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A Multidimensional Model:

Assessing Space Needs in Healthcare Facilities in Response to COVID-19

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A doctoral project submitted to the faculty of the Medical University of South Carolina  
in partial fulfillment of the requirements for the degree  
Doctor of Health Administration  
in the College of Health Professions

HEALTHCARE SPACE NEEDS BEYOND COVID-19


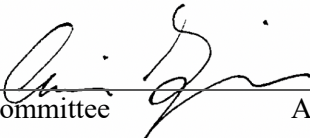

A Multidimensional Model:

Assessing Space Needs in Healthcare Facilities in Response to COVID-19

BY

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## EXECUTIVE SUMMARY

The assessment of space needs in healthcare facilities has become a growing issue as a result of COVID-19 and its impact on the US healthcare system. Healthcare leaders and facility decision makers have a unique opportunity to evaluate space needs by rightsizing and adapting to reflect current and future pandemic-related events. This paper aims to support the decision-making process by presenting an integrative developmental model of a conceptual framework conceived through a synthesis of the existing literature.

Three major dimensions have been identified in the Findings which serve as a foundational guide to addressing space needs: processes, people and the built environment. **Processes:** highlights operational-enablement activities and the need to redefine tasks across the spectrum of on-site to remote; the potential to reengineer directional flow of people through facilities and how people arrive and wait; infection and prevention controls (IPC) through proximity parameters and cleaning protocols. **People:** considers patient mix through evaluating degree of patient segmentation and desired utilization levels for healthcare services; worker engagement and how spaces will encourage productivity, collaboration and flexibility; visitor management through enhanced communication efforts and outlining accessibility and tracking needs. **Built environment** explores elements of space planning including agile design, spatial configuration and touchless functionality; the impact of technology through again, touchless functions, level of infrastructure and changing privacy and security implications; facility components through the intensified role of mechanical systems, signage to support major processes and reworking of furniture, fixtures and equipment (FF&E).

## INTRODUCTION

The arrival of COVID-19 in the United States has triggered a disturbance of historic proportion and the impact felt by the US healthcare system has been immense. This health crisis has amplified many known pain points while presenting fresh challenges. Over the past year healthcare leaders have worked to quickly adopt new safety guidelines to reduce disease transmission. Guidelines like social distancing have led to mass conversion of non-essential workers to a work from home model. During the early months of the pandemic most healthcare centers and providers were forced to temporarily halt non-urgent care and procedures (American Hospital Association, 2020).

Therefore, healthcare organizations not only faced remotely displaced workforces but many endured financial setbacks. Consequently, the need to mitigate COVID-19 exposure has stimulated a greater demand for alternative care models like telehealth. Factors such as these have prompted healthcare leaders to rethink their physical space needs, the impact of workforce changes, evolving models of care and the role of the built environment. How will healthcare facilities assess future space needs in response to COVID-19?

This paper aims to begin answering this question through an integrative developmental model of a conceptual framework conceived through a synthesis of the existing literature. The following section will highlight the changing healthcare landscape and some of the key sources of literature that contributed to the creation of the output of this research: a multidimensional model to evaluate space needs. The resulting work serves as a guide for the decision-making process.

### LITERATURE REVIEW

The proceeding literature review is a scoping review to provide a clear landscape of the issue under investigation. This review is meant to orient the readers' thoughts to the perspective which has been facilitated through the COVID-19 pandemic. See Methods section for data source details.

#### **The Changing Healthcare Landscape**

Healthcare leaders are presented with a rare occasion to reset and “right-size” their brick-and-mortar spaces. However, before leading into themes within the literature, it's important to first note the forces which emphasize that the current status quo leaves room for improvement. Four drivers have been identified through analysis of existing literature which reinforce the notion that healthcare leaders should examine their space requirements and needs in response to COVID-19.

#### *Financial Disturbance*

Like many industries, the healthcare industry experienced a significant hit to bottom lines as a result of the pandemic. Not only have organizations faced a loss in revenue, but an increase in pandemic related expenses such as staffing and personal protective equipment and other inpatient resources needed to treat COVID-19 patients (Whitford, 2020). Given many organizations normally operate under narrow margins, the financial threat posed by COVID-19 cannot be overstated. The American Hospital Association predicts these financial effects will be a long-term issue for hospitals and the uncertain trajectory of COVID-19 will influence hospitals' ability to serve their communities (American Hospital Association, 2020). To mitigate mounting financial pressures, organizations will need to employ creative and resourceful maneuvers to reduce costs while transforming models of care (CBRE Healthcare, 2020)

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### *Growth of Virtual Care*

A critical determinant of financial stability is rooted in the changing terrain of care delivery. Recent widespread expansion of telehealth has proven to be an essential tool for healthcare providers and consumers in the fight against COVID-19. Importantly, 2020 saw record numbers of telehealth visits and while volumes are stabilizing, it is predicted 20-30 percent of all future care encounters will be provided virtually (Berkowitz et al., 2021). Moving beyond the pandemic, organizations should seriously consider telehealth to be a service requirement and as such the delivery of high-quality, accessible virtual care will need to be a top strategic priority.

### *Workforce Changes*

In one of the largest disruptions to the US workforce, 2020 saw a mass exodus of non-essential, on-site employees converted to remote workers. By April of 2020, it was estimated that nearly half of US workers were operating under a work from home model (Guyot & Sawhill, 2020). This is especially impactful in the healthcare industry where historically; adoption of remote working models has been slow to gain traction. The option to work remotely for healthcare workers has fostered three main advantages critical in a health crisis of this nature: increasing workplace safety, improving productivity and efficiency and reducing capacity constraints (Siemens Healthineers, 2020).

### *Health & Safety*

Concerns over health and safety remain at the forefront of facility-based discussions. Protecting the safety of healthcare workers has proven fundamental in safeguarding the successful operation of a healthcare system (World Health Organization, 2020). Notably the way people have worked and received in-person care in the past has changed. The issue of

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enhanced health and safety remains a complex problem that will require ongoing consideration and creative solutions. Healthcare leaders will need to reconfigure high-density areas in new ways while developing alternative functional practices to promote operational excellence and quality care while supporting the needs of their workers.

### **Major Themes**

As noted by Architectural Digest's Alyssa Giacobbe, this is not the first time a health crisis has flipped design assumptions upside down. Over time the built environment has been made over and redesigned in response to large-scale health crises such as Hausmann's renovation of Paris in the 1800s and London's cholera outbreak (Giacobbe, 2020). COVID-19 exposed many flaws inherent in the design of modern healthcare spaces such as the inability to accommodate high volumes of complex patients and a lack of flexibility to convert room types which left many facilities with too few ICU beds. Many leading architectural experts agree, we are likely at the beginning of a major shift in healthcare design (Giacobbe, 2020).

Furthermore, notoriously crowded areas such as emergency department waiting areas became unsafe under COVID-19 conditions (Giacobbe, 2020). Creative design strategies like dispersed "waiting nooks" and utilization of enhanced patient tracking and alert mechanisms like RFID (radio frequency identification) technology may become more common place. Other likely design choices may look like doorless entry ways and an increased selection of antibacterial materials. Giacobbe also points to predictions for accelerated development and use of automation to help decrease high-touch surfaces (Giacobbe, 2020). The link between the built environment and health is not a new revelation but the importance of the role it plays in disease transmission is significant considering most people spend more than 90 percent of their daily lives inside built environments (Dietz et al., 2020). The built environment broadly includes all the physical,



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human-made parts where we live and work such as homes and buildings (Environmental Protection Agency, 2017).

In a review published by the American Society of Microbiology, authors identify several tactical considerations within the built environment to help mitigate COVID-19 and other viral infections (Dietz et al., 2020). Areas of concern include those well-known such as occupant density, shared areas, high contact surfaces and air filtration and circulation as well as those less familiar including the role of light and humidity levels. Organizations will encounter unique and difficult challenges as decision makers contemplate redesign efforts through changes in spatial configurations, mechanical systems and human behavior. Healthcare facilities should aim to provide physical spaces that support social distancing and minimize pathways to common areas while allowing for enhanced flexibility and efficient operations (Dietz et al., 2020).

Similar ideas are expressed in another study in which authors Megahed and Ghoneim (2020) illustrate the opportunity to reshape and reset the built environment through the application of recent lessons learned to protect against and overcome future “virus attacks”. One area authors highlight is specific construction strategies leveraged by response teams early in the pandemic to erect emergency field hospitals (Megahed & Ghoneim, 2020). These techniques include the use of prefabricated, modular components which support standardization and the ability to quickly adapt to diverse service requirements. Accordingly, the use of modular and universal designs is supported elsewhere in the literature. Use of standardized design components not only accommodate room-type conversions but they also ease relocation efforts that may be required as systems look to right-size their real estate footprint (LeRoy & Hsu, 2020). LeRoy and Hsu (2020) claim these types of flexible designs will provide the most effective way to future-proof clinical spaces amidst changing needs.

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Like Giacobbe, Megahed and Ghoneim foresee the integration of technologic solutions will gain popularity in the post pandemic environment (2020). While no single strategy will make built environments resistant to pandemics, a model that incorporates a multi-layered defense system will be better prepared to protect its occupants (Megahed & Ghoneim, 2020). When addressing the healthcare-built environment, it is also important to recognize the ways in which activities need to occur or have changed to best support organizational operations.

One example of a shift in functional activities is the recent proliferation of virtual care. The current evidence suggests virtual care will no longer be a supplemental service but a primary, essential offering. The longevity of expanded telehealth appears optimistic with commentary such as the following quote from CMS Administrator, Seema Verma, “I think the genie’s out of the bottle. I think it’s safe to say that the advent of telehealth has been just completely accelerated, that it’s taken this crisis to push us to a new frontier, but there’s absolutely no going back” (Advisory Board, 2020). It remains up to healthcare leaders how this opportunity will be seized and operationalized. In a claims-based analysis by McKinsey & Company, around 20 percent of all in-person emergency room visits could be avoided through urgent telehealth services while 24 percent of office visits and 35 percent of regular home health services could be conducted remotely (Bestsenny, Gilbert, Harris, & Rost, 2020). Given these projections, it will be prudent for decision makers to plan for long-term virtual care solutions that mitigate privacy and security implications while providing convenient, quality care. The integration of widespread telehealth modalities will require development of new processes for most organizations.

Turning to in-person care, decision makers will need to consider implementation of updated processes to manage patient and people flow. Authors LeRoy and Hsu (2020)

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recommend the use of single-direction patient flow to curtail the chance of people bottlenecks. Additionally, thought will need to be given to how patients arrive, are screened, checked-in and where and how they wait (LeRoy & Hsu, 2020). However, the concept of people circulation is a broader issue than patients alone. In their series, “*Navigating What’s Next: The Post COVID-19 Workspace*”, leading furniture manufacturer, Steelcase (2020), highlights several design challenges brought about through COVID-19 such as understanding circulation patterns. In order to protect individuals’ personal sphere, directional traffic should be evaluated through the lens of one-way vs two-way traffic and then reinforced through the appropriate signage (Steelcase, 2020b).

This series points out other critical features of the post pandemic workplace including productivity and the need to collaborate and socialize safely in-person (Steelcase, 2020). These sentiments align with predictions for the future workplace published by commercial real estate service company, CBRE. While workers seem to embrace the benefits of remote working, they still value interactions that take place in the physical workplace (Kupiec, 2020). The workplace will need to deliver an experience that is distinct from the remote working experience (CBRE, 2021). Anticipating a distributed, hybrid workforce it’s likely that employees showing up to the office will be more focused on “we”, collaborative tasks and less on “me”, individual tasks.

Therefore, workplace space allocation should adjust by providing a setting for culture, community and collaboration (CBRE, 2021). Furthermore, it appears that flexibility will remain a central aspect within choosing where one works whether that be an office or remote location as well as functionality in how one works. Furniture should remain flexible so it can be easily reconfigured to meet a variety of needs (Steelcase, 2020). What remains clear is the workplace

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of the future will be more flexible with an increased intention on elements that support productivity.

Equally important across all space types is safety. The burden of fostering a safe environment will remain a primary responsibility for healthcare systems. The primary step in keeping patients safe is maintaining safe and healthy healthcare workers (World Health Organization, 2020). Robust safety policies and protocols are paramount to best protect healthcare workers and consumers. Accordingly, organizations will need to modify communication processes to align with changing safety requirements and expectations of consumers (Steelcase, 2020a).

Design and redeployment of spaces will likely reflect new infection prevention protocols. While most clinical healthcare areas have utilized surfaces and furniture designed for harsh disinfecting cleansers, this trend will need to expand to non-clinical areas as well. Space design should integrate with processes for disinfection and should be reflected furniture and fixture selections (Steelcase, 2020a). Ultimately, not only will healthcare leaders need to champion strong safety policies, but they will need to enhance administrative and human resource policies to support the changing demands placed on their workforce as they carry out diverse job duties.

## METHODS

### **Design**

This research employed a literature synthesis approach to provide an integrative developmental model of a conceptual framework. The current literature was referenced to define a clear landscape of the issue, gaps, opportunities and recommendations. Relevant data sources (detailed below) were synthesized through the context of COVID-19 while incorporating elements unique to healthcare.

### **Data Sources**

Sources of data came from relevant healthcare, design, furniture and real estate industries' body of knowledge including best practices, new research, expert opinion, polls and surveys. In addition, emerging health and safety guidelines were consulted. Data and information originated from published material in professional journals and other online sources.

### **Data Analysis**

Diverse sources of data were collectively interpreted and subsequently constructed into a multidimensional model. While this area of research is new and rapidly evolving, a suitable level of evidence was found to meaningfully define multiple dimensions, core concepts and areas of analysis that impact space design and utilization within the context of COVID-19.

## **FINDINGS**

Through a synthesis of the existing literature, future space considerations fell into three major categories. These categories serve as the model's primary dimensions: processes, people and the built environment. Dimensions should be reviewed in the same sequence as they are presented in this document. The order is significant as processes establish the foundation and drive the needs of people and the built environment. *Figure 1* shows the recommended analytical pathway. Each dimension is systematically organized into an informational hierarchy broken down into core concepts and narrow into relevant areas for analysis.

### **Processes** (*illustrated in Figure 2*)

Defining key processes will be fundamental in assessing future space needs. Processes will direct how people behave and interact within physical and virtual spaces.

*Operational enablement activities*

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Defined as any activity which contributes to the overall operation of a healthcare organization; operational enablement activities range from care delivery to support and administrative functions. As a result of increased remote working and virtual care alternatives, operational enablement activities will need to be redefined under different assumptions. In what location should activities take place? What tasks will need to occur on-site and which tasks can and should take place in a remote and/or alternative setting?

### *Flow of People*

The way people maneuver through physical spaces may need to be reengineered to minimize viral spread. Importantly, the design of directional traffic should be considered as people circulate interior corridors and navigate pathways between departments. Thought will also need to be given to how people arrive and wait. What is the method for screening and check-in? How and where will people be instructed to wait without compromising safety?

### *Infection and prevention controls (IPC)*

With a strong emphasis on patient and worker safety, IPC practices will need to be incorporated into space decisions. The long-term plan for proximity parameters like social distancing should be determined. Equal attention should be given to enhanced cleaning protocols and how these are executed across diverse types of space.

### **People, (illustrated in Figure 3)**

There are many types of people who interact with healthcare facilities. Each of these stakeholder groups have differing needs and preferences some of which have been impacted by COVID-19. People-based implications need to be reflected in decisions regarding space.

### *Patient mix*

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In order to best meet the needs of patients, organizational patient mix must be reexamined. To address existing and future virus concerns, decisions about the degree of patient segmentation for varying acuity types should be revisited. A second area to consider is updated utilization levels for healthcare services. Through redefining operational activities in the previous dimension, what proportion of these services should now take place virtually as opposed to on-site?

### *Worker engagement*

Given the magnitude of change and disruption felt by healthcare's workforce, organizations need to evaluate how to create spaces which foster worker engagement. Supporting healthy worker engagement will take a dynamic approach. Workers will require spaces designed to support productivity for a variety of activities. While high-density work areas may be a pre-pandemic reality, the on-site workplace of the future still needs to integrate areas that allow for safe collaboration. Workplaces of the immediate future will need to accommodate various work styles and flexibility. These factors will be critical in providing workers an element of choice in how they need to work when they are on-site.

### *Visitor management*

Efforts to reduce occupant density and person-to-person exposures have led to restricted visitor access. These restrictions have left many patient companions feeling out of the loop and frustrated. Communication will be a crucial element for visitor management. How will visitors be kept informed and updated regarding their loved ones? Communication methods may need to be enhanced through creative solutions. This could be tablets and kiosks designed to supplement direct communication where appropriate. Pre-visit communication may also need to be coordinated for planned visits. Moreover, how and when will visitors be granted access to restricted areas? Will there be a mechanism to track visitors through a facility?

### **Built Environment, *Figure 4***

The healthcare-built environment plays a critical role in disease transmission. Built-environment considerations must be aligned with decisions made through review of prior dimensions, processes and people.

#### *Space planning*

As evidenced through literature review, flexibility will be a key feature in the healthcare-built environment. All space types should include agile design to support adaptability and convertibility to meet multiple scenarios and needs. Spatial configuration will be executed through proximity parameters and will help organize where major elements exist within space. Touchless functionality as an intentional design choice should be explored where applicable to reduce contact with high-touch surfaces.

#### *Technology*

Use of technology-enabled tools has seen tremendous growth in recent months. First, is a shared attribute of touchless functionality where technology can facilitate automated actions to minimize high-touch contact. However, to realize the benefits technology has to offer, organizations must invest in the right technology infrastructure that aligns with organizational needs. While the growth of virtual care has brought many benefits, it has introduced added challenges. Healthcare workers will need access to dedicated spaces that protect data privacy and security.

#### *Facility components*

Mechanical systems have taken on an intensified role and systems such as air circulation and filtration will need to be assessed under new guidelines. People interacting inside the healthcare-built environment will encounter much more information than they have in the past. Signage will



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take on more importance to provide instructions, wayfinding and influence behavior. Furniture, fixtures and equipment (FF&E) may require change in a post pandemic environment through incorporation of tools like acrylic barriers, integration of hygienic surfaces and materials that can withstand frequent disinfection.

### **Application**

Consider the following as a micro-example of these research results in action.

- *Context:* Four provider medical clinic, 12 exam rooms (three rooms per provider).
- *Objective:* Minimize people traffic in existing space while maintaining or growing patient capacity.
- *Processes:* Providers clearly differentiate between activities they need to perform on site and those they can perform virtually, off-site. Once completed, the resulting “Scheduling Process” provides the construct for the providers to schedule their services.
- *People:* Having a clear “Scheduling Process” provides the ability to arrange services optimally for staff and patients allowing providers to operate within the setting that supports their productivity while segmenting patients based on their care needs.
- *Built Environment:* Once the type and frequency of services is understood, the existing space could be redesigned in several ways including:
  1. Redeploying exam rooms
  2. Configure entry ways to accommodate patient access
  3. Incorporation of video conferencing equipment to provide ability for in-office providers to do a combination of virtual and in-person visits

### **DISCUSSION**

COVID-19 has introduced new complexities into the US healthcare delivery system. Addressing future space needs in healthcare facilities will require a comprehensive solution that considers when, where, why and how patients, healthcare workers, visitors and others interact with the healthcare environment. Leaders will need a full understanding of the innerworkings of processes, people and the built environment to arrive at the best recommendations for their own institution. Organizational leaders who leverage this model in assessing major space requirements beyond COVID-19 will need to prioritize any needed changes against competing priorities and financial capabilities present in the organizational climate. It is likely that many core concepts may be rooted in organizations' strategic goals and therefore space-related decision making should be aligned to major strategic initiatives. The exercise of assessing space needs should follow a continuous cycle of evaluation, prioritization, implementation and reevaluation. Finally, it is important to recognize existing licensure and code requirements that vary by state or local municipalities. Healthcare organizations should work with these entities to revise requirements where needed.

#### **Limitations**

There are limitations within this research that are important to acknowledge. As previously noted, the issue under investigation is new and as such, the breadth of current research is growing. Therefore, areas of analysis presented under this model are not considered exhaustive. Furthermore, every organization is unique, and all outlined elements may not be applicable or feasible. Lastly, the result of this research is geared toward US-based institutions are not necessarily generalizable to countries outside the US.

### CONCLUSION

The impact of COVID-19 has resulted in a need to evaluate space needs and design within healthcare facilities. Through interpretation of existing literature to date, critical areas to evaluate fall within three major dimensions: processes, people and the built environment. Within these three dimensions, nine core concepts and 21 areas for analysis have been identified to systematically guide facility-based decision making. Priority of addressing all areas for analysis will vary by organization. The organizational undertaking of this type of evaluation should be initiated at the senior leadership level and cascaded throughout the organization. Feedback of front-line workers and managers is crucial in defining key processes and requirements. The multi-dimensional model presented in this paper is intended to serve as a tool for healthcare leaders and facility decision makers to assess space needs unique to their institution. This work contributes to the current body of knowledge and will enable leaders to make informed, actionable decisions about their future space needs beyond the COVID-19 crisis.

### Future Research

Recommended areas for future research include but are not limited to the following: 1) role of data analytics available through new technology solutions, 2) training and education needed for effective utilization of technology, 3) impact of mixed presence interactions in the workplace and care areas, 4) development of enhanced pre-visit coordination and preparation efforts for patients and visitors and 5) integration of human resource services to support diversity, equity and inclusion strategies and wellbeing initiatives.

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Figure 1

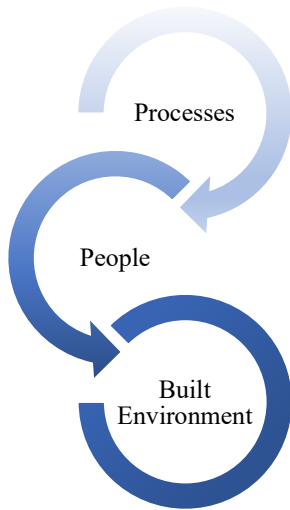
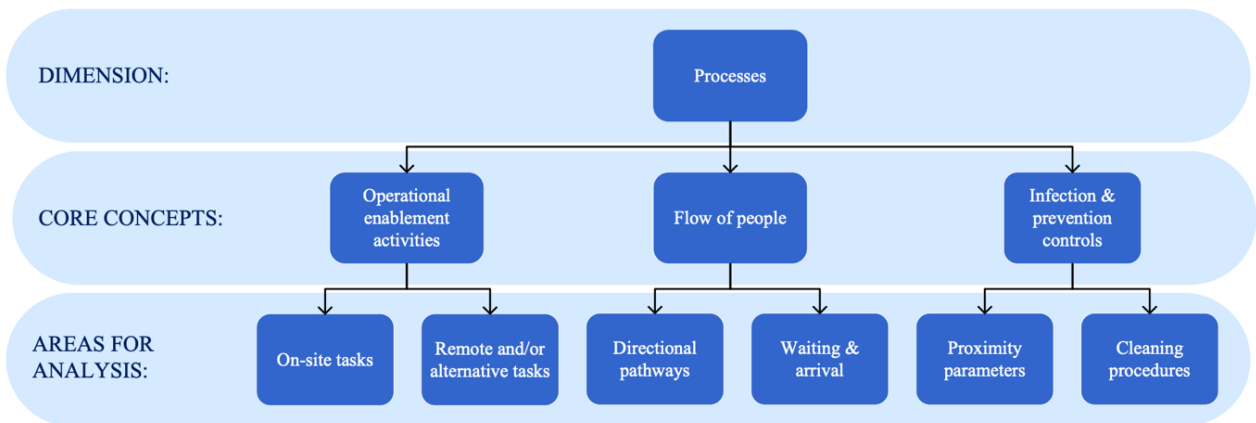


Figure 2



# HEALTHCARE SPACE NEEDS BEYOND COVID-19

Figure 3

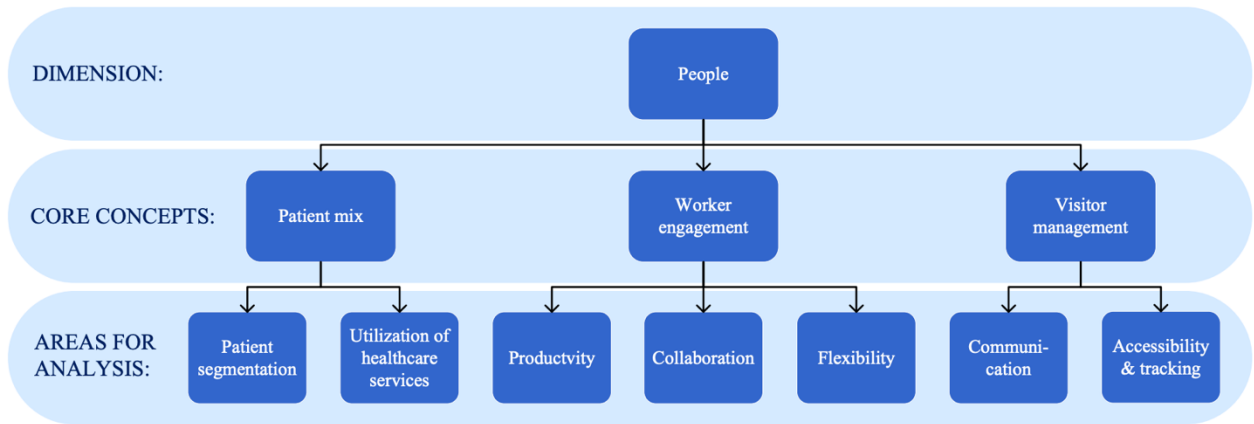


Figure 4

