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Healthcare Built Environment and Telemedicine Practice for Social and Environmental Sustainability

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Abstract: The practice of telemedicine started at the beginning of the 20th century but has never been widely implemented, even though it is significantly sustainable compared to traveling to healthcare However, the ongoing COVID-19 pandemic pushed organisations and patients to accept this technology. During the pandemic, telemedicine consultations took place in ad hoc environments without much preparation and planning. As a result, there is a knowledge gap in the field between telemedicine's clinical care services and healthcare built environment, in terms of design. This research focused on addressing the quality of service and experience of telemedicine in primary healthcare settings and how this could be influenced by the digital infrastructure. Our aim was to understand the correlations between telemedicine and healthcare built environment and whether the latter could have a significant impact on telemedicine practice. The methodology included interviews with professionals involved in healthcare planning, architecture and ethnography, and end user research involving telemedicine sessions. The interviews highlighted that professionals involved in the design of healthcare environments demonstrated limited consideration of telemedicine environments. Yet, the ethnographic, end-user research identified areas where the telemedicine environment could affect user experience and should be taken into consideration in the design of such spaces.

Keywords: telemedicine; healthcare built environment; COVID-19; primary health care; remote consultation

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1. Introduction

The global COVID-19 pandemic has pushed healthcare services, physicians/health care workers and patients to adopt digital technology-based treatment approaches [1,2]. Policy measures implemented by governments to respond to the spread of COVID-19 across different intensity levels, populations and contexts, including "stay-at-home requirements", "restrictions on internal movement", and "practice social distancing", became a globally typical pattern of influencing human behaviour [3]. Healthcare systems faced significant challenges and occasionally restricted or compromised access to healthcare. This was translated to fragmented access to global and national healthcare provisions, especially in primary health care (PHC)—the first point of contact for patients and considered as a mean to attain universal health coverage (UHC)—and emphasized the need to move towards the integration of the core capacities of UHC systems [4].

Soon, remote video consultations were promoted to improve the global public response to COVID-19. However, telemedicine service implementation disparities between countries emerged in terms of regulatory frameworks for reimbursement opportunities and integration into their healthcare systems [5]. More importantly, the outpatient care

service delivery of telemedicine into PHC systems, in particular during the COVID-19 pandemic, was characterized by large increases in the volume and by changes in the type and clinical content, including mainly virtual visits not related to COVID-19 symptoms, namely behavioural health and chronic diseases [6–8]. This fact shows that the incorporation of telemedicine services into healthcare, besides becoming a resilient means to safely deliver care in a public health emergency, it can feasibly strengthen the structure of integrated care to provide access to cost-effective interventions of care [9,10].

For this research, the cases from the United Kingdom (UK) and China were used as this is where the researcher who performed the fieldwork had direct access to medical care. The UK, even before COVID-19, had a mature market for telemedicine as it has the most established telemedicine market compared to the largest European Union countries (Germany, Spain, France, Italy) in terms of regulation, reimbursement, and usage of platforms [11]. China has embarked on a technology-led revolution to create a new internet healthcare ecosystem, long before the COVID-19 outbreak, with new investments in China's Internet healthcare market massively increasing since 2013 [12].

In the UK context, the practice of modern telemedicine after periods of steady development is becoming a critical alternative medical solution [13]. The National Health Service (NHS) published the 'NHS Long Term Plan' in 2019. This plan highlighted how medical practices can cut costs by eliminating the number of patients being seen in clinics. By 2024, the plan aims to redesign thousands of GP practices and hospitals in the UK to provide digital consultations [14]. In fact, the proactive initiatives across NHS Digital and NHSX (NHS England Transformation Directorate) during COVID-19 supported the accelerated implementation of digital technology and remote contexts into clinical practice and transformed the structure of healthcare in a short period of time [15]. More specifically, NHS Digital supported the public (NHS app, NHS COVID pass, COVID-19 advice/testing/vaccinations), supported frontline staff (NHS Spine for secure information sharing across the NHS, e-referrals service, electronic prescription service, connecting GPs, care records service, etc.), and built and ran the core IT infrastructure and live services of the NHS and social care system [16]. NHSX played a key role in setting up the NHS COVID-19 Data Store which provided continuous support for better understanding of the virus and the pressure it places on the system and, along with local teams, support on how to make better use of the available resources [17].

In China, telemedicine was nominated as one of the critical parts of the "New Infrastructure" investment policy. It has been used as a crucial method by the government to address the inequality of medical resources between urban and rural areas. As a result, China now has three major telemedicine networks [18] and medical experts from large hospitals in developed cities can provide telediagnosis for patients in rural/remote areas through telemedicine and enable patients to be treated locally by off-site medical experts [19].

Telemedicine is on track to become one of the most promising industries. According to WHO [20], telemedicine technologies have been beneficial in the European Region in the screening, diagnosis, treatment, and long-term follow-up of a series of chronic diseases. Moreover, during the COVID-19 pandemic, it has also become necessary as countries around the world relied heavily on telemedicine technologies as the ideal solution to provide continuity of care for patients with chronic diseases and to offer support to those infected by the disease [21]. This boost in telemedicine implementation makes the discussion on the environment for remote consultations extremely timely. Until now, there has been a physical setting where patients and doctors met, facilitating the consultation process. For example, in the West, this space would be designed around a desk with a chair for the consultant and a couple of chairs for the patient and the carer and possibly an examination bed or in Asian contexts, there might be another set of arrangements [22]. In the NHS, the Health Building Notes (HBNs) provide extensive guidance on consultation room layout as well as on equipment [23]. There is a growing amount of research on the spatial configuration of the consultation room and how this affects the interaction between patient, doctor, and carer as well as the patient experience [22,24–28]. Studies

addressing other spatial contexts and the patient–physician interaction, such as the area around the hospital bed, highlighted that the position of the different actors and the objects that surround them in space matter [29,30]. Considering the importance of space in the patient–doctor relationship and the patient experience, we argue that space should be important during a remote consultation [31].

Yet, as there is limited research to discuss the healthcare built environment for consultations, knowing what the environment of remote consultations should be is even more challenging.

This research is a pilot to help us approach how the built environment of the clinicians' physical premises could affect teleconsultations from a patient's perspective. We focused on primary care as it constitutes a priority for achieving financial [32], environmental [33–35], and socio-geographical sustainability [36,37]. The hypothesis is that the built environment where healthcare services take place can significantly impact telemedicine practice. To explore this hypothesis, the research team has looked into (a) the existing literature and research on the topic, (b) healthcare built environment professionals' perception of the importance of the actual environment for telemedicine, and (c) the user's experience during a telemedicine consultation.

2. About Telemedicine

Telemedicine is an evolving service that includes, but is not limited to, diagnosis, treatment, prevention, research, evaluation, and healthcare education [38]. It aims to provide services such as consultation, diagnostic support, and monitoring that allow, among others, healthcare professionals and patients to connect remotely [39]. It connects primary care or emergency department clinicians to medical specialists remotely via electronic information and telecommunications technology [40], which could be described as a B2B model, i.e., business to business and in this case clinician to clinician. During the pandemic, this was replaced by person–patient consultations in a B2C model, i.e., business to client and, in this case, doctor to patient. The doctor-to-patient communication and relationship is systemically important for delivering care, whereas space can be systemically important too [41–43]. The application of telemedicine may provide solutions for facilities with poor healthcare infrastructures, low mobility, limited funding, and insufficient staff [44].

2.1. Definition: Telemedicine, Telehealth, and eHealth

Telemedicine, telehealth, and eHealth are three terms that are usually discussed interchangeably. The United States Department of Health and Human Services notes that telemedicine refers to "remote clinical services". At the same time, telehealth relates to "non-clinical services, such as providing training, administrative meetings, and continuing medical education" [45]. The World Health Organization includes all aspects of healthcare services under the umbrella of telemedicine [38]. The American Telemedicine Association uses telemedicine and telehealth interchangeably but admits that telehealth covers a broader scope of application [46]. Another related term, eHealth, is a more general concept that includes telehealth, digital healthcare records, and other healthcare information technology [47]. The broader concept of telemedicine includes, but is not limited to: online consulting through virtual conferences; online conferences where two healthcare professionals discuss actual cases; surgeries done remotely using robotics; physical treatments conducted through virtual live monitoring equipment; medical test collaborations between different facilities for interpretations by more experienced health experts; a continuous patient data stream with home monitoring; and even the ability to receive interpretation during medical videophone conferences. In the context of this research, however, we focused our empirical investigation mainly on the part of telemedicine that concentrates on the patient–clinician interface, even though the interviews were more exploratory and inclusive about the definition of telemedicine.

2.2. Telemedicine and Healthcare Built Environment

According to the literature, the healthcare built environment is important in terms of the quality of telemedicine practice (Table 1). Room design impacts the quality of telemedicine services, as it needs to accomplish two major functions: create the visual and audio accuracy needed to support a clinical examination and diagnosis from a distance as well as creating the connection between the patient and the remote provider where the patient–clinician interaction is of outmost importance [48]. Healthcare built environments need to enable technology as much as possible for medical professionals and patients who participate in telemedicine sessions to interact successfully [49]. Telemedicine patient experience can be significantly affected by the following factors related to the built environment: Functionality; Technologies, Equipment, and Power; and Other Social Factors. It is important to note that the factors above relate to the physical space in the built environment, and these factors are equally important for the digital space and the digital infrastructure; these aspects will not be addressed here, however, as it is outside the remit of this paper.

Table 1. Telemedicine and healthcare built environment space design qualities.

Telemedicine and Healthcare Built Environment Space Design Qualities	
Room size	• Could vary—depends on the type of telemedicine service
Room planning	• Quiet location (minimal exposure to outside noise) Preferably windowless room (or use of blinds to reduce light and glare)
Room lighting	• Diffused light source in front of the patient (optimal) Warm, white fluorescent light fixtures with consistent colour temperatures (optimal)
Room design	• Use of carpet (advisable) Use of acoustic materials (reduce echo/improve audio quality) (advisable) Wall colour: medium shades of grey-blue instead of white/light colours (advisable)
Room identity	• Clear screen image: clinician with the name of the health centre • Clear site identification (could act as 'voucher' for reimbursement)
Room privacy	• Authority to listen: only those involved in the teleconsultation • Avoid disruptions by other doctors during teleconsultation sessions

2.2.1. Space Size

The room size of telemedicine facilities could vary and it is critical to understand the medical activities that will take place in these spaces. The type of telemedicine service determines how the facilities will be used, and the tele-clinical rooms need to be adaptive to establish and re-establish these particular needs [50]. The most common store-and-forward services (i.e., teleconsultation) do not consume large spaces. In terms of planning, the room should be arranged in a quiet location, minimizing exposure to office noise or other areas such as parking lots, waiting rooms, stairwells, or busy corridors [48]. A windowless room is more ideal for video transmission since direct sunshine will affect the video quality. If this is not feasible, shades or blinds should be used to reduce light and glare [48].

2.2.2. Space Visibility

Lighting, audio, and colour are three critical factors that affect most types of telemedicine service experience. Lighting impacts the clinician's ability to see the patient clearly with accurate colour reproduction. The optimal lighting is a diffused lighting source in front of the patient. Windows or other light sources behind the patient could create shadows which will interfere with the accuracy of the clinical evaluation [48]. Using warm, white fluorescent light fixtures (3200–4000 K) with consistent colour temperatures is advised. This is particularly important in services like tele-dermatology, where colour information can affect diagnostic accuracy. It is advisable to use carpet and acoustic materials in clinic rooms to reduce echo and improve audio quality. Wall colour is another factor which could impact how patients look on the video. It is recommended to use medium shades of grey-blue as

the wall colour, which makes it easier to highlight patients during consultations. White or light walls can make features hard to see during this remote consultation. Matte (or flat) are ideal finishes to minimise reflections during videoconferences [51].

2.2.3. Space Identity

When telemedicine overcomes custom and policy reimbursement obstacles and becomes extensively adopted, emerging challenges to user experience are expected to arise in the coming years [52]. As discussed previously, obscure reimbursement policies and regulations have been one of the greatest challenges to the wide spread use of telemedicine. However, as more organisations establish telemedicine reimbursement policies, this gap will be bridged. These considerations can affect the identification and design process of telemedicine rooms since the site identification of the facilities can be a "voucher" for reimbursement. A typical telemedicine room shows a clinician with the name of the health centre behind them [50]. This enables a patient to take a screenshot for authenticity purposes, which can be used as proof should reimbursement be needed.

2.2.4. Space Privacy

Privacy needs to be considered in telemedicine facilities' built environment. For example, only those involved in teleconsultations should have the authority to listen and see what happens in the room [50]. A negative example of a teleconsultation room is when another doctor comes into a patient's sight. This may, in turn, cause patients to feel a lack of privacy. The designers of telemedicine rooms need to avoid the above conditions as much as possible. Here, we need to mention that there is very little empirical data juxtaposed to the mentioned data. The studies conducted on telemedicine and patient experience have a peripheral interest in the experience of the actual physical environment, such as audiovisual quality or satisfaction in general [53]. Moreover, very few studies focused on primary care, which is the backbone of the health service and one of the most important streams of healthcare provision that support strategies of transitions to sustainable healthcare provision in general [54].

2.3. The Impact of Telemedicine-Related Technologies to Healthcare Built Environment

Emerging telemedicine-related technologies have been identified, which could have an impact on healthcare facilities' planning and design, such as the Fifth Generation Technology Standard for Cellular Networks (5G), Tele-Robotics, Artificial Intelligence (AI), Big Data, Virtual Reality (VR), and Augmented Reality (AR). New technologies could pose new space requirements that need to be considered during the design phase, such as space requirements for emerging machinery and equipment, power plants, wires, and cables [55].

5G technology is a vast stimulator for telemedicine, enabling a connected system of telemedicine-related devices. It could also indirectly impact on facility planning and design, as it could affect facility site location since new healthcare facilities will need to consider staying near 5G base stations until full country-level coverage is achieved [56]. In the case of tele-robotics, facility planners and designers need to consider the requirements of those machines in regards to size, weight, and method of operation, as inappropriate space planning will limit the potential of these robots. Artificial intelligence could also affect space design, as healthcare planners with the help of AI findings could possibly predict space spatial requirements more accurately and generate more financially efficient buildings. Big Data could also pose changes in healthcare facilities design, as analysing data such as for patient flow could provide helpful information to designers for better spatial efficiency and, as a result, better user experience [57]. VR technology will be the technological basis for creating 'virtual healthcare facilities', which will be part of telemedicine services. Lastly, with AR technology, planners will need to consider AR virtual objects during the design stage to better facilitate AR-related activities in the future.

2.4. The Impact of Telemedicine to Environmental Sustainability

Health services contribute significantly to waste production and energy consumption [58]. According to Pichler et al. [59], healthcare can account for up to 5% of a country's annual carbon footprint. Specifically in England, the NHS accounts for 4% of the country's emissions of greenhouse gases, having approximately 7000 GP practices spread over 9000 buildings, with total estate emissions in 2021 of 167 ktCO2e [60]. During COVID-19, the primary care response accelerated the digitalisation of outpatient and primary care appointments [60]. Research has demonstrated the potential for telemedicine to reduce greenhouse gas emissions and other air pollutants due to reduced travel [58]. Thus, telemedicine programs should be considered a global strategy option in the fight against climate change [61].

2.5. The Impact of Telemedicine to Social Sustainability

In cases of patients who would not be able to travel for medical care, high quality telemedicine services could be their only option to equal healthcare provisions and one of the most effective ways of increasing accessibility of services, saving time and money for patients, as well as improve their quality of life [61]. Especially in rural and remote areas, access to care could be challenging, especially in deprived areas where patients may not have the means to travel for a medical or specialist appointment. This fact could be perceived as a means of geographical inequality in access to healthcare. Telemedicine technologies can successfully cover that gap by improving access to care, especially in rural and remote areas, and providing specialty expertise that would not be available otherwise [58]. In such settings, people suffer from a lack of health infrastructure which could jeopardise their right to access care. Telemedicine could act as a tool able to improve accessibility to healthcare by increasing the coverage of specialist services and by offering adequate and reliable levels of care, taking into account the medical, social, and economic factors of patients [62]. Considering the significance of telemedicine in health service planning, it is therefore important to facilitate its implementation by increasing end user experience and removing barriers that could result from weak systemic links, such as the built environment for teleconsultation.

3. Research Methodology

The project's aim included exploring the relationship between telemedicine and the healthcare built environment and considering how these findings will guide further practices and research. There are three objectives for this project. On the one hand, to identify what is the state of the art when it comes to environments for telemedicine. The second is what different stakeholders, who are responsible for teleconsultation's therapeutic space, consider important. Finally, this research set out to discover unidentified issues and potential opportunities regarding this topic from an end-user perspective.

The research team wanted to explore what the stakeholders involved in the programming and design of healthcare premises think about their role in the design of spaces for telemedicine consultations and potential correlations between space and telemedicine. For this reason, semi-structured interviews with British and Chinese healthcare professionals (planners, architects, managers, and investors) were conducted online between May and August 2020. Five major questions were prepared before the participants received an invitation. The interview questions were related to the following topics:

- What issues do they find more critical in healthcare facility planning and design;
- What trends do they observe in healthcare planning and design;
- What do they know about telemedicine and how does it affect healthcare design.

The interviewees were approached by e-mail, LinkedIn, and through acquaintances. The researcher explained the project to them and sought their verbal consent before the interview. Twenty-three participants were invited to the interview; eleven accepted the invitation, and ten interview results were used in the research. All interviews were conducted by one researcher, the primary researcher of the project. The interviews were all virtual meetings using the following online video software: Google Meet, Skype, Teams,

and WeChat. Each interview lasted approximately 15–30 min. The interviewees were professionals with more than ten years of experience in the healthcare property sector. Six were healthcare architects and planners and the four remaining individuals had diverse backgrounds ranging from managers to property investors to educators. Professionals working in the built environment sector were easier to reach, while professionals from telemedicine companies were more reluctant to respond or accept the invitation.

Finally, one of the researchers involved in the project conducted autoethnographic research, in particular, end user research, to get a first-hand understanding of the process and identify potential areas that could be further researched more systematically in the future. Following the Jones and Smith classification [63], the approach used was between 'complete participant', and 'participant-as-observer' as the researcher was fully integrated into the setting by disclosing themselves as a researcher. Out of a list of four possible providers of teleconsultations—two in the UK and two in China—one was selected based on convenience. Compared with the other three, the selected company was able to respond within 10 min after the appointment. The researcher arranged and attended eight online consultations of about 10 min each—three in video and five sessions sharing text and images—with telemedicine doctors at primary care clinics that operated via telemedicine. The consultations took place during working hours between July and August 2020. The sessions were on spine problems, an actual condition that the researcher needed consultations for. The researcher recorded the consultations by video and made notes during the process. The researcher noted the two goals (spinal issue and end user research) of the consultation at the beginning. The doctors were all supportive in understanding these goals and willing to share their opinions regarding the research topic.

Adopting this autoethnography approach—trying to analyse telemedicine built environment through personal experience [64]—in parallel combination with the researcher's architectural background, allowed the researcher to be more sensitive to matters of the built environment in comparison to another patient coming from a different background. Because of their background, the researcher utilised their analytical thinking skills about space to collect data on issues that piqued their attention during the consultations. This individual perspective, in combination with their architectural skills, helped in putting into words the distress and discomfort other patients may have felt during consultations but could not be placed or elaborated on. For example, a patient might have been annoyed by not having the opportunity to see the mouth of the clinician, especially if they needed to lip-read but would not necessarily be able to make the connection between the position of the screen and the ergonomics around the doctor's chair and the placement of the camera. Or they could be distracted by the clutter and maybe lose at that moment their attention to the doctor but not necessarily being aware that the clutter was the trigger. There are also some limitations as being an insider researcher could induce challenges and blurred boundaries, as the researcher acts both as the patient and the researcher [63]. Moreover, data saturation can be a challenge during ethnographic studies, as there is a certain number of consultations both financially and time-wise the researcher could perform. Additionally, the participant's performance may be affected during sessions due to the presence of the researcher—for example, they may pay more attention to issues they would not normally do in cases of other anonymous patients [63]. Afterwards, the general results of the physical environment were compared to the literature findings. The research methodology is presented in Figure 1.

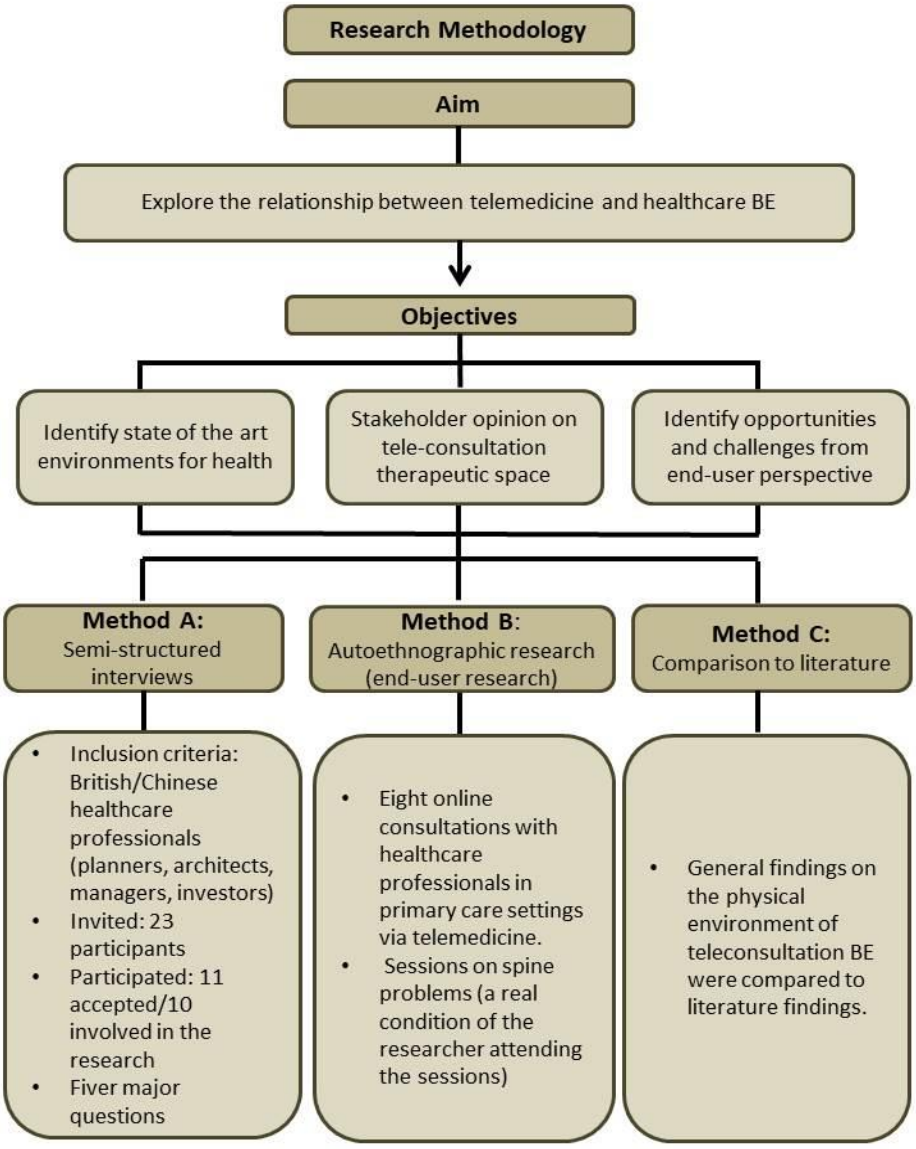

Figure 1. Research methodology diagram (Copyright: the authors).

As far as ethics is concerned, approval was granted by the BSSC Research Ethics Committee (Reference: 2020-PGT-CS-001). The researcher collected data from healthcare planners, architects, managers, and doctors via interviews. All interviews were anonymized and the interviewees were not identifiable. The researcher also informed all the clinicians involved in the autoethnographic eHealth consultations that parallel to him having a diagnosis on a specific medical issue, he wanted to use the opportunity of the consultation to understand the process of tele-consultation as a patient himself and he would use that experience by anonymising the clinician/clinic involved. The clinicians, who were randomly selected as a response to the clinic booking system, provided oral consent to facilitate the research together with the consultation.

4. Findings

4.1. Defining and Understanding Telemedicine

Because telemedicine is a new trend, defining it can be difficult, as it could be confused with other related concepts based on information communication technology and internet technology, such as "telehealth" and "mhealth". Among the ten interviewees, only one could clearly define telemedicine, but half raised questions such as, "What is telemedicine?". Most of the interviewees marked themselves from 3 to 4 when asked, "What do you know

about telemedicine? Please mark yourself from 1 to 10." Only one person marked himself a 6 and one person marked himself a 2.5. When it comes to healthcare professionals, most have heard of telemedicine and some have even experienced its practice during the COVID-19 pandemic.

4.2. Interview Results: Opinions from the Healthcare Industry

When asked "How would telemedicine affect the healthcare built environment?", most interviewees acknowledged the potential changes that telemedicine could bring to healthcare systems. One interviewee mentioned that "telemedicine could help to balance the healthcare resources, bring convenience to patients, especially during the pandemic, and would invite new medical habits like self–monitoring and self-treatment."

Their predictions were oriented to three aspects: size, function, and flexibility. First, when it comes to size considerations, there was a common understanding that a decent amount of rooms and space would no longer be needed since patients would use services online without physically visiting hospitals. For example, digital registration services could dramatically decrease patient waiting time, because those would be given an exact visiting time. In addition, considering the online appointment method, there would be no need for large waiting areas. Second, some telemedicine-related services require more space and room for telephone operators and online doctors. Third, flexibility would be a requirement for hospitals, as some of the rooms would need to be adaptive and multi-functional. For example, a meeting room could also be used for tele-consultations, which would more fully utilise the space (Table 2).

Table 2. Healthcare facilities' trend observation (Note: some of the answers appear more than once).

Main Topics	Answers from Interviewees
Size	Room size/Smaller hospitals/Less consulting rooms/More rooms for equipment/Fewer bedrooms/Less infrastructure /Increasing need for public healthcare facilities
Function	Less visits/Consider the importance of call centre/ Diverse functions/Micro hospitals
Flexibility	Flexible/Adaptability/Multi-functional office

However, most interviewees did not hold the opinion that these changes would come soon because there would be challenges from other factors including cultural and economic factors, clients' experiences, and policy. As one interviewee noted, "I don't feel optimistic that telemedicine will directly change the healthcare built environment." Overall, the interviewees admitted the potential changes that telemedicine might bring to the healthcare built environment, but they remained unaware of the roadmap. This is an interesting point, highlighting the fact that there is guidance in the literature but there is a lag in applying in practice. Having said that, this may have to do with the fact that, in the UK context, HBNs have not yet been informed on these technologies. Furthermore, none of the interviewees mentioned the changes brought up by other telemedicine-related technologies, which were discussed previously.

4.3. Autoethnography and End User Research Results

During a consultation, the researcher observed some concepts that were in opposition to literature. First, the face of the general practitioner was located on the lower level of the screen, meaning that the camera was not positioned at an appropriate angle. Second, the doctor's face was not well lit and they had avoided opening the curtain as it would cause camera overexposure. Third, the background of the room was not in good order having too many distractions, including the window, cabinet, and camera. Last, there was no clear evidence to show the authenticity of the GP (i.e., a GP logo or a name), which might cause trouble in the future (i.e., for reimbursement) (Figure 2). The facility did well, however, in two aspects. First, the sound quality was good, without many disturbances. The other

aspect was that the internet signal was stable and the whole video experience was smooth. The backup power could not be verified in this research, as it was outside the scope.

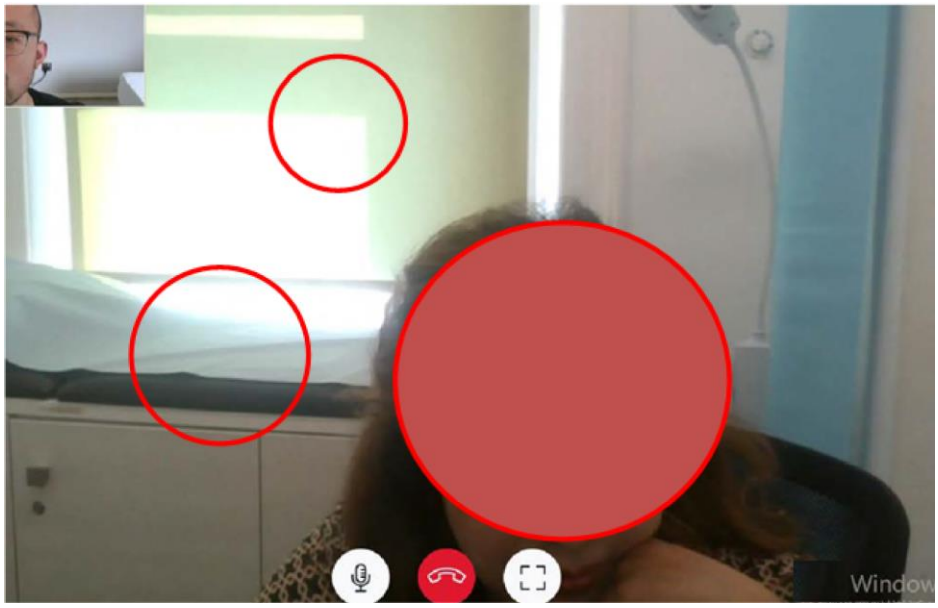

Figure 2. Ethnography research on the telemedicine built environment. The red circles highlight distractions in the room for the patient during the tele-consultation. The red circle on the face of the doctor highlights her disposition in relation to the screen (also, the face of the doctor has been blurred). (Copyright: Chongling Sun).

As the results of the ethnography research showed, telemedicine consultation rooms did not always follow the guidance of the literature or guidelines, which in turn affected the quality of the consultation. The researcher involved in the study had an unpleasant experience due to the doctor's face not being positioned in the centre of the screen, the dark environment, and the various other distractions. However, this discomfort was less important in comparison to the huge convenience of online consultations. Furthermore, in terms of the entire process of this form of medical treatment, the physical environment can only affect the experience of online consultations, but cannot significantly affect the experience of other procedures, like online registration.

5. Discussion

As already stated, there is evidence that the healthcare built environment has huge potential to profoundly influence the telemedicine practice experience. The studies and practices around this area are becoming more prevalent. However, interestingly, among the interviewees, only one was in a position to clearly define telemedicine and half of the sample raised questions such as, "What is telemedicine?". When interviewees were asked about the potential impact that telemedicine may pose on the healthcare built environment, the respondents were not sure about the roadmap of this changing process, even though all respondents reckoned that this technology is likely to impact the healthcare built environment. Their predictions were mainly related to size, function, and flexibility of space as, for example, certain telemedicine-related services may require more room for telephone operators and online doctors, but most of the participants supported the idea that these changes will need time to implement due to other factors such as culture and economic policy. There is a gap between healthcare planners and architects in understating the actual impact and nature of telemedicine on healthcare facilities. The findings showed that they place the need to redesign the healthcare built environment in the not-so-near future. However, this may not be necessarily the case as from what we have seen during the pandemic, telemedicine is already gathering momentum, especially in the primary care setting. During this period, consultations in the primary care setting were taking place

remotely for practical reasons (this research took place during the lockdowns). Within this framework, healthcare designers and planners seemed to not have a clear definition of what telemedicine is and seemed disconnected from a technology that is already here. The interactions between telemedicine and healthcare environments are both intriguing and uncertain. Such interactions intrigue the interests of healthcare professionals and scholars, and are stimulating discussions and practices in the field; it also causes uncertainties in the development of healthcare facilities, uncertainty in functionality, uncertainty in size, and even uncertainty in the necessity of physical healthcare facilities. This might be due to a lack of knowledge and experience as well as a lack of sufficient guidance. For example, the HBNs have not covered the subject yet. It might also stem from the virtual attribute of this technology. Healthcare architects and planners usually find it confusing to see the importance and the potential impact but are unable to handle the specifics at this stage. This demonstrates the urgent need to develop guidance for the planning and the design of those spaces, perhaps as a framework to support the future development of HBNs or equivalent.

The autoethnographic research also supported the idea that there is a lack of knowledge when designing and using teleconsultation spaces, as the researcher had an unpleasant experience during a session due to the dark environment, the mispositioned doctor in front of the camera, and various other distractions.

The overall research indicated that more work needs to be done in telemedicine practice in terms of the healthcare built environment where consultations take place. It is a crucial aspect that may contribute to patient experience. Meanwhile, this research is a reminder that technology is still the key to experience in telemedicine practice. The emerging telemedicine technologies are challenging physical requirements, planning and design, and the spatial experience of healthcare facilities. Furthermore, due to the rapid development of medical technologies and equipment, healthcare facilities' planning and design need to be flexible, so that they can catch up with changing technologies. As one of the emerging technologies, the impact of telemedicine is rapidly spreading from industry to industry and country to country. It can potentially disrupt the current healthcare system as well as healthcare infrastructure. New trends have made their appearance and hybrid models of healthcare delivery will continue to grow, due to the decentralisation of healthcare facilities and the mixture of online and offline consultations and services. However, due to the hysteretic nature of the built environment, more patience and time will be required for people to witness this impact. Consequently, it is promising that people's attitudes toward the healthcare built environment will finally change in the short-term.

6. Conclusions

This research aimed to understand how current telemedicine literature responds to healthcare facilities' planning and design. It also discovered potential influences that telemedicine and its related technologies could bring to healthcare facilities. Overall, these interactions between telemedicine and healthcare facilities could be intriguing for healthcare professionals and scholars but at the same time, due to the research gap, could cause uncertainty for the future of the healthcare space as we already know and experience it.

More specifically, telemedicine stimulates new research surrounding the built environment area and new guidelines to facilitate this emerging technology. Furthermore, telemedicine-related technologies and processes have the potential to further impact healthcare facilities' planning and design. Additionally, telemedicine has the potential to disrupt healthcare facilities' planning and design and to reconfigure healthcare facilities for a more socio-demographically and carbon-footprint sustainable healthcare provision.

Based on this research, those involved in the design of healthcare spaces, could better understand telemedicine and acknowledge the impact that it could bring to their work on both a short and long-term basis. It also highlighted how crucial technology will be in terms of daily workflow and the importance of taking this into account during the design phase. Telemedicine technologies can have a great impact on the reconfiguration of the healthcare space. Telemedicine is still a new technology, and even its definition and

concepts are rapidly developing. The physical environment of healthcare facilities will need to follow this development to better facilitate changing technologies and healthcare built environment professionals need to incorporate digital technologies as an integral part of healthcare planning. From the discussion, it became clear that healthcare planners and architects do not have the complete picture of telemedicine technology, which has a direct effect on their strategic role in the remodelling or new design of future healthcare facilities. There is a need to bring together technology designers, healthcare designers, and the people who utilise those spaces (clinicians and managers) in a common dialogue so that they are all well-informed from the start (to succeed not only in the best possible operation but also a sustainable one) in order to co-create a framework which will lead to a fit-for-purpose guidance.

Lastly, limitations include the challenges already stated on the autoethnographic approach used, which is an individualistic method with valuable insights but has a limited sample, and the small sample of interviews is partially a result of healthcare architecture being niche. This pilot study could be the basis of future studies applied to more countries and a larger sample, to further assess the relationship between telemedicine and the healthcare built environment and how they can influence one another in the future.

Telemedicine has the potential to guide the development of healthcare systems and form the future of healthcare facilities in a way that is more environmentally sustainable, equitable, and socially sustainable. Future trends in healthcare facilities including hybrid functionality, decentralization of healthcare facilities, and a mixture of online and offline consultations and services become more prominent after COVID-19 as they provide realistic and sustainable solutions. These will become even more prominent as the health services have been crippled after COVID-19 and face unprecedented demand in an ageing society. Therefore, this topic will require further attention from scholars and practitioners across the spectrum of healthcare provision and its built environment.

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