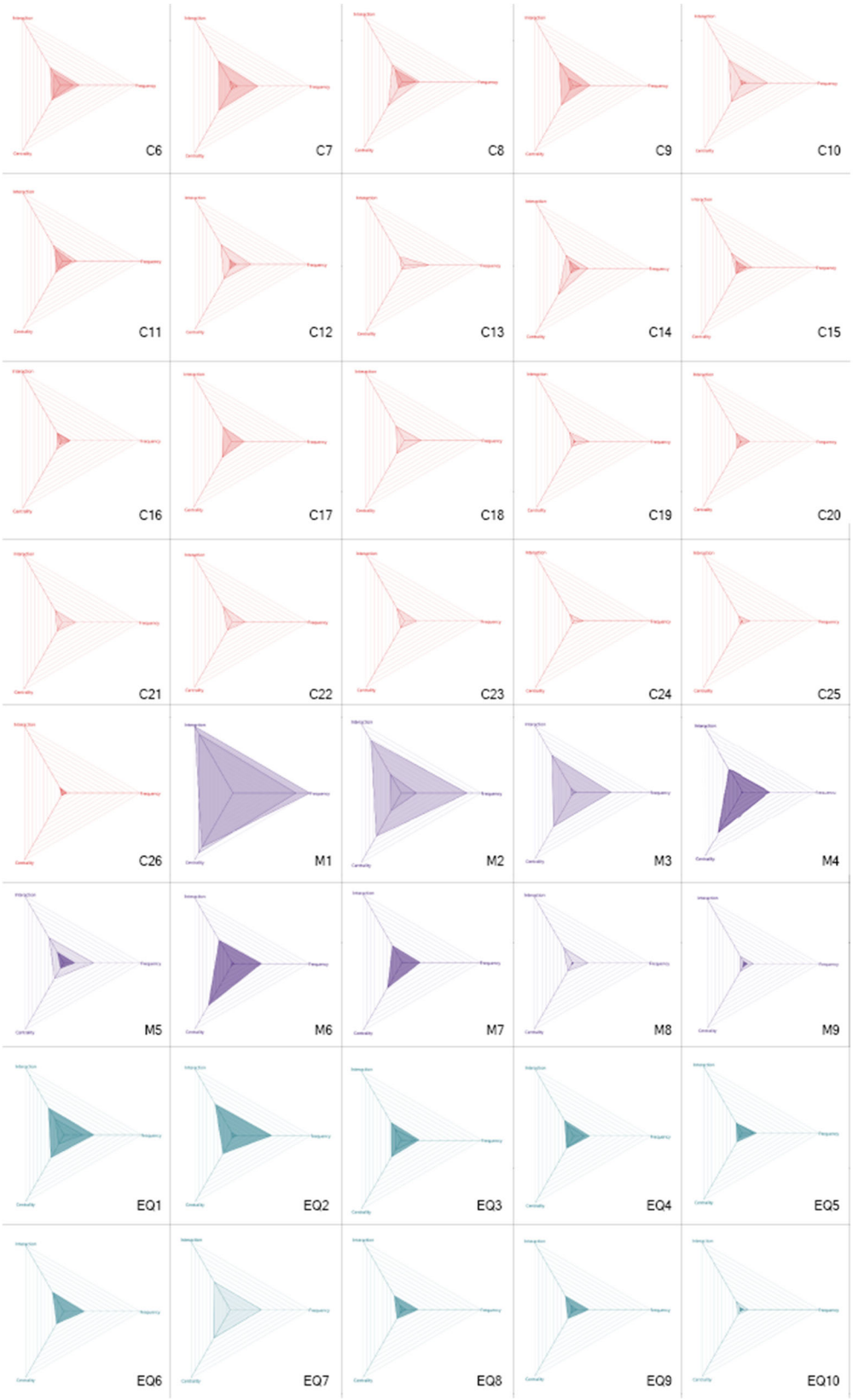


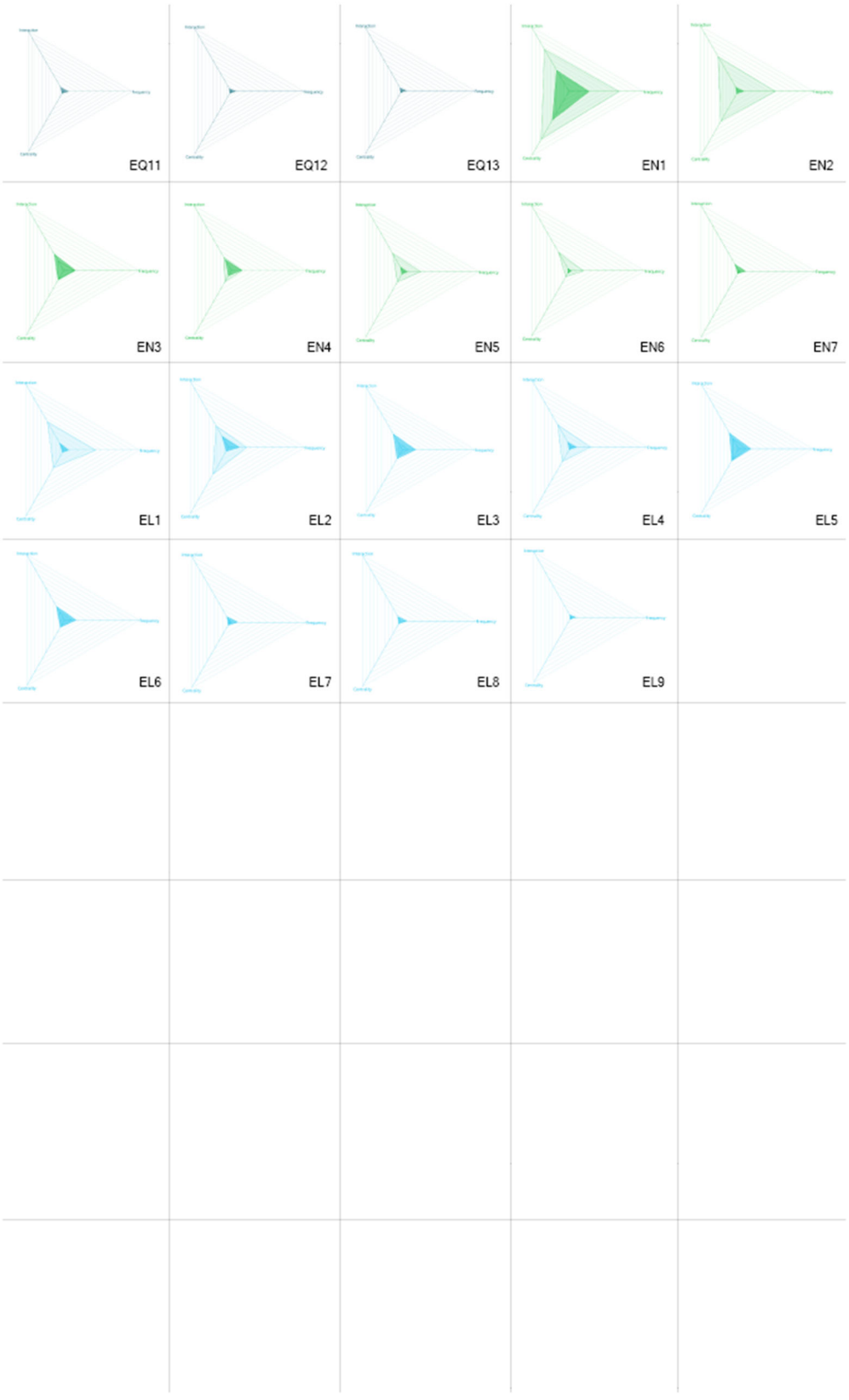
(for KPS documents coded)



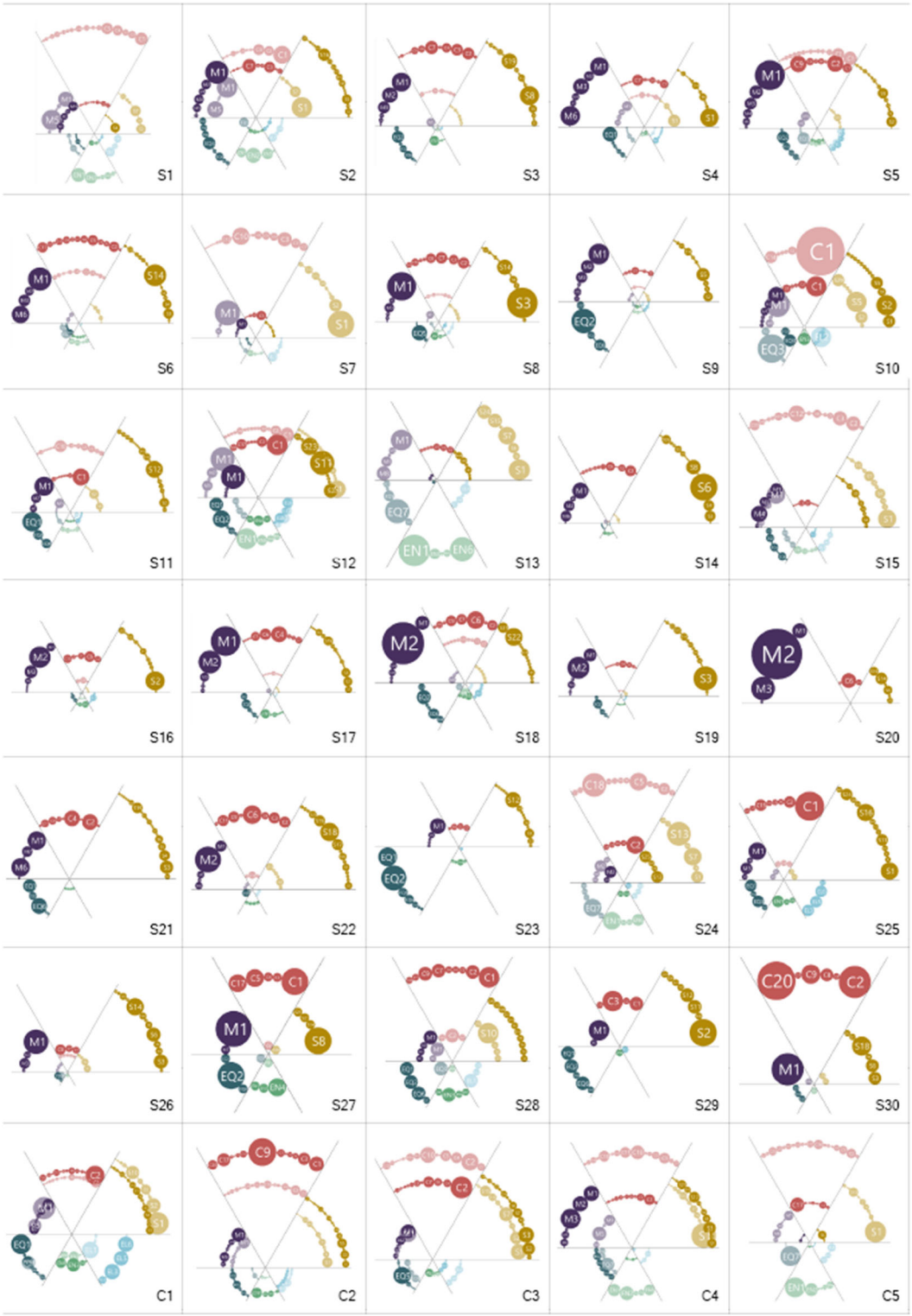
C. Significance matrix of codes



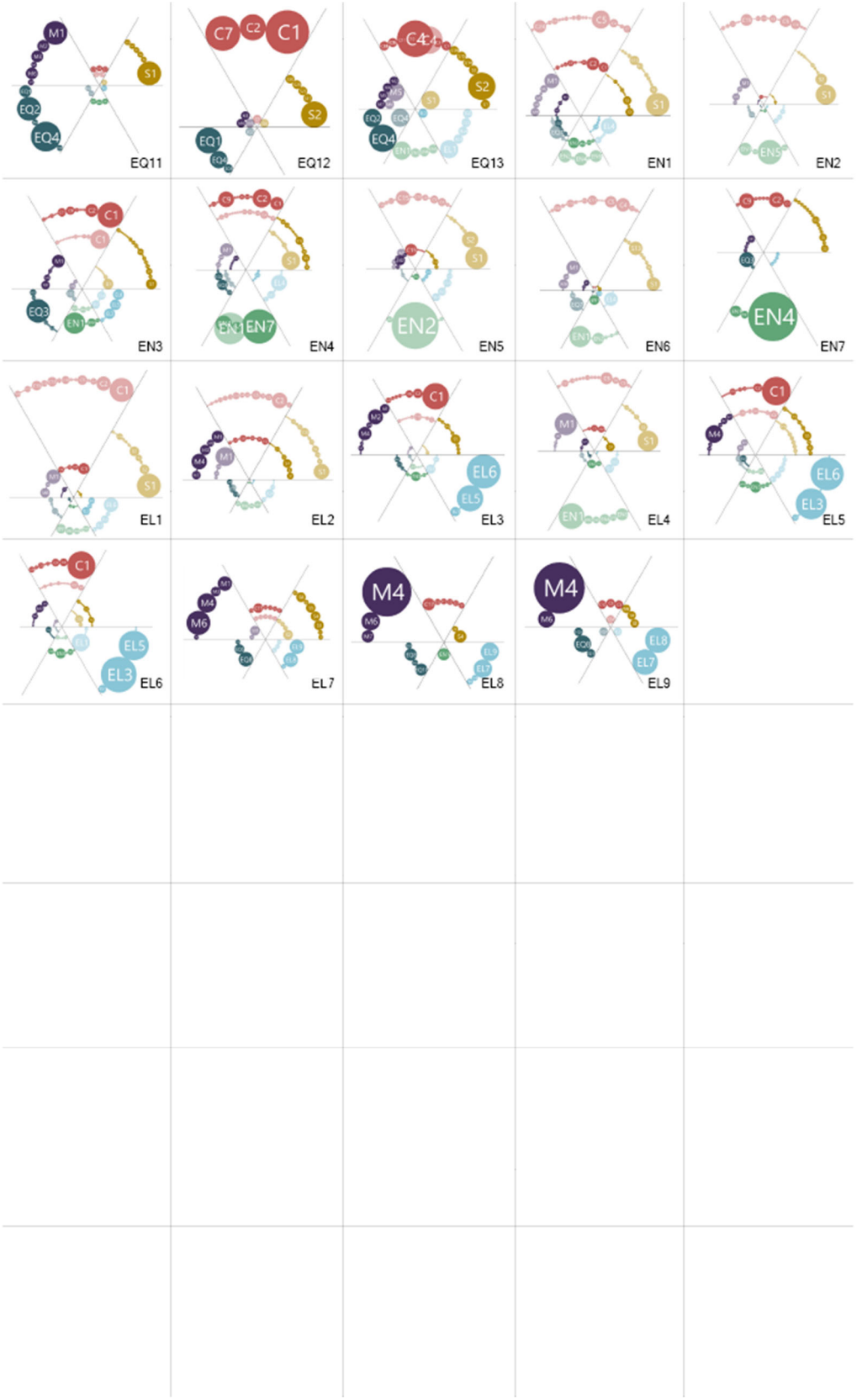

C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
M1
M2
M3
M4
M5
M6
M7
M8
M9
EQ1
EQ2
EQ3
EQ4
EQ5
EQ6
EQ7
EQ8
EQ9
EQ10


EQ11
EQ12
EQ13
EN1
EN2
EN3
EN4
EN5
EN6
EN7
EL1
EL2
EL3
EL4
EL5
EL6
EL7
EL8
EL9

D. Integrated matrix of taxonomic structures

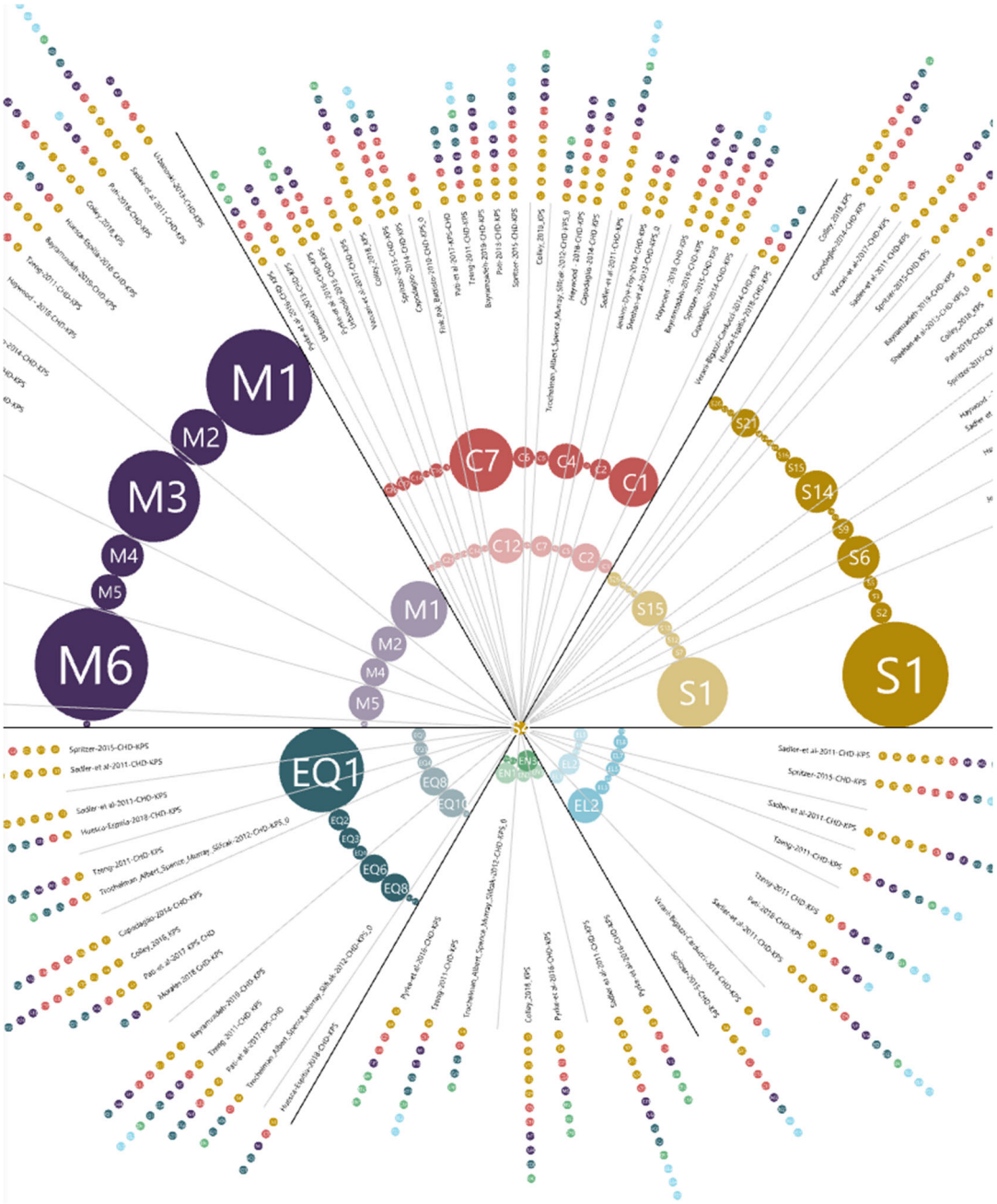



C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
M1
M2
M3
M4
M5
M6
M7
M8
M9
EQ1
EQ2
EQ3
EQ4
EQ5
EQ6
EQ7
EQ8
EQ9
EQ10

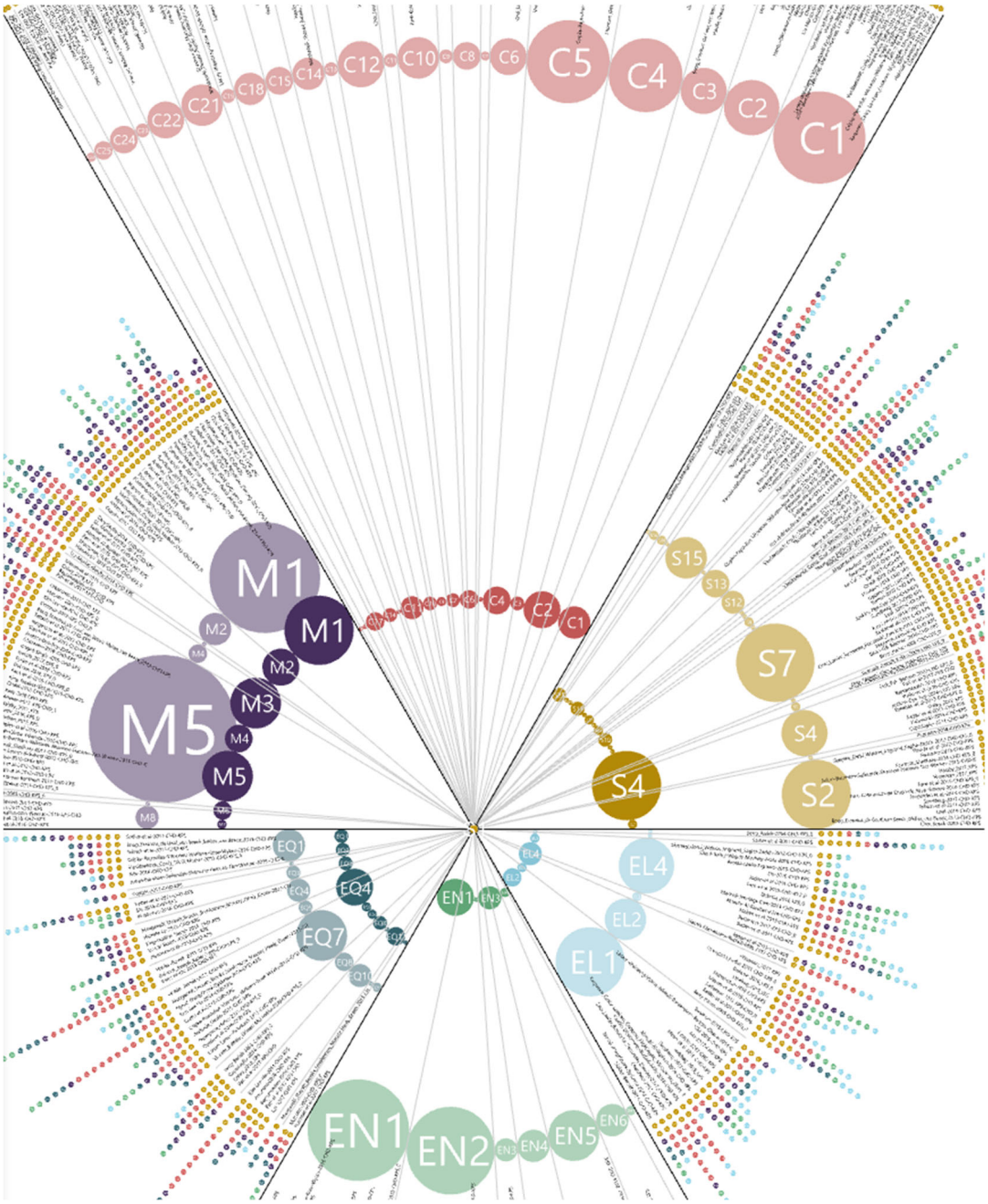

EQ11
EQ12
EQ13
EN1
EN2
EN3
EN4
EN5
EN6
EN7
EL1
EL2
EL3
EL4
EL5
EL6
EL7
EL8
EL9

E. Taxonomies of significant ontological cases

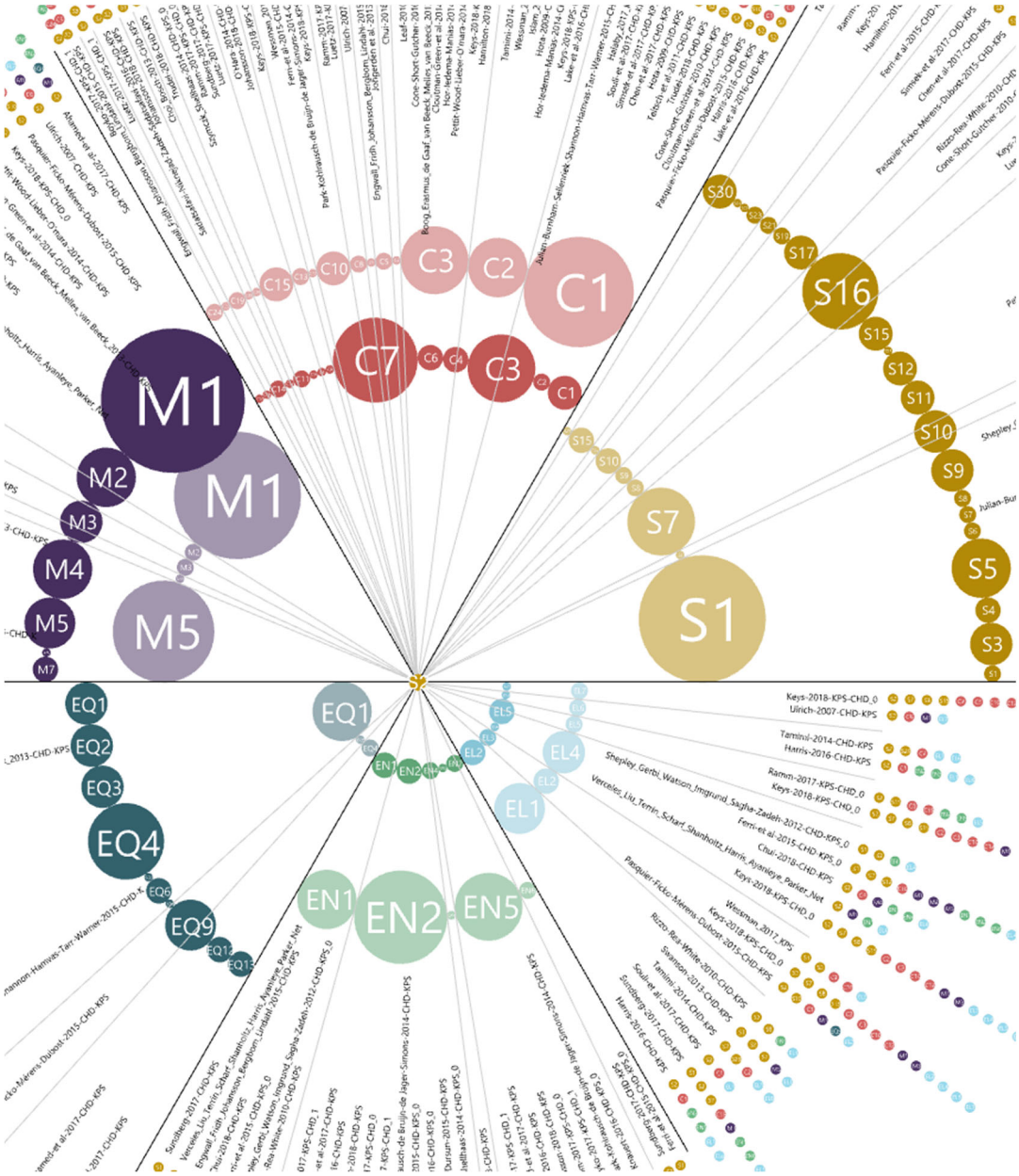
CASE 1 / S4: wet spaces/bathrooms/toilets etc.



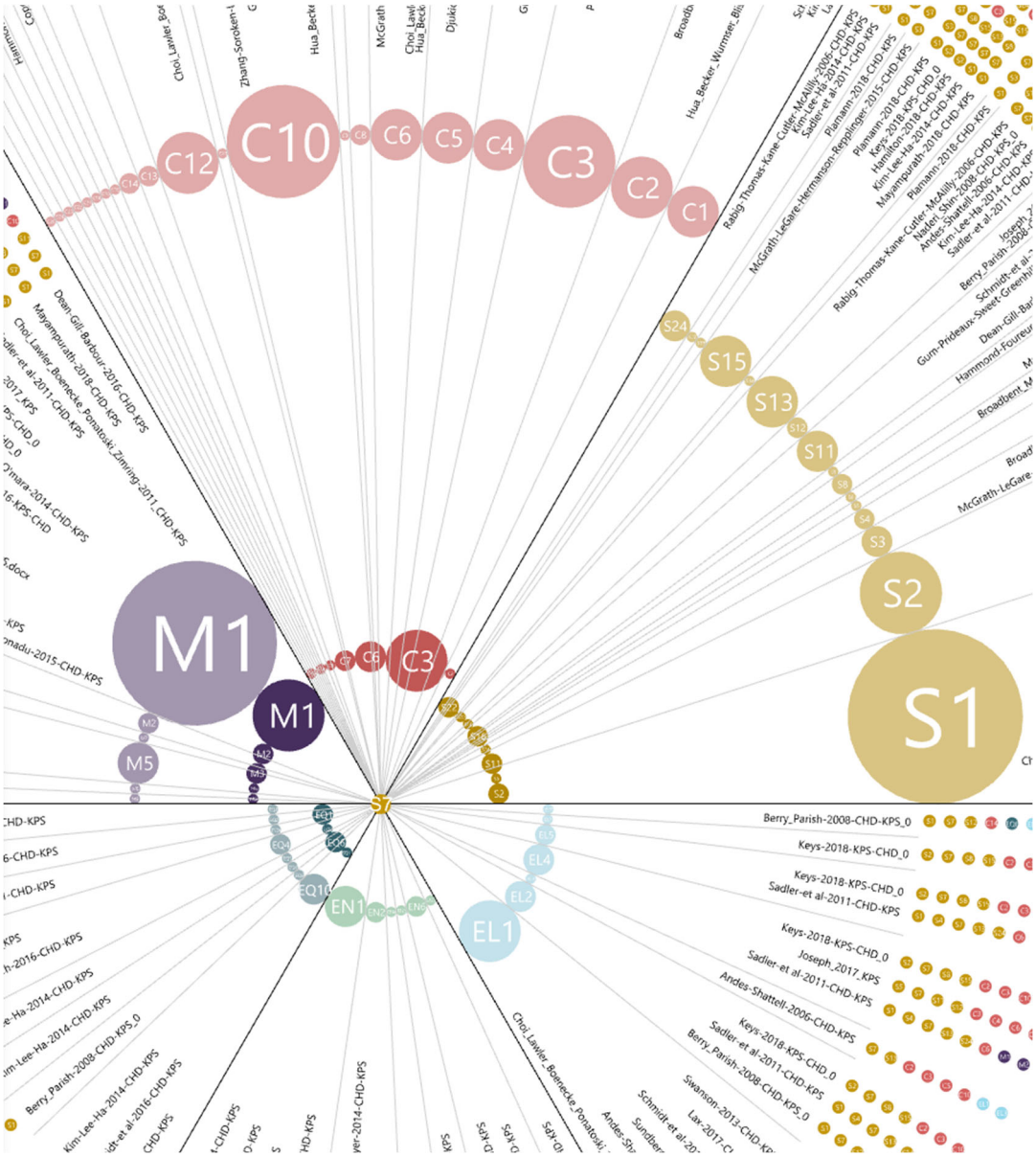
CASE 2 / S1: patient rooms



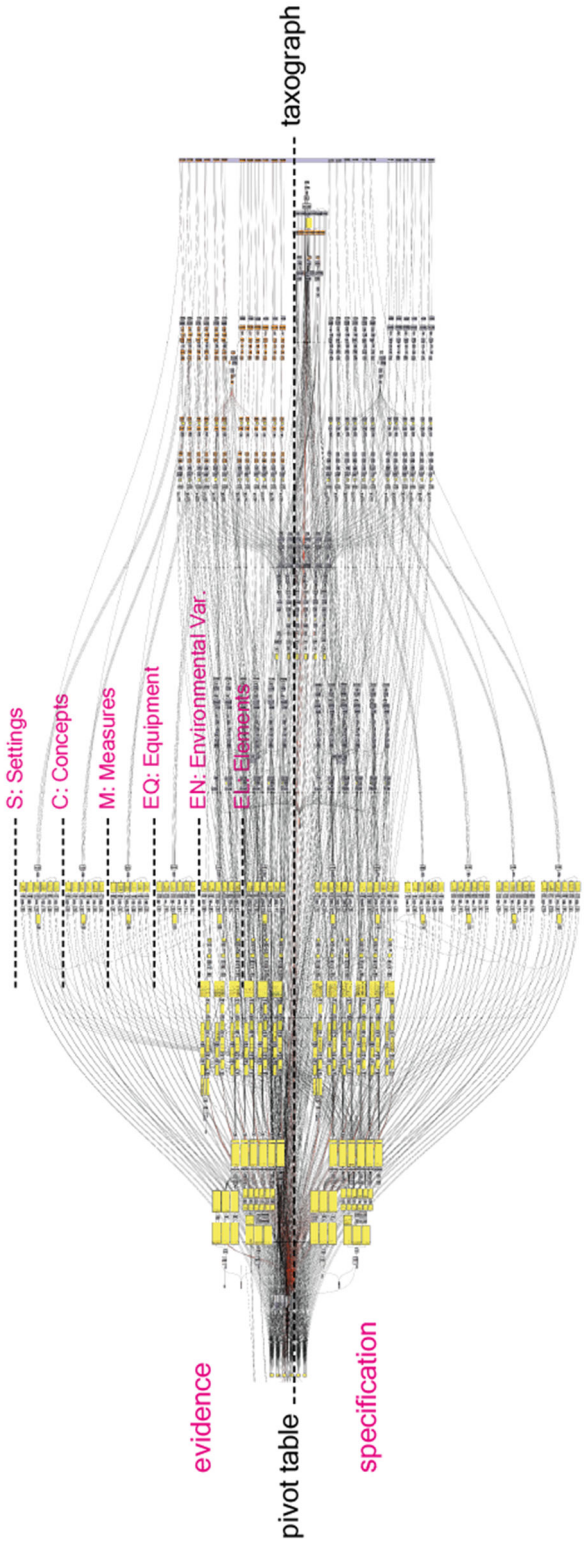
CASE 3 / S2: ICU(s)



CASE 4 / S7: nurse/nursing stations

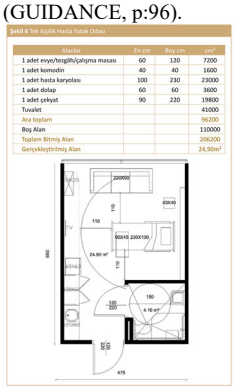
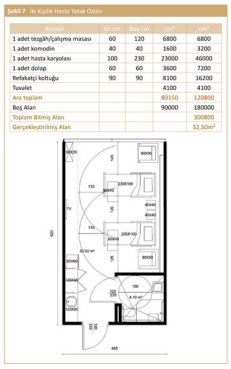


F. Rhino/Grasshopper scripts



G. Segments retrieved from particular ontological structures reviewed

QMaE Documents

- Hasta odaları, hasta ve yakınının konforunu sağlayacak şekilde düzenlenmelidir. Hasta odaları en fazla iki kişilik olmalıdır. Odalar gün ışığı ve taze hava alacak şekilde olmalı, iklimlendirme sağlanmalıdır. Odada banyo, tuvalet, televizyon ve refakatçiler için açılır kapanır koltuk bulunmalıdır. Hastaya özel ayarlanabilen gece lambası, dolap, etajer ve buzdolabı bulunmalıdır. Hasta odası gürültüden uzak ve gün ışığından yararlanabilecek şekilde düzenlenmelidir. Hasta başı panelleri gizli olmalıdır (SKS, p:401)
- Hasta odalarında lavabo, banyo ve tuvalet bulunmalıdır (SKS, p.426)
- Yatarak hizmet alan hastaların kullandığı tüm banyo ve tuvaletlerde hemşire çağrı sistemi bulunmalıdır (SKS, , p.426)
- Çalışma odaları, hasta odaları, izole odalar, kardiyak yoğun bakım, mutfak, toplantı salonu, yemekhane, koridor gibi ortamların tavan yükseklikleri ince işleri bitmiş durumda iken en az 270 cm olmalıdır (SKS, p:47)
- Birden fazla yatağın bulunduğu odalarda (koğuş tipi yoğun bakım veya acil müşahede gibi), yatak veya sedye başına en az 7 metrekarelik boş zemin alanı olmalıdır. Ayrıca bir bölme ve söz konusu bölmenin 120 cm genişliğinde girişi olmalıdır (GUIDANCE, p:48)
- Her hasta, hasta odasından genel koridora (ara koridor hariç) çıkmadan tuvalete erişim imkânına sahip olmalıdır. Bir tuvalet, dört yataktan ve iki hasta 78 odasından fazlası için hizmet vermemelidir. Tuvaletler kadın erkek olarak ikiye ayrılmalı ve içinde en az bir klozet ve bir lavabo bulunmalıdır. Kabinli tuvaletlerde her bir tuvalet alanı 120cmX150cm'den küçük olmamalıdır. Duvarda uygun yerde klozet örtüsü ve tuvalet kâğıdı konacak aparatlar bulunmalıdır (GUIDANCE, p:95)
- Hasta odası tuvaleti ve engelli tuvaleti, kapı çizgisi, lavabo ve klozet-küvet üçgeninde bir daire çizildiğinde dairenin çapı en az 152 cm olmalıdır. Bu husus aynı zamanda tüm engelli tuvaletleri için de geçerlidir. Klozetler duvara gömme şeklinde olmalı, altında temizlenmeye imkân bırakacak boşluk mesafesi bulunmalıdır. Klozetlerin montajı en az 350 kg. Yüke dayanacak şekilde yapılmalıdır (GUIDANCE, p:96).
- Oda içinde bulunan tuvaletlerin kapı eni en az 90 cm olmalı ve kapıların tamamı dışarıya doğru (oda içine) açılmalıdır (GUIDANCE, p:96)
- Hasta odalarındaki duşlu tuvaletler ise el yıkama donanımı dâhil 3,35 m2 den küçük olamaz (GUIDANCE, p:96).
- Banyo/duşlarda tutamaklar bulunmalı ve bu aygıtlar 130 kg yüke dayanıklı olmalıdır (GUIDANCE, p:96).
- Tüm el yıkama alanlarında kâğıt havlu depolanacak aparatlar ve kullanılan kâğıtların atılacağı aparatlar bulundurulmalıdır (GUIDANCE, p:96).
- Ayrıca bahsi geçen tüm tuvalet/banyolarında en az bir mekanik veya doğal havalandırma sağlanmalıdır (GUIDANCE, p:96).
- 
(GUIDANCE, p:97)
- 
(GUIDANCE, p:98)

- Tek kişilik odalar, en az 13 m2 boş alana sahip olmalıdır. Odada bulunan tuvalet Bölüm 6.4.1.4'ün özelliklerine uygun olmalıdır. Odanın boyutları ve şekli yatağın kenarları ve ayak kısmıyla herhangi bir duvar veya sabit engel arasında asgari 120 cm açıklık bulunacak şekilde düzenlenmelidir. Sütunlar ve tuvaletler de dâhil olmak üzere işlevselliğe müdahale etmeyen küçük engeller, hasta odaları için mekânsal gereklilikler belirlenirken göz ardı edilebilir (Şekil 8) (GUIDANCE, p:100)
- Her bir ünitede, hayati bulguların sürekli izlenmesini sağlayacak ve her hasta yatağının yanında ve hemşire istasyonunda görsel monitörlerin olduğu donanımlar bulunmalıdır. Monitörler, görüş ve erişim kolaylığı sağlayan ancak hastaya erişimi engellemeyen yerlere yerleştirilmelidir (GUIDANCE, p:103).
- Yoğun bakım hastaları sürekli olarak gözlenir. Bunu sağlamak için hemşire masası; hemşirenin, hasta ile sürekli göz teması sağlayabileceği bir yerde olmalıdır. Her birim, bu imkânı verebilecek şekilde tasarlanmalıdır (GUIDANCE, p:103).
- Her koroner yoğun bakım hastasının odasında tuvalet bulunmalı ve tuvalette klozet olmalıdır. Tuvalet yarı açık oda şeklinde olabilir (GUIDANCE, p:104).
- Odalar için uygun hasta tuvaletleri temin edilmelidir (GUIDANCE, p:108).
- Hasta odalarındaki banyolardan faydalanamayan her altı yatak başına bir banyo veya duş temin edilmelidir. Banyo/duş, hastalar için uygun olacak ve ayrıca mahremiyeti koruyacak şekilde tasarlanıp ve konumlandırılmalıdır. Her duş yıkanma, kurulanma ve giyinme esnasında mahremiyeti sağlayacak şekilde bireysel bir oda veya kapalı bir alan içerisinde olmalıdır. Hasta tuvaleti/tuvaletleri doğrudan merkezi banyolara açılmalıdır (GUIDANCE, p:110)
- 

Cerrahi alanlar kirli, yarı steril ve steril alanlardan oluşur. Steril alanlar; ameliyathane ve steril yoğun bakım odalarıdır. Yarı steril alanlar; hastaların ameliyata hazırlandığı ve sonrasında bekletildiği, ayılma odaları, ameliyathane koridoru ve sedye transferi yapılan alandan ameliyathaneye kadar olan kısımdır (Şekil 11). Kirli alanlar ise; sedye transferinin yapıldığı kısmın dış tarafı, girişteki bekleme alanları, personelin kıyafet değiştirdiği alanlar, duş ve tuvaletler, ameliyathane kirli malzeme odası ve koridordur. Bu alanlarda trafik her zaman yarı steril alandan temiz alana, temiz alandan yarı steril alana ve buralardan kirli alana doğru olmalıdır. Fakat hiçbir zaman kirli malzemenin dönüşü temiz alanlara doğru olmamalıdır (GUIDANCE, p:111/112)
- Psikiyatri hasta odaları, tuvaletler ve tecrit odalarındaki tavanlar, kaçma veya intihar olasılığını engellemek için tek parça olacaktır. Tavana monte havalandırma ve aydınlatma cihazları emniyetli olacak ve yangın önleyici başlıkları gizli olacaktır (GUIDANCE: p.145)

KPS Documents

- The focus group interviews conducted with those who moved to the new wing (movers) and those who stayed were revealing in demonstrating the need for hospitals to obtain and use nurses' input in the design of new facilities. The beauty of the space is diminished when it does not function as needed. Movers in the focus group complained that the equipment storage space was poorly designed, that doors were difficult to open when their hands were full, and that the exit ramp for patients in wheelchairs was too steep. Facilities design research can include observing nurses' work habits in existing facilities and asking them about design features that facilitate or hamper their work and about what they need that is missing. Predesign research also can include staff preference surveys as well as creating drawings, physical models, and actual-size mockups of spaces (such as a patient room) and obtaining reactions and suggestions. Nor should research cease when a new facility opens, because at least some design mistakes are correctible. Most of the design concerns expressed in the movers' focus group could have been rectified early in the post occupancy period (KPS 1).
- Designers should take into consideration the following while designing bathrooms in rehabilitation units: • Adequate space for maneuvering assistive devices including wheelchairs and mobile heists; and for the movements of an accompanying nurse • Difference in appearance of towel rods and handrails • Switches, shelves, etc. to be reachable for a wheelchair or sitting patient • Handrail locations to be ergonomic and consistent in placement • Continuity of handrails between the bed and the bathroom • No difference between the heights of the shower seat and a standard wheelchair seat (KPS 2).
- Providing patients with private rooms, bathrooms, and amenities such as telephones, desks, and communal kitchens can help promote positive perceptions of a psychiatric facility's overall atmosphere. However, this level of autonomy could be balanced with staff perceptions of treatment processes so that the staff does not feel that important workflows are disrupted. Accounting equally for patient and staff needs prior to redesigning a facility could be an important step towards improving healthcare outcomes overall (KPS 15).
- According to this study, nurses associate a good work environment with better quality of care, safety, fewer infections, and higher confidence in parents' caring ability as compared to a poor work environment (KPS 20).
- The theoretical backdrop of this study, along with the subsequent findings, indicates that the physical design of a healthcare environment can either positively or negatively affect professional relationships as well as patient care by either reinforcing or disrupting pre-existing communicatory hierarchies and divisions between individuals. Designers should consider how the placement of nurse or physician stations, patient rooms, and other areas might affect communicatory patterns, and whether or not the location of these spaces positively or negatively affects quality of care (KPS 21).

- This study presents evidence in support of patient- and family-centered design of patient rooms, which incorporate designated family zones to accommodate a few family members. The results indicate that this increases family presence, providing patients with increased emotional and physical support during their hospital stay (KPS38).
- In hospitals where nursing stations are not highly visible and ward entrances are located at the ends of double rows of linear patient rooms, designers looking to reconfigure ward floor plans might consider how patient room adjacency to ward entrances affects important health outcomes. This study indicates that in such situations, providing patient rooms closer to ward entrances may help avoid higher rates of patient critical illness, mortality, and length of stay (KPS 41).
- Large single, acuity-adaptable rooms with large windows and hand hygiene provisions, large bathrooms with double access doors, HEPA filters with 99.97% ability to filter airborne contaminants, ceiling-mounted lifts, decentralized nursing stations, sound-absorbing acoustical ceiling tiles and finishes, high-efficiency building envelope and glazing, high-efficiency mechanical and heat recovery equipment (to reduce energy demand), low-flow fixtures and provisions for rainwater capture (to reduce water demand), electronic ICUs, healing art and gardens and other measures for positive distraction, family and social space, respite areas for patients, staff gyms, are some of the design recommendations from this study (KPS 44).
- When designing elder-friendly or geriatric hospitals, following design factors may be considered: • Fall prevention – handrails in corridors and pathways, safety/grab bars in bathrooms, furniture without sharp edges, and visual link with the nurse station • Multi-bedded spaces – private territory to ensure privacy and confidentiality and nature views • Familiarity – age-appropriate lighting and color • Wayfinding – color codes, comprehensive signage, provision for personalizing patient room doors, open space with daylight in public spaces • Social support areas – small in size for less people and community buildings/ activity rooms • Nature distraction – indoor plants • Infection prevention – hand-washing sinks (KPS 57).
- Design teams are encouraged to explore high-observation, concentric designs for intensive care units, where staff can maximize both staff and patient visibility (KPS 63).
- It may be noted that the study was an exploratory one. The implications for design from the findings of this study include: • Locked unit with controlled entry access • Need for multiple emergency panic buttons within the ICU • Centrally monitored security cameras at several points in the ICU • Smaller units with 12-14 beds or rooms with ability to see coworkers and visitors in the hallway • U-shaped or circular configuration to heighten visibility and safety • Centralized nursing station with a view of all rooms and decentralized nursing stations • An emergency exit door from the patient room or on the unit into a secure, staff-only-accessible hallway in case of an active shooter • Low windows in decentralized nursing stations to enable visibility while caregiver was seated • Foldaway or breakaway glass doors into the unit for better visibility and for quick access to the patient with emergency equipment and carts5 • Ability for continuous monitoring of patients from centralized nurse station • Ceiling-mounted lifts for positioning and movement of patients to prevent staff injury • Mechanisms in patient room to call for coworker assistance in emergencies – emergency buttons, audiovisual link to central stations, and other devices • Metal detectors and provision of site inspection before visitors and outsiders enter the ICU • Security desks in monitored waiting areas (KPS 64).
- Although the authors discovered the opposite of what they expected (that patients in HVRs had higher mortality rates than those in LVRs), the health outcomes that derive from high-visibility rooms are still well documented. The highest degree of visibility possible should be available so that visual contact can be established between patients, nurses, and physicians. However, as this study shows, the converse to this is that LVRs can still function as equally effective treatment spaces, so long as they are carefully monitored. The existence of a centralized nursing station around which patient rooms were situated was pivotal to this study; centralized nursing stations could provide a high degree of visibility and mobility for nurses (KPS 80)
- The following may be considered for the location of ABHR dispensers in single-patient rooms. They should be: Within line of sight Within reach Offering unobstructed access to the dispenser Near familiar objects (KPS 86).
- This study suggests that installing additional mobile computer stations for nurses closer to patient rooms could be a more practical solution for enhanced visibility, as opposed to a complete redesign of the ICU itself. Equipping low-visibility patient rooms with bedside video monitoring systems is another way to improve visibility that is gaining popularity as the demand for ICU beds exceeds the supply of physicians (KPS 88).
- Implications for the design from this study include: • Incorporate bathrooms in patient rooms so patients do not have to cross corridors for personal care. • Design team areas to allow interaction between healthcare professionals in a confidential secure area, not in a hallway. If conversations/interactions need to occur in a corridor, incorporate alcoves with white noise to promote confidentiality of patient information. • Provide additional storage areas or alcoves to place equipment such as wheelchairs and other equipment out of the travel pathway. • For rehabilitation facilities, design corridors to be wider than code minimum and entry/egress points (doorways and elevators) to accommodate wheelchairs. Perhaps a rule of thumb should be that rehabilitation unit corridors are wide enough for two-way traffic. • Design rehabilitation units without corridors. Perhaps an open architectural concept may eliminate or reduce the number of corridors that patients must contend with. This would imply that medication, clean utility, soiled utility, and staff spaces may be designed to one side of a unit rather than centralized. In addition, placing satellite nurses' documentation areas in proximity to a cluster of patient rooms would allow better staff observation of patient rooms. • Deinstitutionalize the look and feel of rehabilitation units. One patient comment reported that "hallways give a first impression" of the unit. • Incorporate therapy services into rehabilitation units themselves or within close proximity to the unit to prevent excessive travel by patients. • If the unit has an outdoor patio or common area, do not have the access point through a patient room, as reported in the study. • Use interactive virtual reality (VR) mockups during the design phase of the unit building/remodeling to allow staff and patients input to unit layout (KPS 93).

- Single-bed patient rooms in ICUs (and the resultant decrease in patient transfers) were considered more effective in reducing infections. The design of these patient rooms may consider accessible sinks (both inside and outside the rooms) to promote improved hand hygiene compliance as well as features to promote infection control practices such as ease of cleaning (KPS 110)
- Participants indicated that they give better care to patients when they feel better. It is important to recognize that if the ICU environment is improved, it helps the staff to create a more supportive and caring atmosphere, which will lead to better patient outcomes. Additionally, this study noted that bed space can be varied according to the physical condition of the patient and may need to be adjusted for machinery or other care items. Finally, the study reinforces the importance of room uniformity within a unit. This study demonstrated that improvements in acoustics, lighting, interior design, and nature views positively impact the well-being and caring behaviors of the nursing staff and should be considered in future design projects (KPS 114).
- The authors recommend designing an ICU with single-patient rooms (KPS 127).
- The findings of this study show that in psychiatric facilities in the UK, staff satisfaction was higher in wards that had personal bathrooms for the patients. The staff found working in wards with corridors as less satisfactory than working in wards without corridors (KPS 129).
- It cannot be ascertained which physical design aspect(s) of the new unit contributed to the decrease in total duration of seclusion, number of seclusion incidents, number of patients secluded, and the number of reported aggressive incidents. However, the following four aspects were identified as critical factors affecting the unit's functioning: single patient rooms with en-suite bathrooms, separate areas for assessing patients in police custody, seclusion areas near nurse stations, and gender separate areas (KPS 142).
- The results from this study support the notion that evidence-based designs, such as single patient rooms and bathrooms, access to natural light, and patient control over lighting and noise levels may significantly improve objective measures of patient sleep quality. Designers could consider implementing these designs where possible in order to potentially improve patient health outcomes (KPS 161).
- Separate, easily accessible spaces near or inside patient rooms intended for necessary staff conversation could be implemented to reduce staff-generated noise via conversation. Research cited within this article noted that 85% to 99.5% of alarm sounds generated within ICUs were not clinically relevant; equipment that produces fewer unnecessary alarm sounds should be considered (KPS 169).
- Prior to any renovations or new construction projects, designers should consider several aspects of the indoor and outdoor environment, such as temperature, humidity, lighting levels, and projected foot traffic. Understanding spaces in this way can better inform design decisions and allow for the inclusion or exclusion of features that might help or hinder a given space's optimum performance (KPS 172).
- Some of the implications for design from this study are presented by the authors with their disadvantages. Designers may take both positive and negative aspects into consideration before incorporating these design aspects into an ICU setting: • Large windows with access to natural light and views of nature or artificial skylights. • Provision to control light and sounds. • Single-occupancy rooms in ICU with adequate space for family members and providers; more space at the bedside for multiple providers. The challenge with this is difficulty in hearing bedside alarms and more walking for providers. • Clustering of rooms into clinical pods was considered advantageous as a pod allowed family members to identify the ICU team. However, they were considered disadvantageous by the care providers as these were seen to hinder interaction between them, a smooth flow during busy times, challenged teamwork, and led to more walking and a need for more numbers of providers. • Medication rooms with space for multiple providers, low noise levels, restricted access; the challenge was the inability to hear alarms. • Family support areas with a mix of spaces for larger groups (for social networking) and smaller groups (for privacy); and access to computers, Internet, and public telephones. • Storage configuration for equipment and supplies may be identical in all pods (KPS 176).
- The author recommends using the Tour Model (which involves the calculation of the distances between patient rooms and between patient rooms and nurses' stations) and its expanded version (to include utility stops) to compare two different layouts prior to design (KPS 182).
- While there is no consensus on whether an observation unit should be adjacent to an ED or not, this organization found success in a 14-bed unit located away from the ED. The location was based on available shell space along one hallway. Two types of rooms were used: single rooms with private bath for isolation precautions, and single rooms with shared hallway bath/shower. It also included decentralized nursing, a family lounge, clean and soiled utility rooms, and a reception desk. This design solution took into account that a separate unit within the hospital was superior to keeping the patients in the emergency department. The "Iowa model" of evidence-based practice was used to develop the observation unit with the following steps: 1. Identify a practice question: Improving care through a care delivery change through an observation unit. 2. Obtain support for the project: Care concept was submitted to the board and a 14-bed unit proposal was submitted to the finance committee and board of directors for approval. An IRB was not required for the study. 3. Form a team: An interdisciplinary team was used – physicians, nurses, administrators, support functions, other ad hoc members, and the architect. 4. Review the evidence: Literature review and a conference on best observation unit development and operation. 5. Implement: Established unit design, EMR design, patient care standards, and staffing levels. 6. Evaluate: Outcome measure defined by multiple stakeholders (service line, accounting, performance improvement, IT); outcomes established as a separate area in the enterprise data warehouse and tracked monthly (KPS 189).
- The location and design of corridors in relation to patient rooms can contribute to fall rates among populations of ambulatory patients; designers should consider the layout of rooms and hallways when certain units are intended

for patient populations who are at higher risk of falling. Handrail placement should be carefully considered in accordance with different patient recovery needs; height and length of the rails are especially important variables in both patient bedrooms and bathrooms (KPS 197).

- Physical designs that generally reduce clutter, obstructions, and the amount of constricted turning motions that a patient must make could reduce fall rates. Data analysis revealed that increasing the height of patient chairs could reduce physical instability in the participants. In bathroom spaces, the positioning of handles for balance and movement should be carefully considered so that patient stability is maximized. The authors also suggest that redesigning IV poles to make them easier to manage in restricted spaces could reduce the risk of patient falls (KPS 214).
- The authors strongly recommend the use of copper surfaces in multi-bed pediatric settings, especially for bed rails, faucet handles, intravenous poles, workstations, and nurses' pads (KPS 224).
- Statistical results and analyses from this study suggest that locating patients within private rooms may help deter instances of specific HAIs such as CLABSI. The results also imply that higher nurse-to-bed ratios also impact HAI rates; in instances where designers do not have the spatial resources required for additional private rooms, careful consideration could be given to the placement of nursing stations resources (KPS 242).
- To adopt this type of handover communication approach, the unit must have large sliding glass doors on patient rooms. This tool would have to be considered when decisions are being made in patient room configuration. Templates would have to be decided so that the highlighted areas for reporting can be embossed on the door. Obtaining input on the design from clinical staff is imperative in this design decision. The combination of the glass doors and the communication tool on the glass can be considered a patient safety design intervention (KPS 256).
- With or without any other extensive infection control procedures in place, the results from this study provide evidence for the efficacy of single-patient rooms in mitigating costly and dangerous cross-contaminations within ICUs, even with regard to drug-resistant bacteria. Single-patient rooms offer more variability for treatment options, and can even be designed with enhanced noise reduction in mind, potentially improving staff, patient, and institutional well-being in general (KPS 257).
- No direct connection was found between the study findings and the design of hospital spaces in either patient rooms or nursing stations. However, the authors point out the surfaces of higher microorganism concentration (like the floors, faucet handles, and bedrails). By being aware of the surfaces that might create additional risk for infection transmission, designers can better consider the best material characteristics for the project in coordination with the owner's cleaning regimens and other operational protocols (KPS 265).
- Participants surveyed in this study indicated that the beds they perceive as being the most private are those that are surrounded by fewer beds, have a larger area per bed, and have a longer walking distance to a healthcare worker's station. However, privacy must be balanced with safety, and patient-to-staff visibility is crucial in providing adequate care. Designs should strive to provide patients with a sense of privacy while also allowing healthcare staff to monitor patients and administer care optimally (KPS 279).
- When considering the mitigation of MRSA or other pathogen transmission in hospital design, increasing the numbers of single-patient rooms may not be the most effective solution. This study identified hand hygiene to be the only noticeable variable that affected MRSA levels; thus, the quantity of hand-washing sinks and their placement should be carefully considered (KPS 296).
- Although the study concluded that silent times were longer in the single room NICU, the study doesn't elaborate on what aspects of the environment contributed to the silent times. Hence, there are no design implications resulting from the findings of the study (KPS 304).
- Designers may consider adding a nurse to the design team for clinical and operational input for ICU design (KPS 308).
- Before implementing a widespread private-room format for NICU units, designers might consider nursing staff perspectives on how the structural shift might alter workflows and general communications. Should an NICU be renovated to accommodate more private rooms, designers might consider supplementing these spaces with more comfortable furniture and interior design accommodations for parents (KPS 320).
- This study indicated both open bays and single patient NICU room designs have different advantages. Pending further studies, designers may consider both open bay units and single patient rooms in NICUs (KPS 333).
- Window views and lighting should be incorporated into the design of patient rooms, but should include blinds that may be controlled to avoid glare and contrast as desired by occupants (KPS 337).
- The tool presented in the appendix should be used during the design process to assess existing and proposed bathrooms (KPS 353).
- Changes could be made architecturally by designing rooms with particular spatial properties and by optimizing the location of the nurse station to improve movement patterns. The study models used showed how the different layouts affected the nurses' movement patterns and how visits to patient rooms increased, leading to more care time spent. This simulation model could be used by healthcare planners and designers for the assessment of unit layouts against healthcare outcomes (KPS 357).

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Alp, Ömer Faruk
Correspondence: omerfarukaalp@gmail.com

EDUCATION

Degree	Institution	Graduation
Ph.D. (Candidate)	METU / Architecture	2022
M.Arch (RIBA Part II)	University of Newcastle Upon Tyne	2014
B.Sc in Arch.	Karadeniz Technical University	2011

EXPERIENCE

Year	Place	Enrollment
2008	EMAY International Engineering Consultancy Inc.	Intern. Architect
2015	Adıyaman Uni. / Dept. of Int. Arch.	Research Assistant
2015-2022	METU Department of Architecture	Research/Teaching Assistant

FOREIGN LANGUAGES

Turkish (native), English (advanced)

RESEARCH INTERESTS

Architectural design, research and practice; Knowledge management and representation; Health care building design, Evidence-based design, History and theory of architectural interventions in medical fields

SELECTED WORKS

2011 ‘Trabzon, Ortahisar Elderly Care Housing Complex’, BSc. in Arch Diploma Project / KTU, Turkey

2012 ‘The Global Shift in the Meaning of Healing Environments: Examples of five-star resort hospitals’, M.Arch Pre-dissertation / NCL, UK (unpublished)

2014 ‘Treating the Symptoms: A critical investigation of the profound changes in Turkish healthcare system through the example of Acibadem Maslak Hospital in Istanbul’, M.Arch Master’s Thesis / NCK, UK

2014 ‘Cosmetic Clinic in Istanbul’, M.Arch Diploma Project / NCK, UK

2015 ‘Research Genealogies: Epistemological Context of Environmental Psychology: From demarcating to interlinking’, ARCH615 Term Paper / METU, Turkey (unpublished)

2016 ‘The Enlightenment Period Pavilion Type Hospitals: Re-calling CoChorane Movement of 1970s’, ARCH616 Term Paper / METU, Turkey (unpublished)

2017 ‘Contemporary Health Discourse in Architecture: Architecture can promote health and well-being’, ARCH724 Term Paper / METU, Turkey (unpublished)

2020 ‘Formulating a Researchable Evidence-based Design Question: A course designed for Teaching EBD in Higher Architectural Education’, EDS 660 Term Paper / METU, Turkey (unpublished)

2022 ‘A Quest for Knowledge Synchronization between Evidence and Specification Knowledge Bases of Health Care Buildings Design Field: An ontology-based approach in Turkish context’, Ph.D. Thesis / METU, Turkey

SCHOLARSHIPS

2011 MEB: Ministry of Education of Turkey, International Post-graduate Education (YLSY) Scholarship

2018 YÖK: Council of Higher Education of Turkey, Doctoral Studies Abroad (YUDAB) Scholarship

TEZ İZİN FORMU / THESIS PERMISSION FORM

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences [+]

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences [ ]

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics [ ]

Enformatik Enstitüsü / Graduate School of Informatics [ ]

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences [ ]

YAZARIN / AUTHOR

Soyadı / Surname : Alp
Adı / Name : Ömer Faruk
Bölümü / Department : Mimarlık/Architecture

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English) :

A QUEST FOR KNOWLEDGE SYNCHRONIZATION BETWEEN EVIDENCE AND SPECIFICATION KNOWLEDGE BASES OF HEALTH CARE BUILDINGS DESIGN FIELD: AN ONTOLOGY-BASED APPROACH IN TURKISH CONTEXT

TEZİN TÜRÜ / DEGREE: **Yüksek Lisans** / Master [ ] **Doktora** / PhD [+]

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. [+]
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two year. *** [ ]
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months**. ***** [ ]

***** *Enstitü Yönetim Kurulu Kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir.*
A copy of the Decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.

Yazarın imzası / Signature ..... **Tarih** / Date .....