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Hospitals' decision-making regarding infrastructural adaptations in response to Covid-19

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Abstract | During the first months of the Covid-19 pandemic, crisis management and fast decision-making regarding infrastructural adaptations were key as hospitals faced major challenges while attempting to ensure optimal care. This study aims to gain insight into decision-making processes regarding infrastructural adaptations. Interviews were conducted (in July 2020) with representatives of technical services, facilities and planning departments in six general hospitals in Flanders (Belgium). Interviewees illustrated changes made with building plans, photos and other supportive material. Based on the collected data we identify four main factors affecting decision-making about infrastructural adaptations: enforced measures, demand and supply 'on the ground', knowledge acquired over time, and stakeholders' identities. Whereas the initial approach was predominantly top-down, insights gained into the type of cross-departmental collaboration that was necessary and possible during the Covid-19 crisis may also have value under more regular circumstances to swivel between top-down requirements and design contexts 'on the ground'.

KEYWORDS | COVID-19, DECISION-MAKING, HEALTHCARE, HOSPITALS, INFRASTRUCTURAL ADAPTATIONS

1. Introduction

When the Covid-19 crisis was first labelled a pandemic in March 2020, public health advice urged people to stay at home as much as possible. In hospitals, interactions initially intensified, making it necessary to urgently curate activities taking place in and around these buildings. Activities in many sectors were put on hold or drastically diminished. In Flanders (Belgium), this was also the case for regular healthcare as the government instructed this be put on hold between March 16th and May 3rd. For healthcare organisations, this allowed focusing resources on the immediate crisis and simultaneously entailed re-organising care at multiple levels as (use of) the infrastructure was adapted. As such, the first phase of the Covid-19 pandemic can be seen as a time where new public behaviour and crowd practices were produced (Shields et al., 2020).

In this paper we focus on decision-making that took place within hospitals as they sought to respond to Covid-19, in particular by adapting their infrastructure. We consider this response to Covid-19 a design project with design decisions being made 'in house' and 'on the spot'. A key observation is that the various spatial strategies adopted by hospitals, to make distinctions in the use of space between potentially contagious people and 'stuff', affected the usability of these environments.

For the notion of usability we align our understanding with Van Kuijk et al. (2019). Usability is not an inherent quality of a design outcome but is defined as a function of the context and involves specifying use and user (Bevan & Macleod, 1994 in Van Kuijk et al, p. 140). Van Kuijk et al. develop a framework consisting of 'drivers of usability' which are each collections of factors that affect usability. Important for our use of the term is that the success and impact of usability practices is highly dependent on the organisational context (van Kuijk et al., 2019). User-centred design principles central to the notion of usability and the importance adhered to design methods that introduce knowledge about use and users, form a point of departure to consider 'ad hoc' design in a healthcare context.

Where it concerns architecture and design in healthcare there is a growing understanding that design and designers play a critical role in establishing medical ideas, ideals, roles and practices (Bromley, 2012; Martin et al., 2015). Both construction and experience offer angles to consider the design of healthcare environments and how they change 'in use' over time. Hospitals' response to the Covid-19 crisis offer a unique opportunity as - within a variety of building types - they all faced similar situations. Design quality of physical healthcare environments has been strongly linked to the social interactions and connections the environment facilitates (Anåker et al., 2017) and it is therefore particularly interesting to look closely at situations where spatial strategies are employed to separate Covid from non-Covid within healthcare environments.

A relatively recent shift towards person-centred healthcare entails that patients are addressed as people rather than approached from a strictly biomedical perspective (Lines et al., 2015). While patient-centred care incorporates the aim for a functional life, person-

centred care is seen to aim for a meaningful life (Håkansson Eklund et al., 2019). These types of developments in healthcare in turn affect the built environment (Bromley, 2012) while pandemics of the past have also resulted in shifts in hospital design.

2. Research approach

To gain insight into decision-making processes regarding infrastructural adaptations during the first months of the Covid-19 crisis, we made use of interviews with representatives responsible for these infrastructural adaptations in six general hospitals in Flanders. During these interviews we aimed to capture the culture of practice and professional situation in the respective hospitals.

In order to allow a rapid entry into the organisations to capture adaptations when they were still fresh in mind, hospitals were selected based on convenience in combination with pre-existing connections between the researchers and hospital boards. With this selection, we aimed to cover a broad range of hospital types: both urban and suburban, brand-new facilities as well as older ones, both centralised and dispersed organisations. Table 1 provides an overview of the hospitals, their spatial organisation and location, and the profile of the respective interviewees. Hospitals A and F inhabit brand new buildings taken into use less than five years ago. The other hospitals' infrastructure is older and has, to various degrees, been refurbished and added to over time.

Author 1 and 2 conducted the interviews online (in July 2020) while meticulously taking notes. Some of the interview questions focused specifically on how decisions regarding infrastructural adaptations were taken. Interviewees provided architectural plans, photos and other supportive material to illustrate changes made 'on their watch'. All interviews were recorded. These recordings were used to complement the notes taken in the moment. The notes and provided material formed the basis for the analysis focusing on themes related to the sources of information, people involved in the decision-making process, and prioritising.

Table 1. Overview of the hospitals included in the study.

hospital	interviewee	location	(spatial) organisation
A	director of care supporting services	sub-urban	1 central campus
B	technical and facilities director	urban	1 central campus
C	manager of engineering, infrastructure and master plan	urban	multiple campuses
D	director of facilities	sub-urban	1 central campus
E	manager of technical services	urban	multiple campuses
F	director of quality and strategy	sub-urban	1 central campus

3. Findings

3.1 Enforced measures

A primary factor that influenced decision-making, and how it was organised, concerned measures enforced by the government. In each of the six hospitals a central crisis cell or task force was established to communicate updates and briefings to all other staff. This cell was made up of various key figures and ensured uniformity in carrying out measures. It took responsibility for evaluation and control, and coordinated the hospitals response. Most decisions about infrastructural adaptations were coordinated at this level. Decisions made here were in turn informed by meetings with consultative regional or provincial governmental bodies, external to the hospitals' own organisation.

> "The hospital's Coordination Cell met daily throughout the critical phase and that's where all issues were discussed and communicated. Of course, in these meetings the expertise of the people on the ground was used and a cohort ward was thought through with hospital hygiene colleagues and staff on the ground, in terms of 'where do I enter, where do I get changed, what's clean, what's dirty?'. Nursing staff thought along but decisions were always made under central supervision."
>
> (interviewee in Hospital F)

A mandatory postponement of regular care allowed the various hospitals to repurpose (part of) their buildings and redirect staff to work elsewhere, the latter also affecting how spaces were used. Hospital E initially closed multiple campuses and redirected Covid patients and staff to a single location where both Covid and (a limited amount of) non-Covid care was offered. In other hospitals, entire units were freed up, thus enabling extra doctors to stay overnight, or care professionals to use an empty ward for rest and recuperation. Care professionals on the floor were often not involved in the decision-making regarding the temporary closure of their departments and units. For some, this closure resulted in different tasks and responsibilities and sometimes a new place of work. For example, the catering staff in Hospital D were retrained to work as cleaners when the canteens were closed. Also, for staff working on Covid wards many decisions were communicated in a 'top-down' manner by the head of a department, or through briefings resulting in tasks to carry out or new procedures to follow.

Priorities set by the healthcare organisations (i.e. the 'cells') to a large extent determined where (the focus of) resources were directed. Covid-related concerns 'overruled' many others and the examples illustrate how a 'top-down' enforcement was linked to policy guidelines and was deemed necessary to quickly and effectively roll out measures. Not all measures could be adhered to, as one interviewee illustrates. In their aged buildings, it was impossible to enforce the guideline that (Covid and non-Covid) flows of patients and staff be separated from each other.

3.2 Supply and demand 'on the ground'

The decision-making process necessitated a certain degree of improvisation from those involved, which was partly driven by supply and demand (questions from the ground). Supply refers to both the informal and tacit sources of knowledge, ideas and resources interviewees called on to respond to challenges at hand. Additionally, it points to both tangible 'stuff' (e.g. stocks of personal protective equipment, increased volume of waste, gifts of food for staff) and space (e.g. temporarily empty wards or adjacent buildings available due to renovation plans) which required decisions. Even though hospitals had crisis response plans prior to the pandemic, various interviewees noted that they were unprepared for the crisis to affect the entire region simultaneously. Also, few scenarios envisaged a crisis that would last for months and consist of multiple phases. The coordination of a response by technical services and planning departments were therefore also driven by the questions and demands they received.

> "A unit would hear that they had to start up again and everything had to be done really quickly, well then multiple people jumped into action to organise things. In the very beginning, that wasn't yet 100% coordinated and streamlined … So yeah, that's why people were organising things themselves as much as possible, which was good, right? But then it became really important that it was channelled and assessed by the same group of people, coordinated and only then realised."
>
> (interviewee in hospital C)

Many of the questions from the ground concerned the deployment of 'stuff'. For example, in Hospital C, they were cautious responding to requests for plexiglass screens because they were unsure whether they could keep up with the demand and provide these throughout the hospital. Elsewhere, doctors asked for screens and extra tables in order to distance themselves from patients in consultation rooms, but these were generally not granted as the personal protective equipment they were issued was deemed sufficient. In Hospital E, another example was given regarding a limited number of HEPA filters available to deploy to improve air quality. In theory, the hygiene department advised where these were best placed and the crisis cell made the decisions. However, in practice, they were occasionally deployed to 'show that they were doing something' and 'boost morale'. This resonates with how a technical and facilities director explained that the risk of exposure for staff and the associated fears played a major role in what kept him busy.

> "In those first weeks, we only did Covid, right? For a while there was nothing else … There was a lot of fear. For example, the food that came down from a Covid ward, for the people in the kitchen, yeah, you had to be able to handle that. For people who cleaned, who had to go and clean those rooms, it was similar. Not that obvious. So, that's what you're focused on and nothing else."
>
> (interviewee in Hospital B)

'Carefully listening to what was being asked for' led to new collaborations, often tapping into *what* and *who* was available. Most hospitals entered into intense partnerships with general practitioners to organise emergency departments' triage (Figure 1). One of the nearby university hospitals was considered an important source of practical guidelines and some initiatives were taken based on ideas that came from seeing (in mainstream media) what other hospitals were doing. Also, cross-departmental collaboration within the hospital was a way in which interviewees responded to needs expressed within the organisation. Within Hospital C, the interviewee had taken on additional responsibilities to support the logistics department concluding that a better understanding of another department improved her abilities to function within her own position.

Figure 1. Temporary infrastructure was taken into use extending existing emergency departments with triage facilities (left: Hospital D; right: Hospital C).

3.3 Knowledge over time

Initially, decisions were made under a significant amount of pressure, anticipating worst case scenarios. For most interviewees, the start of the pandemic was a busy and hectic time during which they were adjusting procedures continuously. Developing insights and knowledge that was accrued over time affected subsequent decisions. When the interviews took place, hospital organisations were collecting lessons learned and preparing scenarios in case of a second wave of Covid-19 patients. Interviewees highlighted the value of taking time to consult a diverse group of stakeholders before moving ahead, mainly to avoid making unrealistic or flawed plans. One interviewee explains:

> "The only thing we noticed, not that it was a huge problem, I want to emphasise that, but the only thing is that sometimes because of the acute nature [of the situation] we would work kind of independently. Then care would've gotten started already saying 'OK, we're going to do this and that', while facilities got involved in the second instance and found that we did have to set certain things straight and say, 'OK guys, be aware, you didn't think of this and this. We can resolve that but it's not ideal.'"
>
> (interviewee in Hospital A)

Knowledge that equipped decision-makers in their response was sometimes related to particular experiences gained prior to the pandemic. For example, in Hospital F, the interviewee indicated that they were organisationally well-prepared for the crisis, partly due to their recent move (less than 2 years ago) from 3 separate campuses to a single newly built facility. Coordinating the move (3 years of planning in order to move within 3 days) was considered an ideal preparation for dealing with the pandemic. In his specific role of director of quality and strategy, he described having close and good working relationships with medical, nursing, communication and administrative departments, and that they were accustomed to responding to unexpected issues.

This can be linked to the lifecycles of hospital buildings as recurring theme throughout the interviews. For example, at Hospital C a new building project was in the early design stage. The pandemic was therefore considered 'worthwhile input' as lessons learned could be incorporated in their plans. In Hospital B, planned renovations allowed spatial flexibility that would not have been available under regular circumstances. A number of (already) empty buildings were easily repurposed for use as triage stations and extra storage (Figure 2). The manager of technical services in Hospital E indicated that during the crisis, certain mandatory maintenance tasks were postponed, including the scheduled maintenance of elevators and medical equipment.

Interviewees commented that their own involvement as representatives of technical and spatial planning departments would have been more effective had they been involved early on and preferably within the crisis cell, alongside medical and nursing staff.

> "They were fully engaged with preparations in a medical sense, with logistics and cleaning. They had started up a lot but the infrastructural component was actually not taken into account from the start. You know, of course, once the crisis came 'round then yes, we were of course involved and very able to key into additional demands. Maybe, yes, we were still involved in time but we were less prepared than they were in other areas."
>
> (interviewee in Hospital C)

Figure 2. On-going renovations were interrupted to create a (temporary) waiting room (Hospital C, left). A former crematorium (empty) is taken back into use (Hospital B, right).

3.4 Stakeholders' identities

Finally, the various actors that were mentioned explicitly in the interviews shed light on hospitals' decision-making process. Types of people, groups of users and other stakeholders were labelled. Often the circumstances that interviewees were speaking about necessitated a variety of categorisations, some of which were common (i.e. patients, doctors, visitors). Others were newly introduced due to Covid-19. The specific circumstances of this crisis highlighted the existence of subgroups or brought new characteristics to the forefront. It was remarkable that an important way to distinguish between different types of patients, and users of the healthcare services generally, was entirely new, namely, based on one (being suspected of) having (or not having) the virus (Figure 3).

Interviewees expressed an active involvement in providing services oriented towards creating safe environments for staff and patients. Patients were spoken about as being somewhat at a distance from the daily practice of the interviewees, but were actively linked to infrastructural adaptations when distinctions were made between a) patients with a fever or Covid-suspect patients, b) confirmed Covid patients (seriously ill and more minor symptoms), and c) non-Covid patients. The Covid diagnosis and associated identities trumped any other diagnosis. An interviewee explained that specificities of patient groups were not always sufficiently taken into account.

> "What we perhaps had too little concern for was the differentiation in adult care … Because we repeatedly needed to shift wards to make room for Covid patients we sometimes didn't stop to think about where patients were being shifted to. And yes, at a certain moment we had to say, 'hey guys, the oncological patients need to stay far enough away from the Covid ward'. Because you start shifting that which is adjacent to the Covid ward [to expand it], we ended up with oncological patients coming too close to it, if you know what I mean ... In that sense we didn't have enough of a plan with respect to the patients that are most at risk if they were to come into contact with Covid, to keep them at enough of a distance."
>
> (interviewee in Hospital D)

Care for paediatric Covid patients was challenging in that being accompanied by a parent meant that zones with rigid separations between Covid and non-Covid non-staff persons could not be maintained. Also other patient groups were put forward as having required particular consideration e.g., for gynaecological, geriatric and psychiatric care. Furthermore, no visitors were allowed into the hospitals during the crisis phase of the pandemic. Exceptions (particularly in Hospital D) were made only for a single visitor or family member visiting a palliative ward or other (non-Covid) patient at the end of life.

Staff were separated as much as possible from non-staff. Any shared use of entrances or canteens with other hospital visitors was avoided. Doctors and heads of departments were repeatedly mentioned as being stakeholders who voiced concerns. Cross-departmental collaboration within the healthcare organisations increased and was supported by (cross-campus) thematic working groups. The persons the interviewees often referred to as being

at risk were the cleaners, those engaged in meal preparation and logistics workers. During the crisis certain maintenance technicians were in short supply.

New demands made of the hospital infrastructure required identifying new stakeholder identities. These helped define the aims and outcomes of infrastructural adaptations and in many ways, they co-determined the environmental qualities that were prioritised in the process.

Figure 3. A waiting room in Hospital A was split adding 2 additional spaces: a separate waiting room for (potential) Covid patients and a triage space (left). A nurses' station indicating only those who have not had direct (Covid) patient contact may enter (Hospital F, right).

4. Discussion and conclusion

To gain a better understanding of decision-making processes regarding infrastructural adaptations made in hospitals during the initial crisis phase of the Covid-19 pandemic, representatives of technical and spatial planning departments were interviewed. We identified four factors that shed light on the dynamics between the coordination of adaptations on the one hand, and input from a variety of stakeholders on the other. They are: enforced measures, supply and demand 'on the ground', knowledge over time and stakeholders' identities. Measures issued by the government were enforced in a top-down manner. If we connect this to the usability framework proposed by Van Kuijk et al. (2019),

the prioritisation of usability in our study seems closely linked to safety (from Covid contagion) as guiding value, co-defining outcome priorities and project priorities.

In the hospitals, adaptations were required in response to rapidly changing needs and a changing supply and demand (of space). On-site and ad hoc infrastructural adaptations made in hospitals can be considered 'design in use' (Redström, 2008), where an open-ended design process extends into what is commonly understood as 'use'. This complements related research in healthcare contexts such as Halpern and Anderson's (2020) analysis of an intensive care unit following the completion of a formal design, where on-going adaptations are necessary to rectify (design) flaws and extend the operational life of the unit. The time-frame is different but the processes have similarities. As we have found in previous research (Jellema et al., 2019), a diversity of perspectives is equally valuable to ensure the quality of this ad hoc type of design (outcome) as when it concerns a more formal and demarcated design process. Alongside these diverse perspectives our findings should be seen to complement varied research on e.g. spatial strategies employed to separate flows in hospitals (Annemans et al., 2021; Augustin et al., 2020); construction and furnishing of field hospitals (Ribeiro et al., 2020); supportive design collaborations in response to crisis (Rebola et al., 2020) and indoor air quality (Morawska et al., 2020).

Certain lessons can be drawn from this study for (decision-making in) design in general:

- Firstly, the reasoning behind decisions taken is diverse. As we have pointed out some decisions are directly related to measures enforced 'from higher-up' and the resulting supply and demand. However, alongside actual spatial needs, immediate concerns of users play a role and will sometimes 'accumulate' to result in adaptations being made. Examples include both effective, tangible interventions and initiatives addressing user perspectives but motivated mainly to change perceptions (e.g. to alleviate fear of contagion and boost morale). See Mattern, 2020 for a discussion on plexiglass as 'security architecture'.
- Secondly, the hospital context comes with a wide diversity of stakeholders, from those outside the organisation (e.g. government) and within, to those affected by adaptations, with and without a say in decision-making processes (e.g. staff, patients, visitors). The shifting nature of how these groups are defined raises a concern for a usability approach in terms of who may be overlooked. Nurses, for example were rarely mentioned in the interviews while some sources suggest that in the past they have been a vital link between management and work 'on the ground' but are no longer sufficiently represented in management (Van Merode & Brouwer, 2020). Although largely outside of the scope of this study, our findings also resonate with concerns about decisions to (temporarily) shut down select medical services impacting on some patients disproportionately (Chu et al., 2008). Further research is needed to investigate whether (permanent or semi-permanent) infrastructural adaptations employed during the Covid-19

pandemic have made physically accessing healthcare services more challenging for particular user groups.

- Thirdly, this study highlights the importance of reflection during and on design. Attitudes towards users can change over the course of a design process (Van der Linden et al., 2018). It may be relevant to keep in mind that knowledge has more value to a design team when available earlier in the process (even if considered less reliable) than when provided at a later time (van Kuijk et al., 2019). For crisis situations and ad hoc design, the urgency of the situation demands on-going reflection and incorporation of methods that can further support cross-departmental collaborations.

Limitations of the study include the lack of opportunity to explore experiences of the realised infrastructural adaptations, which could have potentially offered a more nuanced view on how user perspectives were addressed in decision-making. Furthermore, alongside the interviews, interviewees were invited to share relevant documents. The quantity of material provided differed significantly between hospitals and a more systematic approach could have enriched the analysis.

The insights presented may inform day-to-day healthcare facility design and may help to improve collaborations between design practitioners and (within) hospital/healthcare organisations. Supporting bi-directional communication is an important aspect of this. The crisis cell or task force that guarded the uniformity of infrastructural adaptations within hospitals and across campuses required intense communication throughout the organisation. Furthermore, actively anticipating the stakeholders that add particular perspectives or know-how to planned infrastructural adaptations can enhance outcomes. This study suggests that the type of cross-departmental collaboration that was necessary and possible during the Covid-19 crisis may also have value under more regular circumstances in order to swivel between top-down requirements and design contexts 'on the ground'.

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