Perkins&Will

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Research Journal

Journal Overview

The Perkin&Will Research Journal documents research relating to the architectural and design practice. Architectural design requires immense amounts of information for inspiration, creation, and construction of buildings. Considerations for sustainability, innovation, and high-performance designs lead the way of our practice where research is an integral part of the process. The themes included in this journal illustrate types of projects and inquiries undertaken at Perkins&Will and capture research questions, methodologies, and results of these inquiries.

The Perkins&Will Research Journal is a peer-reviewed research journal dedicated to documenting and presenting practice-related research associated with buildings and their environments. The unique aspect of this journal is that it conveys practice-oriented research aimed at supporting our teams.

This is the 26th issue of the Perkins&Will Research Journal. We welcome contributions for future issues.

Research is a systematic investigation into existing knowledge to discover or revise facts or add to knowledge about a certain topic. In architectural design, we take an existing condition and improve upon it with our design solutions. During the design process, we constantly gather and evaluate information from different sources and apply it to solve our design problems, thus creating new information and knowledge.

An important part of the research process is documentation and communication. We are sharing the combined efforts and findings of Perkins&Will researchers and project teams within this journal.

Perkins&Will engages in the following areas of research:

• Practice related research

• Resilience and sustainable design

• Strategies for operational efficiency

• Advanced building technology and performance

• Design process benchmarking

• Carbon and energy analysis

• Organizational behavior

Editorial

This issue of the Perkins&Will Research Journal includes a dedication to John Haymaker, our Director of Research, who took our practice to the next level, keeping us endlessly curious and consistently cutting-edge, and three articles that offer insight into different research topics—research that aims to provide insights into the myriad factors influencing the need for psychiatric crisis services as to how design can be leveraged to support human-centered care, a design checklist that will help the community to improve their maternal health system and avoid preventable deaths and complications for birthing mothers, and a study with the intent to propose relevant solutions for the challenges COVID-19 brought to the aging population as they attempted to access their healthcare needs virtually.

"Care in the Time of Crisis: Designing for Patients with Behavioral Health Needs in the Emergency Department" presents research focused on specialized patient care models that guarantee immediate access to psychiatric care and connect patients with ongoing support which improves overall emergency department patient throughput resulting in decreased wait times and length of stay. It also reduces utilization in admissions and readmissions and reduces the total cost of care for behavioral health patients and makes provisions for quality acute care for patients in crisis.

"Reimagining Birthing Unit Design: A Qualitative Study to Improve Women's Birthing Experience in Hospitals" aims to identify and explore the links between design practices with an intent to resolve the issue of maternal mortality with the purpose of reimagining spaces that are designed for birthing models and solve the physical challenges that evolve during care provided to birthing mothers.

"Impact of Virtual Healthcare on an Aging Population: Future of Care Delivery for the Elderly" showcases the challenges faced by the elderly population brought upon by the innovations in technology and other environmental design factors post-pandemic as it pertains to their healthcare needs. It highlights the urgent need to rethink the design of the built environment to make it truly inclusive and universal for the well-being of the aging population in the present and the future.

Kalpana Kuttaiah, Associate AIA, LEED AP® BD+C

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In Remembrance

John Haymaker

1967-2022

The passing of John Haymaker has been felt extensively throughout our firm. John touched so many lives—his colleagues, his students, his academic partners, his industry collaborators, and everyday people in the communities we serve. As our friend, he listened, he cared, and he made us smile. As a researcher, he authored and co-authored over 100 peer-reviewed papers which have been cited well over 3,000 times.

As our Director of Research, he took our practice to the next level, keeping us endlessly curious and consistently cutting-edge. Indeed, John saw our professions's challenges—but he constantly pushed us to discover new knowledge to design a better world. He thought about design in ways no one else could.

As we honor John's life, on the following pages are a few key contributions he made to our firm and our profession, the value of which are immeasurable.

You can click on the thumbnails or titles to learn more.
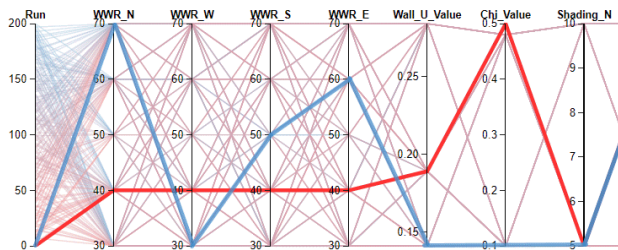
Published Research

Integrating expertise and parametric analysis for a data-driven decision-making practice

Published in 2020 in the *International Journal of Architectural Computing,* the study explores the specification of geometric and material properties pertaining to daylight quality and energy consumption and how they might benefit from parametric data analysis.
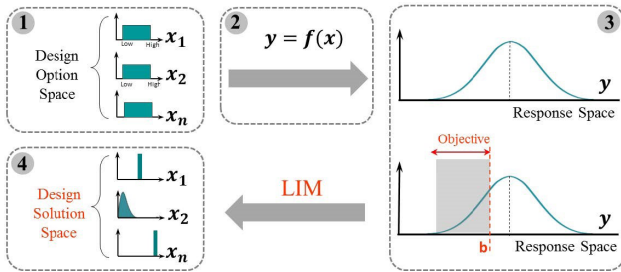

Published Research

A new approach to performance-based building design exploration using linear inverse modeling

Rising from the lack of a systemic framework for designers to make energy-oriented decisions in the early stages of design, this *Journal of Building Performance Simulation-*2018 published study proposes using linear inverse modeling to reach feasible solutions and offer more confidence.
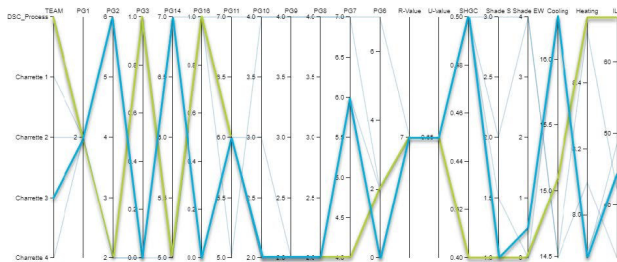
Published Research

Design Space Construction: A Framework to Support Collaborative, Parametric Decision Making

The goal of this paper is to offer design teams a framework to maximize social, environmental, and economic value in their projects. It was published in the *Journal of Information Technology in Construction* in 2018.
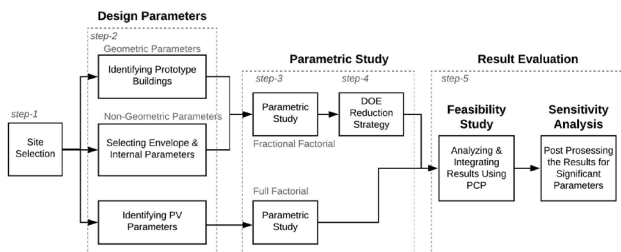
Published Research

Parametric framework for a feasibility study of zero-energy residential buildings for the design stage

This article offers a symmetrical framework to study the feasibility of achieving a zero-energy building. It was published in the *Journal of Building Engineering* in 2021.
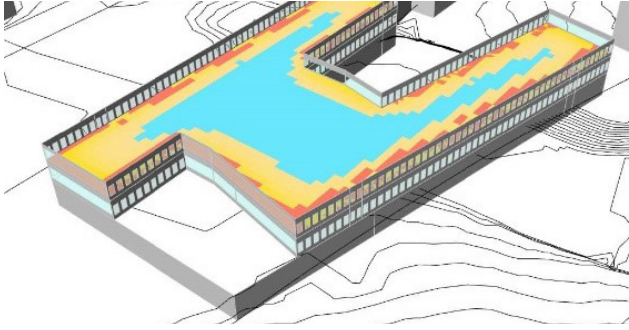
Published Research

Parametric Analysis versus Intuition - Assessment of the effectiveness of design expertise

Published in the joint 2019 SiGraDi-eCAADe conference, this paper employs professional case studies on design solutions produced by teams of experts versus those from systematic parametric analysis. The results showed consistent performance improvement after systemic optimization.

Published Research

Constructing Design Spaces: Case Studies in Parametric Building Performance Analysis at Perkins&Will

Published in a 2018 *Perkins&Will Research Journal,* this article discusses three case studies that have undertaken Design Space Construction for performance-driven building design.
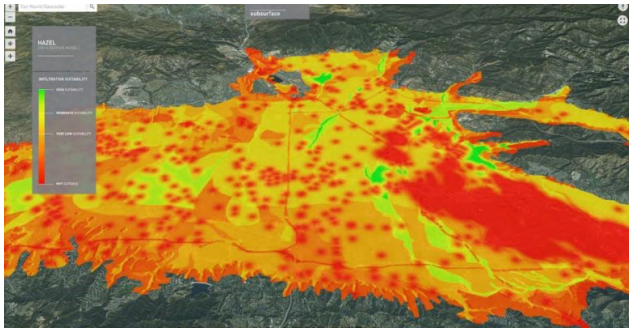
Grant

AIA College of Fellows 2015-2017 Latrobe Research Prize for the Dry Resilience Initiative

A grant-funded collaboration with the Arid Lands Institute out of Los Angeles, this initiative developed a water analysis tool to accelerate smart planning, design, and development for arid cities around the globe. The tool lives on, valued for its ability to advise on resilient water policies.

Grant

American Society of Interior Designers Grant for "Stand Up to Work"

Evaluating behavioral changes in workers who receive adjustable workstations in their office, grant-funded Stand Up to Work explored the impacts of standing desks, which have since been widely adopted.

Grant

University of California San Francisco Grant for the School of Medicine's Mission Hall Workplace Research Study

This grant-funded study examined alternative strategies in academic workplaces based on individuals' surveyed satisfaction, well-being, work effectiveness, and engagement. The study results helped define the brief for a subsequent renovation project, completed in 2019.

01

Care in the Time of Crisis:
Designing for Patients with Behavioral Health Needs in the
Emergency Department

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Abstract

Behavioral health needs are increasing at an alarming rate with one in five adults experiencing a mental illness of varying acuity. Prior research shows that 68 percent of adults with behavioral health conditions also have chronic medical comorbidities.

However, current behavioral health services are plagued by access, payment, and provider gaps. The lack of care continuity results in a failure to engage patients before their needs become severe. As a result, patients with behavioral health needs often present in the Emergency Department for initial treatment. Given that one out of every eight emergency department visits is due to a behavioral health issue, inappropriate utilization of the emergency department is a serious concern. The unpredictable volume of behavioral health patients prevents timely triage, increases wait times, stretches physicians, and requires a higher level of immediate, specialized care that strains many emergency departments. Consequently, behavioral health patients are often placed in emergency department spaces that are not designed to treat them, which can be dangerous and demoralizing for both patients and staff.

Some providers have begun to dedicate specialized support models that guarantee immediate access to psychiatric care and connect patients with ongoing support which improves overall emergency department patient throughput resulting in decreased wait times and length of stay. It also reduces utilization in admissions and readmissions and reduces the total cost of care for behavioral health patients. This research aims to provide insights into the myriad factors influencing the need for psychiatric crisis services and how design can be leveraged to support human-centered care. The research documents expert interviews with clinicians and behavioral health designers; interventions that serve behavioral health patients and the associated outcomes in the function and flow of emergency department services; ultimately facilitating the provision of quality acute care for patients in crisis.

Keywords: *behavioral health, emergency department, acute care, utilization, care quality*

1.0 Introduction

Behavioral health encompasses people's psychological well-being and ability to function in everyday life. In this article, behavioral health is an umbrella term that includes conditions such as mental health disorders and substance use disorders. There is a growing body of evidence that links behavioral health to physical health.[1] Counselors, social workers, therapists, specialized nurses or nurse practitioners, psychologists, and psychiatrists help manage patients' behavioral health needs. Treatment includes therapy, counseling, and medication.

Low-acuity behavioral health needs are the most common.[1] Patients with low-acuity behavioral health needs can function socially and professionally without ongoing support, but they benefit from early identification and prevention. Patients with

moderate-acuity behavioral health needs often have trouble functioning socially and professionally. They require low-intensity, ongoing support to improve functioning, facilitate self-management, and prevent symptom escalation. Patients with severe and persistent behavioral health needs require constant support to allow for semi-independent functioning.

Historically, behavioral health has been funded, structured, and researched separately from other clinical conditions. However, policymakers, payers, and health systems are increasingly recognizing that behavioral health is an essential part of physical health and population health. In recent years, there has been an increased focus on aligning behavioral health with other health services. Emergency departments are not equipped to assist those experiencing an exacerbation of serious mental illness.[2,3] Jails and prisons have become de facto mental institutions where those suffering from severe mental illness are unlikely to receive the care and services they need.[4] Improving behavioral health has the potential to significantly improve clinical outcomes and healthcare costs.

This article is intended to describe the need for dedicated facilities in which emergency services are rendered to stabilize behavioral health patients in crisis; provide design guidance for the creation of healing spaces beyond the requirements in the FGI Guidelines for Design and Construction documents for hospitals and outpatient facilities; and ultimately be a resource for architects and planners who intend to conduct further research on designing for patients with behavioral health needs. The narrative literature review covers the prevalence, utilization, access to appropriate services, the national suicide prevention and mental health crisis hotline, emergency departments, and the role of architects and planners.

1.1 Prevalence and Utilization

Behavioral health conditions are prevalent with 20 percent of the adult population living with a behavioral health disorder. Approximately 70 percent of patients with a behavioral health condition have medical comorbidity.[2] Additionally, "deaths of despair" (from alcohol, drugs, or suicide) have more than doubled since 1999. Despite the prevalence of behavioral health conditions, they often go untreated. Notably,

57 percent of adults with behavioral health conditions did not receive treatment. A consequence of the lack of treatment is the "deaths of despair" that have been associated with substance-use disorders. In 2018, 182,000 adults died from alcohol and drug-related causes.[2] Behavioral health needs are not limited to the adult population alone. Simultaneously, there is an increasing trend of behavioral health cases in the adolescent population with 13 percent of the adolescent population reporting a major depressive episode. Concurrently, research shows that there has been a 60 percent increase in adolescent suicide rates in 2018, increasing from a stable rate between 2000-2007.[4,5]

Behavioral health conditions are some of the costliest comorbidities due to inappropriate care utilization and poor outcomes across conditions.[3] Prior research shows that 68 percent of adults with behavioral health conditions also have chronic medical comorbidities. Current approaches to addressing behavioral health needs are often inadequate and fragmented. These approaches lead to poor outcomes. In 2017 alone, deaths related to suicide, alcohol, and drugs reached the highest rate since the Centers for Disease Control and Prevention (CDC) began collecting this data in 1999.

Treating patients with behavioral health diagnoses cost about $900 more per month than patients without such diagnoses. The cost differential increased by 27 percent from 2014 to 2017. Spending on behavioral health services has reached roughly $280 billion in 2020—5.5 percent of total health care spending. With the ongoing shift to value-based reimbursements, managing the health of complex behavioral health (behavioral health) patients is crucial to reducing expensive over-utilization.

1.2 Access to Appropriate Services

Current behavioral health services are plagued by access, payment gaps, and provider shortages that continue to limit access to reliable treatment. Provider shortages, stigma, and limited reimbursement create significant barriers to timely, cost-effective behavioral health care. A 2016 report by the Health Resources and Services Administration (HRSA) shows a 20 percent decrease in the supply of adult psychiatrists from 33,650 in 2017 to 27,000 by 2030.[8] The report indicated significant shortages of psychiatrists, psychologists, and social workers, school counselors, and marriage and

family therapists. The magnitude of provider shortages, however, is not the only issue when considering access to behavioral health services. Non-uniform distribution is the other major concern, as certain areas of the country have few or no behavioral health providers available.[9] Access to mental health services is especially critical in areas besieged by poverty.[10]

The lack of care continuity results in failure to engage patients before their needs become severe. Patients with a behavioral health need often present in the emergency department for initial treatment. Most notably, many providers struggle to address surging psychiatric emergency department visits nationwide. In recent years, behavioral health-related emergency department visits have increased by 44 percent, but only 17 percent of emergency department physicians say they have access to on-call mental health professionals.[3,5] Due to increased rates of mental illness and the fragmentation of mental health resources across U.S. communities, the number of patients requiring behavioral health treatment who present to U.S. emergency departments is on the rise.[5,6] Given that one out of every eight emergency department visits is due to a behavioral health issue, inappropriate utilization of the emergency department is a serious concern for many providers.[3] Rates of emergency department visits increased from approximately 14.1 emergency department visits to 20 emergency department visits per 1,000 population from 2006 to 2014.[3] During this same period, the rate of mental health and substance abuse-related emergency department visits increased by 44 percent.[7] These visits are three times longer than those of patients with

nonpsychiatric needs and significantly more costly. Many emergency departments are too loud, bright, and busy to help patients in a behavioral health crisis stabilize. To address this, health systems are investing in a variety of specialized emergency services, including telepsychiatry, holding units, emergency department co-located crisis services, and behavioral health-specific emergency units.

1.3 The National Suicide Prevention and Mental Health Crisis Hotline

With the unpredictable volume of behavioral health cases flooding the healthcare system, the Senate and House passed the National Suicide Hotline Designation Act which required the Federal Communications Commission to designate 988 as the new phone number for a national suicide-prevention and mental health crisis hotline.[4]

The new 988 mental health crisis line went live on July 16th, 2022. Federal health officials estimate may receive up to 12 million calls and texts in its first year alone.[4] Prior research has projected that 80 percent of this call volume can be resolved over the phone without dispatching mobile crisis teams, law enforcement, or emergency medical services. However, the remaining 20 percent represents a patient population that requires extremely high acuity care.[4,5]

Even if the hotline is successful in shifting over-reliance on law enforcement, it will overwhelm health systems, particularly Emergency Departments. With the launch
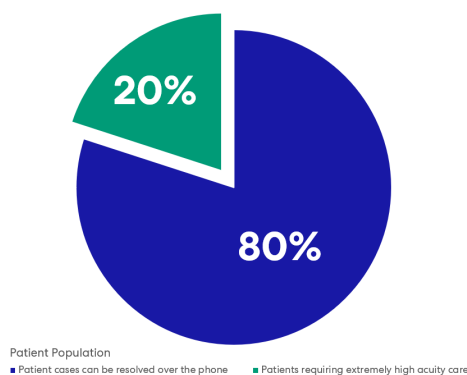

Figure 1: *Patient population requiring varying acuity care.[4,5]*
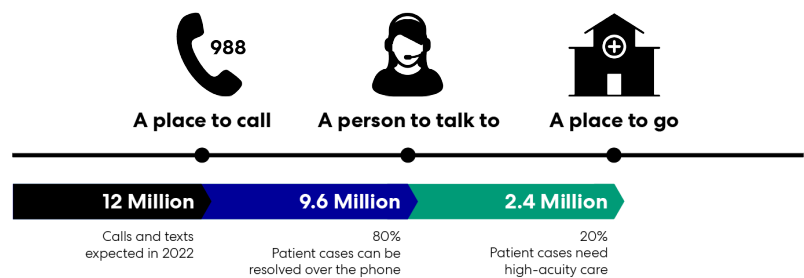

Figure 2: *Crisis care continuum- Alignment of crisis services toward a common goal of optimal care for individuals in behavioral health crisis.[4,5,11]*

of the crisis line, experts argue that demand for acute behavioral health services will outstrip supply as there are not enough beds at appropriate levels of care to respond to this surge in demand. Gaps in behavioral health services negatively impact clinical outcomes, health care utilization, and total cost of care. For many advocates and leaders, the hotline launch serves as an inflection point to reimagine the crisis care continuum starting with the front door to safer, better crisis services.

The current approaches to addressing behavioral health needs are often inadequate and fragmented which leads to poor outcomes. Given the limited availability of psychiatric beds, emergency department staff often "board" patients presenting in acute crisis, who must then wait for appropriate care in a hectic environment that can exacerbate their symptoms. As a result, patients with psychiatric emergencies wait three times longer in the emergency department than non-psychiatric patients, costing an additional $2,200 per visit and experiencing worse clinical outcomes.

Furthermore, between 1998 and 2013, the total number of psychiatric beds in the United States decreased from 34 to 22 beds per 100,000 population, a 35 percent reduction from an already low base rate of psychiatric beds per population. This reduction in the number of psychiatric beds led to higher bed occupancy rates, significantly lower average inpatient length of stay, and prolonged emergency department waiting times for patients with psychiatric illness who need to be hospitalized, all of which have contributed to an increased threshold for admission and decreased threshold for discharge for patients at risk of suicide.

1.4 Emergency Departments

Today in the United States, nearly 50 percent of all hospital care begins in the emergency department, and, over the last 20 years, the emergency department patient volume has increased by 23 percent as many Americans use the emergency department to access primary care services.[12] As a result, the emergency department has become the primary front door for health care; receiving more than 200 visits a minute.[13] Additionally, patient experience and perception of care received at the emergency department impact a health system's brand and ultimately its Net Promoter Score.[14]
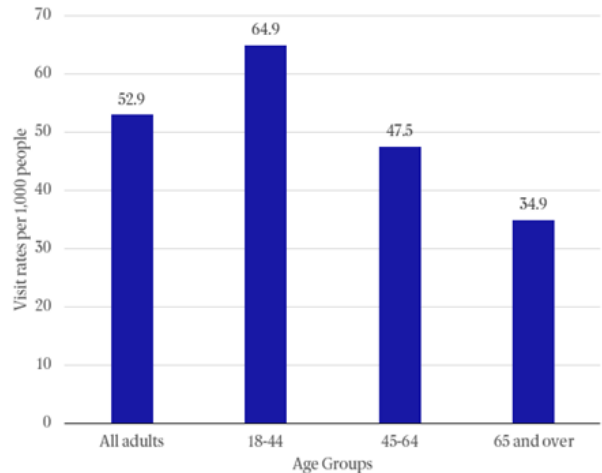
Source: National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey, 2017–2019

Figure 3: *Emergency Departments visit rates for adults with mental health disorders, by age group: U.S. 2017-2019.*
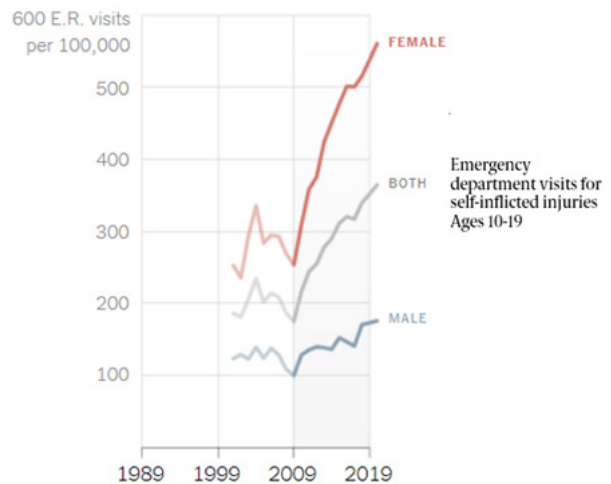
Source: Centers for Disease Control and Prevention

Figure 4: *Emergency Departments visits for self-harm by children and adolescents rose sharply over the last decade, particularly among young women.*

In the United States, emergency departments are required to stabilize all patients under the Emergency Medical Treatment & Labor Act (EMTALA), regardless of their ability to pay, though they can be billed for those services afterward.[15] When there is inadequate access to primary care or preventive care, patients may need to rely on the emergency department. Even when an

individual has a regular source of care, if they are not open at night, on weekends, or have long waits for an appointment, they may not be accessible when they are needed. Several previous analyses have indicated that access and convenience play an important role in the choice to seek care in an emergency department.[16] Individuals may also not have a regular primary care provider, particularly if they are uninsured or newly insured.[17] Other studies have shown that a significant number of patients seeking care in the emergency department are referred there by their primary care physician, in some cases because the regular provider does not have available appointments.[18,19]

A challenge in the emergency department is the potential for crowding, which can have several adverse consequences, including longer wait times, and worse health outcomes including higher mortality for patients.[20,21] Crowding and wait times are not just a function of the volume of patients, but also of how quickly they are assessed and moved through. Behavioral health patients, for instance, can be slower and more difficult to process because of a shortage of behavioral health beds.[21] The unpredictable volume of behavioral health patients prevents timely triage, increases wait times, stretches physicians thin, and often requires a higher level of immediate, specialized care that strains many emergency departments. As a result, behavioral health patients are often warehoused in emergency department spaces that are not designed to treat them, which can be dangerous and demoralizing for both patients and staff.[21]

1.5 The Role of Architects and Planners

The new focus on population health has changed the market.[5] As health systems take on the risk of caring for large populations, managing the health of complex behavioral health patients is crucial to reducing expensive over-utilization.[22,23] As the rising prevalence and changing economics in behavioral health lead to a surge in new builds and renovations, architects and planners in tandem with providers can truly support patients. Since traditional emergency departments do not have sufficient resources to treat patients with

acute behavioral health concerns, some providers have dedicated specialized support models intending to guarantee immediate access to psychiatric care and connect patients with ongoing support. Dedicating urgent psychiatric services improves overall emergency department patient throughput (e.g., decreased wait times, length of stay), reduces utilization (e.g., admissions and readmissions), and reduces the total cost of care for behavioral health patients.

2.0 Methodology

2.1 Literature Review

A narrative review of the literature was conducted to understand current trends in mental and behavioral crisis care. The review included a total of over 60 sources. The keywords used in the search included:

1. Emergency Severity Index (ESI)
2. Psychiatric boarding
3. Behavioral Health
4. Substance-use disorders (SUDs)
5. Psychiatric stabilization
6. EMPATH units
7. Emergency department utilization
8. Environmental Safety Assessment Risk

Search databases included Google Scholar, PubMed, American Psychology Association, Research Gate, and multiple academic and professional journals.

2.2 Expert Interviews

Ten interviews were conducted with industry experts ranging from care providers of psychiatric and emergency medicine (n=6), architects and planners specializing in the planning and design of mental and behavioral healthcare facilities (n=4), and anonymized patient accounts (n=3). These semi-structured interviews included long-form qualitative descriptions of the constructs illustrated in Figures 5 and 6.

The built environment

Process Improvement

Triage and assessment process

Stabilization and de-escalation

Staff interactions

Patient dignity protocol

Transfers

Care continuity

Patient Experience

Access

Milieu experience

Prospect-refuge theory

Social support

Crowding

Privacy

Sights & sounds

Positive distraction

Longitudinal effects

Long-term effects

MBH stigmas & stereotypes

Ideal state operations and patient experence

Figure 5: *Qualitative interview constructs—the relationship between the built environment and psychiatric care.*

Impact

Financial Impact

Increase in hospital ED's fiscal bottom line

Operational Impact

Bed turnover time, reduced LOS in the ED

Shorter wait times

Reduced 30-day psych patient return to ED (recidivism)

Reduced inpatient admissions; reduced psychiatric bed utilization

Opening beds for non-psych patients

Improved outpatient follow up of patients

Clinical Impact

Reduced use of sedation medications

Reduced escalation behavior

Reduced use of restraints

Improved staff experience

Figure 6: *Understanding the outcomes—the financial, operational, and clinical impact of interventions.*

2.3 Case Studies

Four crisis care facilities were selected based on their unique crisis care design strategies. The facilities were analyzed to demonstrate the range of design options based on the assumed patient population and operational strategy which included understanding patient flows and the triage process for psychiatric crisis patients. The author also had the opportunity to attend a user group meeting for the expansion of the Northside Hospital Gwinnett project which included new behavioral health pods. The facilities selected for case studies include:

1. University of Virginia University Hospital Expansion, Charlottesville, NC

2. Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA

3. Duke Health Regional Hospital Behavioral Health Expansion and Emergency Department, Durham, NC

4. Emergency Psychiatric Assessment, Treatment, And Healing (EmPATH) Unit

3.0 Results

The results from the literature review, expert interviews, and case studies can be broadly classified under deinstitutionalization of psychiatric services; psychiatric boarding; balancing privacy and safety; theory of supportive design, and the business case for investing in the behavioral health service line.

3.1 Deinstitutionalization of Psychiatric Services

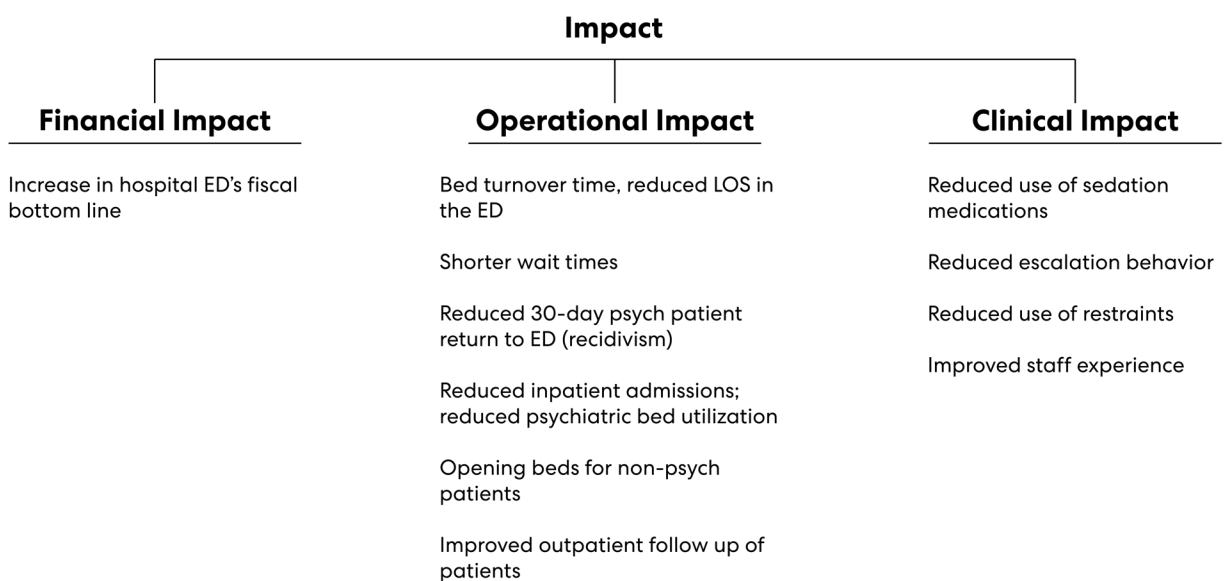Over the past 40 years, services for psychiatric patients have become increasingly deinstitutionalized, shifting away from inpatient facilities. As a result, inpatient beds have dwindled to less than 50,000 nationwide, forcing patients to seek other avenues for treatment, including outpatient facilities, outpatient medical management groups, and community resources.[25,26] There has been a 35 percent decrease in the number of psychiatric beds between 1998–2013 arising from the deinstitutionalization of psychiatry.[27,28] Unfortunately, those resources have also become increasingly constrained by widespread budget cuts, leaving patients with the health care system's last remaining safety net— the emergency department.[27]

3.2 Psychiatric Boarding

Psychiatric boarding is the holding of a behavioral health patient in the emergency department, while an inpatient bed or other appropriate placement is sought.[28] Interviewees (n=6) reiterated that the effect of psychiatric boarding on patient health, hospital finances, and staff resources have long been acknowledged, yet the problem persists. This is fueled by the drastic decrease in inpatient psychiatric beds by 35 percent between 1998 and 2013, the increase in opioid use disorder cases, and inadequate community-based alternatives.[27,28]

In response, the Substance Abuse and Mental Health Service Administration (SAMHSA) has issued several documents outlining the appropriate use and best practices for reducing behavioral health treatment in emergency departments.[28] Among these is the February 2020 "National Guidelines for Behavioral Health Crisis Care," a best practices toolkit for providers, communities, and the public.[28] The toolkit has been combined with related papers contributed by industry addressing key issues relevant to crisis services, homelessness, technology advances, substance use, legal issues impacting crisis services, financing crisis care, diverse populations, children and adolescents, rural and frontier areas, and the role of law enforcement.[29,30,31,32]

3.3 Balancing Privacy and Safety

The New York University Emergency Department Visit Severity algorithm separates visits into non-emergent, emergency but primary care treatable, emergent emergency department care needed but preventable, and emergency care needed and not preventable/ avoidable. Interviewees (n=5) stated that the caveat with this algorithm is that injuries and mental health/ SUD cases are their own category and are not assessed to their level of urgency or ability to be avoided.[24]

A recurring theme in the literature review and expert interviews was the need for security while also promoting safety. Undoubtedly, interviewees (n=4) suggest that there is tension between ensuring security and promoting a therapeutic environment and sometimes facility planners need to prioritize one over the other. Interviewees (n=3) also suggested the need for planners to understand the environmental safety assessment risk framework developed in the behavioral health

design guide (Figure 7). The case studies are examples of innovative facilities that employ one or more design characteristics to best navigate the tension in emergency and extended stay behavioral health settings.[24,16]
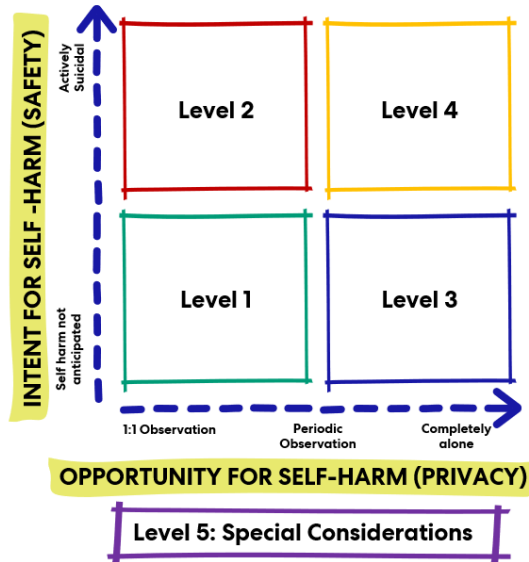
Source: Adapted from Hunt, J. M., Sine, D. M., DrBE, C. S. P., & ARM, C. (2018). Behavioral health design guide.

Figure 7: *Environmental Safety Assessment Risk.*

3.4 Theory of Supportive Design

Scientific research pioneered by Ulrich et al. suggests that healthcare environments support coping with stress and promote wellness by providing space flexibility; access to nature; calming interior design elements; positive distractions and clear lines of sight. To achieve safety, privacy and comfort, designers are implementing these five core tenets of healing design in a new era of behavioral health environments.[33,34]

1. Space flexibility enables facilities like emergency departments to accommodate large volumes of behavioral health patients, but also flex to meet the needs of non-behavioral health patients.[35]

2. Access to nature and/or natural light creates a relaxing atmosphere to help individuals de-escalate.

3. Calming interior design, including color palette, wall decorations, and furniture, contributes to the therapeutic environment.

4. Positive distractions, such as music, televisions, arts and crafts, and exercise areas supplant patients' anxieties.

5. Clear lines of sight from nurse stations are essential to preserving the security and safety of patients and staff.[36]

3.5 Establishing the Business Case

In the interviews, clinical experts (n=5) agree that emergency departments, inpatient psychiatric units, local law enforcement, and community-based services have limited resources and competing priorities. Despite the high prevalence of acute needs, interviewees (n=4) suggested that reimbursement for behavioral health services is inconsistent across payers and sites of care. After assessing behavioral health access in their market, health systems often start where they experience the highest patient demand for initial treatment: primary care and the emergency department.[37,38,39] The business case for targeted investments in behavioral health facilities can be broadly categorized under the financial impact, operational impact, and clinical impact.[40,41]

3.5.1 Financial Impact

Patients with a behavioral health diagnosis incur 2-3 times more cost than those patients without a diagnosis. Within the emergency department, behavioral health patients often require extended specialty care. Each behavioral health visit to the emergency department prevents 2.2-bed turnovers and results in a loss of $2,265.[25]

3.5.2 Operational Impact

Emergency department staff are often ill-equipped to address patients' behavioral health needs, increasing length of stay by 38 percent and slowing throughput. A patient with a psychiatric emergency waits more than three times longer than a patient with non-psychiatric needs, blocking at least two patients from receiving more timely care.[24,16]

3.5.3 Clinical Impact

Adults suffering from mental health conditions are more likely to have medical comorbidity and often experience worse clinical outcomes due to poor self-management.[31,20] For example, depression is consistently associated with an increased risk of poor glycemic control, complications, and care utilization for diabetic patients.[20]

3.6 Case Studies

3.6.1 University of Virginia University Hospital Expansion, Charlottesville, VA

University of Virginia Health System is a large academic system in Charlottesville, Virginia. It is a designated Level I Trauma Center with a high admission rate of 25 percent. The Emergency Department in 2013 had 41 exam rooms, two trauma rooms and there were no dedicated behavioral health rooms. Each time a behavioral health patient was seen in the Emergency Department, the staff had to remove all equipment, supplies, or chairs in the rooms to provide a safe environment. Designed to address critical medical and behavioral health needs for upwards of over 70,000 patients annually, the new emergency department was designed and nearly doubled the health system's prior emergency room capacity, significantly reducing patient wait times. The prior facility's Emergency Department beds frequently reached full capacity and these patients had to be treated on stretchers in hallways. It was important to the facility to provide for patient privacy, safety, and dignity.

One of the key features of the design was flexibility/adaptability. This allows the Emergency Department to immediately adjust to variations in workload and patient types such as adults, adolescents, and children.

A dedicated pediatric check-in and waiting room welcome the health systems' youngest patients with bright yellow couches, child-sized seating, a playfully shaped ceiling light, and views of the light-filled atrium. An interactive wall depicting a topographical map of the Shenandoah Valley invites children to play with built-in animal figures that can be slid along tracks. Also, among the new spaces in the new emergency department are eight secure behavioral health rooms—separate from the hustle and bustle of the emergency department—that provide a safe, calming environment for patients in acute mental health distress. Bright clerestory windows in these rooms usher in natural light, creating a soothing effect.

The large team workstation in the behavioral health module allows for collaboration between staff and providers. Being an academic center, the workstations required enough space for rounding with several students. The medications, supplies, and equipment are maintained in the module to increase efficiencies and decrease walking distances. Three of the rooms can be cordoned off from the rest of the behavioral module so they can flex if needed with the adjacent emergent Emergency Department module rooms or be used for pediatric behavioral health patients separated from the adult population. Anti-ligature-resistant resistant hardware is used throughout the module.

Glass partition ensures staff safety & privacy

Flexible room swings between BH and Peds

Windows provide access to nature and natural light

Clear lines of sight from nurse's station ensure security

Figure 8: *Emergency department, University of Virginia University Hospital Expansion, Charlottesville, VA, Perkins&Will.*

Clinical staff at University of Virginia Health System served as expert interviewees. The team approached the project with a "build and they will come" approach, which ultimately led to other hospitals and providers sending their patients to the new behavioral health unit. As a result, the emergency department is absorbing greater community needs and will need to find flexible options to expand the behavioral health unit. The current behavioral health unit is fully occupied and is under-resourced due to a lack of supply due to growing demand. As a result, behavioral health patients have a longer length of stay.

The unit staff prefers the separation of their team station from the corridor. The glass enclosure provides visibility and controls sound and a level of safety. The unit staff prefers an intercom system inside the behavioral health team station so they can better understand everything being said in the hallway, and interviewees (n=1) have indicated that the space is good for this type of interaction. There is a lack of consult rooms, specifically, a family consult room. This room was on the conceptual drawings but was ultimately removed as a security measure. Currently, a regional staff member works with patients with legal orders in this space. The staff has positive feedback on the large bathrooms in the behavioral health area. Earlier, they did not have a patient shower in this space but were added to the project program prior to the unit becoming operational.

The behavioral health unit is an open unit due to state regulations. However, there are different rules for a locked unit. Patients stay in the room and patient observers sit outside the room, in the corridor. Within the behavioral health unit, the patient room doors are left unlocked. Staff indicated recommendations for acoustic treatment of the behavioral health module to reduce noise in the patient areas. The patient observers sit directly outside the patient rooms in the corridors which have poor acoustical quality.

3.6.2 Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA

Northside Hospital Gwinnett Emergency Department Expansion was conceived with the idea that having separate areas for behavioral health patients is the first step to accommodating behavioral health needs in its new 5,000-square-foot "behavioral health holding unit" in the emergency department. The unit, designed by Perkins&Will and JE Dunn Construction is attached to the emergency department via a secure hallway and can accommodate up to twelve patients at a time.

Prior to the renovation of the new area, the behavioral health patients were treated in a large room that could accommodate three stretchers and three recliners. Due to privacy issues, they did not like to hold more than three patients at a time in this room. They also tried to keep only same-sex patients in the room, and the room was not a locked unit. A high-risk and suicidal or homicidal patient was not placed in this area but retained in the treatment rooms in the main Emergency Department. The closest bathroom for this space were in the main Emergency Department. The closest shower room for these patients was on the second floor. The camera within the room was monitored by the tech in the adjacent trauma nursing station. Patients stayed in this area for several hours, up to several days awaiting placement and transfer to other facilities. The mental health evaluators had to utilize a desk in another area of the Emergency Department to do their paperwork because there was no space allocated for them near the behavioral health room. These patients were considered low-risk, but there were concerns about possible elopement from the area. Security was distant from this room and visibility was limited. The area for these patients needed to be updated for these patients' safety.

Each patient bay is outfitted with positive distractions, such as a TV covered with unbreakable material and a window. Clinical interviewees (n=3) reiterate that space flexibility helps even small facilities achieve separation through swing rooms. A strategy to meet behavioral health patients' needs in the emergency department was the provision of positive distractions within separate behavioral health areas. The holding unit's separation from the emergency department, combined with its incorporation of positive distractions, helps patients de-escalate more quickly while also increasing the throughput of non-behavioral health patients in the main emergency department. By embracing positive distractions, the unit has balanced the security/comfort tension in a way that benefits both behavioral health and non-behavioral health patients.

Figure 9: *Emergency department plan, Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA, Perkins&Will.*

Glass partition ensures staff safety & privacy

Calming color palette reduces anxiety

Windows provide access to nature and natural light

Clear lines of sight from nurse's station ensure security

Figure 10: *The nurse's station in the behavioral health holding unit, Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA, Perkins&Will.*

Curved edges to promote safety and comfort

TVs promote positive distraction

Windows provide access to nature and natural light

Clear lines of sight from nurse's station ensure security

Figure 11: *Treatment bays for low-risk patients in the behavioral health holding unit, Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA, Perkins&Will.*

Curved edges to promote safety and comfort

Calming color palette reduces anxiety

Flexible room used for patient de-escalation or naps

Clear lines of sight from nurse's station ensure security

Figure 12: *Patient nooks (left), treatment bays (right), and de-escalation rooms (further right) in the behavioral health holding unit, Northside Hospital Gwinnett Emergency Department Expansion, Lawrenceville, GA, Perkins&Will.*

3.6.3 Duke Health Regional Hospital Behavioral Health Expansion and Emergency Department, Durham, NC

Durham Regional Hospital, now Duke Health Regional Hospital, for years served many patients through the Emergency Department. They were continuously trying to meet the needs of patients experiencing behavioral health issues. The emergency department was initially designed to accommodate between 25,000 to 35,000 patients per year. The number of high acuity cases in the emergency department has now increased to around 64,000 per year. An expert interviewee (n=1) stated that the increase in behavioral health cases led to the expansion of the current emergency department. The Duke Behavioral Health Center North Durham at Duke Regional Hospital is the realization of their vision. Changes in the healthcare market include more patient-centered care that involves the family and community.

Within the expanded Emergency Department there is a secured unit of private rooms to specifically meet the needs of behavioral health patients. The new Behavioral Health Center consolidated Duke University Hospital's and Duke Regional hospital's behavioral health inpatient units into one private unit. They also relocated their clinic, electroconvulsive therapy (ECT), and outpatient services to this facility. The design considerations included enhancing efficiency through adjacencies and enabling a safe, healing environment for high-risk and low-risk patients. The facility incorporated state-of-the-art care using best practices for psychiatric treatment and created outdoor courtyards, group therapy space,

and support groups for the community. The Behavioral Health Emergency Department patients have secure outdoor access. Flex rooms allow for use by both patients with behavioral health needs and non-behavioral health needs. Patients that are seen in the Emergency Department can be referred to outpatient Behavioral Health services or transferred to inpatient behavioral health services as needed. There are 42 private inpatient rooms with windows, 30 rooms for outpatient visits, a gym, a multipurpose room, and three secure courtyards for recreation and meditation.

The space has been designed for operational efficiency with direct feedback from the space's users. The milieu is located closer to the emergency department's treatment rooms, because of which staff members no longer make the approximately 300-foot walk to and from the temporary waiting area they've been using since construction began. The waiting area gives the security team more space to check in patients and visitors and gives better visibility to the triage nurses who give patients initial evaluations. Instead of central spots within the emergency department where medications or clean utilities are stored, they are stored in multiple medication rooms, nourishment stations, and clean holds scattered throughout the space. This drastically improves flow by reducing the number of steps for the team members who make frequent trips to these spaces during their shifts.
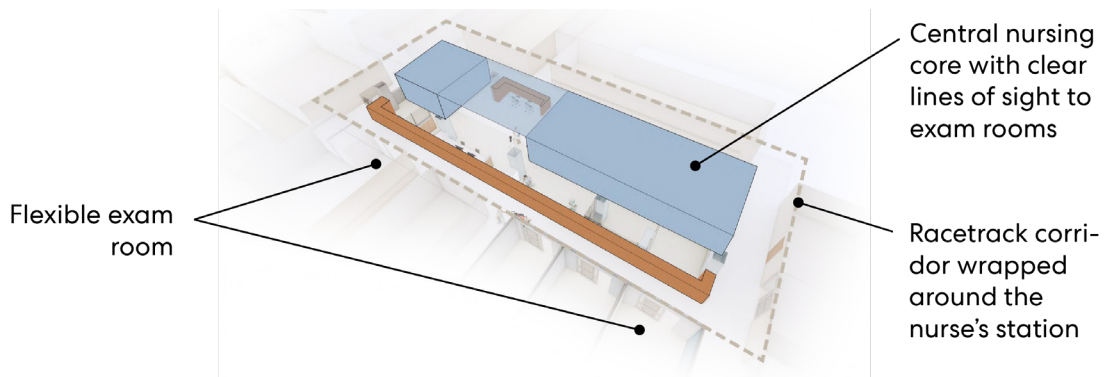
Figure 13: *The emergency department nurse's station conceptual diagram, Duke Health Regional Hospital Behavioral Health Expansion and Emergency Department, Durham, NC, Perkins&Will.*
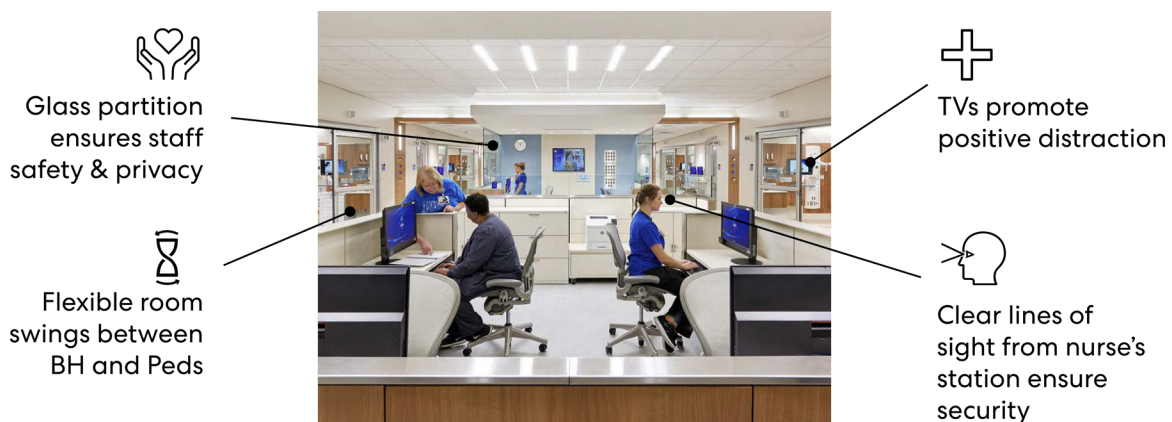
Figure 14: *The nurse's station, Duke Health Regional Hospital Behavioral Health Expansion and Emergency Department, Durham, NC, Perkins&Will.*

3.6.4 Emergency Psychiatric Assessment, Treatment, and Healing (EmPATH) Unit

To improve care for patients in the emergency department and hospital operations, several models have been implemented across the country to provide more focused, immediate care for mental health patients and to reduce the need for inpatient treatment. Past research has shown a decrease in psychiatric admissions with the implementation of a variety of psychiatric emergency services models.[42] Other outcomes that have shown improvement are emergency department boarding times and a 70 percent reduction in length of stay (LOS) from 16.2 hours to 4.9 hours.[43,44]

Much of the problem is due to a mismatch between patient demand and health care supply. The demand for emergency psychiatric care is increasing, yet the supply

is not enough.[31,33] Hence, many of the interventions to address this problem focus on one or both variables. The Emergency Psychiatric Assessment, Treatment, and Healing (EmPATH) unit was developed to accomplish several goals, primarily to increase the supply of mental health care and to offload the demand in the Emergency Department. Specifically, it was intended for patients with acute mental health needs to receive more immediate and focused care and, when possible, avoid hospitalization. In the past, patients too unstable for discharge from the Emergency Department waited days for an available inpatient psychiatry bed and, during this boarding period, did not receive the needed attention or treatment.[25] The EmPATH unit aims to decrease the time, space, and monetary burdens on the Emergency Department and to preserve the limited inpatient psychiatry beds for patients who truly need

a higher level of care. Most notably, the EmPATH unit was able to demonstrate a 25 percent reduction in the 30-day psychiatric patient recidivism to the emergency department; a 60 percent increase in the outpatient follow-up of patients from 39.4 percent to 63.2 percent; a 60 percent reduction in inpatient psychiatric admissions and a total of $861,000 added to the hospital's bottom line by relocating psychiatric patients which led to increased beds for non-psychiatric patients.[43,44]

3.7 Patient Vignettes

A detailed review of the literature on policies that shaped the current behavioral health crisis shows that lack of funding, insurance coverage, provider shortages, and stigma have led to the present state of crisis care where patients languish in emergency departments for days at a stretch.[45] In addition to overwhelming healthcare

systems, this experience can be dehumanizing for the patient experiencing the symptoms.

3.8 Patient Experience Mapping

Based on the qualitative interviews with anonymous behavioral health patients (n=3), a patient experience map with touchpoints that included gain points and pain points across three stages—pre-arrival, triage, and boarding was charted as shown in Figure 15.

Figure 15: *Mapping the behavioral health patient experience through the Emergency Department.*
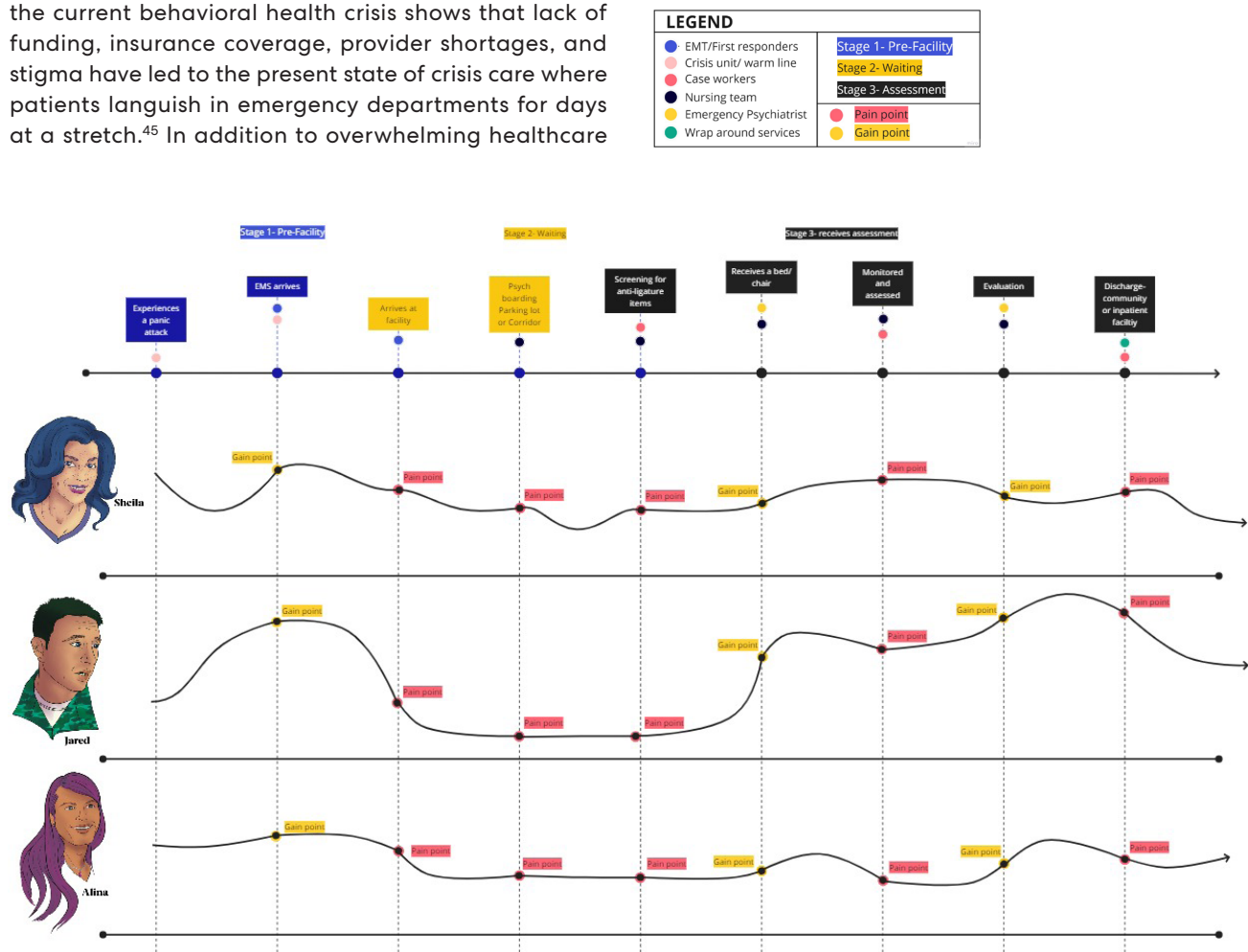
4.0 Discussion

Adequate behavioral health patient care in emergency department settings has been a challenge, but designers and facility planners have found innovative ways to balance the security/comfort tension, primarily through space flexibility, positive distractions, and calming interior design. Patients respond best to treatment when they feel at home, and facility planners and designers can potentially create a comforting environment. Cold, institutional wards focusing only on security leave behavioral health patients feeling anxious and stigmatized.[45,46]
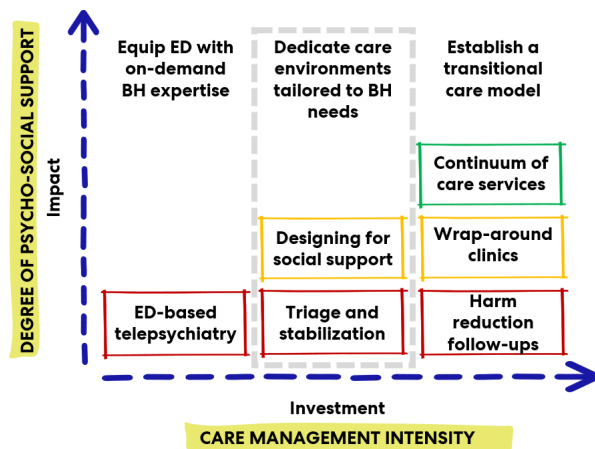
Figure 16: *Impact vs. Investment of interventions for behavioral health quality improvement in the emergency department.*

4.1 Design Recommendations

The following design recommendations (see Table 1) have been developed based on the barriers to optimal behavioral health care as expressed by the interviewees (n=13).

Table 1: *Barriers to optimal behavioral health and associated design recommendations.*

BARRIERS TO OPTIMAL BEHAVIORAL HEALTH CARE	DESIGN STRATEGIES
Space constraints limit behavioral health-specific room construction	Turn one or more patient rooms into swing rooms to flex to the needs of the care-seeking population
Emergency department spaces are constricting and chaotic	Incorporate windows, murals, or posters to provide patients with access to nature and natural light
Non-behavioral health patients feel uncomfortable in behavioral health-outfitted rooms	Use calming interior design to create behavioral health rooms that are as comfortable for all patients as possible
Emergency department spaces exacerbate behavioral health conditions	Design a separate space for behavioral health patients with positive distractions to promote self-de-escalation
Traditional emergency department rooms are safety hazards and make staff supervision difficult	Establish clear lines of sight with an open nurse station

The following design recommendations center on the core tenets of healing design derived from Ulrich's theory of supportive design.

4.1.1 Calming Interior Environments

Interior Design choices shift the emphasis of space from security to comfort, without sacrificing safety. Soft color palettes, comfortable furniture, biophilic wall decorations, and large open group spaces promote healing. Incorporating elements of nature is also beneficial, either through indestructible murals or secure healing gardens. Large windows with minimal or no window treatments provide natural light and minimize dark corners.

4.1.2 Positive Distractions

Key features of behavioral health treatment and recovery are positive distractions ranging from a digital fish tank to chalkboard-painted walls to gyms that can help patients reconnect to life outside the facility. For facilities with available space, dedicated rooms for de-escalation can be extremely therapeutic. Facilities that do not have the space or the patient volumes to dedicate an entire room for de-escalation, can consider creating flexible spaces in communal areas that contain positive distractions.

4.1.3 Designing for Safety

Ensuring the safety of the care environment by offering patients who board for longer than 24 hours, and their caretakers, access to personal care and hygiene supplies. An ideal emergency department provides access to spaces showering and private spaces to address other activities of daily living (ADLs); access to clean hospital gowns/scrubs; access to a safe and private sleeping space with a bed or adapted sleeping lounge chair, clean sheets, blankets, and pillows. In addition to providing a safe environment to the patient, the emergency department must also provide provisions for the caretaker(s) to charge their phones and other devices safely and appropriately. Table 2 provides examples of various design strategies for making physical design and operational decisions that can be identified during the risk assessment process.

Table 2: *Strategies for safety and security.*

GOAL	INTENT	DESIGN STRATEGIES
Staff and visitor identification	Identify authorized individuals in the unit	1. Employee badges 2. Visitor management software
Controlled access	Permit only authorized individuals in the unit	1. Electronic access control systems 2. Secure sally port entry and exit 3. Buffer zones 4. Time-delayed egress 5. Designated visiting hours
Perimeter detection	Prevent unauthorized or unwanted intrusions to the unit.	1. Perimeter detection alarms (e.g., sensors on doors and windows, surveillance cameras) 2. Adequate interior and exterior lighting 3. Monitored radio frequency for devices worn by patients
Reduced risk for patient suicide	Reduce safety risks inherent in the unit's patient population, including patient elopement	1. Behavioral and mental health risk assessment to identify and mitigate features that could be used to attempt suicide 2. Training of staff caring for at-risk patients 3. Assignment of patient self-harm risk categories to each room 4. Surveillance cameras
Staff safety	Identify staff risks and mitigations to address them and improve safety on the unit	1. Fixed and portable duress alarms 2. Video surveillance 3. Staff training 4. Required staff competency in verbal and non-verbal de-escalation techniques

Note: *Adapted from FGI Design of Behavioral Health Crisis Units (2022)*

4.1.4 Social Support

Group areas serve as spaces where patients can carry out the routine of daily life, which aids in recovery. Simple common rooms foster social interactions and should be designed flexibly so that patients can engage in a variety of activities in one space, such as arts and crafts, games, and movies. For emergency departments with adequate space, a central corridor or 'Main Street' model can simultaneously provide a residential feel and positive distraction. The Main Street space provides a very literal representation of a residential area, with quotidian space that helps to deinstitutionalize the overall environment. Additionally, the Main Street space can be designed to accommodate different patient acuity levels, so that all patients at a given facility can feel engaged.

4.1.5 Space Flexibility

Designing for flexibility ensures that spaces are acuity-adaptable for the patient population. Most emergency departments should have at least one, if not an entire pod, of 'swing rooms.' Swing rooms facilitate necessary medical treatment and are also outfitted to be safe for behavioral health patients. Swing rooms provide separate spaces for behavioral health patients, where they can be removed from the chaotic emergency department environment. Additionally, providers can use swing rooms for non-behavioral health patients to increase throughput and utilization and allow the space to flex to meet the needs of the emergency department patient population. Pod models separate different behavioral health populations into separate units, each of which contains patient rooms, group areas, and potentially treatment rooms. The level of security can be modified for each pod. Ideal state planning and operations must minimize exposure to Emergency Department events that can be traumatizing by boarding children and teens in rooms distanced from Trauma Rooms and distanced from adult behavioral health patients. Large pods should have small dayrooms that can accommodate behavioral health patients who are in the Emergency Department for more than 24 hours. Behavioral health patients benefit by having their own dedicated space, and non-behavioral health patients benefit by getting expedited care that might normally have been delayed due to emergency department overcrowding.

4.1.6 Programming Phase

This is a critical first step in the design process in which the scope of a project is reviewed and needs are identified. During programming, the design team and the clinical operations team confirm key planning figures (e.g., number of recliners and beds) and allocate appropriate support spaces to ensure the new or renovated unit includes all areas and spaces necessary for effective and efficient execution of the operational model described in the functional program. Specific design strategies should be taken into consideration regarding access, flow, adjacencies, and management of the unit to support optimal care and safety of patients and staff. See Table 3 for an annotated list of rooms and areas that may be included in a behavioral health crisis unit.

Table 3: *Programming—Summary of spaces, intended uses, design strategies, and justification.*

SPACE	INTENDED USES	DESIGN STRATEGIES	JUSTIFICATION
Intake room or area	Initial assessment prior to beginning treatment	1. Located near entrance 2. Two means of retreat for staff safety 3. Typically designed as a high-risk space	Patient behavior is an unknown risk
Nurse station (commonly referred to as a care team station)	Often considered home base for the care team. The care team will use this space to conduct clinical tasks and documentation; observe patient care areas, directly or via surveillance cameras; and meet with other staff.	1. Minimizes patient access to devices, supplies, and documentation 2. Provides good visibility to patient care areas 3. Promotes staff interaction with patients 4. Surveillance camera monitors (if present) shielded from patient view	The care team often requires a safe, designated staff space that allows for patient observation. Where the nurse station is open to a multiple-patient observation area, provision of a directly accessible, lockable staff work area should be considered

Note: *Adapted from FGI Design of Behavioral Health Crisis Units (2022).*

Table 3 (continued): *Programming—Summary of spaces, intended uses, design strategies, and justification.*

SPACE	INTENDED USES	DESIGN STRATEGIES	JUSTIFICATION
Staff toilet room	To relieve the staff during shifts	1. Separated with locked door 2. Located near nurse station 3. Directly accessible to the unit	A toilet room that is convenient for staff to access minimizes time away from patient care areas.
Medication safety zone	Storage for medication to be administered on the unit. Medication may be administered from this zone	1. Located out of circulation path 2. Separated with locked door from other spaces 3. Work counter 4. Handwashing facilities 5. Acoustic design to minimize sound transmission 6. Visible to the nurse station	Most jurisdictions require medication to be stored in a secure location. Separation with a locked door is a best practice
Exam/ treatment room	Medical assessment and minor medical treatment for patients on the unit. This space might be used to medically clear a patient prior to admission to the BHCU	1. Handwashing facilities 2. Often designed as a medium-risk space 3. Secure storage	Exam/treatment rooms located in the BHCU will reduce the need for patients to leave the unit for medical examination or treatment
Multiple patient observation area	Provision of a therapeutic and comfortable setting in which patients can stabilize and receive therapy and treatment	1. Open-plan area 2. Directly visible from nurse station 3. Camera surveillance 4. Furnished with recliners and/or other patient care station types 5. Furnished with small activity tables 6. Access to daylight 7. Non-institutional décor 8. Could be designed as a high- or medium-risk area depending on facility and acuity of patients	A therapeutic stabilization and treatment space has proved to reduce average length of stay for many patients. An open area provides space for a variety of patient activities and direct visibility of patients by staff
Single-patient observation room	Observation of patients in a private space	1. Designed for only one patient at a time 2. Observable from a constantly attended location (i.e., a nurse station) 3. Camera surveillance considered where direct visibility from the care team station may be impeded 4. Typically designed as a high-risk space	Some patients may benefit from private observation. If a patient is too disruptive, staff can move that patient to this room
Patient toilet room	For patients to relieve themselves, patient hygiene	1. Durable, tamper-resistant, and ligature-resistant fixtures, finishes, and hardware throughout 2. Anti-barricade door options 3. Designed as a high-risk space	Staff need to be able to monitor and access the room without compromising patient dignity and privacy
Shower room	Patient hygiene	1. Durable, tamper-resistant, and ligature-resistant fixtures, finishes, and hardware throughout 2. Designed as a wet location 3. Designed as a high-risk space	Access to a shower helps to provide a hygienic, shared patient care environment Staff members need to be able to monitor and access the room without compromising patient dignity and privacy
Quiet room	A quiet space for patients to go when they are agitated	1. Calming, color-changing lights 2. Minimal stimulation from other patients or the environment 3. Acoustic privacy from common areas 4. Often designed as a high-risk space	Quiet rooms and similar spaces increase patient choice and can help calm a patient, reducing the need for involuntary medication or physical restraint

Note: *Adapted from FGI Design of Behavioral Health Crisis Units (2022).*

Table 3 (continued): *Programming—Summary of spaces, intended uses, design strategies, and justification.*

SPACE	INTENDED USES	DESIGN STRATEGIES	JUSTIFICATION
Secure holding room	Temporary holding space to provide patients a secure environment until they are ready for treatment or transfer to another facility	1. Separated with locked door 2. Designed for one patient at a time 3. Observable from a constantly attended nurse station 4. Small window in the door or the wall adjacent to the door 5. Camera surveillance may be added 6. Design as a high-risk space	This is a dedicated, patient-safe environment for short-term use during a crisis for which other spaces on the unit may not be appropriate
Consultation room	A private setting in which patients can meet with a provider	1. Considerations: 2. Barricade-resistant hardware 3. Vision panel for door or wall 4. Duress alarm 5. Options for staff retreat 6. Patient-facing design	Consultations with a psychiatrist, social worker, therapist, or other professional should occur in a private setting
Nourishment area	Storage for snacks and beverages for patient use	1. Extent of patient access determined by the facility risk assessment and functional program 2. Work counter with easily accessed snacks and beverage dispenser so patients can serve themselves 3. Ice machine 4. Handwashing facilities 5. Patient food refrigerator 6. Storage for non-refrigerated food	Designated space for patient nourishment increases choice and a sense of normalcy
Outdoor area	Space for patients to sit, walk, converse, or engage in leisure activity outdoors	1. Enclosed, secure, safe, and elopement-resistant 2. Visible from the nurse station 3. Dedicated space separate from public spaces and paths	Access to nature and daylight has proved to be therapeutic. It can reduce stress and anxiety, which in turn promotes a safer environment for staff and patients
Clean workroom or clean supply room	Storage of clean supplies used in the unit and/or space for work activities associated with these supplies	1. Separated with locked door	Space designated for these uses must be accessible to staff only
Soiled workroom or soiled holding room	Storage for soiled supplies prior to processing and/ or associated work activities	1. Separated with locked door 2. Negative pressure ventilation	Space designated for these uses must be accessible to staff only
Equipment and supply storage	Storage of equipment and supplies used in the unit	1. Separated with locked door	Space designated for storage of equipment and supplies is needed.
Environmental services room	Storage for environmental services supplies	1. Separated with locked door	Designated space for environmental services supplies should be inaccessible to patients
Family lounge/ waiting area	Public waiting area (not for patient visitation)	1. Located outside of patient care area 2. Located near public toilets 3. Amenities, as appropriate, including space for family/visitor consultation	A comfortable space for family and visitors that is separate from patient treatment areas can reduce complications and potential negative effects of interactions with all patients and staff

Note: *Adapted from FGI Design of Behavioral Health Crisis Units (2022).*

5.0 Conclusion

The spatial design of an emergency department has a considerable impact on the quality and effectiveness of behavioral health treatment and plays a key role in recovery for many patients. The importance of comfortable and secure facilities in achieving population health goals cannot be underestimated. Architects and facility planners play a pivotal role in advocating for these spaces.

It is important to note that key challenges in the emergency department may be addressed at various points of leverage. Change to the built environment is only one leverage point. Other potential leverage points include the use of technology, process improvement, education and training, and operational policy changes. The scope of this research was limited by the availability of time, funds, and resources. Future studies on care environments for acute behavioral health patients can explore rigorous post-occupancy evaluations for individual interventions or the case studies highlighted in this research.

Ideally, crisis services must be designed to serve anyone, anywhere, and anytime. Communities that commit to this approach and dedicate resources to address needs decrease psychiatric boarding in emergency departments and reduce the demands on the justice system. These two benefits translate into better care, better health outcomes, and lower costs. In addition to continuous funding for process improvement by healthcare systems, a commitment by the community and state and local governments is essential for crisis services to remain a crucial element of the continuum of care for individuals in a behavioral health crisis.

Acknowledgments

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02

Reimagining Birthing Unit Design:

A Qualitative Study to Improve Women's Birthing Experience in Hospitals

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Abstract

In the United States, the maternal mortality rate is 23.8 per 100,000 pregnancies representing 861 maternal deaths in 2020.[1] Hospitals have made pregnancy a medical condition rather than a life event and it lacks patient-centeredness and empathy.[2] To resolve the issue of maternal mortality and solve the physical challenges evolving during care, the need for reimagining the birthing model is evident.

This research aims to study the needs of birthing women, focusing on enhancing the delivery of care and developing a new obstetrics program supporting patient-centeredness. A narrative literature review of the clinical needs of labor and delivery care is described to understand the importance of spatial conditions.[3] The study will involve a descriptive evaluation of current facility standards and workflow of the obstetrics program in existing hospitals. The discussion from the interviews will be used as a base to outline design guidelines and goals for the study. The research findings are concluded in the form of a design checklist that fulfills all the design goals or a better patient experience in birthing models.

This research resulted in the creation of a design checklist for any women's department planning and design in a hospital healthcare setting. The findings of this study will also help the community to improve their maternal health system and avoid preventable deaths and complications for mothers.

Keywords: *women's health, childbirth, labor & delivery, patient-centered care*

1.0 Introduction

In the United States, the maternal mortality rate is 23.8 per 100,000 pregnancies representing 861 maternal deaths in 2020.[1] These deaths are influenced by various social, economic, cultural, and physiological factors.[4] Amongst these factors, the built environment has a significant role in the well-being of an individual. It is well-known that a physical environment with good ventilation, windows, access to nature, and a safe environment helps induce the healing process positively.[5] Most women need quality care in a safe, calm, and secure environment so that their mental and

hormonal systems can function properly without any complications.[6]

Childbirth is a significant life event for women that will be remembered throughout their lives. Today, most childbirth happens in hospitals, where the environment is more unsympathetic than in a respite place. Hospitals have made this life event a medical condition rather than a physiological one.[4] This medicalization of childbirth has made childbirth hospital spaces a function of biomedical intervention These conditions require an environment to reduce their stress levels and pain. It is

a well-known fact that the built environment plays an important role in birthing women's health, well-being, and mindfulness.[3] But there is a gap in research done to justify the role of the built environment in improving the women's birthing experience in hospitals.

This research aims to study the needs of birthing women, focusing on enhancing the delivery of care and developing a new obstetrics design program supporting patient-centeredness. The study involves narrative literature that summarizes care delivery and spatial and operational components related to labor and delivery. Four case studies were conducted to assess their departmental configuration, aesthetics, and operational capacity to understand the spatial configuration.[7] These findings from the case study were used as topics of discussion among industry experts and user groups to outline the study's design goal. The results are concluded in the form design checklist for each design goal domain—Spatial Configuration, Room Design, and Amenities that support social, operational, and built environment factors.

1.1 Importance of Women's Health Services

Women are the primary healthcare decision-maker in the household. The current healthcare system recognizes women's health as a medical sub-specialty but not "health" as a holistic approach. There is no one-size-fits-all solution available for women's health in healthcare

delivery.[8] There is a need for women-focused health centers to expand their OB-GYN practice. This expansion would address the broad definition of women's health and well-being as primary care. Women should be part of designing healthcare as their experiences and knowledge drive more inclusive and targeted strategic planning.[4] To improve women's health, maternal deaths and access to quality healthcare should be tackled at the community level.

1.1.1 Causes of Maternal Deaths

As per World Health Organization (WHO), Maternal Mortality is measured as a death that occurs while being pregnant or within 42 days of the end of pregnancy from any cause related to medical complications by the condition of pregnancy or by its management, but not from accidental or incidental causes.[4] The recent statistics released by the Centers for Disease Control and Prevention (CDC) claimed a 14 percent increase in the maternal mortality rate from 861 in 2020 to 754 in 2019. This ratio is higher than the other developed countries like the UK, Canada, France, etc. (refer to Figure 1).[1] Data shows that 17 percent of the deaths occur on the day of delivery. The Report showed a significant racial disparity between Black women compared to white women; it was found that the rate for black women was 55.3 deaths per 100,000 in 2020, whereas the rate for white women was 19.1 deaths per 100,000.[4] The data doesn't directly highlight the differences in underlying health
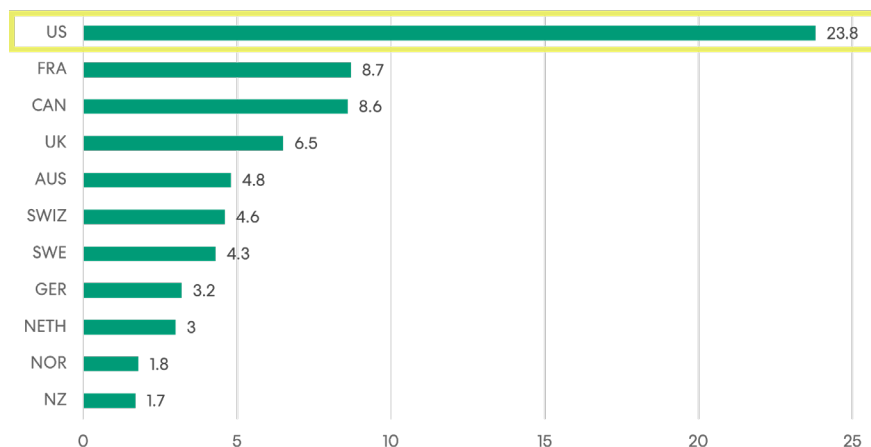

Figure 1: *Maternal Mortality Ratios per 100,000 live births in Selected Countries, 2018 (Data source adapted graphically from OECD Health Data 2020, showing data for 2018 except 2017 for Switzerland and the UK; 2016 for New Zealand; 2012 for France).*

conditions, access to quality health care, and structural health inequities. This disparity highlights the lack of community-based care and ignorance of healthy living conditions.

Medical conditions like severe bleeding, high blood pressure, and cardiomyopathy are the most common causes of death during the first week of postpartum.[4] About 60 percent of these deaths are preventable through decreased medical errors, effective treatments, and proper coordination by clinicians and hospitals.[9] On the other hand, the US has a shortage of maternity care providers for the number of births. The data showed that the US has 15 providers per 1000 live births in comparison to the other developed countries.[1] The overall shortage of maternity providers, lack of access to postpartum care, and healthcare inequities are contributing towards rising maternal mortality.[10]

During the pandemic, the fear of contracting COVID-19, unstable employment conditions, and social isolation were the key contributors to stress, mental health problems, and substance abuse amongst expecting mothers. COVID-19 could also have contributed to the rise of the problem in the first year of the pandemic, as healthcare systems were not prepared to manage maternal care virtually. Hence, the need to evaluate care delivery and humanize the health system by improving patient satisfaction and maternal psychosocial well-being outcomes is evident.

1.1.2 Gaps in Healthcare Delivery

The shortage of maternity providers and lack of integration of primary care and midwives in specialty care contribute to the multi-faceted high mortality rate in the US.[1] There is a lack of knowledge and communication among patients and providers, leading to errors in diagnosis World Health Organization (WHO) recommends that midwives help in reducing the maternal mortality rate by assisting in childbirth and building a relationship with mothers to support the natural reproduction process.[4] Although insurance plans in the US do not cover this prenatal care by midwives, access to integrated care services is limited. As per the commonwealth study, US and Canada have the lowest supply of midwives and ob-gyns, i.e., 12 and 15 per 1,000 live births, OB-GYNs outnumber the midwives in the maternity workforce. There are also several state laws, rules, and restrictions on midwifery services in the US that require physician supervision of midwives.[4] Whereas in other developed countries, there is an integration of both midwives and OB-GYNs throughout the pregnancy which helps lower medical intervention rates and costs for best outcomes.[1]

Beyond the differences in healthcare delivery in developed countries, there is also an issue of racial disparities in care delivery. The CDC report in 2020 suggested that Black women are three times more likely to die of maternal complications than white
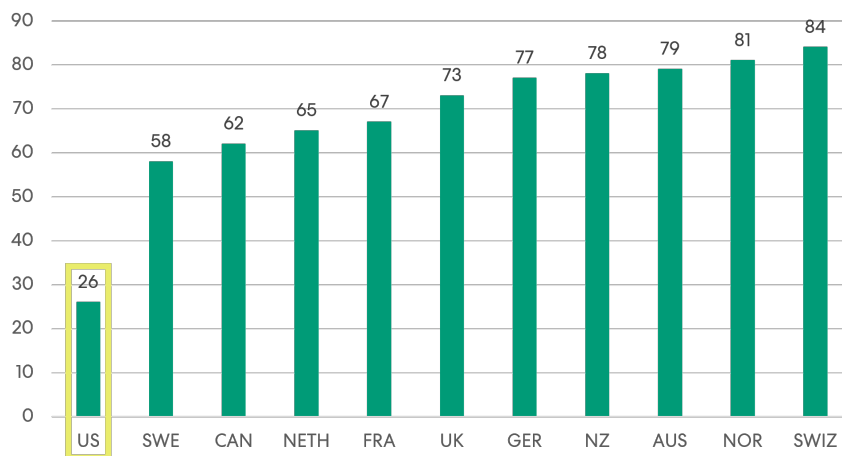

Figure 2: *Chart showing that only one-quarter of US women of reproductive age rated the overall performance of their country's health care system as "very good" or "good," less than all other developed countries (Data source adapted graphically from The Commonwealth Fund 2020 International Health Policy Survey).*
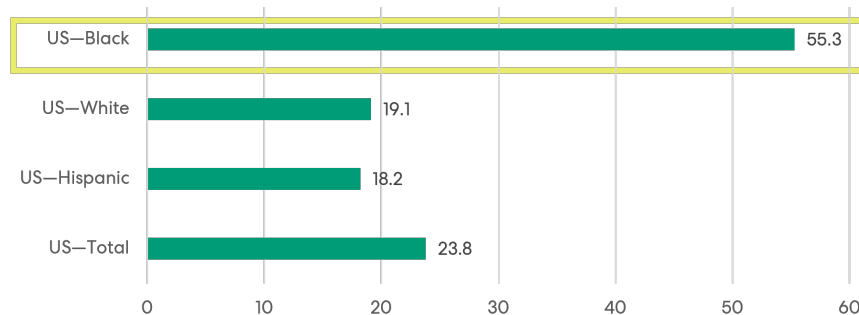
Figure 3: *Maternal Mortality Rates, by Race and Hispanic Origin in the US (Data source adapted graphically from CDC).*

women.[1] The root cause of the inequity lies in a systemic, institutional, interpersonal, and individual approach.[4] It is perceived by 40 percent of first- and second-year medical students that black people have thicker skin than white people, leading to undertreatment of pain for black patients.[10] There is also insufficient access to affordable and quality care for black women, hence they end up at lower-quality hospitals with higher morbidity rates.[11] This can be solved by identifying the care gaps, giving community-based resources, and diversifying the healthcare force to incorporate an inclusive impact on maternal healthcare delivery.

2.0 Methodology

The research framework included a narrative literature review, interviews with industry experts, and case study analysis. The data from this research was summarized to validate the design guidelines needed for positive health outcomes.

2.1 Literature Review

Narrative literature was conducted to understand the role of the built environment in improving patient health outcomes. The review included 40-plus sources from different search databases like PubMed, Google Scholar, ResearchGate, and peer-reviewed journals. The keywords searched were women's health, birthing unit design, childbirth, maternal healthcare design, empathy, and midwifery. The articles were evaluated on clinical, operational, social, and environmental implications that would influence maternal health outcomes like

safety, supporting normal childbirth, reducing stress, and improving the patient experience in the hospital, most of the research articles were hypothetically based and weren't tried in actual settings; hence the reliability of evidence wasn't validated. Amongst those articles, seven with environmental implications to health outcomes were tabulated below and were experimented with randomized and controlled trial settings, thus can be validated for design guidelines.

2.1.1 Clinical Implications

During the whole pregnancy journey, women go through many physical and mental changes. The increased need for medical intervention in the birthing process contributes to the high maternal mortality rate. As per the CDC report, in 2020, the cesarean delivery rate increased from 31.7 percent in 2019 to 31.8 percent in 2020, and 55 percent of the C-sections performed in the US were elective. These cesarean deliveries can be avoided through non-pharmacological measures. Most women are fearful about the pain and side effects their bodies will face during pregnancy. This "fearful cluster" had poor individual emotional health and a longer labor length of 10 hours with more pain intensity.[8] They are the individuals who demonstrated higher epidural use and a greater likelihood of elective cesarean.[2] The fear cascade theory suggests that anxious or stressed women's bodies produce neurochemical hormones like catecholamines that obstruct oxytocin production. This oxytocin is needed for uterine contraction and helps induce the labor process. The low oxytocin level and high catecholamines level leads to less oxygen flow causing

Figure 4: *The research process.*

fetal distress.[12] Endorphins are released when oxytocin levels are high, they help in transcending labor pain. It helps in giving mothers the energy to push the baby and experience undisturbed and unmedicated labor. But if they demonstrate fear and stress, these hormones are disturbed and the need for medical interventions like induction, epidural analgesia, and cesarean sections becomes necessary. Some of these interventions are also biologically necessary depending on the physiological conditions of a mother before the delivery.[13] Though this could be avoided by the non-pharmacological method by keeping positive emotional health and a less stressful attitude, it is essential to stay calm, comfortable, and confident to promote normal oxytocin levels.[2]

2.1.2 Operational Implications

Ariadne Labs while working on the management of care processes in childbirth developed the "Pressure Tank Model" which explains that the clinical environment influences the decision to perform cesarean delivery.[7] It suggests that three management of care systems— capacity, workload, and motivation influence the decision between vaginal and cesarean delivery. The high workload, less capacity, and little motivation increase the clinician's pressure to accelerate the patient turnaround, hence marginally increasing the cesarean delivery cases. On average, vaginal delivery needs at least 20 hours of medical attention, whereas cesarean delivery requires 2 hours of medical attention.[7] The difference in care delivery methods and planning impacts clinical decisions.[7]

Workload is determined by clinical protocols and productivity achieved by staff in the unit. Distance between Labor & Delivery Rooms (LDR), workstations, and room standardization play a vital role in patient turnaround and efficiency of care. Research also shows that women who receive continuous support have fewer reports of operative deliveries, dissatisfaction during labor, and decreased need for analgesia.[13] It is the recommendation to have a shorter distance between LDR and staff support spaces to achieve constant care support.[14] It will help in reducing the travel distance and fatigue associated with walking. Also, operational simulation mock-ups for staff training and preparing them to adapt to the environment can improve patient care.[15]

Capacity means the availability of space impacting clinical functions to be performed timely. Observational studies have found that delayed admissions in the active phase of labor leads to more labor arrests and cesarean births. Timely admission and care are necessary for pain management and maternal fatigue. Hence, annual delivery volume per LDR drives the room demand and pressure to manage the surge in treatment intensity.[7] The literature's observational feasibility study suggests that the ratio of overflow beds to LDR can accommodate the unexpected surge and demand.[7] Also, clinically when there is a delay in admission, alternate overflow beds help in giving women rest and reduce pre-labor stress.

Motivation among the staff to integrate best practices comes through collaboration and training. Hands-on training helps in handling the high-acuity scenarios in the Labor and Delivery unit. The involvement of staff during early design phases helps in giving confidence and
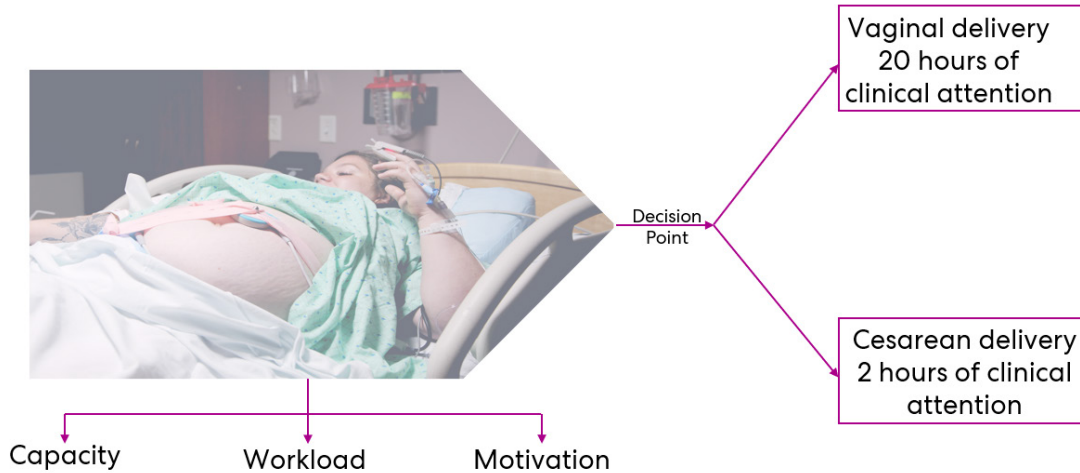
Figure 5: *Pressure Tank Model.[7]*

opportunity to perform better.[7] This confidence helps inpatient experience and efficacy expectations.[15]

2.1.3 Social Implications

The evidence from the studies shows that family support helps give mothers comfort and relaxation. Women labor in pain for hours and need nourishment support to maintain their hydration and access to food to avoid exhaustion.[8] Hence, accommodation for companions and birth attendants helps provide basic needs like support during pain, walking around the unit, and motivation to push. It also gives a sense of control to mothers that their family is part of the life event.[16] Family-oriented care supports parental satisfaction and facilitates shorter labors, controls pain better, and lowers the need for medical intervention. Social support is also provided through doulas and midwives who help harmonize the courses of birth and help in providing information regarding the birthing process. Their presence helps reduce the anxiety caused by miscommunication or lack of control in the care process.[8] Communication helps enhance self-awareness and confidence among mothers.[17]

2.1.4 Environmental Implications

The well-known research about physical environment affecting the patient's healing process and improves their well-being.[5] The evidence-based design focused on improving patient safety, length of stay, spatial orientation, stress, and communication in critical care units. Though this doesn't directly connect to the influence of design on birthing units, there are recent journal articles and opinion pieces that hypothesize different design measures for better patient experience.[5] The research shows multiple evidence of design interventions in form of conceptual room models, visual and positive distractions like nature, art, and daylight, and auditory and aesthetical interventions like furniture. The earlier evidence from Ulrich's View Through the window proved that visual connection to nature improves recovery and decreases the length of stay.[18] A recent experimental study examined the presentation of images of nature on the labor and delivery experience. The results showed that women showed lower heart rates and were supporting non-pharmacological methods to soothe the pain.[19] In another experimental study, an alternative delivery room was set up with Snoezelen, and experiences of women giving birth in that setting were studied. Snoezelen is a multi-sensory environment that is used for therapy with neuro-diverse people. The results showed that it helped in reducing anxiety in transitioning to the hospital setting and gave comfort. This study supported the concept

of patient-centeredness by stimulating the sensory experience.[20]

The "Ambient Room" experimental study explored a randomized controlled study among women who were admitted in the standard labor room and others in the "Ambient Room". This experimental room included concealed medical equipment, a lounge chair, a birthing ball, an LCD projector with a selection of nature images, auditory speakers, and a folding double-sized mattress instead of a labor bed.[21] It was found that women in the ambient room were less likely to have artificial oxytocin during the first or second stage of labor which helped in reducing the likelihood of dystocia. Though it didn't show any effect in the vaginal or cesarean delivery as they had premedical conditions. It still needs more evaluation in an adequately powered trial. But in terms of patient experiences, they liked the freedom of mobility and flexibility of the bed (the option of a labor bed and folding mattress was provided) to cope with labor.[21]

A similar recent study was published to explore the women's experiences of physical features in birthing as per their wishes. This study also conducted a randomized controlled trial in the "Room4Birth" alternative setting. This room consisted of familiar homelike features that provided privacy and space for companions. Characteristically, the room consisted of nature scenery, dimmable lighting, and concealed medicotechnical devices. The room also has an option of a bathtub and supporting equipment. The room was ranked for all its features and the bathtub ranked the highest and the birth support rope was ranked the lowest. Overall, the room exceeded the patient's expectations in providing a distinct experience from the traditional setting.[22]

The" BUDSET (Birth Unit Design Spatial Evaluation Tool)" provided the guidelines for optimal birth space that would influence the physiology of women in labor positively. The BUDSET principles are divided into four domains—fear cascade, facility, aesthetics, and support.[3] These domains are subdivided into segments that follow the sequence of the patient's journey through the birth unit from the entry point to exit. Another article investigated the impact of the physical environment on

Table 1: *Summary of seven journal articles selected to relate environmental implications with health outcomes.*

JOURNAL ARTICLE	DESIGN INTERVENTIONS	HEALTH OUTCOMES/IMPACT TO IMPROVE PATIENT SATISFACTION
The Influence of Nature Stimulus in Enhancing the Birth Experience.[19]	Visual nature images	Improves clinical and behavioral outcomes, higher satisfaction, and low anxiety/stress rate
Re-conceptualizing the hospital labor room: the PLACE (pregnant and laboring in an ambient clinical environment) pilot trial.[21]	Concept of Ambient room with flexible bed positions, concealed medical equipment, comfortable chair, dim lights, audio, and visual distractions	Women in the ambient room were less likely to have artificial oxytocin and a shorter labor period
Feathering the nest: what women want from the birth environment.[8]	Physical elements like privacy, ability to work around, sense of control, acoustics, and comfortable homelike furniture	Women were less likely to have any medical interventions like a cesarean delivery
An Exploratory Study of the Relationship between Facility Design and the Provision of Childbirth Care.[6]	Maximum distance between LDRs, the average distance from support spaces, bed capacity, unit circulation	Optimal unit planning based on capacity, workload, motivation, and contextual factors can help in reducing cesarean rates
Healing architecture and Snoezelen in delivery room design: a qualitative study of women's birth experiences and patient-centeredness of care.[20]	Snoezelen room to enhance women's experience during labor	Provided positive distraction, relaxation, comfort, and choice of therapy
Developing the Birth Unit Design Spatial Evaluation Tool (BUDSET) in Australia: A Qualitative Study.[3]	Birthing room layout with earthy colors, adjustable lighting, soft surfaces, daylight, storage space	Provides positive emotional, psychological, and physiological responses and facilitates active labor
Women's Experiences of Physical Features in a Specially Designed Birthing Room: A Mixed-Methods Study in Sweden.[22]	Room4birth is designed with a bathtub, window, dimmable lighting, sound absorber, media installation, companion space, storage, birthing equipment, and rounded corners on furniture	A welcoming and familiar environment gave integrity and social support through privacy and space for a companion, a positive emotional state.

intrapartum intervention rate and mothers' well-being. The article outlined design guidelines for eight building spaces—unit layout configuration, midwives' hub, social room, birth philosophy vectors, the configuration of the birth room, dimension and shape of the birth room, filter, and sensory elements. The research guided the architectural recommendations for future projects.[23]

2.2 Industry Expert Interviews and User Needs

Women's expectations and needs should be supported to improve the physical environment. Women's satisfaction is strongly related to a sense of being in control and being able to control panic.[14] The physical environment is one crucial factor that has tended to be neglected.[6] Other critical factors that play a significant part in women's labor experience, such as staff attitudes, midwifery care, and support continuity, have been researched more extensively.

2.2.1 User Needs

According to the British survey, access to clean rooms and space to move around freely mattered to women. It was also vital that they were not seen and heard everywhere; they wanted their privacy to be respected without being overlooked by the staff. Some women also insisted on accessing the birth pool if needed while being in labor pain.[8] The evidence showed that immersion in warm water such as a bathtub helps in giving comfort and produces significant pain relief through redistribution of blood volume, which stimulates the release of oxytocin and vasopressin, a hormone that regulates pain. Providing an ensuite toilet is also a need that most women highlighted in their surveys; during labor, women yield to the power of contraction and relax their pelvic muscles and hence need to open their bowels frequently. Heating and lighting were also considered necessary as they needed to adjust heating during labor, and more than half of women claimed that dim lighting helped them relax.[8]

The evidence from the studies shows that family support helps give mothers comfort and relaxation.[13] Women labor in pain for hours and need nourishment support to maintain their hydration and access to food to avoid exhaustion. Hence, accommodation for companions and birth attendants helps provide basic needs like support

during pain, walking around the unit, and motivation to push. It also gives a sense of control to mothers that their family is part of the life event.[16] Family-oriented care supports parental satisfaction, facilitates shorter labor, controls pain better, and needs less medical intervention. Social support is also provided through doulas and midwives who help harmonize the courses of birth and help in providing information regarding the birthing process. Their presence helps reduce the anxiety caused by miscommunication or lack of control in the care process. Communication helps enhance self-awareness and confidence among the mothers.[17]

Furnishing and aesthetics in the maternity units is also an important feature that is often overlooked in the clinical environment. Women liked their environment to be "homelike", which helped reduce their anxiety.[21] Fewer than half of the women who wanted floor mats, extra pillows, or a bean bag to help them relax or change positions said that these aids were readily available.[21] The comfort of cushions, mats, and bean bags helped them relax and change positions. The soft protective floor mats are occasionally used whenever women feel stuck in their labor beds.

The Advisory Board resources were used to get a broader perspective on the industry's needs. Resources like customer surveys, market analysis, and future trends were referred to get data. One such data was the nationwide customer survey on pregnancy needs from different demographic groups.[24] The survey involved 2000 women between 18 to 40 ages who expressed their top concerns and how they would like to choose their pregnancy care. The survey categorized women into five ideologies and preferences: Gen X moms-to-be, Millennial moms-to-be, Freestanding birthing center fans, Midwifery-minded, and current mothers who had babies before.

Most women preferred a facility close to their home that has private family space and staff with a good bedside manner. They also chose to deliver in facilities with good quality scores (i.e., low rates of birth trauma and C-section).[24] Most women ranked the option of choosing alternative pain relief options, cord blood options, and vaginal birth after cesarean. Providing amenities like private rooms, water tubs, and wireless monitoring mattered. They also scored highly on the choice of babies sleeping in the same room as mothers. This breaks the notion of women wanting to use nurseries for their
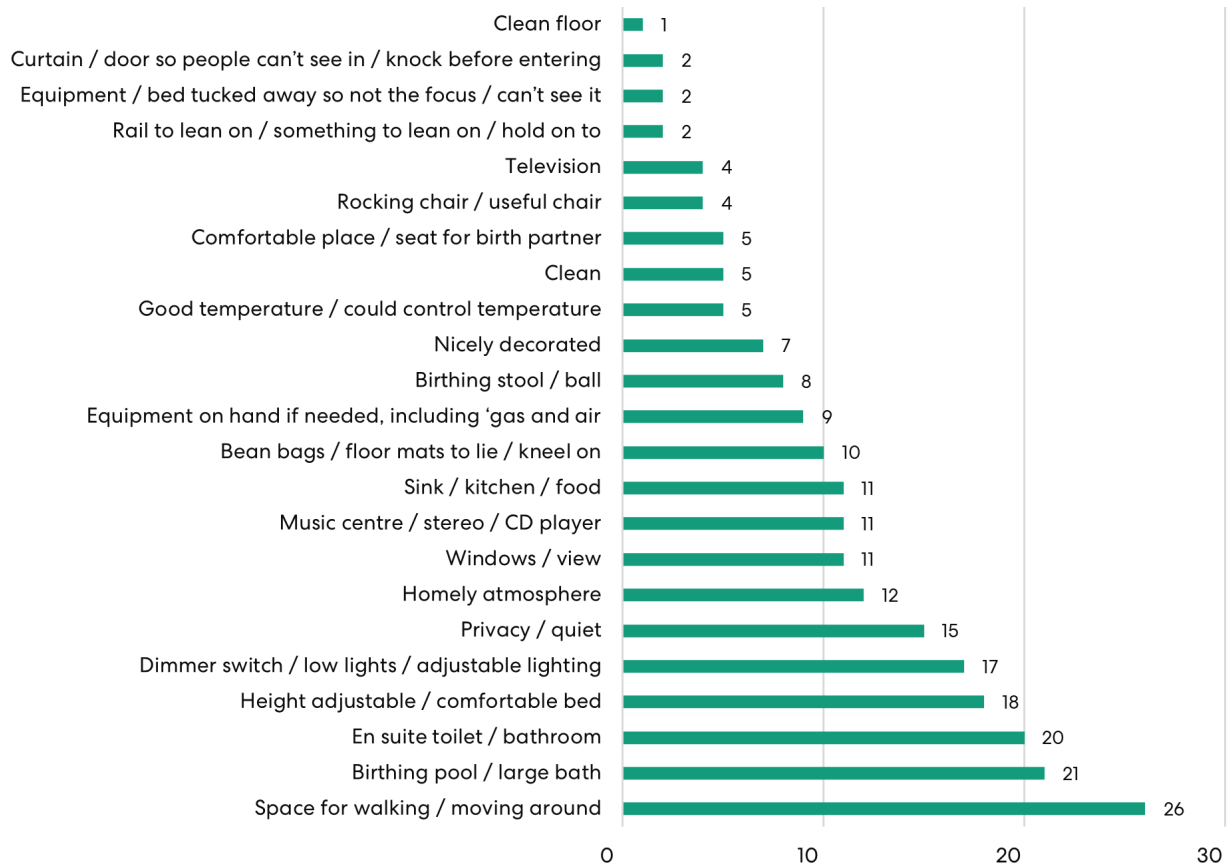
Category	Value
Clean floor	1
Curtain / door so people can't see in / knock before entering	2
Equipment / bed tucked away so not the focus / can't see it	2
Rail to lean on / something to lean on / hold on to	2
Television	4
Rocking chair / useful chair	4
Comfortable place / seat for birth partner	5
Clean	5
Good temperature / could control temperature	5
Nicely decorated	7
Birthing stool / ball	8
Equipment on hand if needed, including 'gas and air	9
Bean bags / floor mats to lie / kneel on	10
Sink / kitchen / food	11
Music centre / stereo / CD player	11
Windows / view	11
Homely atmosphere	12
Privacy / quiet	15
Dimmer switch / low lights / adjustable lighting	17
Height adjustable / comfortable bed	18
En suite toilet / bathroom	20
Birthing pool / large bath	21
Space for walking / moving around	26

Figure 6: *Graph showing the survey results of highly important physical aspects that women desire during labor.[8]*

babies so they can get some sleep. Hence, the 'rooming-in' with the babies and mother together is trending.[24]

2.2.2 Expert Interviews

Seven industry experts who could share their experience as architects, one nurse, two planners, and mothers were interviewed. There were one nurse and two planners, mothers, and architects. In the interviews, they were asked how they feel about the current health system providing maternal care and how they would like to improve that. The main subject of the interviews was to understand the challenges they faced and how to overcome those in the future. These interviews were based on lessons learned from the projects, user group meetings experience, operational needs, and future trends. These insights summarized below would guide the design considerations and environment supporting quality of care for women:

• Lessons Learned from the projects: Labor and Delivery Rooms (LDR), postpartum rooms, and C-section room ratio need to suffice the volume projections for future growth. The adjacency of women's departments and pediatric care spaces helps in the continuum of care. A dedicated entry and elevator to the patient's floor gives easy access to laboring mothers and eliminates their challenge to walk around the whole hospital to get to their floor. Providing on-stage/off-stage workflows for efficiency between the units and improving efficiency in care.

• User Group Meetings: The need for social space for a companion was prioritized by most experts. It was suggested that anything that could make women self-conscious in expressing their concerns and feel insecure would detract from the quality of care they should get from the hospital, hence design needs to reflect privacy and respect for women. Staff suggested areas for respite like on-call rooms on the LDR patient floor and a

Figure 7: *Illustration from The Advisory Board highlighting the preferences of pregnancy care between different demographic groups from a customer survey.*[24]

separate nourishment space from the patient families should be considered. Staff need privacy from their patients while they are trying to rest. The aesthetics of the inpatient room was always suggested to be homelike and calming.

• Operational: There has always been a need for excess storage space for staff and patients. The distance from the nurse station to patient rooms shouldn't belong, especially on LDR. The use of LDRP rooms in the program is not advisable as that causes nursing issues and an unpleasant environment for mothers to room in after birth.

• Future Trends: Most experts shared the idea of having flexibility in layout to accommodate the boutique needs of clients and birthing mothers. There should be an option of a birthing tub or even space in LDR to accommodate inflatable water tubs for an immersive water birth experience. Flexibility should also cater to the emerging change in delivery methods and technology. For example, high-risk antepartum rooms can flex to labor and delivery or postpartum rooms depending on patient volume and acuity. Though there isn't a code in FGI for windows in LDRs, it is a best practice to provide LDRs with exterior windows and daylight.

2.3 Case Study Analysis

The insights from literature and expert interviews facilitated the framework for existing facility studies. The goal of case studies is to identify the design strategies to achieve the design goals. The collection of this data is used to understand how these unique strategies were used in social, operational, or environmental factors. Four case studies were selected based on different clients, facility ages, design strategies, and capacities.

The Medical University of South Carolina (MUSC), Shawn Jenkins Children's Hospital & Pearl Tourville Women's Pavilion

Figure 8: *Labor and Delivery room at MUSC*

Project Location: Charleston, South Carolina

Client: Medical University of South Carolina

Project Completion: 2019

Program: 12 LDR, 41 Ante Partum Postpartum beds including 7 Couplet Care rooms, 2 C-Section ORs

Annual Delivery average: N/A

Project Background:

The Medical University of South Carolina – MUSC Shawn Jenkins Women's and Children's Hospital and Pearl Tourville Women's Pavilion is a ten-story, 249-bed patient tower adjacent to a four-story Diagnostic and Treatment podium, which focuses on the advanced and specialized needs of pediatric tertiary and quaternary cases in South Carolina. It is a spectrum-friendly hospital with a full sensory experience. The hospital is designed resiliently to combat the site's floodplain challenge by moving patient care space from the second-floor level to ensure continuous care.

Analysis:

• Environmental Implications: The welcoming and family-friendly environment aesthetics help reduce the stress and anxiety that most women and children feel in hospitals. The ample daylight flowing through staff and patient areas enhances the healing environment. Natural colors and autistic-friendly experiences reduce the environmental stressors throughout its interior spaces. The co-location of services for women and children's care helps bridge the critical care gap needed after postpartum. The couplet care rooms are the distinctive feature where women and newborns can recover together.

• Social Implications: The multiple family lounge between the patient rooms helps divide the crowd and gives more space for family members. The private terrace for adults on the seventh floor is used to relax and connect to the city views for positive distraction. The lounge & play area provides space for their family to rewind and wait during the labor. There is also a quiet/ bereavement space at the end of the unit for grief. The idea of sensitive adjacencies where the families are given separately from celebrating and mourning is well executed. The custom design sleeping furniture for support companions in the patient room provides comfort for sleeping.

• Operational Implications: The project focuses on specialized care for pediatric & women's healthcare services—the program integrated with a women's program for high-risk births under one roof. A dedicated stork elevator to the women's pavilion gives easy access and reduces travel distance. The triage location between the LDR minimizes the travel distance for staff to observe the patient and transfer them later to the Labor and Delivery Room when they are ready to labor.

Virginia Mason Birth Center

Figure 9: *Calming and comfortable Labor and Delivery room at Virginia Mason Birth Center.*

Project Location: Seattle, Washington

Client: Joint Venture between Virginia Mason and CHI-Franciscan

Project Completion: 2020

Program: Triage, 5 LDR, 6 Postpartum, 4 NICLET rooms, 2 Triage, 2 C-Section ORs

Annual Delivery average: 1200

Project Background:

This birth center is in the shell space of Virginia Mason campus in Seattle. This 20,000-sf birth center provides a comprehensive spa-like atmosphere for a boutique birth experience with all the clinical support needed for a mother to deliver. The birth center bridges the gap between the traditional hospital obstetric model and the freestanding birth center due to its location on the medical center campus. Thus, providing a continuum of care for mothers and babies at one facility. This facility is an example of how personalized care spaces can be achieved through active user participation in decision-making.

Analysis:

• Environmental Implications: The cozy aesthetics of the interiors give a familiar environment for the mothers and reduce their fear. The option of choosing the immersive water birth in the labor and delivery rooms gives the flexibility of choosing a non-invasive pain relief option. Thus, increasing patient satisfaction. The ample daylight and vibrant coral prints with a bold custom graphic wall in the labor and delivery room provide positive distraction and promote the healing environment during labor. Similarly, the post-partum rooms have a calming teal color palette which helps in the recovery process. The nursery is in the center away from the direct daylight over the bassinets but also gives enough light to illuminate the space.

• Social Implications: The inpatient rooms have comfortable sleeping space with space to store their belongings. The waiting area near reception, which is designed as a formal living room with an electric fireplace offers calming and inviting space for families and visitors. The dedicated pantry space in the waiting area for families satisfies the nourishment support needed by families and mothers.

• Operational Implications: The overall layout is planned in such a way that there is proximity from the central team nurse station to the patient care spaces. This helps in providing visibility to the patient's spaces and reduces travel distance. The project integrated a Lean process to collaborate with the staff and clinicians to develop a comprehensive and efficient flow for the new model of care. The design process incorporated room mock-ups for clinicians and staff to validate the planning strategies. Another distinctive feature is NICLET care rooms which provide recovery space for mothers and infants together. NICLET rooms allow critical care infants to stay with mothers instead of separate NICU space and offer all the benefits of a Level II nursery with the added benefit of privacy and proximity to their recovering mothers.

HCA Medical City Dallas

Figure 10: *Labor and delivery rooms at Medical City Dallas.*

Project Location: Dallas, Texas

Client: HCA Healthcare

Project Completion: 2018

Program:24 LDR, 16 Postpartum, 3 C-Section OR

Annual Delivery Average: 4200

Project Background:

The women's department expansion is a Level IV designated maternal facility in the medical campus of Medical City Dallas. The designation gives access to onsite consultation to maternal, surgical, and behavioral specialists and services. The five-story vertical expansion addresses the luxurious and aesthetic needs of a women's department.

Figure 11: *Attached family space in VIP postpartum rooms at Medical City Dallas.*

Analysis:

• Environmental Implications: The labor and delivery rooms are designed to conceal all the medical equipment and provide a clutter-free room. The shades of soothing blue abstracting to water elements give a natural soothing visual for patients and staff. The ample daylight in the patient rooms promotes the patient's healing experience. The hospital has suites with high-end finishes, a spa-like bathroom, and hardwood-looking floors to cater to the patient wanting a more luxurious experience.

• Social Implications: The highlight of the program is the VIP postpartum room with attached family room which gives family their own private space to recover and spend time. Families of the patients in the VIP suites have access to a refrigerator and dining space for family to fulfil their dining needs.

• Operational Implications: The racetrack layout helps in connecting the staff and patient spaces in proximity, The labor and delivery rooms have attached storage rooms that help staff efficiently grab equipment whenever needed.

Methodist Richardson Medical Center – Bush/ Renner Hospital

Figure 12: *Labor and delivery rooms at Methodist Richardson.*

Project Location: Richardson, Texas

Client: Methodist Health

Project Completion: 2014

Program:10 LDR, 16Postpartum beds, 2 C-Section ORs

Annual Delivery average: N/A

Project Background:

The S-shaped design of the hospital's expansion highlights a few of the evidence-based strategies in the analysis below. The layout links three 25-bed nursing units flowing in an end-to-end arrangement. The modern architectural style of the building gives a fresh outlook to the traditional campus.

Analysis:

• Environmental Implications: The S-shape layout facilitates the accessibility and wayfinding to the care spaces and thus gives a sense of wayfinding. The facility's interior design is inspired by the healing properties of nature; however, instead of choosing a natural theme (such as leaves or water). The ample daylight and welcoming aesthetics give a calming environment.

• Social Implications: The spacious family spaces in the patient room give comfortable space for companions

to spend time with the patient. There are on-call rooms for staff to relax during long shift hours.

• Operational Implications: "The front of house" and "back of house" concept separates the public areas and service areas, hence reducing the overlap between different flows. The Women's Center of Excellence included space for central postpartum units and labor and delivery units adjacent to NICU thus giving continuous clinical flow for mother and baby on one floor. The labor and delivery suite has storage rooms that help staff grab equipment whenever needed.

3.0 Recommendations: Design Guidelines

The primary goal of the environment is to influence the pattern and progress of labor, affecting both the number of vaginal births without major interventions and the rate of emergency cesarean sections.[6] During labor, women's bodies need to soften and open to let the baby be born. They need to feel safe and secure, be protected from disturbances and adverse stimulation, and be able to relax to let their body work more effectively. Hence their sequence of patient journey informs the strategies needed for planning strategies.[25] A typical patient journey for pregnant women starts at triage, where they are evaluated for dilation and active labor. Depending upon the clinical condition, they are either discharged or moved to an antepartum room. After the observation, women with active labor are transferred to the labor and delivery unit for vaginal delivery and where vaginal delivery cannot be instrumented. They are taken to C-section for delivery. Mothers are then transferred to postpartum to recover for a few days and then discharged.

As per Facility Guidelines Institute (FGI), Labor and Delivery rooms (LDR) should have a minimum 325 sq. ft. clear floor with a minimum wall head of 13 ft. The clear floor area includes infant stabilization and resuscitation space of 40 sq. ft.[26] Each patient's room should have direct access to a private toilet room with a shower or tub. A typical patient journey for pregnant women starts at triage, where they are evaluated for dilation and active labor. Depending upon the clinical condition, they are either discharged or moved to an antepartum room. After the observation, women with active labor are transferred
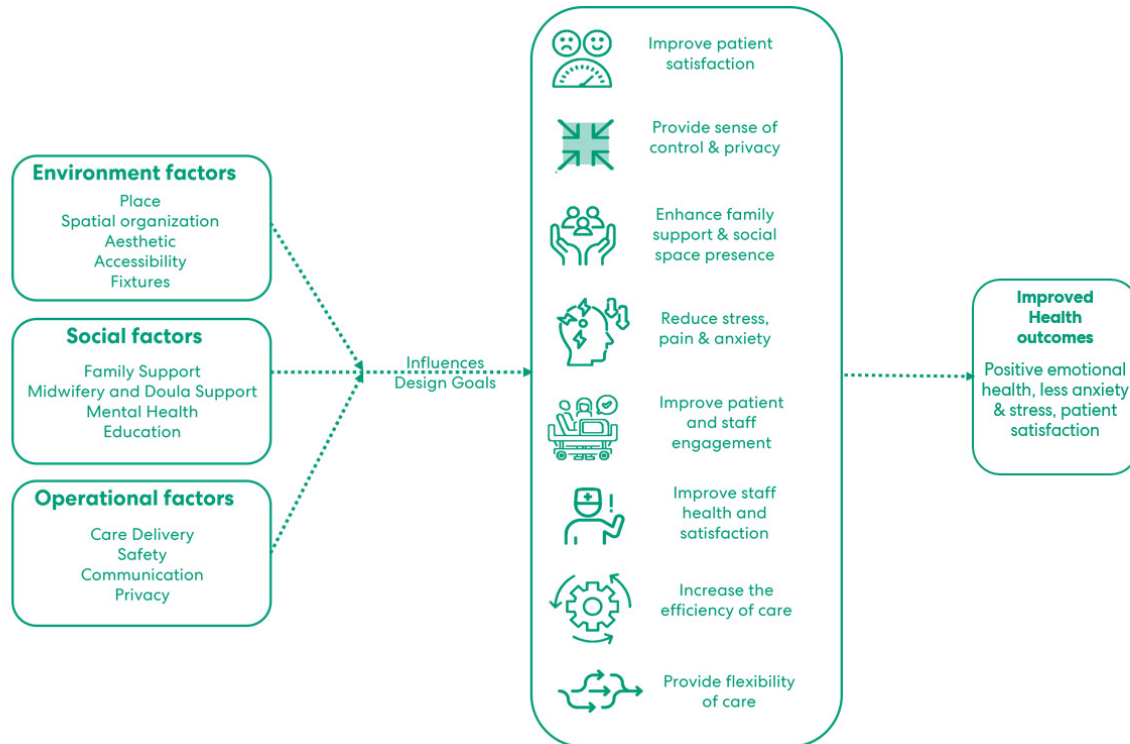
Figure 13: *Illustration showing the design goals influenced by environmental, social, and cultural factors.*

to the labor and delivery unit for vaginal delivery and where vaginal delivery cannot be instrumented. They are taken to C-section for delivery. Mothers are then transferred to postpartum to recover for a few days and then discharged.[26]

The implications from the case studies are used to define the environmental, social, and operational factors of design. Each of the factors has sub-factors that categorize the use of design goals in those domains. These design goals are not intended to be applied in isolation. Many works with each other and strategies can complement each other. Implementing design strategies that reduce stress and fear can aid in reducing medical

intervention in the birthing process, thus supporting patient satisfaction. The aim is to understand that design should do these things, and that there are strategies and many ways to achieve them. Understanding the multiple causes and influences of these factors can help in achieving these goals for better outcomes.

The design checklist is a tool that can be used in pre-design to evaluate the programming and planning of any new or renovation of a women's project. The checklist has three categories—environmental, social, and operational factors. Each of the design strategies complies with one or more design goals.

Environment Factors:

Legend icons: Improve patient satisfaction · Provide sense of control & privacy · Enhance family support & social space presence · Reduce stress, pain & anxiety · Improve patient and staff engagement · Improve staff health and satisfaction · Increase the efficiency of care · Provide flexibility of care

☐ Provide visual distractions by adding windows with controlled shade for daylight in staff and patient areas

☐ Provide ample space in the room to move or flex around to walk or change positions during labor

☐ Providing privacy from the public corridor or areas by adding alcove /curtains at room entrance

☐ Private bathroom with sufficient space and ergonomic design for labor and delivery (e.g. fixture height, hand rail supports, drainage not blocked by use of birth ball if included)

☐ Providing the patient with control of adjustable temperature, varied/dimmable lighting and shades, and entertainment within reach of patient bed and chair

☐ Patient control of visibility and room entrance (e.g. privacy curtains controlled by patient, sign requesting privacy)

☐ Provide the option of rooming-in for newborn and mother together in room by giving space for bassinet on the side of mother's bed.

☐ Provide multimedia access for distraction and engagement

☐ Eliminate any visual clutter of equipment and wires concealed from patient view

☐ Providing options of boutique needs like birthing tub in the unit to accommodate flexible care option

☐ Provide acoustical sound absorption measures (e.g. acoustic ceiling tile) to minimize sound transmission between patient rooms, and between patient rooms and corridors

☐ Providing excess storages spaces in the unit as well as in the department

☐ Provide high quality durable finishes and linen for patient so they feel more comfortable and home-like.

☐ Providing spaces or furniture/fixture that support massaging (e.g. roller, table, chair, bed)

☐ Provide lighting variation (i.e. bright light during daytime and reduced light during nighttime) for the purpose of maintaining patients' circadian rhythm

☐ Considering the option of providing more comfortable bed rather than hospital bed for patients to make them feel more at home

☐ Provide appealing artwork/graphics that educates as well as motivates during the labor.

☐ Considering fresh air and options of soothing smells through aromatherapy in the patient room and eliminating unpleasant odors

☐ Provide access to outdoor space adjacent to the department for walking.

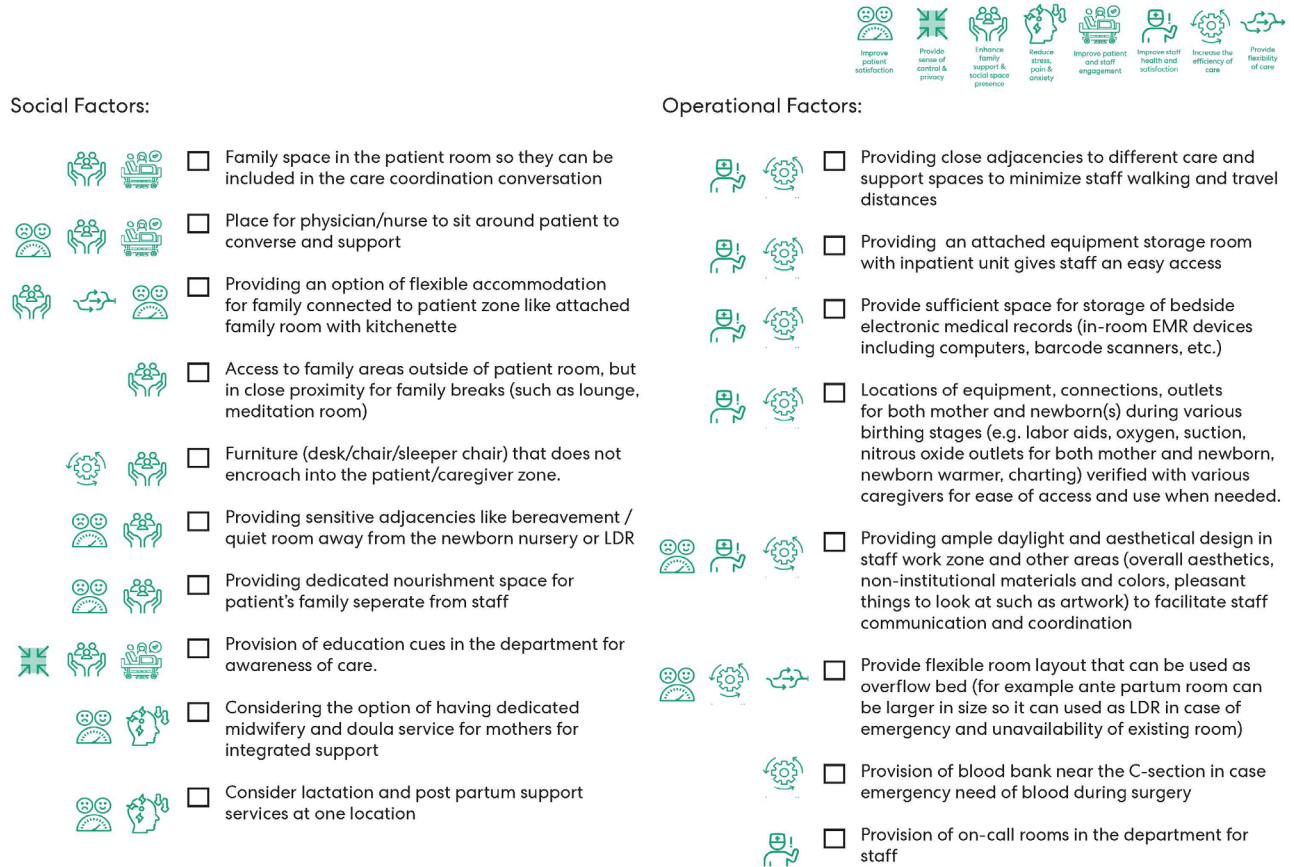**Figure 14:** *Design Checklist—Environmental factors.*

Improve patient satisfaction | Provide sense of control & privacy | Enhance family support & social space presence | Reduce stress, pain & anxiety | Improve patient and staff engagement | Improve staff health and satisfaction | Increase the efficiency of care | Provide flexibility of care

Social Factors:

☐ Family space in the patient room so they can be included in the care coordination conversation

☐ Place for physician/nurse to sit around patient to converse and support

☐ Providing an option of flexible accommodation for family connected to patient zone like attached family room with kitchenette

☐ Access to family areas outside of patient room, but in close proximity for family breaks (such as lounge, meditation room)

☐ Furniture (desk/chair/sleeper chair) that does not encroach into the patient/caregiver zone.

☐ Providing sensitive adjacencies like bereavement / quiet room away from the newborn nursery or LDR

☐ Providing dedicated nourishment space for patient's family seperate from staff

☐ Provision of education cues in the department for awareness of care.

☐ Considering the option of having dedicated midwifery and doula service for mothers for integrated support

☐ Consider lactation and post partum support services at one location

Operational Factors:

☐ Providing close adjacencies to different care and support spaces to minimize staff walking and travel distances

☐ Providing an attached equipment storage room with inpatient unit gives staff an easy access

☐ Provide sufficient space for storage of bedside electronic medical records (in-room EMR devices including computers, barcode scanners, etc.)

☐ Locations of equipment, connections, outlets for both mother and newborn(s) during various birthing stages (e.g. labor aids, oxygen, suction, nitrous oxide outlets for both mother and newborn, newborn warmer, charting) verified with various caregivers for ease of access and use when needed.

☐ Providing ample daylight and aesthetical design in staff work zone and other areas (overall aesthetics, non-institutional materials and colors, pleasant things to look at such as artwork) to facilitate staff communication and coordination

☐ Provide flexible room layout that can be used as overflow bed (for example ante partum room can be larger in size so it can used as LDR in case of emergency and unavailability of existing room)

☐ Provision of blood bank near the C-section in case emergency need of blood during surgery

☐ Provision of on-call rooms in the department for staff

Figure 15: *Design Checklist—Social & operational factors.*

4.0 Conclusion: Moving Forward

The COVID-19 pandemic taught us that the current healthcare system needs to keep up with upcoming challenges and surges. It made us reevaluate our healthcare services and the delivery of care. Similarly, women's health is a significant service line that needs to evolve with women's current trends and needs. There is no one-size-fits-all solution, but it cannot be overlooked as just a medical sub-specialty. It needs to be seen more as a holistic health approach.

4.1 Initiating the Business Case for Patient Satisfaction

Women count as the influential decision-maker and contribute 29 percent more per capita to healthcare than men. They control 80 percent of healthcare decisions in the US and represent a significant consumer of healthcare services.[27] Healthcare organizations need to understand the needs of women and tailor their services as per their demands. Choosing a pregnancy care provider is a major decision a woman takes that introduces her to healthcare settings. This introduction leads to the future use of other healthcare services. Nowadays, women look for more comprehensive care services with primary care and mental health services available at one location. This attracts them more as it saves time and makes care accessible. This idea of 'co-locating' the services reduces the wait times and gives patients one consolidated location for all their healthcare needs.

The first step to understanding women's needs involves decision-making. Most of these decisions earlier were governed by men who failed to empathize with women's needs. The strategic planning needs to involve a diverse group of women and 'co-create' an experience that leverages their opportunities to access care. The design process needs to identify the challenges and provide solutions that holistically empower women's health.[28] Recently, one such all-women-designed and women-voiced center—Ripa Center for Women's Health, provided more equitable, holistic, and consumer-friendly women's care. This outpatient center provides an integrated experience under one roof by providing a 'Half Day for Health' program where they can schedule a three-hour appointment for primary and gynecological care visits. This fulfills their needs and empowers them to access the care efficiently. This concept gives an excellent marketing pitch and business case for future healthcare services and planning.

4.2 Partnership Between FemTech Companies and Health Systems

Upcoming FemTech startups offer combined services at their clinic locations and virtually at telehealth platforms through a membership-based model. These startups are trying to give education and support through telehealth appointments and more spa-like boutique care services at their clinics. These startups are trying to bridge the gap that most women are looking to fill and give a more equitable approach to diverse groups of people.[29] Their clinics are inspired by the local community and incorporate local design features and artwork to give women more familiarity with the space. The colorful and lounge-like spaces empower them to express their concerns more freely and comfort them. One such example is their exam rooms, which look more like spa treatment rooms than monotonous exam rooms (see Figure 16).

Tia expanded their clinics in partnership with UCSF Health in recent news. The collaboration aims to provide a more 'modern medical home for women.' The two organizations are trying to fill the gap between primary and OB-GYN care by integrating patient-centered physical, mental, and reproductive health. This teamed approach meets current women's needs and creates a new model for more 'one-size-fits-most' solutions.[30] Their integrated program includes shared leadership and clinical protocols to coordinate primary consistency and specialty care. This will help improve maternal health outcomes and increase access to care. The co-location of outpatient services in the medical center connects the complex healthcare needs in one location.

This model can be the future of health system master planning with more distinguished women's services. However, there are specific capital concerns between for-profit and non-profit healthcare providers that can be systematically resolved in the future.

Figure 16: *Calming aesthetics of exam rooms at Tia's Los Angeles Clinic (Image Courtesy: Alda Ly Architecture).*

4.3 Keeping Up with Public Health Policy Changes

Center for Medicare and Medicaid Services (CMS) announced a 'birthing-friendly' designation for hospitals; as per this designation, consumers can choose hospitals that commit to delivering high-quality maternity care. This measure requires hospitals to collaborate in state or national perinatal quality improvement programs and enact safety practices for birth complications such as sepsis or hemorrhages. These policy recommendations will govern future safety protocols like readiness and responsiveness of staff and facility spaces to reduce obstetrics errors and maternal morbidity.[31]

Congress passed the black Maternal Health Momnibus Act to tackle the maternal health crisis among black and indigenous people of color. The Momnibus Act includes measures to strengthen the maternal health workforce, improve care for people who receive maternal health care through government agencies through investments in research and funding, promote innovation of care with digital tools and payment models, and ensure continuity of care through pregnancy and up to one year postpartum.[11]

The research highlighted the challenges and needs for improving the patient experience in the hospital; the design checklist and goals are a first step to achieving better patient experience and improving health outcomes. But women's health is a major public health component that, it needs tangible and intangible efforts to make it better. For future growth and trends for marketing, women's programs need to look beyond obstetrics, prioritizing gynecology, behavioral health, and fertility services depending on local patient demand. Women's health programs should integrate telehealth to increase access to care and provide a continuum of care. Design might solve tangible issues, but it takes a community effort to create intangible change. As healthcare designers, we need to look beyond design problems. Design should not stop here to check a box and complete the checklist. It requires working with our clients, users, and those caring for maternal health. It is easy to agree that yes, design should do all these things. However, it is up to architects and designers to creatively implement strategies based on additional factors operational processes, social and regulatory factors.

Acknowledgments

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03

Impact of Virtual Healthcare on an Aging Population:

Future of Care Delivery for the Elderly

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Abstract

This research aims to present the impact that COVID-19 had in the field of geriatrics. The article showcases challenges faced and current behavioral trends seen in the elderly population post-pandemic as it pertains to their healthcare needs. The aging population is the most vulnerable group of patients being cared for by the social care systems and healthcare providers across the world. There are three major reasons. First, the aging population is living longer than seen in the past. Recent studies suggest that in the next 10-15 years, the population of people 65 and older will outnumber the population 18 and younger, making them a majority. Secondly, as per research, 65 percent of the adults in the 65-84 age group have two or more chronic conditions. And lastly, with the increase in the use of technology to deliver healthcare, it is important to understand how the aging population will receive care while they are still adapting to new technologies.

This research on recent innovations in the environmental design and technology of the aging population was informed by a literature review and survey. This article investigates the myriad ways in which healthcare services are designed for the growing, aging population. The purpose of this study was to analyze the effects of these evolving trends on healthcare facilities and the care spaces they access and to identify new ways of designing environments. The findings highlight the urgent need to rethink the design of the built environment to make it truly inclusive and universal for the well-being of this population in the present and the future

Keywords: *elderly, virtual healthcare, COVID-19, aging, technology*

1.0 Introduction

Major demographic changes have been anticipated for the coming years due to three observed trends: the current population growing older than expected with a comparatively longer life expectancy rate; a dip in the middle-aged population due to Gen X being smaller in size compared to Millennials and the Baby boomers; and a continuous slowdown of population growth as Millennials choose to have fewer kids.

The aging population is living longer than anticipated and it is expected that in the next 10-15 years, people aged 65 and older will outnumber those aged 18 or younger. Since 1990, the Old Age Dependency Ratio (OADR) has increased across all regions in the world. As per a 2019 UN report, by 2050, the OADR is expected to reach 28 per 100 working people from 16 per 100 people in 2019.[1] As more individuals are becoming dependent on digital technologies post-pandemic and shifting

Figure 1: *Demographic changes and increase in the elderly population.*

towards a virtual operating world, it is uncomfortable and challenging for a high percentage of the senior population globally to adapt to this change. According to a 2021 article by The Medical Futurist, seniors are connected to the internet more than ever before because of loneliness and isolation during the pandemic.[2] The overall use of telemedicine services increased by 300 percent among seniors. It has increasingly become necessary for seniors to acquire technological skills, whether desired or not, to stay connected with their families and friends and catch up with this revolution.

Although, most of the user-facing applications, devices, care services, and built environments are designed by the younger population and majorly for the younger population, seniors seem to be neglected in this design process. An article by the United Nations suggests that the number of older people is projected to double by 2050.[1] As older adults become a majority population, understanding their needs is important. Based on their stage of life and abilities, they have different requirements compared to the younger population. There has been immense development in medical technology and care delivery services, after the COVID-19 pandemic, to provide care at home. The question that arises is how these care models are going to affect the elderly and the physical environment around them.

1.1 Hypothesis

COVID-19 has highlighted many of the gaps and challenges that the older population had been facing in accessing healthcare for years. A shift is being observed in the care delivery models from inpatient hospitals to outpatient and at-home services. This has also expedited the dependency on medical technology and changed the way healthcare services are being delivered. While these changes are advantageous for the users, they also bring along challenges for service providers in terms of delivering care at home. Moreover, as per an American Association of Retired Persons (AARP) Survey, 77 percent of 50 and older adults wants to remain in their home as they age.[3] Having said that, the current built environment is not well-equipped and designed to accommodate these healthcare needs. Providing care at home not only requires changes in the physical environment but also in the logistical and operational work too.

Hence, working towards undertaking these challenges presents an untapped opportunity. This article will address issues and impacts of virtual care on the aging population and present some conceptual design strategies which could help in facilitating the need of receiving healthcare outside hospitals and health facilities. In the future, this will provide age-friendly care, and address the needs of elderly users while reducing the load on hospitals and service providers.

2.0 Methodology

2.1 Literature Review

A snowball sampling method was adopted to find relevant articles. This is a nonprobability sampling approach in which current research subjects recruit prospective study volunteers from their social circles. The search included keywords from the title and the potential hypothesis of the article. Multiple studies were found and selected based on their abstracts and results for further investigation.

Keywords including 'aging,' 'virtual healthcare,' 'technology,' 'elderly,' and 'COVID-19' were used to find scholarly and authentic literature, newsletters, and articles, written in 2019 or later. On review, these documents showcased the challenges faced and solutions provided to the elderly during the pandemic.

2.2 Survey

A quantitative survey was conducted to understand the perspective of care receivers, care providers, and at-home help through three groups: Physician/Academician/Field Expert/Paid Professional (anyone related to the geriatric industry), Mid-aged Adults (30-65) and Elderly/Older Population, all living in urban areas.

This segregation of user groups provided a comprehensive perspective from care providers, care receivers, and helpers. An analysis of the received responses provided an understanding of the past and present experiences of the users and informed future spatial needs of the elderly population, in terms of care at home and hospitals. Based on this data, design strategies were conceptualized and presented to provoke a discussion within the design community.

A total of 54 responses were received. These respondents included field experts including physicians, designers, medical planners, and the elderly population. Based on the data received, 61.8 percent of people who responded to the survey were mid-aged adults, 11.8 percent were field experts and 26.5 percent were the older population. 20.4 percent of the respondents were people who take care of an elderly person, out of which 81.8 percent did that in a private setting or at their homes.

As a result of this survey, a significant percentage of the elderly population believed that loneliness is one of the biggest problems in their age group and they would prefer to age in place or at home, post-pandemic. In addition, access to healthcare has also been linked to affordability issues by some people. Approximately, 61.9 percent of mid-age adult respondents were involved in their older member's healthcare routine and most of them helped them with technology, especially during virtual visits. As a result of this survey, challenges faced by these user groups were identified along with their expectations for the future of the healthcare system. In addition to the survey, insights were solicited from field experts on how the physical environment can be leveraged to address challenges faced by the aging population post-pandemic.

3.0 Virtual Healthcare and the Aging Population

The COVID-19 pandemic made it increasingly difficult to connect to people, whether it is family, work, or any other professionals. During this unprecedented shift, telehealth, and telemedicine were embraced at an unprecedented rate. A surge in medical cases forced physicians and healthcare providers to adopt a virtual approach to treatment to reach the maximum number of people without safety risks.

Virtual care has helped provide multiple services that help support an over-burdened traditional healthcare system. The ease of use for telemedicine differs across different age groups. Research suggests that senior citizens are less willing to engage with and try new technologies. This has been attributed to variability in consumer demands at different ages. Accenture's 2020 Digital Health Consumer Survey found that the younger generation has been more open to using technology and receiving virtual care compared to the older generation, especially in rural areas.[4] Several factors which curb the use of technology as the consumer ages are discussed in this article. Section 3.2 below will discuss what factors contribute to the challenges that hinder the older generation from using technology to receive care.

3.1 The Aging Population

According to a 2021 article by WHO, aging results from the impact of the accumulation of a wide variety of molecular and cellular damage in an individual over time.[5] This leads to gradual loss of physical and mental capacity, a higher risk of getting diseases, and finally death. An article by National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP), claims by 2060, the number of older adults is expected to reach 94.7 million and will make up 25 percent of the US population.[6] That means comparatively a higher percentage of people will be at risk of chronic diseases such as Alzheimer's, Dementia, Arthritis, Diabetes, and Cancer. These are all physical aspects of aging.

Psychologically, aging also means retirement, value versus expendability, increasing dependency, social isolation and loneliness, loss of friends and family, challenges in adapting to change, and more.[7] These changes are neither consistent nor straightforward and vary from person to person.

According to the Centers for Disease Control and Prevention (CDC), social isolation was associated with a 50 percent increased risk of dementia and other serious medical conditions. A report from the National Academies of Sciences, Engineering, and Medicine states that more than one-fourth of adults aged 45 and older are feeling lonely, and nearly one-fourth of adults aged 65 and older are considered socially isolated.[8] These factors contribute to physical and mental illnesses in the older generation and further serious public health risks. Hence, at present, many organizations (as discussed in Section 3.7.1) are strategizing ways to support all age groups in society and prepare to care for an aging population.

3.2 Increasing use of Virtual Healthcare and its Challenges faced by the Aging Population

In response to COVID-19, most states in 2020 began to introduce stay-at-home policies. These policies were intended to prevent transmission of the disease to the patients within the hospital as well as control the surge. According to a research report by the Assistant Secretary of Planning and Evaluation, the number of Medicare fee-for-service (FFS) beneficiary telehealth visits increased 63-fold in 2020, from approximately 840,000 in 2019 to nearly 52.7 million in 2020.[9] Ninety-two percent of the beneficiaries received telehealth visits from their homes, which wasn't permitted in the pre-pandemic times. Adoption of telehealth services, pre-pandemic, was slow. A Harris Poll conducted in collaboration with American Well in early 2019, stated that 66 percent of Americans were willing to use telehealth but only 8 percent did.[10] Only 10 percent silent generation, 8 percent of Baby Boomers, and 21 percent of Gen X received any kind of virtual healthcare compared to 35 percent of millennials and 38 percent of Gen-Z pre-pandemic.[4] But surprisingly, 92 percent of people reported using virtual care for the first time during the pandemic.[11]

Video visits and telephone visits are being adopted by many, but not all age groups see virtual care as an adequate substitute for the in-person care they received in the pre-pandemic era. As per Accenture's Digital Health Consumer Survey, pre-pandemic, only 20 percent of Baby boomers were willing to try virtual care compared to the younger population. Another October 2019 report by the University of Michigan National Poll on Healthy Aging stated more than half of the older adults who had telehealth visits indicated that in-person visits were better than telehealth visits regarding feeling cared for (56 percent), communicating with the healthcare professional (55 percent) and amount of time spent with the healthcare professional (53 percent). Moreover, 58 percent of people viewed in-person care as better in terms of overall quality of care.[12] Findings from the poll also express concerns about providers not being able to do a physical exam, privacy, feeling disconnected, difficulty using technology, and difficulty in seeing and hearing the healthcare professional. The pandemic ushered in unexpected levels of interest in virtual care. However, most people over age 57 still preferred in-person care due to the various challenges they face.[13]

Despite convenience being identified as the differentiator of virtual healthcare in geriatric care,[14] it is important to understand the weaknesses that come along and the challenges they encounter. Technology is ubiquitous in almost all aspects of our daily lives; however, some barriers prevent the older population from accessing technology and ultimately virtual healthcare. Lack of instructions and guidance, lack of knowledge and confidence, health-related barriers, and cost were identified as perceived and actual barriers in a study.[15] Similarly, another study reported physical barriers, lack

of access, and lack of interest as key barriers for older adults in using technology.[16] Several organizations and institutions define the challenges of aging through distinct perspectives. Below are the two most important categories which encompass the factors that are holding back seniors from becoming part of the healthcare revolution.

3.3 Challenges: Physical Barriers

Cognitive abilities: As we get older, our mental functions become less nimble and flexible, and many aspects of memory worsen. This means the body parts become less efficient which makes daily life tasks difficult. In the UK, studies have shown that 45 percent of seniors have trouble using an iPad due to cognitive issues, and less than 50 percent of seniors with dementia can use technology by themselves.[17] Another study reported that cognitive deficits and low self-efficacy significantly reduced participants' ability to use technology.[18]

Dexterity: Certain characteristics of fingers can reduce the electrical conductivity of skin such as calluses and dry skin lacking the moisture needed for the flow of electricity. Elderly people with dry and wrinkled fingertips have significant difficulty with touchscreens. Gestures like rotating and zooming in/out require the use of multiple fingers which gets challenging too. Therefore, it is difficult for them to operate devices since it gets physically impossible. 60-99 percent of the elderly population are affected by dry/leathery skin conditions and touch screens did not recognize the touch of 25-28 percent of the participants.[17]

Other physical impairments like multiple sclerosis, Parkinson's disease, and arthritis conditions, which are quite common in the elderly population, make it difficult and awkward for them to hold and use devices.

Vision: Decreased visual capacity sometimes prevents the elderly to access digital content or even hardware features. A study highlighted the various challenges like finding the charging connection because of concealed or hidden connections, replacing batteries, and more. This was mainly due to difficulty in seeing small symbols and visual disability.[19] As a result, seniors get frustrated which leads to reluctance to use technology.

Hearing: As people age, technologies (care bots, virtual assistants, etc.) and activities (video calls, phone calls, etc.) that require voice commands become difficult to use. A study reported approximately 20 percent of older patients were not ready to use telephone health visits because of difficulty in hearing, communicating, or dementia.[20] Another study's results showed people with hearing loss declined the offer of telemedicine appointments, rated telemedicine outcomes significantly less positively, and had a strong preference for in-person visits. This was mainly due to hearing and related difficulties, concerns about miscommunication, lack of privacy, and associated stress and anxiety.[21]

3.4 Challenges: Emotional Barriers

Motivation: Even though telehealth might give a sense of security but learning to use a new device takes extra effort. Older people would be more open to learning new devices if the possible advantage of the new technology offsets the amount of effort involved in adapting to it. Difficulty in remembering instructions was seen as an important barrier to the use of technology amongst the older population.[22] The uneasiness leads to discouragement and lessens motivation to learn new things. Computer self-efficacy has proved to be an important influence on attitude and intention to use in the case of older adults.[23] As stated in a National Institute on Aging (NIA) article, it is important to understand how people make decisions as they age.

Hesitation and Discouragement: Mastering new technology is difficult as the old population has had no experience before. It gets difficult for them to absorb new knowledge. Another article stated that users aged 65 and older are 43 percent slower at using websites compared to the younger population.[24] One of the main reasons is hesitation and discouragement. Forty-five percent of seniors showed behaviors that indicated discomfort in trying new things or hesitation to explore. Seniors are almost twice as likely to give up on a task and blame themselves 90 percent of the time.[24] One of the survey respondents stated the difficulty their parents face in using anything that requires an app or separate log-in since they do not own a laptop or a tablet. They not only face frustration but also gets agitated easily.

Mistrust/ Fear: In telemedicine, privacy and security are closely linked. According to the University of Michigan's National Poll on Healthy Aging, 49 percent of older adults reported privacy concerns.[12] Another respondent in their survey stated the need to address issues related to privacy. More reliability and power given to technology can be a deterrent to people's trust and cause people to be afraid of things that could provide great support.

An article states this is an important issue in telemedicine adoption for an older population with concerns about their personal data being stored in a secure and immune location that prevents data breaches. Medicare fraud is an increasing issue across the country. Scams like medical billing, coercing beneficiaries to enroll in plans and programs, alluring people to sign up for services that offer free gifts, etc. are some of the common swindles. Medical professionals have encountered situations in which patients feel uncomfortable on video visits due to privacy concerns.[25] The Federal Trade Commission (FTC) had logged nearly 626,000 consumer complaints related to COVID-19 and stimulus payments, 73 percent involving fraud and identity theft.[26]

Remote Monitoring is being used much more compared to the past and has become a vital component of telehealth. The surveillance nature of this process allows the caregiver to monitor activities that an elderly person does. Although, this has raised concerns about privacy in both old and young people. They perceive significant overlap between values of privacy, independence, identity, and freedom.[27] Therefore, perceived security is predicted to exert an important influence on older adults' acceptance of home telemedicine services.[23]

3.5 Challenges: Other Barriers

Affordability: At times, when the technology is good for seniors, it is not affordable. All the 'smart' devices in the market often come with a high price tag, ruling out a big part of society including seniors.[2] Research conducted by a consulting firm predicted virtual health visits to reach one billion in 2020. Although this number may not include several people like the elderly population.[28] 87.5 percent of the elderly (65 years and above) who responded to the research survey said affordability is a concern when it comes to accessing proper healthcare. Many lower-income adults, even pre-pandemic, would not be able to
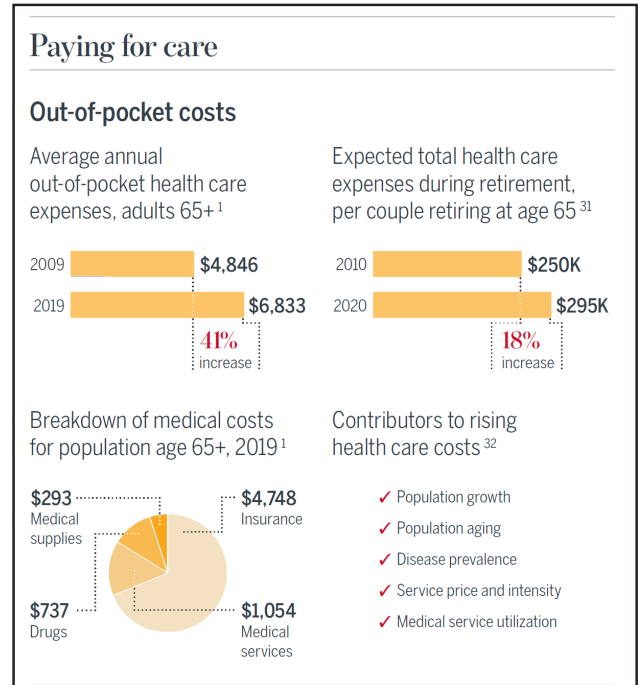

Figure 2: *Change in demographics and health needs of older adults over time.[29]*

afford Medicare. Buying hardware to access telehealth becomes impossible for these people. Similarly, an analysis by Advisory Board states that when older adults move to Medical coverage, they may face difficulties with out-of-pocket costs with a fixed retirement income. Medicare actuaries project an increase in spending growth, increased use of services and intensity of care, and rising healthcare prices.[29] A study suggests that as telemedicine becomes global, telecommunication devices should be covered as a medical necessity, especially due to the relation between poverty and telemedicine unreadiness.[20]

Accessibility: This can be categorized as Design Accessibility (virtual platform design) and Physical Accessibility (access to hardware, internet, etc.).

> *Design:* Visual impairment is a very common problem while aging. Sites and apps that target seniors as end users should consider design (readability, accessibility, font size, colors, font style, etc.) to make targets and use prominent. Seniors often feel that websites are not designed with consideration for their needs and interest and digital products still discriminate against seniors.

Physical: UK Office of National Statistics reported only 50 percent ownership of smartphones in those aged 55 and above versus up to 95 percent in the 16-24 age group.[30] The use of internet services for communication purposes is seen as less frequent in rural areas compared to urban areas leading to disparity.[31] Limited access to high-speed internet affects the ability of physicians and patients to effectively communicate and participate in video consultations, gather information, and monitor health.

Lack of Support: Social context affects whether a senior will use telehealth services or not. Adults surrounded by friends and family are more likely to use telehealth and adopt the practice because of the availability of support. The survey reported 19 percent of the respondents expected a great deal and 38.1 percent of people expected a moderate amount to get involved in the healthcare routine of the senior adults at their homes. When asked, most of them mentioned they help seniors with technology, driving to the hospital, coordinating care, and participating in doctor recommendations. Another study reported a better response to video visits from older adults who had social support.[20] Seniors aged 60 and over can struggle to set up tech devices that companies target them to use. However, the growing number of seniors who will need more care is leading to a greater market gap and interest from providers and developers to develop digital health technologies that seniors can easily use.[2]

3.6 Consequences of the Challenges

Virtual healthcare, with its advancement in the past few years, has had its broad reach except for the older population. This is due to their deteriorating physical and mental health, inexperience and mistrust of technology and various other reasons mentioned previously in this article. These challenges along with the pandemic have had their implications. A few of the main consequences that are essential to discuss are social isolation and loneliness, delay in care, and reduced mobility.

Human beings tend to naturally seek quality relationships for their health and well-being. Social isolation or lack of social contact with others is an underappreciated public health risk. Even though pre-pandemic this was an issue, COVID-19 and the lockdown have exacerbated the problems for the elderly. And as the world connected

more and more through technology, older adults were held back due to their physical and behavioral barriers. A report from the National Academies of Sciences, Engineering, and Medicine (NASEM) points out that 24 percent of community-dwelling Americans (65+ years) are considered socially isolated, 35 percent of adults (45+ years), and 43 percent of adults (60+ years) feel lonely.[8] Older adults are at increased risk of facing social isolation and loneliness due to various reasons like inexperience with tech, living alone, loss of family and friends, physical impairments, and more.[32] This leads to major health risks as reported in many studies. Social Isolation increases a person's risk of mortality from all causes by 29 percent, increased the risk of cancer mortality by 25 percent,[33] and increased the risk of dementia by 50 percent.[34] Similarly, loneliness has been associated with a 59 percent increased risk of functional decline,[35] and among patients with heart failure conditions, there's an increased death risk by four times, a 68 percent risk of hospitalization, and a 57 percent increased risk of Emergency Department visits.[36]

3.6.1 Social Isolation and Loneliness

This phenomenon has also been associated with other issues relevant to demographics, planning, gender, and socio-economic status.[37] Migrants, especially older people who had to move to another country/city with their adult children were more likely to suffer from loneliness due to a lack of social support and companionship, declining health, language barriers, and new surroundings.[38] Reviews and analyses also found that higher income and more education are correlated with reduced loneliness. People with lower income and education levels might stay at locations with other social and environmental issues which reinforces loneliness.[39] 88.9 percent of the elderly (65 years and above) who responded to the survey said loneliness is the biggest problem for their generation. A respondent also emphasized the importance of human contact and human touch.

3.6.2 Delay in Receiving Care

Even though telehealth has been cited as a convenient way to access care, older adults with chronic conditions might not be fully satisfied, leading to delaying care to

schedule an in-person visit with the physician. Inconsistent quality of care, patient experience and engagement, loss of connection, and mistrust are four overarching themes identified in a recent article. The participants expressed concerns about the clinical effectiveness and limitations of virtual physical examinations and disparities in access, harm to the patient-clinician relationship, restricted ability to comfort patients in virtual settings, and reduced patient trust. On the other hand, many older adults are also fearful about visiting a healthcare facility and being exposed to COVID-19. According to the National Poll on Healthy Aging, the pandemic disrupted healthcare for 30 percent of older adults.[40] As per a study in 2019, 14 percent of respondents postponed or canceled, or rescheduled their visits with health providers for COVID-19-related reasons.[41] 24 percent of cancer patients, 29 percent of diabetes patients, and 30 percent of people with heart conditions said they had put off at least one telehealth visit. While telehealth provides the flexibility of receiving care at home, not all people, especially older adults, are comfortable or experienced in using technology and still prefer in-person visits. Although the fear of in-person visits might not go away for some time.

3.6.3 Lack of Mobility

Many seniors fear a 'Lack of Mobility' as they age. Being mobile not only means being able to walk in their surroundings but also being able to do basic quotidian activities like grocery shopping, driving a car, etc. COVID-19 and lockdown have increased these mobility restrictions. 4 in 10 seniors said they walk less than before while 3 in 10 responded vice versa.[42] Working from home, decreased use of public transport post-pandemic, and increased time on the internet add to the problem. People get drained out too soon in these times.[43] A New York Times article has stated that health experts are concerned about reduced mobility and physical conditioning in older adults due to the pandemic.[44]

For technology to be fully inclusive, it needs to be designed around the necessities and limitations of all user groups. Especially in the case of the elderly population, the design needs to be simple, safe, and easy to navigate. The design of the built environment also needs to be rethought and researched to make spaces adaptable to 'care-at-home' or 'hospital-at-home' concepts to meet the desires and complex care needs of the elderly population.

3.7 Trends and Technologies for Aging Well in Future

The Demand for healthcare has rapidly shifted from in-person to virtual and at present, a hybrid system exists post-pandemic. While it became convenient for younger patients to access care, older patients experienced challenges due to high vulnerability to the COVID-19 virus in hospital environments, and discomfort and inexperience while using technology. A National Poll on Healthy Aging (NPHA) showed that 1 in 3 older adults had canceled or postponed care in 2020 due to personal concerns about COVID-19 exposure in the healthcare environment.[12] As we step into the future, we are seeing value-based transformation in healthcare delivery. Value-driven care strives to improve access to healthcare, improve patient experience and quality of care, and moderate healthcare costs.[45] Innovative products, programs, and care models are being developed to deal with the desires and complex needs of the aging population from hospitals to outpatient settings. And more recently, we are also seeing care options expanding within a household setting—from products to the design of the built environment itself.

3.7.1 Technologies

Interest in technology among older adults has continued to expand, especially after the COVID-19 pandemic. As many of the seniors are catching up with the current technology, many others are awaiting new advances. 64 percent of 50 and older adults are interested in at least one type of upcoming advancement. Older adults are continuing to spend time on technology. By 2030, the 50+ market is expected to spend 108 billion dollars on average, annually on tech products.[46]

Several age-tech companies are utilizing Virtual and Augmented Reality solutions that provide an immersive experience. Embodied Labs offer immersive caregiver training, XR Health offers rehabilitation, and Rendever and Silver Adventures offer virtual experiences to improve the well-being of the elderly population.[47]

Recently Google introduced 'Project Starline'—a video-conferencing technology project that enables friends, families, and coworkers to feel together even when they're cities apart. Through this tech, one can see the other person's life-size in three dimensions. Google has been conducting demos with healthcare and media partners

to get early feedback.[48] This can improve telehealth experience and patient experience, especially for older adults who still prefer in-person visits. Alexa, Amazon's smart-voice assistant, also made their way into the senior living communities during the pandemic. It became easy for older adults to use the multiple features and gain the ability to manage their living environment and stay connected with their families. Senior living providers are seeing promise in voice technology and strong results from pilot programs.[49]

Robotics and its implementation into facility operations have taken a rise due to staffing pressure, especially post-pandemic. Robotic assistants might routinely feature in older people's homes, helping them with self-care, providing emotional support, and allowing virtual access to doctors and nurses. In retirement homes, they could be helpful for entertainment or cleaning while in hospitals they are already doing basic tasks to free up nurses to focus on patient care.[50] With this increasing demand for healthcare workers for future and current shortages, medical scientists and experts are looking at robotics to mitigate this demand-supply issue. The home eldercare market, driven by expanding elderly population, is anticipated to increase to $224 billion by 2024 from $100 billion in 2016.[51] Social robots, service robots, autonomous mobile robots, surgical-assistance robots, and modular robots are a few categories seen within the medical field.[52] Robotics in the healthcare industry is beneficial as it enables high levels of patient care, efficiency, and accuracy and saves work environments for caregivers and patients.

3.7.2 Hospital at Home:

The preference to 'age in place rather than in any kind of facility' is widely recognized in the elderly population post-pandemic. As per a National Poll on Healthy Aging (NPHA) article, 'Aging in place refers to living independently, safely, and comfortably in one's home for as long as possible. There have been many advantages of care at a home model decrease in mortality, better functional outcomes for patients, reduced risk of hospital-associated infections (HAIs), shorter hospital stays, cost-effectiveness, more physical activity, and better sleep for patients.[53] Studies found that the average cost of care for patients at home was 52 percent less than in-hospital care.[54] Moreover, healthcare at home may also reduce

the burden of overloaded health facilities and systems.

However, it can become challenging for older adults to safely remain in homes without certain modifications and additional support from others. Many older adults are not prepared to age-in place. They either do not have common accessibility features or haven't given much thought to what modifications might be needed.[55] Moreover, the successful implementation of home care also requires adequate social support. Hence, soon, residents will need to employ a Human-centered design in its true sense.

The Center for Health Design released a white paper that presented research strategies that facilitate healthcare at home. These findings included considerations for building and room configuration, patient handling equipment, furniture, accessibility fixtures, storage, waste disposal, flooring, lighting, technology, and home aesthetics.[53] Residential designs are mostly oriented towards young, healthy, and abled individuals and do not support accessibility needs or healthcare services. Hence, homes need to be universally designed for aging in place which would include not only patients' needs but also the care provider's physical and psychosocial needs. 'Telemedicine: Where We Are and Why the Built Environment Matter,' a Center of Health Design webinar, talks about video etiquette and how location is considered an examination room despite its intended use. The room should be sufficient in size, safe, lit with minimum external noise (audio and visual privacy), have comfortable seats, and be able to accommodate posture and movement visualization. Therefore, home renovations and new models of acute care in the home are growing all around the country. Moreover, Medicare Advantage Plans may cover home modifications and other benefits.[56]

Research shows that home-based primary care has been shown to improve the quality of life of home-limited patients and their caregivers with reduced healthcare costs. Home-based primary care resurgence is occurring fast with time due to factors like an aging society, improved technology, increased emphasis on home and community services, and cost savings.[57] The article suggests an expansion of the home-based workforce to support home-based services for better healthcare delivery in the future. The hospital-at-home care model is particularly good for patients with well-defined treatment protocols such as pneumonia, congestive
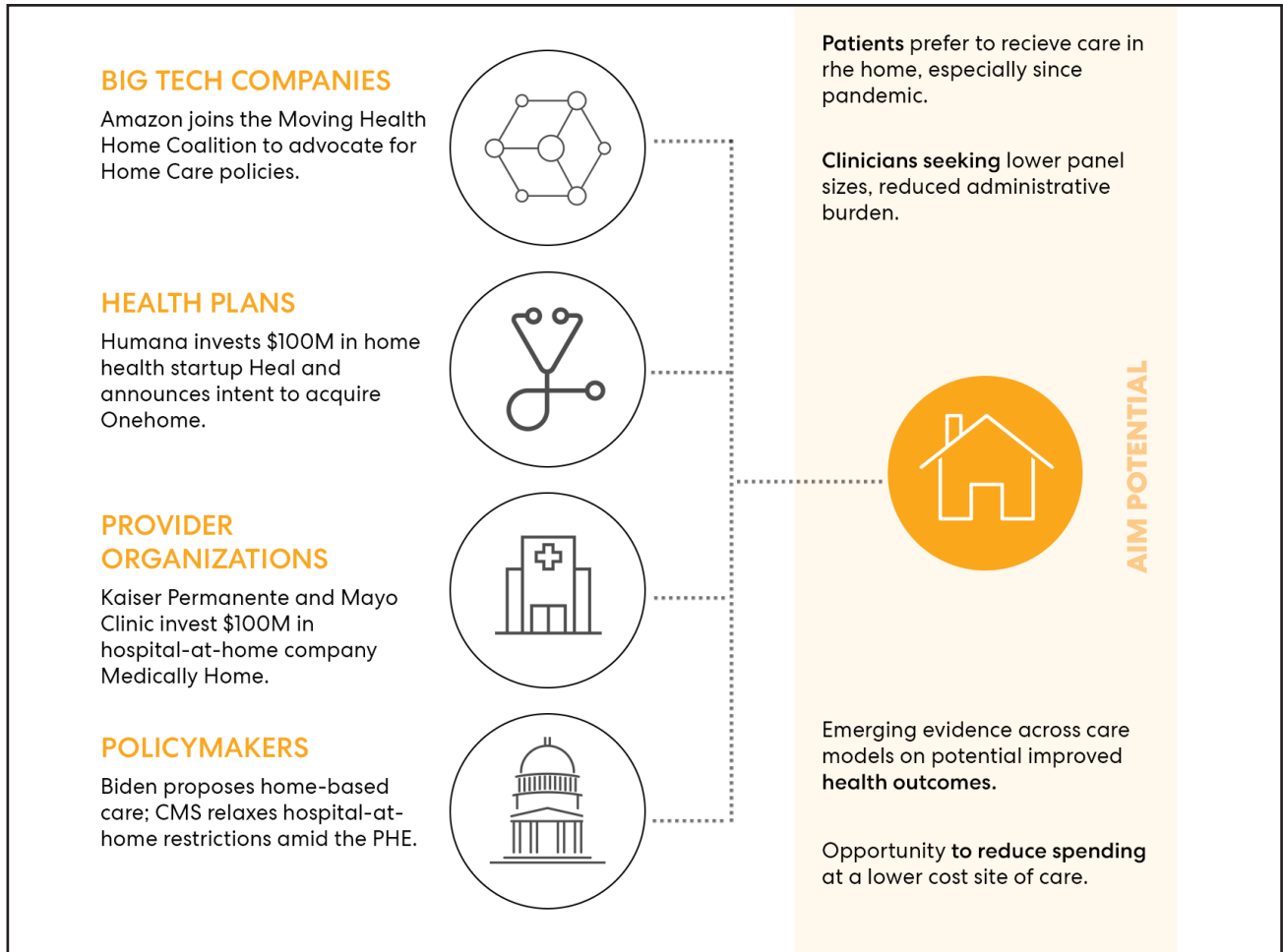
BIG TECH COMPANIES

Amazon joins the Moving Health Home Coalition to advocate for Home Care policies.

HEALTH PLANS

Humana invests $100M in home health startup Heal and announces intent to acquire Onehome.

PROVIDER ORGANIZATIONS

Kaiser Permanente and Mayo Clinic invest $100M in hospital-at-home company Medically Home.

POLICYMAKERS

Biden proposes home-based care; CMS relaxes hospital-at-home restrictions amid the PHE.

Patients prefer to recieve care in rhe home, especially since pandemic.

Clinicians seeking lower panel sizes, reduced administrative burden.

AIM POTENTIAL

Emerging evidence across care models on potential improved **health outcomes.**

Opportunity **to reduce spending** at a lower cost site of care.

Figure 3: *Home-based care and key stakeholders. (Courtesy – Women in Healthcare National Webinar: State of Healthcare Market in 2022 presented by Advisory Board).*

heart failure, diabetes, COPD, etc. Mount Sinai's at-home program provides services for acutely ill patients who would otherwise require hospitalization. The hospital reported increased patient satisfaction and lower cost of care.[58] Current Health, being acquired by Best Buy, is a leading care platform that provides remote patient monitoring, telehealth, and patient engagement in a single solution for healthcare organizations.[59]

The Care at Home model has the potential to innovate how and where hospitals provide care. Home is identified as the best location to receive care, and by leveraging technology, hospitals can add value, reduce the cost of care, and keep their patients in a safe environment.

3.7.3 Other Care Models

Healthcare systems are well prepared to develop and evaluate ways to identify social isolation and loneliness among the elderly in clinical settings.[8] Doctors can assess the risk of loneliness and social isolation and can connect older adults to community resources that offer help.[32] AARP, Area Agencies on Aging, Eldercare Locator, National Council on Aging, and National Institute on Aging (NIA) are a few examples of organizations that promote social connections and healthy habits for the elderly population. Companies like 'Papa' helps health plans and employers connect members and their families to real people for help with companionship, everyday tasks, transportation, and more.

3.7.4 The Post-pandemic Urban Environment

In addition, Innovative Programs such as Case-Finding for Complex Chronic Conditions in Seniors 75+ and Geriatric Patients-Aligned Care Teams highlight the evolving and enhanced healthcare delivery models that target multidisciplinary interventions to maintain the health and well-being of an individual.[60] Research by HealthTech points out senior care trends to watch out for in 2022. It states, with increasing ownership of technology and increasing burden on the independent facility staff, organizations are creating tech concierge roles for assistance.[61]

4.0 Results

4.1. Population Preferences

The responses received from the survey helped in strengthening the arguments and backing up the referenced data in the paper. Five main topics, answered by all groups, were identified, interpreted, and summarized in the form of a table.

1. Adapting to virtual healthcare has been most challenging for people who lack social support or who are not tech-savvy. Because of the circumstances and the need to access care providers, most of the elderly were forced to use telehealth.

2. The choice between in-person care, virtual care, and hybrid care is highly based on convenience. If the health issue is less critical, young, or old, people prefer the virtual option since it saves time. Hence, it's a need-based choice.

3. Although the most common challenge people faced as elderly was to gain the same experience as in-person like lack of human touch, complications with technology, and clarity.

4. Given a choice, people express interest in devices that provide safety more than extra care or help.

5. Expectations from healthcare providers vary with different age groups. Mid-aged adults expect more access to quality care, faster service, convenience, and transparency and older adults expect simpler designs and the ability to age well. The survey reported responses to people's expectations from

the healthcare system like the availability of remote monitoring, access to Electronic Medical Records and communication with clinicians, better management of fragile and brittle conditions, and better quality of life for aging.
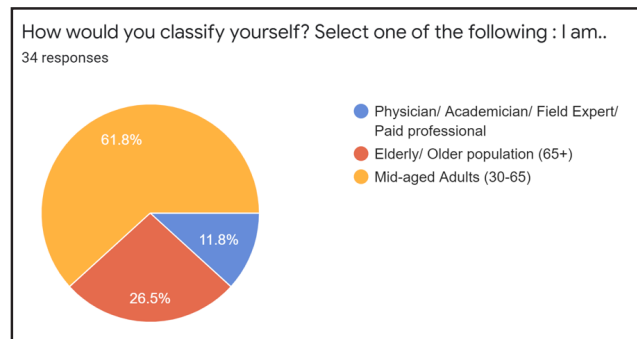

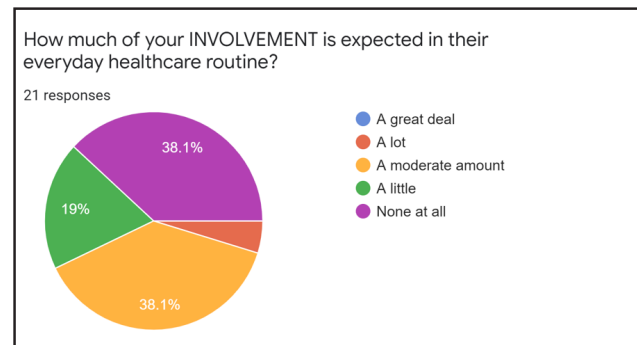**Figure 4:** *Diversity of people who responded to the research survey.*

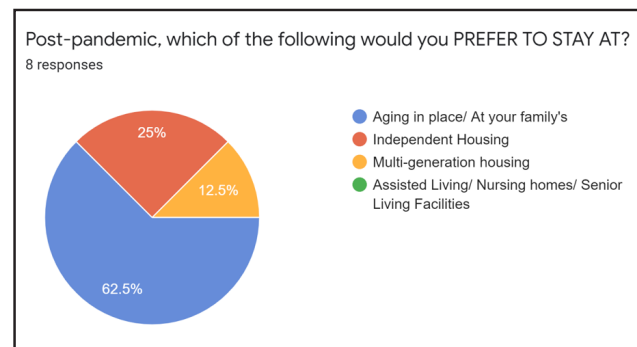**Figure 5:** *Response by mid-aged adults (30-65) to the research survey.*

Figure 6: *Response by elderly/older population on their preference to stay (65+ years).*

People Perspective

	Mid-aged Adults (30-65 years)	Elderly/ older population (65+ years)	Physicians/ academicians/ field experts/ paid professionals	Inferences
Convenience in **adapting** to change in Healthcare Delivery Systems	Most common response stated adapting to new technology becomes difficult for seniors and it also depends on the cognitive abilities of the person	22.2% - Very convenient, 55.6% - Somewhat convenient, 22.2% - Neutral	Overall participants felt it was easy for tech savvy elders to adapt to the change and with a speedy adoption, they did better than expected.	Overall, seniors adapted well, (even though it seemed forceful) to the virtual system, especially the tech savvy individuals.
Preference for Elderly: In-person versus Virtual visits versus Hybrid visits	• 63.1% responders preferred hybrid option as it depends on the care required. • 21.0% people preferred in-person visits because of real-time experience of challenges faced by older adults. • 15.7% people preferred virtual visits as it's a more convenient option	N/A	While 50% people chose Hybrid visits, rest 50% chose in-person visits backed up by reasons like more personal interactions and familiarity.	Based on the needs, all groups prefer the most convenient option. Care-at home model can consider parameters for less critical issues in patients/ in-person visit by the doctor.
Challenges and **positive outcomes** faced by elderly to access Telehealth or Virtual Healthcare	• Accessibility and ability to navigate through portals and apps is seen as the most common response • Cognitive abilities defines the level of challenge. For e.g., people with dementia gets really confused. • Complicated paperwork • Videocalls helped people with mental health.	• Longer wait time • No Dental care or eye exams for long time • Lack of human touch and contact • Less flexible automated systems	• All (100%) of the responders thought access to technology was one of the main challenges followed by access to internet, disability, and improper physical environment (75%). • Some also considered absence of human assistance and comfort with technology as challenges.	Common challenges like in-person experience and lack of human touch and complications with technology are identified by all groups.
Technologies looking forward to: Carebots, Robotic arms, VR Tech for Immersive Experiences, Wireless Motion sensors and AI monitoring solutions	First choice for 52.4% of the participants was Wireless motion sensors and AI monitoring solutions while 19% of the people chose carebots and VR Technology for immersive experience	First choice for 55.6% of the participants was Wireless motion sensors and AI monitoring solutions while 44.4% people chose VR Technology for immersive experience	N/A	Wireless motion sensors and AI monitoring solutions are first choices. Safety > Support/ Extra care
Future expectations and preferences regarding care delivery models	• Remote monitoring, access to Electronic Medical Records, more transparency • Access to specialists and MDs, beyond local hospitals and clinics • Better quality of life for aging • Online portals and automatic check-ins • On-demand care, quick turn arounds, home visits • In-home diagnostic interface • Clear communication, Simple terminology	• 62.5% people prefer to Age-in place or stay at their family's post pandemic, 25% people prefers Independent housing while 12.5% preferred Multi-generational housing • 32.5% participants responded that the future of healthcare is not being designed keeping seniors in mind while the rest disagreed. Human connection, complex navigation, flexibility were identified as some of the stated issues.	• Older adults expect a simpler design of apps, patient portals or any web-based site and larger graphics for readability for seamless use, reduced noise levels and increased access to outdoors. • Caregiving services like physical and occupational therapy, hospice services, monitoring and help with everyday activities, tech training sessions and on-call doctor or nurse service might be beneficial in future. • Flexible, mobility friendly and intuitive built environment	While the mid-aged adults (next set of older population) expect more accessibility to quality care, faster service, conveniency and transparency, the older people only want to age well and need simpler designs in the present,

Figure 7: *Summary of responses from the research survey.*

4.2 Promoting Healthy Aging

As we move forward with these upcoming trends and technologies, below are some recommendations for the design industry to promote healthy aging.

4.2.1 Universal Design and Aging in Place

Residential designs, whether single-family homes or apartments, are mostly oriented toward young, healthy, and abled individuals and do not support accessibility and future healthcare needs. Hence, homes need to be creative and universally designed for all people regardless of their age, gender, or abilities. This also makes the space adaptable for future use. To design a space for aging in place, it should not only include patients' needs but also care providers' physical and psychosocial requirements like accessibility features, type of fixtures, patient handling, and monitoring equipment requirements, etc. Common diagnostic spaces or exam-like rooms can also be included.

With the advent of hospital-at-home care models, infection control methods, temperature check machines, equipment storage requirements, and accessibility are important considerations. Evidence-based design and research for healthcare at home are emerging. As designers, one needs to explore ways to facilitate 'care at home without making the physical environment too institutionalized and uninviting. Architects, designers, and healthcare professionals must consider this opportunity to design 'Healthcare at Home. Even though the design of a residential environment with clinical requirements might seem like a difficult union, there is a growing need for support. With its potential benefits, it is important to explore ways in which every home can support healthcare and older people's everyday needs.

Flexible and Multi-generational living options in any housing can help them get integrated into the communities through design and can help reduce loneliness and social isolation. Participation in communal events helps in keeping seniors active.

4.2.2 Decentralized Care

Decentralization in healthcare delivery is gaining pace as consumers continue to demand affordable and personalized healthcare. Healthcare facilities would need to incorporate telemedicine space for consulting within hospitals and introduce decentralized, outpatient care locations which are safe for people who still prefer in-person care. The distributed network of healthcare facilities not only facilitates easy access but is less likely to be affected in case of another crisis. This model can connect the healthcare system closely with the community to provide personal and responsive care as per the need.

4.2.3 Digital Detox

As we introduce and use more and more technology, a large portion of the day is spent staring at screens, either for work or entertainment. The use of streaming devices, social media platforms, and wearables all day has made people feel the need for some 'no-tech' time. In the case of the elderly, post-pandemic, as people are learning to use technology, most of their time is spent on devices which has resulted in a reduced number of physical activities. Designing environments, indoors or outdoors, where people could get 'unplugged' and connect with others around them can immensely help in overall well-being.

4.2.4 Design for Healthy Aging

As we design our urban spaces, we need to begin thinking of creative, flexible, and inclusive solutions to create an ecosystem for aging well in a community and promote a socially interactive lifestyle. Biophilia, indoor environmental quality, and opportunities for social interaction play a major role as design elements to age well. For older adults, giving them the ability to exert control over their environment can support healthy aging.[62] A 2021 article by UC Davis informs developers, planners, home builders, and other key stakeholders of the need and ways to create innovative, healthy aging communities through strong and consistent evidence.[63] Land-use planning and design can improve health and well-being, and this is the perfect opportunity for designers to rethink the design of our urban environment to support healthy aging.

5.0 Conclusion

Aging with integrity is important. With the growing percentage of the elderly population in the world, healthcare does not just need to be brought 'at home' but should be considered for all spaces that an older person could use or access. COVID-19 has highlighted various questions that were very prevalent in the past but are more severe now. The study has shown considerable influence on the elderly population due to the changing trends.

New models and technologies are beneficial, but only to those who can access them. The physical environment needs to be modified to deliver care at home. This study is only a first step to investigating opportunities that are brought along with the positive or negative trends for the aging population. By analyzing the effects of this evolution in healthcare facilities and care spaces, designers must identify new ways of planning environments that are not only tech friendly, but also elderly-friendly.

Acknowledgments

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01

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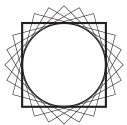
03

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