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How do care environments shape healthcare? A synthesis of qualitative studies among healthcare workers during the COVID-19 pandemic

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TITLE

How do care environments shape healthcare? A synthesis of qualitative studies among healthcare workers during the COVID-19 pandemic

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ABSTRACT

Objective: To investigate how care is shaped through the material practices and spaces of healthcare environments during the COVID-19 pandemic.

Design: Critical interpretive synthesis of qualitative research.

Participants: Studies included qualitative research investigating the experiences of healthcare workers involved in the care of individuals during the COVID-19 pandemic.

Results: 134 articles were identified in the initial sampling frame with 38 studies involving 2507 participants included in the final synthesis. Three themes were identified in the analysis: 1) the hospital transformed; 2) virtual care spaces; and 3) objects of care. Through the generation of these themes, a synthesising argument was developed to demonstrate how material spaces and practices of healthcare shape care delivery and to provide insights to support healthcare providers in creating enabling and resilient care environments.

Conclusions: The findings of this study demonstrate how healthcare environments enable and constrain modes of care. Practices of care are shaped through the materiality of spaces and objects, including how these change in the face of pandemic disruption. The implication is that the healthcare environment needs to be viewed as a critical adaptive element in the optimisation of care. The study also develops a versatile and coherent approach to critical interpretive synthesis methods that can be taken up in future research.

Keywords: COVID-19, quality in health care, qualitative research, intensive & critical care

ARTICLE SUMMARY

Strengths and Limitations of This Study

- This study is the first to synthesise qualitative research during the COVID-19 pandemic on how the materiality of healthcare environments shape practices of care.

- This study demonstrates a cogent working approach to critical interpretive synthesis methods for review of qualitative research, which helps to generate insights beyond the goals of the original studies.
- Included studies were primarily limited to the earlier stages of the COVID-19 pandemic and inconsistently defined COVID-19 care and treatment.
- The analysis highlights the importance of developing adaptable environments as part of systemic responses in times of emergency such as pandemics.

INTRODUCTION

This paper investigates how the materiality of the healthcare environment shapes care experiences, and how care practices and spaces transform in uncertain health contexts. Taking the COVID-19 pandemic as our case, this review synthesises qualitative studies investigating the experiences of healthcare workers involved in the care of patients during the COVID-19 pandemic. While these studies attend to COVID-19 in an 'emergency' framing, they call attention to enduring concerns that will affect healthcare practices and spaces in the years to come. The COVID-19 context presents an opportunity to identify the ways through which the materiality of the care environment enables and constrains ways of doing healthcare with particular attention to care as an emergent and adaptive feature of its environment and situation.[1-4] This work is important, not only for considering how care is adapted in fast-moving situations of disruption such as emergency, but also for how adaptive responses to care can endure as part of a systemic response.[2]

Existing reviews into the experiences of healthcare workers during the COVID-19 pandemic have primarily focused on the mental health impacts of COVID-19 on healthcare workers (and interventions and strategies for coping), and other barriers to and adaptations for care including those related to resource allocation, access to relevant information and

1
2
3 training, the impacts of wearing personal protective equipment (PPE), stigma, and logistical
4
5 challenges, particularly around infection control and prevention.[5-18] Another review
6
7 examined the impacts of environments on workers in the COVID-19 context more broadly,
8
9 including the environments of healthcare workers.[19] To investigate this further, we trace
10
11 how aspects of the healthcare environment (that is, the sites, spaces, and conditions
12
13 through which care is delivered and/or received) shape the healthcare experience,
14
15 particularly in uncertain or rapidly changing health contexts. We consider ways of
16
17 identifying how healthcare workers can be better supported not only *in* but *through* their
18
19 environments. We finally explore how healthcare services might develop up efforts to
20
21 create enabling and resilient environments of care for healthcare workers as well as
22
23 patients.
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30 This analysis has practical implications, as the forms of care provided by healthcare
31
32 workers, as well as the quality of such care, are contingent on how healthcare environments
33
34 adapt to changing health needs and contexts. The effects of this adaptability are
35
36 compounded in times of emergency and disruption. Our orientation in this synthesis is
37
38 informed by recent work on materialities and ecologies of care[20-24] and how the care
39
40 environment affects the care delivery experience.[25-29] To our knowledge, this is the first
41
42 synthesis of qualitative research to consider how healthcare environments materially affect
43
44 the delivery of COVID-19 care.
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48

49 **METHODOLOGY**

50
51 We draw upon Dixon-Woods et al.'s methods for critical interpretive synthesis (CIS) of
52
53 qualitative research to develop our approach to review.[30] Dixon-Woods et al. argue that
54
55 while conventional comprehensive review methods are useful for aggregative syntheses of
56
57 data, they present limitations when it comes to *interpretive* approaches to synthesising "a
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59
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1
2
3 large and complex body of evidence.”[30] A critical interpretive approach to synthesising
4
5 qualitative evidence is useful because it does not merely describe issues identified within
6
7 the original studies, but also generates new ideas and “assemble[s] findings into a form that
8
9 is useful in informing policy.”[30] Such an approach requires a sample that is *rich* and
10
11 *diverse*, rather than exhaustive, as the focus is on generating theory rather than
12
13 systematically summarising all available data.[30-32] CIS is thus more concerned with
14
15 “*appropriateness of sampling*” than “*comprehensiveness*.”[31] This requires an iterative and
16
17 flexible approach to review, where the research question, sampling strategy, and analysis
18
19 are continuously and reflexively refined.[30, 33] The aim here is to develop insights that
20
21 move beyond the designs of the original studies and have the capacity to produce novel
22
23 contributions to health policy and clinical practice.
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29
30 Guided by Dixon-Woods et al.’s methods, we have outlined each step of our
31
32 approach to synthesis below.[30] It should be noted that these steps are not necessarily
33
34 performed sequentially or independently. Instead, steps may overlap, run concurrently, and
35
36 repeat in response to emerging analysis and theory generation.
37
38
39

40 **Review Question**

41
42 We established an analytical focus for our review around the materiality of the healthcare
43
44 environment. By this, we mean we attended to matter, such as objects (both medical and
45
46 mundane), bodies, buildings, and infrastructures, and how matter relates with practices,
47
48 knowledges, spaces, temporalities, and affects in the care environment.[20, 21] We
49
50 furthermore considered how the care environment itself is made through these relations
51
52 and what is at stake in that making.[20, 21] This analytical focus guided our search and was
53
54 iteratively refined in response to emerging findings.[30] Unlike with conventional review
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3 methodologies, and in keeping with CIS methods, we did not formulate a hypothesis in
4
5 advance, but reflexively refined the research question and analysis throughout.[30]
6
7

8 **Search Strategy**

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10 An explicit, highly structured, and protocol-driven search strategy is ill-suited to the review
11
12 of complex qualitative evidence, as it risks missing relevant materials and can be less
13
14 efficient than other strategies.[30, 34] We combined traditional search strategies with
15
16 other, more iterative methods to assemble a sampling frame. We began with a search of
17
18 PubMed and Google Scholar databases using the search query “(healthcare OR (health AND
19
20 care)) AND (worker OR professional OR staff) AND covid-19 AND qualitative.” These search
21
22 terms were kept intentionally broad to allow for greater inclusivity across topics and
23
24 disciplines in line with the exploratory nature of the review process.¹⁰ Further searches were
25
26 also performed in hand selected journals and via backwards and forwards citation chaining,
27
28 using Google Scholar for the latter. Finally, we used informal networks such as personal
29
30 contacts and Twitter to monitor for additional literature that may have been missed in the
31
32 initial search, especially given the fast-moving production of research in the COVID-19
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34 context.[30, 34] We adopted a “snowballing” approach to our search, allowing studies that
35
36 emerged throughout the review process to be included in the final sample.[34]
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44 **Eligibility Criteria**

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46 In the early stages of study selection, it was important keep the boundaries of our search
47
48 flexible to allow the review question to dynamically evolve in response to emerging findings.
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50 However, given the speed and volume of research being produced within the COVID-19
51
52 context, there was a practical need to limit the number of papers included in the initial
53
54 review. Eligible articles included English-language original studies collecting primary
55
56 qualitative data including interviews, surveys with free-text responses, focus groups, and
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3 observation. Mixed-method studies were eligible for inclusion if evidence of all findings was
4 demonstrated in the qualitative data. All articles were peer reviewed and published or in
5
6 press with the accepted manuscript available online by 31st December 2021.
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9

10 Eligible studies investigated the experiences of healthcare workers involved in the
11 care of individuals with COVID-19. This posed two challenges. First, the category of
12 healthcare workers has no singular definition across studies and geographical contexts, with
13 some articles taking a broad approach and some focusing on specific professions. We
14 adopted an inclusive definition of healthcare workers including, but not limited to, medical
15 and paramedical practitioners, nurses, midwives, allied health professionals, emergency
16 health workers, personal care workers, health management and support personnel,
17 students and trainees, and other health and health associate professionals.
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30 Second, in the context of the pandemic, where the healthcare systems of most
31 countries are directly involved in COVID-19 management and care, it is difficult to define
32 what constitutes COVID-19 care. Healthcare workers in settings that are not established to
33 provide specific COVID-19 care may still encounter individuals experiencing COVID-19 illness
34 who are also, or solely, in need of non-COVID-19 healthcare. Conversely, healthcare workers
35 who are explicitly engaged in the care of patients with COVID-19 are often also involved in
36 care of other patients who are not infected and have other healthcare needs. Most studies
37 did not make clear and consistent distinctions between practices of care performed for
38 patients with and without COVID-19, and the experiences of healthcare workers related to
39 the specific care of COVID-19 patients cannot be disentangled from the broader experiences
40 of providing healthcare during the COVID-19 pandemic. Furthermore, many of the concerns
41 and practices of frontline COVID-19 healthcare workers and other healthcare workers are
42 shared, including managing infection risks and the use of PPE.
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3 We included articles that explicitly reported the experiences of caring for individuals
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5 with confirmed or suspected COVID-19, irrespective of whether COVID-19 care was a
6
7 primary responsibility of the study participants. We additionally included studies in which
8
9 there was ambiguity as to whether the participants themselves were involved in the *direct*
10
11 care of COVID-19 patients, but the practices, spaces, and concerns identified in the findings
12
13 were consistent with other studies. Studies that did not focus on the experiences of
14
15 healthcare workers in care *provision* (e.g. studies investigating experiences of healthcare
16
17 workers as COVID-19 patients themselves) were excluded.
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23 **Sampling and Quality Determination**

24
25 We employed an iterative and purposive sampling strategy to select papers for inclusion.
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27 Rather than producing an exhaustive sample within a rigid and highly specified inclusion
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29 criteria, purposive sampling enables the inclusion of “relevant” literature on the basis of
30
31 likelihood to contribute to the development of theory, with an ultimate aim of “conceptual
32
33 saturation.”[30, 33] This allows for the inclusion of a richer and more diverse sample of
34
35 literature. Thomas and Harden argue that aiming for conceptual saturation may be more
36
37 appropriate for reviewing qualitative literature than traditional sampling approaches, as the
38
39 conceptual findings of the synthesis will not change with the addition of further studies
40
41 beyond the point of saturation.[35]
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47 CIS rejects a “stage” approach to review, instead producing a method that is
48
49 iterative, dynamic, and responsive to the evolving concerns of the synthesis.[30] In practice,
50
51 this involved including and excluding literature on an ongoing basis to adapt to emerging
52
53 lines of analytical inquiry. The aim here is not reproducibility.[30] Instead, much like with
54
55 analysis of data in primary qualitative research, CIS methods produce an interpretation of
56
57 the evidence that is demonstrably grounded and prioritises “meaningful” analysis.[30] While
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total transparency of study selection is not feasible within such a method, we have simplified our selection process into 4 phases (Table 1).

Table 1: Phases of Sampling	
Phase 1	Articles were screened for eligibility and relevance on the basis of titles and abstracts. Selected articles were imported with PDFs into EndNote 20 for full-text indexing (n=134).
Phase 2	A sample of articles (n=53) was read in full and emerging themes were identified, coded, and synthesised into possible search terms with particular attention to our analytical interest in the materiality of healthcare environments.
Phase 3	All indexed PDFs were searched using synthesised search terms and matching articles were screened for inclusion on the basis of the full text for quality, richness of primary data, and relevance (n=96).
Phase 4	All articles included in Phase 3 were screened for final inclusion on the basis of contribution to theory development (n=38).

While the phases of sampling represented in Table 1 are listed in sequential order, Phase 2 and Phase 3 are not a discrete and singular steps, but rather “a constant dialectic process conducted concurrently with theory generation.”[30] Search terms synthesised in Phase 2 were continuously tested for usefulness and refined in response to emerging themes (Table 2); for example, despite the attention to material objects within the synthesis, “material” was determined to be an unhelpful search term as it captured all articles that referenced “supplementary materials.” Similarly, articles selected in Phase 1

were iteratively included and excluded on the basis of relevance in Phase 3 as the concerns of the synthesis evolved.

Table 2: Synthesised Search Terms

Search Term(s)	Sample (N)
bed	75
body OR bodies OR bodily	68
disinfect	25
dispose OR disposal	9
facility OR facilities	61
gear	33
mask	93
ppe	101
redeploy	26
room	90
space OR spatial	58
telehealth OR teleconsult OR telemedicine	23
ventilator	46
virtual OR digital OR remote	70
war OR battle OR soldier	62
waste	12
zone	23

Following Dixon-Woods et al., we adopted an approach to quality appraisal in Phase 3 that maximised inclusion at a conceptual level, rather than taking a hierarchical approach

determined by particular methodological standards.[30] Though articles would only be *included* on the basis of their interpretive value, articles would also only be *excluded* if they were deemed to be “fatally flawed.”[30] We developed a set of appraisal prompts adapted from those proposed by Dixon-Woods et al. for assessing if an article should be excluded on this basis (Table 3).[30] Finally, Phase 4 of the sampling process appraised all articles included in Phase 3 for their overall contribution to the conceptual findings of the review. As the methodological aim of this review was to reach “conceptual saturation,” we deemed it unnecessary to include multiple articles that all presented the same findings without meaningful variation. Articles that produced no additional insights to other included articles and did not provide rich empirical data for interpretive analysis were excluded in this phase (Table 4).

Table 3: Quality Appraisal Prompts

Are the objectives of the research clearly stated?
Is the research design clearly described and appropriate?
Are data collection methods transparent?
Are data analysis methods clearly described and appropriate?
Are there sufficient data to support the authors’ interpretations?

Table 4: Study Characteristics

Author (Date)	Aims	Country or Region	Sample (N)*	Qualitative Data Collection Method*
Al Ghafri et al. (2020)	To explore the experiences and perceptions of medical professionals working frontline in the management of COVID-19	Oman	40	Focus groups
Arnetz et al. (2020)	To explore perceptions of stress for nurses working in the early stages of the COVID-19 pandemic	United States	455	Survey with free-text response
Aughterson et al. (2020)	To explore the psychosocial impact of the COVID-19 pandemic on frontline health and social care workers	United Kingdom	25	Semi-structured interviews
Baldwin & George (2021)	To develop an understanding of the experiences and needs of healthcare workers during and after the COVID-19 outbreak	United Kingdom	19	In-depth, semi-structured interviews
Banerjee et	To explore perceptions, experiences, and challenges	India	148	In-depth, semi-

al. (2020)	of healthcare workers involved in dementia care during the COVID-19 pandemic			structured interviews
Billings et al. (2021)	To explore the experiences, views, and needs of mental health professionals supporting frontline health and social care workers during the COVID-19 pandemic	United Kingdom	28	Semi-structured interviews
Blake et al. (2021)	To evaluate wellbeing centres established to provide psychological support to healthcare workers during the COVID-19 pandemic	England	24	Semi-structured interviews
Butler et al. (2020)	To explore perspectives and experiences of clinicians on resource limitation and patient care during the COVID-19 pandemic	United States	60	Semi-structured interviews
Chandler-Jeanville et al. (2021)	To explore the lived experiences and perceptions of the COVID-19 pandemic amongst frontline nurses and their relatives	France	49	Semi-structured interviews
Chen et al. (2021)	To explore the experiences of wearing PPE for nurses caring for patients with COVID-19	China	15	Semi-structured interviews
Cheong (2020)	To explore the impact of the COVID-19 pandemic on hospital-based clinical pharmacists	Malaysia	19	Semi-structured interviews
Conlon et al. (2021)	To understand the experiences of emergency care staff during the COVID-19 pandemic	Ireland	15	Semi-structured interviews
Crowe et al. (2021)	To examine the mental health of critical care nurses providing direct COVID-19 care during the early phase of the pandemic	Canada	15	Semi-structured interviews
Deliktas Demirci et al. (2021)	To explore the experiences and coping strategies of nurses working on COVID-19 wards	Turkey	15	In-depth, semi-structured interviews
Digby et al. (2021)	To investigate the well-being of hospital staff during the early stage of the COVID-19 pandemic	Australia	321	Survey with free-text response
Fernández-Castillo et al. (2021)	To examine the experiences of intensive care nurses during the COVID-19 pandemic	Spain	17	Semi-structured interviews
Galehdar et al. (2020)	To explore experiences of distress among nurses caring for patients with COVID-19	Iran	20	In-depth, semi-structured interviews
Hayirli et al. (2021)	To describe how personal protective equipment and distancing affect teamwork in the emergency setting	United States	55	Semi-structured interviews
Hoernke et al. (2021)	To explore the experiences and concerns related to healthcare workers' use of PPE during the COVID-19 pandemic and its impact on care delivery	United Kingdom	46	In-depth, semi-structured interviews
Jia et al. (2021)	To examine nurses' ethical challenges in delivering COVID-19 care	China	18	In-depth, structured interviews
Kurotschka et al. (2021)	To explore the care experiences of general practitioners during the first phase of the COVID-19 pandemic	Italy	149	Survey with free-text response
Liberati et al. (2021)	To investigate the experiences of healthcare workers in secondary mental health services during the COVID-19 pandemic	England	35	Semi-structured interviews
Liu et al. (2020)	To explore the experiences of healthcare workers recruited to provide direct care for COVID-19 patients	China	13	In-depth, semi-structured interviews
Montgomery et al. (2021)	To investigate the experiences of healthcare workers in critical care settings during the COVID-19 pandemic	United Kingdom	40	Semi-structured interviews
Ness et al. (2021)	To investigate challenges faced by healthcare workers during the COVID-19 pandemic	United States	23	Semi-structured interviews
Newman et al. (2021)	To explore the psychological impact of the COVID-19 pandemic on frontline healthcare workers	United Kingdom	395	Survey with free-text response
Norful et al. (2021)	To investigate the impact of stress on frontline healthcare workers during the initial outbreak of COVID-19	United States	55	Open-ended interviews
Palacios-Ceña et al. (2021)	To examine the experiences of frontline physical therapists during the COVID-19 pandemic	Spain	30	In-depth, semi-structured interviews

Parsons Leigh et al. (2021)	To investigate the perceptions and experiences of critical care physicians in the context of resource strain during the COVID-19 pandemic	Canada	15	Semi-structured interviews
Pastrana et al. (2021)	To explore the impact of COVID-19 on palliative care	41 countries	79	Survey with free-text response
Rao et al. (2021)	To examine the perspectives of frontline clinicians providing care to patients with COVID-19	United States	50	Semi-structured interviews
Rees et al. (2021)	To explore the experiences of paramedics providing care during the COVID-19 pandemic	Wales	20	Semi-structured interviews
Ross et al. (2021)	To investigate the experiences of paediatric hospital social workers during the COVID-19 pandemic	United States	55	Focus groups
Saleem et al. (2021)	To explore the experiences of frontline Pakistani emigrant physicians working in the UK during the COVID-19 pandemic	United Kingdom	10	In-depth, semi-structured interviews
Sheng et al. (2020)	To explore the impact of involvement in COVID-19 rescue on professional identity among nurses	China	14	Semi-structured interviews
Testoni et al. (2021)	To examine COVID-19-related stress in doctors and nurses	Italy	17	In-depth, semi-structured interviews
Williams Veazey et al. (2021)	To explore how entanglements of affect, space, and evidence shape care in the COVID-19 context	Australia	63	In-depth, semi-structured interviews
Yip et al. (2021)	To examine the experiences of junior nurses providing care to COVID-19 patients in acute care settings	Hong Kong	40	Semi-structured interviews
<i>*For mixed-method studies and studies investigating multiple populations, only primary qualitative data collected from healthcare worker participants (as defined under "Eligibility Criteria") are represented.</i>				

Data Extraction and Analysis

Data were collected and organised by synthesised search terms (Table 2). Emerging themes were identified across the collected data and a "synthesising argument" was developed.[30]

The goal of the synthesising argument is to make sense of ideas across the review by bringing together arguments and evidence within multiple studies in ways that are explanatory and theoretically generative, and attend to the relationships between constructs.[30] We analysed both the primary data presented within the studies, and the interpretations by the study authors, to generate new interpretative findings (what Dixon-Woods et al. describe as "synthetic constructs").[30] We then generated three themes to organise these synthetic constructs, which allowed us to present our synthesising argument in a way that was internally coherent and facilitated a stronger theoretical understanding of material practices and spaces of healthcare environments.

Patient and Public Involvement

1
2
3 There was no patient or public involvement in this study.
4

5 **FINDINGS**

6
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8 Our synthesising argument is organised across three interconnected themes: 1) the hospital
9 transformed; 2) virtual care spaces; and 3) objects of care. To present these themes, we
10
11 have included illustrative extracts of participant responses from included studies, which are
12
13 italicised in-text.
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17 **Theme 1: The Hospital Transformed**

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19 During the COVID-19 pandemic, the hospital environment has undergone spatial, material,
20
21 and temporal transformations to accommodate changing healthcare needs. Three distinct
22
23 but intersecting burdens on physical space in the hospital setting emerged in the literature:
24
25 the increase in hospitalisations in COVID-19-affected geographical locations; the need for
26
27 hospital zoning to separate confirmed or suspected COVID-19 cases from other patients;
28
29 and the need for general physical distancing between all staff, patients, and visitors in the
30
31 hospital. These burdens led to material and organisational changes in the hospital, which
32
33 impacted how healthcare was done in these environments.
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40 The introduction of COVID-19 cases into hospitals presented a need for higher
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42 capacity emergency departments and intensive care units to keep up with the demand, as
43
44 well as additional isolation facilities to prevent further infection within the hospital.[36, 37]
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46 Hospitals and healthcare delivery environments implemented and strengthened triage
47
48 systems to establish “hot zones,” which separated patients with confirmed or suspected
49
50 COVID-19 from other patients.[36, 38-40] This required the adaptation of existing spaces
51
52 and infrastructure, and changes to hospital staffing to support this zoning, leading to further
53
54 recruitment and redeployment of healthcare workers.[36, 41] Redeployed healthcare
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56 workers reported low support, inadequate specialised knowledge and training for COVID-19
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3 care, a lack of familiarity with patient treatments, poor communication, and feelings of
4
5 uncertainty, which impacted the quality of patient care delivery[38, 42-44]: *“They gave us 2*
6
7 *1/2 hours overview lecture on [Intensive Therapy Unit] setting then that is that, working in*
8
9 *an environment that you don’t know [...] Asked to give medications which you’re not*
10
11 *competent to do so.”*[44]
12
13

14
15 Studies also evaluated the materiality of healthcare environments in relation to staff
16
17 comfort and safety. Existing spaces for staff in the hospital, including changing and
18
19 showering facilities and break rooms, often did not meet the increased need to physically
20
21 distance, decontaminate, and relax, and in some cases further spaces were found or
22
23 built.[43, 45, 46] The materiality of COVID-19 care spaces within the hospital also enhanced
24
25 the sense of risk in these environments: *“You were continuously exposed, closed spaces fully*
26
27 *covered with patients with COVID-19, where invasive techniques were conducted, there were*
28
29 *aerosols, vomits.”*[41] This sense of risk extended to homes as well, which became sites of
30
31 potential contagion that put those cohabiting with healthcare workers at risk.[46] One study
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33 described healthcare workers managing this risk by creating “hot and cold zones” within
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35 their homes, or even residing in hotels, thus isolating themselves from families and loved
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37 ones.[47]
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45 In addition to the materiality and spatial layout of healthcare environments,
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47 operations were also adapted to suit the evolving needs of hospitals, which further
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49 impacted the ways in which bodies travelled and interacted with each other. Some services
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51 and modes of care were prioritised as essential, leading non-essential services to be
52
53 conducted remotely (see “Virtual Care Spaces”).[48] The changes to hospital zoning
54
55 highlighted the need for adequate staff to ensure healthcare workers were not moving
56
57 between zones, thus impacting infection control measures.[36] Spatial limitations in the
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1
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3 hospital further impacted communication between healthcare workers. Material barriers
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5 within the hospital built environment required the implementation of different technologies
6
7 and procedural changes, such as the use of baby monitors or whiteboards, in order for
8
9 healthcare workers to communicate with each other and with patients.[46, 49] These
10
11 spatial barriers to face-to-face communication impacted the quality of care as
12
13 communication and emotional connection were compromised: *“Typically, when a trauma*
14
15 *patient comes in we're in the room first thing and we're sort of hearing the story. [...] And*
16
17 *now we're not in the room because of PPE. [...] we're getting a lot of information from these*
18
19 *very sick patients secondhand.”*[49]
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25 While the transformations outlined above largely point to adaptative changes
26
27 implemented in response to evolving healthcare needs, hospital environments also
28
29 underwent atmospheric transformations that produced affective engagements with the
30
31 care space. Participants in the literature employed the metaphor of the healthcare worker
32
33 as a “soldier” fighting a war and described the hospital environment as a “war zone” or
34
35 “battlefield”[41, 45, 50-54]: *“It was like that scene on ET, all that plastic.... So, there's all this*
36
37 *plastic and, I get it, but just walking into this other world, there was just mayhem,*
38
39 *pandemonium. People running around, alarms going off.... it was like a war zone.”*[45] Care
40
41 practices were also understood as generating affects that could resonate through the care
42
43 environment. One study highlighted a (variably defined) distinction between triaging care
44
45 and “rationing,” where the latter was described as a “taboo.”[39] This led in some cases to
46
47 care being provided beyond what was considered normal or beneficial clinical practice:
48
49 *“because of the sensitivity, the concern that people are going to be withholding care and this*
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51 *institution doesn't want to be seen like that.”*[39]
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3 Events of high emotion and trauma haunted spaces in the hospital environment:

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6 *“Even now, when I am on duty, when I enter some room(s), I see patients who could not*
7
8 *breathe, in bed, who died suddenly. I still have these flashes that still shock me, especially*
9
10 *when I enter two rooms in particular.”*[55] One study connected these local affects in the
11
12 hospital space to global atmospheres that are generated in the pandemic and travel through
13
14 media networks: *“I just had this moment of those pictures that you see from the New York*
15
16 *Times or whatever, of hospitals in America flashing up in your brain and going, ‘This is not*
17
18 *dissimilar. Are we going where they’re going?’”*[54] As with the other transformations
19
20 highlighted in this section, these atmospheric transformations were produced in and
21
22 through the materiality of sites of COVID-19 care and spatiotemporally reticulated the
23
24 healthcare environment.
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29 30 **Theme 2: Virtual Care Spaces**

31
32 The use of virtual spaces in healthcare has significantly expanded during the COVID-19
33
34 pandemic. As physical touch and interaction between bodies became understood as “risky,”
35
36 contact between bodies was mediated in healthcare environments via technologies
37
38 enabling remote care, including telephones, tablets, and online services.[54, 56] In addition
39
40 to reducing the risk of SARS-CoV-2 transmission, remote consultation services were
41
42 identified as having the capacity to increase healthcare access by reducing barriers relating
43
44 to travel, geographical location, time, disability, and resources[57, 58]: *“Patients could make*
45
46 *appointments and communicate with GPs online, then they were offered guidance on health*
47
48 *care and psychological support, and purchased drugs online under the instructions of*
49
50 *doctors, which may be a new way of work for GPs.”*[59] However, the digital divide was
51
52 identified as an issue affecting both healthcare workers and patients, as digital literacy and
53
54 internet access varied from person to person and region to region.[57, 60] Already-
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3 vulnerable patients could thus be made more vulnerable: *“When reopening begins, those*
4 *who have suffered as a result of these disparities will return to our care sicker and with*
5 *deeper social needs.”* [60]
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10 Quality of care in virtual care environments was a common concern in the literature.
11
12 Studies highlighted the practical implications of healthcare workers not being in the same
13 room as patients, which could lead them to miss symptoms or changes in patients, misread
14 body language or non-verbal communication, or experience increased language and
15 intercultural communication barriers [57, 61]: *“Patients keep requesting for physical*
16 *examination. [...] How will I prescribe without being sure...”* [57] One study also highlighted a
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“ripple’ effect” from the lack of physical assessment, where patients requiring general
treatment were referred to emergency, thus increasing the burden placed on the
emergency department. [36] In these ways, the virtual environment not only enacted
changes in the individual care encounter between patient and healthcare worker, but also
produced extended effects in the care journey and other care practices and experiences in
the healthcare environment.

Remote care systems presented practical challenges when it came to monitoring and
administering medication. [57, 62] The lack of face-to-face interactions (between both
patients and doctors, and patients and their families) also produced barriers to emotional
and social care [56, 61, 63]: *“the most important part of caring is PRESENCE. Touch, intimate*
conversation, allowing the patient to sit close, face-to-face interaction.” [56] This was
signalled as being particularly problematic in the context of COVID-19 given the heightened
need for this kind of support; for example, one study emphasised the need for some
patients with mental health issues to experience simple moments of physical contact: *“I*
think that some people just need the power of touch or a hug or a face-to-face human

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2
3 *person to ensure that they're kept safe and okay.*"[61] Telehealth was framed as a
4
5 compromised form of care that traded (but would "never be able to replace") "physical
6
7 touch and presence" for safety.[56]
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10 Yet one study also identified a potential for increased emotional support through
11
12 remote care for patients who were already in isolation.[58] Participants identified
13
14 technologies of remote care as enabling new forms of interpersonal connection, fostering
15
16 modes of care that emphasised thoughtful verbal communication as an intentional practice
17
18 of care: *"The rediscovered importance of words, of a telephone conversation that becomes*
19
20 *an essential connection, and which is able to concentrate all the possible humanity,*
21
22 *closeness and help.*"[58] The study also reconceptualised virtual care as taking place not
23
24 "remotely," but rather "in the home," allowing a new and different form of intimacy to that
25
26 produced through face-to-face care in the hospital setting: *"Every day I called them, I*
27
28 *entered their homes, I saw their eyes, I evaluated their breathing. [...] I have been living with*
29
30 *them for these 20 days.*"[58]
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37 While remote care had the capacity to enable healthcare workers to 'enter the
38
39 homes' of patients, so too did it bring the healthcare environment into the homes of
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41 participants who worked remotely. Some studies found working from home gave
42
43 participants greater flexibility in work, limited workplace distractions, and reduced fears of
44
45 becoming infected or sick.[38, 43] However, for others, working from home presented
46
47 several challenges including technological issues (e.g. internet speed), distractions from
48
49 other occupants in the house, and insufficient or inappropriate physical space.[43, 60]
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54 Many healthcare workers reported difficulties in establishing boundaries between
55
56 professional and personal space, especially when the broader pandemic context introduced
57
58 additional home responsibilities (e.g. homeschooling).[43, 48, 56, 60, 64] Working from
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1
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3 home brought colleagues and patients (virtually) into the personal spaces of healthcare
4
5 workers in ways that challenged comfort and privacy[56, 64]: *“Something I found hard was*
6
7 *the room I work in is also my bedroom. It can be a lot to have these difficult conversations in*
8
9 *your own room where your bed is, not having that space.”*[64] There were other practical
10
11 implications to this decrease in privacy as well; for example, one study noted the difficulty
12
13 of conducting confidential conversations when working in a shared living space.[48]
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18 The erosion of boundaries between work and home also dissolved temporal markers
19
20 of ‘worktime.’ As homes became workplaces, other aspects of homelife (such as childcare)
21
22 became folded into the workday, thus disrupting work and family routines.[56, 60] More
23
24 rigid scheduling in virtual environments limited opportunities for informal discussions and
25
26 debriefs, and the absence of a daily commute (which previously operated as a temporal
27
28 boundary of worktime) caused the workday to stretch beyond regular hours.[48, 60] Such
29
30 spillage of worktime created a sense of pressure to always be available and “at work”[48,
31
32 60]: *“Working from home means that I am never ‘not working.’”*[60] These challenges
33
34 produced an increase in burnout, guilt, uncertainty in decision-making, and feelings of being
35
36 underappreciated.[38, 43, 48, 60, 61]
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43 Virtual care spaces were also produced through the engagement of healthcare
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45 workers with social media platforms. Studies described social media use as a practice of
46
47 knowledge sharing, enabling healthcare workers to access rapidly emerging information
48
49 about the pandemic through informal networks and put this emergent information into
50
51 practice.[52, 54, 65] These networks were identified as constituting experiential evidence
52
53 that could be disseminated and accessed more rapidly than traditional evidence through
54
55 official channels: *“our colleagues who are in the hot areas [...] send out some of their*
56
57 *experiences, how they are managing it, on Facebook or WhatsApp. So, we are just reading to*
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3 *see if we can incorporate their experience and then go from there.*"[65] However, these
4
5 modes of knowledge sharing were also conceptualised as risky, with the potential to amplify
6
7 misinformation and produce uncertainty through conflicting accounts of successful COVID-
8
9 19 care practices.[52, 54] Accessing information through social media also led some
10
11 participants to feel overwhelmed and anxious, particularly due to the circulation of news of
12
13 patient and healthcare worker deaths.[54, 59, 66]
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18 Social media furthermore produced spaces of connection between healthcare
19
20 workers and the public. These spaces enabled the circulation of viral images (such as photos
21
22 of healthcare workers with sores from extended PPE use) and allowed healthcare workers
23
24 to disseminate information and share their personal experiences of working during the
25
26 pandemic.[66] They also created opportunities for both displays of gratitude and support
27
28 from the public and occasionally negative comments and abuse.[52, 65] These virtual spaces
29
30 of public engagement thus constituted potential sites of psychosocial support or anxiety for
31
32 healthcare workers.
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36 37 **Theme 3: Objects of Care**

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39 Material objects formed a central mechanism of COVID-19 care across the literature. The
40
41 most prominent object of care identified in the literature was PPE; studies described
42
43 shortages of PPE (particularly at the beginning of the pandemic) as a barrier to both the
44
45 safety of healthcare workers and their capacity to delivery care, with inadequate PPE
46
47 supplies causing anxiety and prompting participants to limit patient interactions and re-use
48
49 and/or share PPE [38, 42, 43, 45, 46, 49, 52, 58, 65, 67, 68]: *"I have the same N95 since*
50
51 *March. We also are only allowed one surgical mask for one week. We still are rationing*
52
53 *PPE."*[42] Several studies also identified inequities in PPE distribution, with lower-waged and
54
55 non-acute care roles being more likely to experience shortages.[38, 43, 46, 51, 62] Guidance
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3 around PPE use was often unclear, inconsistent, or changed from day to day, producing
4
5 anxiety in healthcare workers around the proper use of PPE.[36, 42-46, 67-69] Some studies
6
7 also noted problems related to the size and fit of PPE, especially for women and people with
8
9 facial hair (including people who do not shave for religious reasons).[46, 50, 66, 67]
10
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13 When PPE was available, its use presented a barrier to everyday practices of care.
14
15 Interactions with patients and their families were made more difficult as PPE obscured
16
17 faces, muffled voices, and obstructed body language, thus impacting communication and
18
19 emotional connection[36, 46, 48, 49, 51, 55, 70, 71]: *"I think arriving in full PPE, you're a bit*
20
21 *like an alien or a person from a nuclear reactor or something, and I think it's hard to build a*
22
23 *rapport with that."*[48] Communication with colleagues was also affected by PPE use,
24
25 especially between newer team members, impacting professional relationships and
26
27 increasing the risk of miscommunication in care practice.[36, 46, 49, 63, 71] Attempts to
28
29 bridge these emotional and communication gaps included individually decorating PPE or
30
31 attaching disposable photos of staff faces to gowns, which also had the practical benefit of
32
33 allowing patients and colleagues to differentiate between healthcare workers.[46, 63] The
34
35 literature also described PPE as limiting healthcare workers' senses (e.g. through the fogging
36
37 of glasses and face shields) and dexterity, producing challenges with some patient
38
39 procedures and increasing the risk of healthcare workers missing important health signs in
40
41 patients[40, 46, 48, 55, 62, 63, 67, 69]: *"I had to rely on the anatomical location to find the*
42
43 *femoral artery because I could not feel the pulsation when performing the arterial blood*
44
45 *taken for gas analysis."*[67] Healthcare workers additionally raised concerns about protocols
46
47 in emergency situations, where the time taken to don and doff PPE could leave patients
48
49 waiting longer for vital support.[46, 48, 69]
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3 The wearing of PPE took a significant physical and emotional toll on healthcare
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5 workers. PPE was described as exhausting, uncomfortable, hot, difficult to breathe in, and
6
7 produced skin damage such as bruising and dermatitis[38, 40, 42, 43, 46, 61, 63, 65, 67-69,
8
9 71]: *“Wearing the whole set of PPEs is very uncomfortable. I have difficulty breathing and
10
11 feel very hot and my heart rate speeds up. We keep on sweating and the clothes are
12
13 soaked.”*[40] Adhering to infection control protocols (e.g. correctly donning and doffing PPE)
14
15 took a considerable amount of time and impacted how long healthcare workers could spend
16
17 with patients and their families.[36, 46, 68, 69] Healthcare workers adopted different
18
19 techniques to combat this issue. Some participants reported that shifts and processes were
20
21 reorganised so that care delivery could be clustered, allowing healthcare workers to visit
22
23 more patients in one go.[36, 68] However, studies also described healthcare workers
24
25 skipping breaks, not drinking water or using the toilet, and wearing adult diapers in an effort
26
27 to avoid donning and doffing (and possibly disposing of) PPE.[38, 43, 45, 46, 67, 68]

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30 In addition to PPE shortages, the literature also revealed shortages of other essential
31
32 material objects of care (as well as the human resources necessary to use them), including
33
34 ventilators, dialysis machines, isolation and critical care beds, testing equipment, cleaning
35
36 supplies, and body bags.[38, 39, 42, 47, 51, 55, 57, 58] Triage became an important part of
37
38 the allocation of limited resources, however this required healthcare workers to make
39
40 ethical decisions about which patients were in most need of equipment such as ventilators
41
42 (which sometimes meant adapting guidelines on a case by case basis)[39, 53, 55, 57]: *“I had
43
44 to decide if the 88 year old grandma on dialysis gets the ventilator or the 44 year old [in full
45
46 code]. And even just the weight that you have to carry if that’s your decision right? That you
47
48 just condemned this person to die and not this person.”*[53]

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3 Studies described changes to practice and other innovations that enabled healthcare
4 workers to adapt to these resource challenges. Patients on ventilators who would normally
5 receive one-on-one care had nurses working between them, and some patients were put on
6 travel ventilators.[39] Staff at one hospital developed “grab bags” of equipment to help with
7 clustered care and created a portable “resus trolley” so that patients did not need to be
8 moved to a dedicated resuscitation area (which also helped limit virus transmission).[36]
9
10 One study even described a healthcare worker’s son using a 3D printer to make face shields
11 and connections for a dialysis machine.[39] Across the literature, however, resource
12 limitations were described as leading to compromised care: “Everybody gets a little bit of
13 bad care.”[39]

14
15 A significant concern in the literature related to uncertainties around appropriate
16 treatment, frequent changes in protocols, and inconsistencies in treatment plans when it
17 came to the acute care of patients with COVID-19[40, 42, 53, 55, 59, 63, 65, 71]: “The fact
18 that a medication wasn’t proven. We didn’t have good data. [...] If you’re going to do
19 something that’s unproven, you should do it within a trial. We could really be doing more
20 harm than good.”[53] Studies described an absence of evidence-based treatment for
21 COVID-19, though often did not make clear distinctions between pharmaceutical drugs and
22 other clinical interventions when referring to treatment. Similarly, there was an implied but
23 usually unarticulated distinction between “good data”[53] and informal knowledge sharing
24 between healthcare professionals. Some studies noted that the lack of effective ‘treatment’
25 options led to an increase in supportive care, which produced higher and unequally
26 distributed workloads among healthcare workers, with nurses being disproportionately
27 impacted by additional work (and the resultant risk of infection).[50, 70, 72]

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3 Changes to care protocols transformed the bedside as a site of care. The types and
4 frequency of care changed, with restrictions on visitors and in-person carers (including
5 supportive care such as through social services) impacting the level of emotional support
6 received via bedside care.[40, 49, 53, 62, 63, 69, 72, 73] These changes also had logistical
7 impacts on care; for example, some hospitals implemented hybrid systems of care where
8 nurses or trainee doctors would provide patient care in-person, with doctors and
9 consultants using remote technologies to observe patients and support care without
10 entering the ward.[48, 73] This required the healthcare workers providing in-person care to
11 embody the authority and expertise of the doctor, while also observing the patient: "*The*
12 *consultant was probably heavily relying on the nurses and the doctors there, rather than*
13 *himself, to look at smaller behaviours ... little things like facial reactions, body language,*
14 *things like that.*"²⁹

15
16 A notable motif throughout the literature was the affecting presence of pandemic
17 death, which came to be known through the materiality of objects of care such as body bags
18 and beds. Many healthcare workers had no experience handling dead bodies prior to the
19 pandemic and this lack of knowledge, along with changes to processes for managing death
20 in the hospital, meant that bodies were often not prepared in accordance with the religious
21 or cultural beliefs of patients.[37, 51, 55, 71] Several studies described the affect generated
22 through the object of the body bag or the physical preparation of dead bodies in accordance
23 with infection control measures[40, 42, 55, 63]: "*When a patient with an infectious disease*
24 *dies, the body is wrapped in several layers of cloth, packed into two bags, which are sprayed*
25 *with disinfectant... It is a little hard to accept this form of death.*"[40] One study also
26 described the emotional labour of a participant who spent multiple full shifts transporting
27 bodies from hospital beds to the morgue.[38] However, an *absence* of bodies could also
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3 enact the presence of death in the hospital; one study described the experience of dealing
4 with a shortage of beds one day and arriving at work the next day to see “*rows of empty*
5 *beds.*”[38] Pandemic death thus distinctively emerged in the literature through its material
6 relations with/in the COVID-19 context.
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12 **DISCUSSION**

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15 This synthesis demonstrates how material objects, spaces, bodies, and affects entangle in
16 care environments to facilitate the doing of healthcare. Because the materiality of the
17 healthcare environment shapes care practices, transformations in the environment (both
18 intentional and unanticipated) afford differing care experiences, which become ‘good,’
19 ‘bad,’ ‘compromised’ or ‘good-enough’ care. This accentuates the importance of considering
20 the material environment as critical to shaping the quality and delivery of care, especially in
21 times of emergency and disruption. A systemic approach to care delivery not only sees
22 adaptation as a means of working around the constraints of the material environment but
23 demands a need for adaptable environments to enable ‘good care’ to be done. There is a
24 tendency to focus on healthcare workers, and their attitudes and practices, as the locus and
25 focus of change, rather than on the material environments which constrain or potentiate
26 the care that healthcare workers provide. Our analysis, which has relevance for healthcare
27 delivery beyond situations of emergency, pushes us towards a more systemic adaptation
28 and change, from attitudes to materials, from individuals to environments.
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49 **Materially Bounded Care Environments**

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52 The studies examined in this qualitative synthesis were conducted within a range of
53 healthcare delivery settings including hospitals, clinics, hospices, health centres, continuing
54 care facilities, community or field settings, patient homes, and other out-of-hospital
55 environments. Across these settings, healthcare was delivered within in-person, virtual, and
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3 hybrid environments. Though these healthcare delivery contexts were typically defined
4 through architectural (e.g. the hospital building) and technological (e.g. telephone
5 conferencing) mechanisms, such definitions inadequately encompass the spaces in which
6 healthcare was done. Rather, we find that the boundaries of healthcare environments are
7 neither solid nor fixed, as care extends in relations between and beyond these spaces.
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15 Virtual environments brought healthcare into virtual spaces, but also into the homes
16 of patients and healthcare workers. Virtual care facilitated new and altered ways of
17 travelling with and to patients and produced (sometimes unwanted) intimacies: the
18 healthcare worker was able to 'enter the homes' of patients and develop a different kind of
19 proximity to that which takes place in a hospital or clinic, but so too could patients and
20 colleagues enter the homes of healthcare professionals working from home. The latter was
21 conceptualised as an undesirable intimacy, which was not understood as facilitating 'better'
22 care. Changes in the care encounter also resulted in new care paths and journeys in ways
23 that were both enabling and produced capacities for harm. A virtual healthcare consult, for
24 example, could improve healthcare access for some patients, but produced risks of
25 overlooked symptoms and postponed healthcare procedures, thus resulting in delayed yet
26 intensified healthcare needs.
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45 While our analysis reveals the ways in which the spaces of healthcare have spilled
46 out beyond healthcare settings, it also identifies more localised spaces and encounters as
47 sites of care. Restrictions on visitors and healthcare practices drew attention to sites such as
48 the bedside, which is normatively understood as a place where care happens. In this context
49 the bedside is a site of *touch* and *presence*, both of which were conceptualised in the
50 literature as modes of care practice that also facilitated certainty (e.g. physical examinations
51 as a way of 'being sure' in care decisions). Negotiating the materiality of the healthcare
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3 environment thus became a crucial part of adapted care practice in the pandemic context.
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5 Barriers to touch and presence, produced via alterations in zoning, PPE, care schedules, and
6
7 modes of communication, simultaneously enabled and constrained 'good' and 'safe' care.
8
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10 As touch between bodies became 'risky,' barriers to touch and presence, such as PPE and
11
12 zoning, enabled care to be done. However, these adaptations in the care environment
13
14 generated new risks, as they were also understood as producing 'compromised' care. Virtual
15
16 care environments, communication technologies (e.g. whiteboards, radios), hybrid
17
18 consultations, and other material innovations (e.g. decorated PPE) constituted proxies for
19
20 care, enabling a different proximity between healthcare worker and patient.
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24 25 **Extending Relations of Care**

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27 Our analysis shows that spatial and temporal constraints entangle with material practices in
28
29 healthcare systems, which produce 'rippling effects' beyond the individual care encounter.
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31 For example, hospital infection control protocols led to changes in hospital zoning, which
32
33 revealed constraints in the resourcing of staff, PPE, and other equipment. Individual
34
35 adaptations in response to these constraints included healthcare workers reusing PPE,
36
37 skipping breaks, and spending less time with patients. In contrast, adaptations that
38
39 attended to the spatial or temporal features of the material environment allowed for
40
41 differing ways of doing care. Examples included creating schedules to facilitate care
42
43 clustering, developing hybrid consult systems, and implementing the use of objects such as
44
45 grab bags, trolleys, and radios. These adaptations allowed for altered ways of moving and
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47 relating within the hospital, in turn producing new care spaces and care journeys.
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54 Our mapping of the extending relations of the COVID-19 care environment allows us
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56 to understand the ways through which local care practices—and how these are shaped by
57
58 the materiality of care environments—are themselves located in, and shaped by, broader
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3 health systems and ecologies. We saw this, for instance, in how the rippling effects of virtual
4 care encounters impacted upon hospital emergency departments, and how 'experiential
5 evidence' from geographically distant COVID-19 'hot areas' was shared through informal
6 virtual networks and tested in local care environments. Our analysis also points to the ways
7 in which healthcare workers mediated their experiences and knowledge of COVID-19 care
8 through engagement with a global pandemic imaginary. For example, a site of emotional
9 trauma in a hospital might be enclosed by the four walls of a ward and tied to a single event,
10 but this trauma became known through its relations with broader temporal and global
11 pandemic uncertainties. The affects generated in and through the care environment
12 facilitated other forms of knowing as well; (double) body bags, empty beds, social media
13 posts, news media images, and practices of infection control in corpse management all
14 enacted a knowing of pandemic death, distinct from other forms of death in healthcare
15 work. These findings highlight how locally materialised affects and experiences of care
16 connect with broader, as well as global, affects and adaptations generated by pandemic.

37 **Implications for Future Research and Practice**

38
39 A pervasive orientation in the literature is emphasising what is absent, or deficient, in care
40 environments. Our analysis, however, testifies to a responsiveness and ingenuity in how
41 healthcare workers and services have adapted within constraining and disruptive care
42 relations to make care environments work in the face of emergency. In turn, our findings
43 emphasise a need for care environments themselves to be made more adaptable and
44 malleable, such that these adaptive potentials can come together to enable 'good' care in
45 times of uncertainty and change. The insights produced through this synthesis thus
46 explicate how and why we might better attend to the material spaces, objects, practices,
47 and affects through which healthcare environments are made (and made differently). This
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3 has practical implications for the building of resilient, responsive, and enabling care
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5 environments. We highlight five implications:

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8 • While the COVID-19 context calls attention to the consequences of insufficiently
9
10 flexible healthcare systems, the materiality of care environments is always in the
11
12 process of adapting what care is made possible. This gives us insights to build upon,
13
14 including for considering how good care is made possible, even in situations of risk
15
16 and constraint.
- 17
18 • Interventions for optimising good and better care delivery need to move beyond a
19
20 focus on individual practices and better attend to the effects of the material
21
22 environment and how this enables or constrains care.
- 23
24 • Interventions can capitalise on the fluid boundaries of care environments which
25
26 extend beyond local spaces and buildings to connect with more distant as well as
27
28 virtual care experiences.
- 29
30 • Mapping how the material effects of healthcare 'ripple out' beyond individual
31
32 encounters and beyond particular healthcare environments is an important first step
33
34 to designing a more systemic and ecological approach to care.
- 35
36 • Optimising the material care environment to deliver good care, especially in times of
37
38 emergency, requires learning from everyday adaptive practices in healthcare
39
40 experience, while making material environments more adaptable.

41 42 43 44 45 46 47 48 49 **Strengths and Limitations**

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51
52 The approach we have developed for critical interpretive synthesis (adapted from that
53
54 proposed by Dixon-Woods et al.[30]) has produced a versatile yet readily comprehensible
55
56 method for reviewing complex, diverse, and emerging data. We suggest that this method be
57
58 taken up in the development of future protocols for qualitative review. Given the critical
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2
3 interpretive synthesis approach of our review, this paper is not intended as an exhaustive
4
5 account of the literature. The strengths of critical interpretive synthesis lie in its capacity to
6
7 undertake complex analyses of diverse qualitative data, develop insights that move beyond
8
9 the goals of the original studies, and generate theory that has applicability to both research
10
11 and practice. Our purposive sampling strategy facilitates these goals through a highly critical
12
13 and iterative approach to inclusion. It is possible that relevant literature could be missed
14
15 within this strategy, however our more flexible and inclusive approach to literature
16
17 searching in the earlier phases of sampling also make it more likely that papers have been
18
19 captured that would be missed in conventional systematic review methods. The resulting
20
21 sample may therefore reflect a broader and more diverse range of experiences.
22
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26

27
28 There were also some logistical limitations in this synthesis. The global health
29
30 emergency context of the COVID-19 pandemic resulted in rapid publication of studies across
31
32 different temporal, geographical, and professional contexts in 2020 and 2021. Though the
33
34 prominent concerns addressed in this synthesis were found across health contexts, more
35
36 specific and contextual insights may have been missed. While many publishers have
37
38 expedited COVID-19-focused studies since the beginning of the pandemic, due to the timing
39
40 of our writing, the studies included in this synthesis were conducted within the first 18
41
42 months of the pandemic (with the majority of data collected in the first 6 months of 2020)
43
44 and employed methods that could be implemented rapidly, often at a distance, and without
45
46 producing unnecessary further burden on already-stressed healthcare systems. This
47
48 resulted in a lack of longitudinal and ethnographic methods (though some papers were
49
50 linked to larger studies that may include data from such methods). Additionally, we have
51
52 exclusively included studies published in English, as this is the only shared language
53
54 between the authors.
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3 A final limitation of this synthesis relates to the complexity of defining COVID-19
4 care. Much of the literature did not distinguish between findings related to COVID-19-
5 specific and non-COVID-19 care, and terms such as 'treatment,' 'therapies,' and 'care' were
6 employed inconsistently in the literature, often without definitions of what these words
7 meant in practice. Many studies implicitly established distinctions between curative medical
8 treatment and symptom management, with the latter framed as care done in the absence
9 of, or while waiting for, 'effective' treatment options. Such a framing presents several
10 issues. First, it delimits the efficacy of supportive care *as care*, and obscures relations
11 between symptom monitoring or management and health outcomes. Second, it sits at odds
12 with descriptions of informal knowledge sharing networks, which themselves enact an
13 efficacy in their shared care practices, however limited, incomplete, or uncertain. Put
14 another way, framing symptom management practices against *lacking* or *unknown* care
15 practices de-emphasises what care *is already being done* in these contexts. Finally,
16 reinforcing distinctions between types of care may not make sense in the provision of care,
17 but instead reveal an artificial separation in clinical practice.

39 CONCLUSIONS

40
41 This paper is the first to synthesise qualitative research investigating healthcare workers'
42 experiences during the COVID-19 pandemic with an aim to explicate how the materiality of
43 the healthcare environment shapes care delivery. The findings of this paper demonstrate
44 how the healthcare environment can enable and constrain 'good' care, and how changes in
45 this environment produce complex and rippling health effects. The insights generated
46 through this synthesis are valuable in supporting healthcare workers, managers, and
47 organisations in developing up enabling care environments and adapting care practices
48 through an attention to the materiality of the environment itself.

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AUTHOR CONTRIBUTIONS

MH was responsible for the conception and design of the review, data collection, and analysis. TR and KL contributed to research design and provided feedback on data analysis. MH drafted the manuscript. All authors critically revised the manuscript and approved the final version.

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None declared.

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ETHICS APPROVAL

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How do care environments shape healthcare? A synthesis of qualitative studies among healthcare workers during the COVID-19 pandemic

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TITLE

How do care environments shape healthcare? A synthesis of qualitative studies among healthcare workers during the COVID-19 pandemic

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ABSTRACT

Objective: To investigate how care is shaped through the material practices and spaces of healthcare environments during the COVID-19 pandemic.

Design: Critical interpretive synthesis of qualitative research.

Participants: Studies included qualitative research investigating the experiences of healthcare workers involved in the care of individuals during the COVID-19 pandemic.

Results: 134 articles were identified in the initial sampling frame with 38 studies involving 2507 participants included in the final synthesis. Three themes were identified in the analysis: 1) the hospital transformed; 2) virtual care spaces; and 3) objects of care. Through the generation of these themes, a synthesising argument was developed to demonstrate how material spaces and practices of healthcare shape care delivery and to provide insights to support healthcare providers in creating enabling and resilient care environments.

Conclusions: The findings of this study demonstrate how healthcare environments enable and constrain modes of care. Practices of care are shaped through the materiality of spaces and objects, including how these change in the face of pandemic disruption. The implication is that the healthcare environment needs to be viewed as a critical adaptive element in the optimisation of care. The study also develops a versatile and coherent approach to critical interpretive synthesis methods that can be taken up in future research.

Keywords: COVID-19, quality in health care, qualitative research, intensive & critical care

ARTICLE SUMMARY

Strengths and Limitations of This Study

- This study employed a critical interpretive synthesis method for review of literature, which enabled the development of new insights about how the materiality of

1
2
3 healthcare environments shaped practices of care during the COVID-19 pandemic,
4
5 thus extending the goals of the included studies.
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- 8 • This study utilised a flexible and iterative purposive sampling strategy, which
9
10 prioritised diversity and richness of qualitative data over exhaustive representation.
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- 13 • This study is oriented towards practice and presents a starting point for the
14
15 development of further theoretical work.
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- 18 • Included studies were primarily limited to the earlier stages of the COVID-19
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20 pandemic and inconsistently defined COVID-19 care and treatment.
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22
- 23 • Included studies were limited to interview, focus group, and survey methods.
24

25 **INTRODUCTION**

26
27 This paper investigates how the materiality of the healthcare environment shapes care
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29 experiences, and how care practices and spaces transform in uncertain health contexts.
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33 Taking the COVID-19 pandemic as our case, this review synthesises qualitative studies
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35 investigating the experiences of healthcare workers involved in the care of patients during
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37 the COVID-19 pandemic. While these studies attend to COVID-19 in an 'emergency' framing,
38
39 they call attention to enduring concerns that will affect healthcare practices and spaces in
40
41 the years to come. The COVID-19 context presents an opportunity to identify the ways
42
43 through which the materiality of the care environment enables and constrains ways of
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45 doing healthcare with particular attention to care as an emergent and adaptive feature of
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47 its environment and situation.[1-4] This work is important, not only for considering how
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49 care is adapted in fast-moving situations of disruption such as emergency, but also for how
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51 adaptive responses to care can endure as part of a systemic response.[2]
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57 Existing reviews into the experiences of healthcare workers during the COVID-19
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59 pandemic have primarily focused on the mental health impacts of COVID-19 on healthcare
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3 workers (and interventions and strategies for coping), and other barriers to and adaptations
4
5 for care including those related to resource allocation, access to relevant information and
6
7 training, the impacts of wearing personal protective equipment (PPE), stigma, and logistical
8
9 challenges, particularly around infection control and prevention.[5-18] Another review
10
11 examined the impacts of environments on workers in the COVID-19 context more broadly,
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13 including the environments of healthcare workers.[19] To investigate this further, we trace
14
15 how aspects of the healthcare environment (that is, the sites, spaces, and conditions
16
17 through which care is delivered and/or received) shape the healthcare experience,
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19 particularly in uncertain or rapidly changing health contexts. We consider ways of
20
21 identifying how healthcare workers can be better supported not only *in* but *through* their
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23 environments. We finally explore how healthcare services might develop efforts to create
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25 enabling and resilient environments of care for healthcare workers as well as patients.
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33 This analysis has practical implications, as the forms of care provided by healthcare
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35 workers, as well as the quality of such care, are contingent on how healthcare environments
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37 adapt to changing health needs and contexts. The effects of this adaptability are
38
39 compounded in times of emergency and disruption. Our orientation in this synthesis is
40
41 informed by recent work on materialities and ecologies of care[20-24] and how the care
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43 environment affects the care delivery experience.[25-29] To our knowledge, this is the first
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45 synthesis of qualitative research to consider how healthcare environments materially affect
46
47 the delivery of COVID-19 care.
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51 52 **METHODOLOGY**

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54 We draw upon Dixon-Woods et al.'s methods for critical interpretive synthesis (CIS) of
55
56 qualitative research to develop our approach to review.[30] Dixon-Woods et al. argue that
57
58 while conventional comprehensive review methods are useful for aggregative syntheses of
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3 data, they present limitations when it comes to *interpretive* approaches to synthesising “a
4 large and complex body of evidence.”[30] A critical interpretive approach to synthesising
5 qualitative evidence is useful because it does not merely describe issues identified within
6 the original studies, but also generates new ideas and “assemble[s] findings into a form that
7 is useful in informing policy.”[30] Such an approach requires a sample that is *rich* and
8 *diverse*, rather than exhaustive, as the focus is on generating theory rather than
9 systematically summarising all available data.[30-32] CIS is thus more concerned with
10 “*appropriateness of sampling*” than “*comprehensiveness*.”[31] This requires an iterative and
11 flexible approach to review, where the research question, sampling strategy, and analysis
12 are continuously and reflexively refined.[30, 33] The aim here is to develop insights that
13 move beyond the designs of the original studies and have the capacity to produce novel
14 contributions to health policy and clinical practice.

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Guided by Dixon-Woods et al.’s methods, we have outlined each step of our approach to synthesis below.[30] It should be noted that these steps are not necessarily performed sequentially or independently. Instead, steps may overlap, run concurrently, and repeat in response to emerging analysis and theory generation.

Review Question

We established an analytical focus for our review around the materiality of the healthcare environment. By this, we mean we attended to matter, such as objects (both medical and mundane), bodies, buildings, and infrastructures, and how matter relates with practices, knowledges, spaces, temporalities, and affects in the care environment.[20, 21] We furthermore considered how the care environment itself is made through these relations and what is at stake in that making.[20, 21] This analytical focus guided our search and was iteratively refined in response to emerging findings.[30] Unlike with conventional review

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3 methodologies, and in keeping with CIS methods, we did not formulate a hypothesis in
4
5 advance, but reflexively refined the research question and analysis throughout.[30]
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8 **Search Strategy**

9
10 An explicit, highly structured, and protocol-driven search strategy is ill-suited to the review
11
12 of complex qualitative evidence, as it risks missing relevant materials and can be less
13
14 efficient than other strategies.[30, 34] We combined traditional search strategies with
15
16 other, more iterative methods to assemble a sampling frame. We began with a search of
17
18 PubMed and Google Scholar databases using the search query “(healthcare OR (health AND
19
20 care)) AND (worker OR professional OR staff) AND covid-19 AND qualitative.” These search
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22 terms were kept intentionally broad to allow for greater inclusivity across topics and
23
24 disciplines in line with the exploratory nature of the review process.[30] Further searches
25
26 were also performed in hand selected journals and via backwards and forwards citation
27
28 chaining, using Google Scholar for the latter. Finally, we used informal networks such as
29
30 personal contacts and Twitter to monitor for additional literature that may have been
31
32 missed in the initial search, especially given the fast-moving production of research in the
33
34 COVID-19 context.[30, 34] We adopted a “snowballing” approach to our search, allowing
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36 studies that emerged throughout the review process to be included in the final sample.[34]
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45 **Eligibility Criteria**

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47 In the early stages of study selection, it was important keep the boundaries of our search
48
49 flexible to allow the review question to dynamically evolve in response to emerging findings.
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51 However, given the speed and volume of research being produced within the COVID-19
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53 context, there was a practical need to limit the number of papers included in the initial
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55 review. Eligible articles included English-language original studies collecting primary
56
57 qualitative data including interviews, surveys with free-text responses, focus groups, and
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3 observation. Mixed-method studies were eligible for inclusion if evidence of all findings was
4 demonstrated in the qualitative data. All articles were peer reviewed and published or in
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6 press with the accepted manuscript available online by 31st December 2021.
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10 Eligible studies investigated the experiences of healthcare workers involved in the
11 care of individuals with COVID-19. This posed two challenges. First, the category of
12 healthcare workers has no singular definition across studies and geographical contexts, with
13 some articles taking a broad approach and some focusing on specific professions. We
14 adopted an inclusive definition of healthcare workers including, but not limited to, medical
15 and paramedical practitioners, nurses, midwives, allied health professionals, emergency
16 health workers, personal care workers, health management and support personnel,
17 students and trainees, and other health and health associate professionals.
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30 Second, in the context of the pandemic, where the healthcare systems of most
31 countries are directly involved in COVID-19 management and care, it is difficult to define
32 what constitutes COVID-19 care. Healthcare workers in settings that are not established to
33 provide specific COVID-19 care may still encounter individuals experiencing COVID-19 illness
34 who are also, or solely, in need of non-COVID-19 healthcare. Conversely, healthcare workers
35 who are explicitly engaged in the care of patients with COVID-19 are often also involved in
36 care of other patients who are not infected and have other healthcare needs. Most studies
37 did not make clear and consistent distinctions between practices of care performed for
38 patients with and without COVID-19, and the experiences of healthcare workers related to
39 the specific care of COVID-19 patients cannot be disentangled from the broader experiences
40 of providing healthcare during the COVID-19 pandemic. Furthermore, many of the concerns
41 and practices of frontline COVID-19 healthcare workers and other healthcare workers are
42 shared, including managing infection risks and the use of PPE.
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3 We included articles that explicitly reported the experiences of caring for individuals
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5 with confirmed or suspected COVID-19, irrespective of whether COVID-19 care was a
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7 primary responsibility of the study participants. We additionally included studies in which
8
9 there was ambiguity as to whether the participants themselves were involved in the *direct*
10
11 care of COVID-19 patients, but the practices, spaces, and concerns identified in the findings
12
13 were consistent with other studies. Studies that did not focus on the experiences of
14
15 healthcare workers in care *provision* (e.g. studies investigating experiences of healthcare
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17 workers as COVID-19 patients themselves) were excluded.
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23 **Sampling and Quality Determination**

24
25 We employed an iterative and purposive sampling strategy to select papers for inclusion.
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27 Rather than producing an exhaustive sample within a rigid and highly specified inclusion
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29 criteria, purposive sampling enables the inclusion of “relevant” literature on the basis of
30
31 likelihood to contribute to the development of theory, with an ultimate aim of “conceptual
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33 saturation.”[30, 33] This allows for the inclusion of a richer and more diverse sample of
34
35 literature. Thomas and Harden argue that aiming for conceptual saturation may be more
36
37 appropriate for reviewing qualitative literature than traditional sampling approaches, as the
38
39 conceptual findings of the synthesis will not change with the addition of further studies
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41 beyond the point of saturation.[35]
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47 CIS rejects a “stage” approach to review, instead producing a method that is
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49 iterative, dynamic, and responsive to the evolving concerns of the synthesis.[30] In practice,
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51 this involved including and excluding literature on an ongoing basis to adapt to emerging
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53 lines of analytical inquiry. The aim here is not reproducibility.[30] Instead, much like with
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55 analysis of data in primary qualitative research, CIS methods produce an interpretation of
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57 the evidence that is demonstrably grounded and prioritises “meaningful” analysis.[30] While
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total transparency of study selection is not feasible within such a method, we have simplified our selection process into 4 phases (Table 1).

Phase 1	Articles were screened for eligibility and relevance on the basis of titles and abstracts. Selected articles were imported with PDFs into EndNote 20 for full-text indexing (n=134).
Phase 2	A sample of articles (n=53) was read in full and emerging themes were identified, manually coded, and synthesised into possible search terms with particular attention to our analytical interest in the materiality of healthcare environments.
Phase 3	All indexed PDFs were searched using synthesised search terms and matching articles were screened for inclusion on the basis of the full text for quality, richness of primary data, and relevance (n=96).
Phase 4	All articles included in Phase 3 were screened for final inclusion on the basis of contribution to theory development (n=38).

While the phases of sampling represented in Table 1 are listed in sequential order, Phase 2 and Phase 3 are not a discrete and singular steps, but rather “a constant dialectic process conducted concurrently with theory generation.”[30] Articles sampled in Phase 2 were iteratively and purposively selected on the basis of titles and abstracts with attention to diversifying study context and aims until emerging themes no longer meaningfully deviated from existing coded themes. Search terms synthesised in Phase 2 were also continuously tested for usefulness and refined in response to emerging themes (Table 2); for example, despite the attention to material objects within the synthesis, “material” was

determined to be an unhelpful search term as it captured all articles that referenced “supplementary materials.” Similarly, articles selected in Phase 1 were iteratively included and excluded on the basis of relevance in Phase 3 as the concerns of the synthesis evolved.

Table 2: Synthesised Search Terms

Search Term(s)	Sample (N)
bed	75
body OR bodies OR bodily	68
disinfect	25
dispose OR disposal	9
facility OR facilities	61
gear	33
mask	93
ppe	101
redeploy	26
room	90
space OR spatial	58
telehealth OR teleconsult OR telemedicine	23
ventilator	46
virtual OR digital OR remote	70
war OR battle OR soldier	62
waste	12
zone	23

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Following Dixon-Woods et al., we adopted an approach to quality appraisal in Phase 3 that maximised inclusion at a conceptual level, rather than taking a hierarchical approach determined by particular methodological standards.[30] Though articles would only be *included* on the basis of their interpretive value, articles would also only be *excluded* if they were deemed to be “fatally flawed.”[30] We developed a set of appraisal prompts adapted from those proposed by Dixon-Woods et al. for assessing if an article should be excluded on this basis (Table 3).[30] Finally, Phase 4 of the sampling process appraised all articles included in Phase 3 for their overall contribution to the conceptual findings of the review. As the methodological aim of this review was to reach “conceptual saturation,” we deemed it unnecessary to include multiple articles that all presented the same findings without meaningful variation. Articles that produced no additional insights to other included articles and did not provide rich empirical data for interpretive analysis were excluded in this phase (Table 4).

Table 3: Quality Appraisal Prompts

35	Table 3: Quality Appraisal Prompts
36	Are the objectives of the research clearly stated?
37	Is the research design clearly described and appropriate?
38	Are data collection methods transparent?
39	Are data analysis methods clearly described and appropriate?
40	Are there sufficient data to support the authors’ interpretations?
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Table 4: Study Characteristics

53	Author (Date)	Aims	Country or Region	Sample (N)*	Qualitative Data Collection Method*
54	Al Ghafri et al. (2020)	To explore the experiences and perceptions of medical professionals working frontline in the management of COVID-19	Oman	40	Focus groups
55	Arnetz et al. (2020)	To explore perceptions of stress for nurses working in the early stages of the COVID-19 pandemic	United States	455	Survey with free-text response
56	Aughterson et	To explore the psychosocial impact of the COVID-19	United	25	Semi-structured

al. (2021)	pandemic on frontline health and social care workers	Kingdom		interviews
Baldwin & George (2021)	To develop an understanding of the experiences and needs of healthcare workers during and after the COVID-19 outbreak	United Kingdom	19	In-depth, semi-structured interviews
Banerjee et al. (2020)	To explore perceptions, experiences, and challenges of healthcare workers involved in dementia care during the COVID-19 pandemic	India	148	In-depth, semi-structured interviews
Billings et al. (2021)	To explore the experiences, views, and needs of mental health professionals supporting frontline health and social care workers during the COVID-19 pandemic	United Kingdom	28	Semi-structured interviews
Blake et al. (2021)	To evaluate wellbeing centres established to provide psychological support to healthcare workers during the COVID-19 pandemic	England	24	Semi-structured interviews
Butler et al. (2020)	To explore perspectives and experiences of clinicians on resource limitation and patient care during the COVID-19 pandemic	United States	60	Semi-structured interviews
Chandler-Jeanville et al. (2021)	To explore the lived experiences and perceptions of the COVID-19 pandemic amongst frontline nurses and their relatives	France	49	Semi-structured interviews
Chen et al. (2021)	To explore the experiences of wearing PPE for nurses caring for patients with COVID-19	China	15	Semi-structured interviews
Cheong (2020)	To explore the impact of the COVID-19 pandemic on hospital-based clinical pharmacists	Malaysia	19	Semi-structured interviews
Conlon et al. (2021)	To understand the experiences of emergency care staff during the COVID-19 pandemic	Ireland	15	Semi-structured interviews
Crowe et al. (2021)	To examine the mental health of critical care nurses providing direct COVID-19 care during the early phase of the pandemic	Canada	15	Semi-structured interviews
Deliktas Demirci et al. (2021)	To explore the experiences and coping strategies of nurses working on COVID-19 wards	Turkey	15	In-depth, semi-structured interviews
Digby et al. (2021)	To investigate the well-being of hospital staff during the early stage of the COVID-19 pandemic	Australia	321	Survey with free-text response
Fernández-Castillo et al. (2021)	To examine the experiences of intensive care nurses during the COVID-19 pandemic	Spain	17	Semi-structured interviews
Galehdar et al. (2020)	To explore experiences of distress among nurses caring for patients with COVID-19	Iran	20	In-depth, semi-structured interviews
Hayirli et al. (2021)	To describe how personal protective equipment and distancing affect teamwork in the emergency setting	United States	55	Semi-structured interviews
Hoerke et al. (2021)	To explore the experiences and concerns related to healthcare workers' use of PPE during the COVID-19 pandemic and its impact on care delivery	United Kingdom	46	In-depth, semi-structured interviews
Jia et al. (2021)	To examine nurses' ethical challenges in delivering COVID-19 care	China	18	In-depth, structured interviews
Kurotschka et al. (2021)	To explore the care experiences of general practitioners during the first phase of the COVID-19 pandemic	Italy	149	Survey with free-text response
Liberati et al. (2021)	To investigate the experiences of healthcare workers in secondary mental health services during the COVID-19 pandemic	England	35	Semi-structured interviews
Liu et al. (2020)	To explore the experiences of healthcare workers recruited to provide direct care for COVID-19 patients	China	13	In-depth, semi-structured interviews
Montgomery et al. (2021)	To investigate the experiences of healthcare workers in critical care settings during the COVID-19 pandemic	United Kingdom	40	Semi-structured interviews
Ness et al. (2021)	To investigate challenges faced by healthcare workers during the COVID-19 pandemic	United States	23	Semi-structured interviews
Newman et al. (2021)	To explore the psychological impact of the COVID-19 pandemic on frontline healthcare workers	United Kingdom	395	Survey with free-text response

Norful et al. (2021)	To investigate the impact of stress on frontline healthcare workers during the initial outbreak of COVID-19	United States	55	Open-ended interviews
Palacios-Ceña et al. (2021)	To examine the experiences of frontline physical therapists during the COVID-19 pandemic	Spain	30	In-depth, semi-structured interviews
Parsons Leigh et al. (2021)	To investigate the perceptions and experiences of critical care physicians in the context of resource strain during the COVID-19 pandemic	Canada	15	Semi-structured interviews
Pastrana et al. (2021)	To explore the impact of COVID-19 on palliative care	41 countries	79	Survey with free-text response
Rao et al. (2021)	To examine the perspectives of frontline clinicians providing care to patients with COVID-19	United States	50	Semi-structured interviews
Rees et al. (2021)	To explore the experiences of paramedics providing care during the COVID-19 pandemic	Wales	20	Semi-structured interviews
Ross et al. (2021)	To investigate the experiences of paediatric hospital social workers during the COVID-19 pandemic	United States	55	Focus groups
Saleem et al. (2021)	To explore the experiences of frontline Pakistani emigrant physicians working in the UK during the COVID-19 pandemic	United Kingdom	10	In-depth, semi-structured interviews
Sheng et al. (2020)	To explore the impact of involvement in COVID-19 rescue on professional identity among nurses	China	14	Semi-structured interviews
Testoni et al. (2021)	To examine COVID-19-related stress in doctors and nurses	Italy	17	In-depth, semi-structured interviews
Williams Veazey et al. (2021)	To explore how entanglements of affect, space, and evidence shape care in the COVID-19 context	Australia	63	In-depth, semi-structured interviews
Yip et al. (2021)	To examine the experiences of junior nurses providing care to COVID-19 patients in acute care settings	Hong Kong	40	Semi-structured interviews
<i>*For mixed-method studies and studies investigating multiple populations, only primary qualitative data collected from healthcare worker participants (as defined under "Eligibility Criteria") are represented.</i>				

Data Extraction and Analysis

Data were collected and organised by synthesised search terms (Table 2). Emerging themes were identified across the collected data and a "synthesising argument" was developed.[30]

The goal of the synthesising argument is to make sense of ideas across the review by bringing together arguments and evidence within multiple studies in ways that are explanatory and theoretically generative, and attend to the relationships between constructs.[30] We analysed both the primary data presented within the studies, and the interpretations by the study authors, to generate new interpretative findings (what Dixon-Woods et al. describe as "synthetic constructs").[30] We then generated three themes to organise these synthetic constructs, which allowed us to present our synthesising argument

1
2
3 in a way that was internally coherent and facilitated a stronger theoretical understanding of
4
5 material practices and spaces of healthcare environments.
6
7

8 **Patient and Public Involvement**

9
10 There was no patient or public involvement in this study.
11
12

13 **FINDINGS**

14
15 Our synthesising argument is organised across three interconnected themes: 1) the hospital
16 transformed; 2) virtual care spaces; and 3) objects of care. To present these themes, we
17
18 have included illustrative extracts of participant responses from included studies, which are
19
20 italicised in-text.
21
22
23

24 **Theme 1: The Hospital Transformed**

25
26 During the COVID-19 pandemic, the hospital environment has undergone spatial, material,
27
28 and temporal transformations to accommodate changing healthcare needs. Three distinct
29
30 but intersecting burdens on physical space in the hospital setting emerged in the literature:
31
32 the increase in hospitalisations in COVID-19-affected geographical locations; the need for
33
34 hospital zoning to separate confirmed or suspected COVID-19 cases from other patients;
35
36 and the need for general physical distancing between all staff, patients, and visitors in the
37
38 hospital. These burdens led to material and organisational changes in the hospital, which
39
40 impacted how healthcare was done in these environments.
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47 The introduction of COVID-19 cases into hospitals presented a need for higher
48
49 capacity emergency departments and intensive care units to keep up with the demand, as
50
51 well as additional isolation facilities to prevent further infection within the hospital.[36, 37]
52
53 Hospitals and healthcare delivery environments implemented and strengthened triage
54
55 systems to establish “hot zones,” which separated patients with confirmed or suspected
56
57 COVID-19 from other patients.[36, 38-40] This required the adaptation of existing spaces
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1
2
3 and infrastructure, and changes to hospital staffing to support this zoning, leading to further
4 recruitment and redeployment of healthcare workers.[36, 41] Redeployed healthcare
5 workers reported low support, inadequate specialised knowledge and training for COVID-19
6 care, a lack of familiarity with patient treatments, poor communication, and feelings of
7 uncertainty, which impacted the quality of patient care delivery[38, 42-44]: *“They gave us 2*
8 *1/2 hours overview lecture on [Intensive Therapy Unit] setting then that is that, working in*
9 *an environment that you don’t know [...] Asked to give medications which you’re not*
10 *competent to do so.”*[44]
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23 Studies also evaluated the materiality of healthcare environments in relation to staff
24 comfort and safety. Existing spaces for staff in the hospital, including changing and
25 showering facilities and break rooms, often did not meet the increased need to physically
26 distance, decontaminate, and relax, and in some cases further spaces were found or
27 built.[43, 45, 46] The materiality of COVID-19 care spaces within the hospital also enhanced
28 the sense of risk in these environments: *“You were continuously exposed, closed spaces fully*
29 *covered with patients with COVID-19, where invasive techniques were conducted, there were*
30 *aerosols, vomits.”*[41] This sense of risk extended to homes as well, which became sites of
31 potential contagion that put those cohabiting with healthcare workers at risk.[46] One study
32 described healthcare workers managing this risk by creating “hot and cold zones” within
33 their homes, or even residing in hotels, thus isolating themselves from families and loved
34 ones.[47]
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52 In addition to the materiality and spatial layout of healthcare environments,
53 logistical adaptations in the day-to-day running of hospitals further impacted the ways in
54 which bodies travelled and interacted with each other. Some services and modes of care
55 were prioritised as essential, leading non-essential services to be conducted remotely (see
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1
2
3 “Virtual Care Spaces”).[48] The changes to hospital zoning highlighted the need for
4
5 adequate staff to ensure healthcare workers were not moving between zones, thus
6
7 impacting infection control measures.[36] Spatial limitations in the hospital further
8
9 impacted communication between healthcare workers. Material barriers within the hospital
10
11 built environment required the implementation of different technologies and procedural
12
13 changes, such as the use of baby monitors or whiteboards, in order for healthcare workers
14
15 to communicate with each other and with patients.[46, 49] These spatial barriers to face-to-
16
17 face communication impacted the quality of care as communication and emotional
18
19 connection were compromised: *“Typically, when a trauma patient comes in we're in the*
20
21 *room first thing and we're sort of hearing the story. [...] And now we're not in the room*
22
23 *because of PPE. [...] we're getting a lot of information from these very sick patients*
24
25 *secondhand.”*[49]
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33 While the transformations outlined above largely point to adaptative changes
34
35 implemented in response to evolving healthcare needs, hospital environments also
36
37 underwent atmospheric transformations that produced affective engagements with the
38
39 care space. Participants in the literature employed the metaphor of the healthcare worker
40
41 as a “soldier” fighting a war and described the hospital environment as a “war zone” or
42
43 “battlefield”[41, 45, 50-54]: *“It was like that scene on ET, all that plastic.... So, there's all this*
44
45 *plastic and, I get it, but just walking into this other world, there was just mayhem,*
46
47 *pandemonium. People running around, alarms going off.... it was like a war zone.”*[45] Care
48
49 practices were also understood as generating affects that could resonate through the care
50
51 environment. One study highlighted a (variably defined) distinction between triaging care
52
53 and “rationing,” where the latter was described as a “taboo.”[39] This led in some cases to
54
55 care being provided beyond what was considered normal or beneficial clinical practice:
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3 “because of the sensitivity, the concern that people are going to be withholding care and this
4
5 institution doesn’t want to be seen like that.”[39]
6
7

8 Events of high emotion and trauma haunted spaces in the hospital environment:
9
10 “Even now, when I am on duty, when I enter some room(s), I see patients who could not
11
12 breathe, in bed, who died suddenly. I still have these flashes that still shock me, especially
13
14 when I enter two rooms in particular.”[55] One study connected these local affects in the
15
16 hospital space to global atmospheres that are generated in the pandemic and travel through
17
18 media networks: “I just had this moment of those pictures that you see from the New York
19
20 Times or whatever, of hospitals in America flashing up in your brain and going, ‘This is not
21
22 dissimilar. Are we going where they’re going?’”[54] As with the other transformations
23
24 highlighted in this section, these atmospheric transformations were produced in and
25
26 through the materiality of sites of COVID-19 care, across time and space.
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32 **Theme 2: Virtual Care Spaces**

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34 The use of virtual spaces in healthcare has significantly expanded during the COVID-19
35
36 pandemic. As physical touch and interaction between bodies became understood as “risky,”
37
38 contact between bodies was mediated in healthcare environments via technologies
39
40 enabling remote care, including telephones, tablets, and online services.[54, 56] In addition
41
42 to reducing the risk of SARS-CoV-2 transmission, remote consultation services were
43
44 identified as having the capacity to increase healthcare access by reducing barriers relating
45
46 to travel, geographical location, time, disability, and resources[57, 58]: “Patients could make
47
48 appointments and communicate with GPs online, then they were offered guidance on health
49
50 care and psychological support, and purchased drugs online under the instructions of
51
52 doctors, which may be a new way of work for GPs.”[59] However, the digital divide was
53
54 identified as an issue affecting both healthcare workers and patients, as digital literacy and
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3 internet access varied from person to person and region to region.[57, 60] Already-
4
5 vulnerable patients could thus be made more vulnerable: *“When reopening begins, those*
6
7 *who have suffered as a result of these disparities will return to our care sicker and with*
8
9 *deeper social needs.”*[60]
10
11

12
13 Quality of care in virtual care environments was a common concern in the literature.
14
15 Studies highlighted the practical implications of healthcare workers not being in the same
16
17 room as patients, which could lead them to miss symptoms or changes in patients, misread
18
19 body language or non-verbal communication, or experience increased language and
20
21 intercultural communication barriers[57, 61]: *“Patients keep requesting for physical*
22
23 *examination. [...] How will I prescribe without being sure...”*[57] One study also highlighted a
24
25 “‘ripple’ effect” from the lack of physical assessment, where patients requiring general
26
27 treatment were referred to emergency, thus increasing the burden placed on the
28
29 emergency department.[36]
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35 One way that consultations were adapted to navigate concerns about infection
36
37 control and quality of care was through the development of hybrid systems in which nurses
38
39 or trainee doctors provided patient care in-person, with doctors and consultants using
40
41 remote technologies to observe patients and support care without entering the ward.[48]
42
43 This required the healthcare workers providing in-person care to embody the authority and
44
45 expertise of the doctor, while also observing the patient: *“The consultant was probably*
46
47 *heavily relying on the nurses and the doctors there, rather than himself, to look at smaller*
48
49 *behaviours ... little things like facial reactions, body language, things like that.”*[48] In these
50
51 ways, virtual and hybrid environments not only enacted changes in the individual care
52
53 encounter between patient and healthcare worker, but also transformed the bedside as a
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3 site of care and produced extended effects in the care journey and other care practices and
4
5 experiences in the healthcare environment.
6
7

8 Fully remote care systems also presented practical challenges when it came to
9
10 monitoring and administering medication.[57, 62] The lack of face-to-face interactions
11
12 (between both patients and doctors, and patients and their families) also produced barriers
13
14 to emotional and social care[56, 61, 63]: *“the most important part of caring is PRESENCE.*
15
16 *Touch, intimate conversation, allowing the patient to sit close, face-to-face interaction.”*[56]
17
18 This was signalled as being particularly problematic in the context of COVID-19 given the
19
20 heightened need for this kind of support; for example, one study emphasised the need for
21
22 some patients with mental health issues to experience simple moments of physical contact:
23
24 *“I think that some people just need the power of touch or a hug or a face-to-face human*
25
26 *person to ensure that they’re kept safe and okay.”*[61] Telehealth was framed as a
27
28 compromised form of care that traded (but would “never be able to replace”) “physical
29
30 touch and presence” for safety.[56]
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37 Yet one study also identified a potential for increased emotional support through
38
39 remote care for patients who were already in isolation.[58] Participants identified
40
41 technologies of remote care as enabling new forms of interpersonal connection, fostering
42
43 modes of care that emphasised thoughtful verbal communication as an intentional practice
44
45 of care: *“The rediscovered importance of words, of a telephone conversation that becomes*
46
47 *an essential connection, and which is able to concentrate all the possible humanity,*
48
49 *closeness and help.”*[58] The study also reconceptualised virtual care as taking place not
50
51 “remotely,” but rather “in the home,” allowing a new and different form of intimacy to that
52
53 produced through face-to-face care in the hospital setting: *“Every day I called them, I*
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1
2
3 *entered their homes, I saw their eyes, I evaluated their breathing. [...] I have been living with*
4
5
6 *them for these 20 days.”*[58]
7

8 While remote care had the capacity to enable healthcare workers to ‘enter the
9
10 homes’ of patients, so too did it bring the healthcare environment into the homes of
11
12 participants who worked remotely. Some studies found working from home gave
13
14 participants greater flexibility in work, limited workplace distractions, and reduced fears of
15
16 becoming infected or sick.[38, 43] However, for others, working from home presented
17
18 several challenges including technological issues (e.g. internet speed), distractions from
19
20 other occupants in the house, and insufficient or inappropriate physical space.[43, 60]
21
22
23

24 Many healthcare workers reported difficulties in establishing boundaries between
25
26 professional and personal space, especially when the broader pandemic context introduced
27
28 additional home responsibilities (e.g. homeschooling).[43, 48, 56, 60, 64] Working from
29
30 home brought colleagues and patients (virtually) into the personal spaces of healthcare
31
32 workers in ways that challenged comfort and privacy[56, 64]: *“Something I found hard was*
33
34 *the room I work in is also my bedroom. It can be a lot to have these difficult conversations in*
35
36 *your own room where your bed is, not having that space.”*[64] There were other practical
37
38 implications to this decrease in privacy as well; for example, one study noted the difficulty
39
40 of conducting confidential conversations when working in a shared living space.[48]
41
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47 The erosion of boundaries between work and home also dissolved temporal markers
48
49 of ‘worktime.’ As homes became workplaces, other aspects of homelife (such as childcare)
50
51 became folded into the workday, thus disrupting work and family routines.[56, 60] More
52
53 rigid scheduling in virtual environments limited opportunities for informal discussions and
54
55 debriefs, and the absence of a daily commute (which previously operated as a temporal
56
57 boundary of worktime) caused the workday to stretch beyond regular hours.[48, 60] Such
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60

1
2
3 spillage of worktime created a sense of pressure to always be available and “at work”[48,
4
5 60]: *“Working from home means that I am never ‘not working.’”*[60] These challenges
6
7 produced an increase in burnout, guilt, uncertainty in decision-making, and feelings of being
8
9 underappreciated.[38, 43, 48, 60, 61]
10
11

12
13 Virtual care spaces were also produced through the engagement of healthcare
14
15 workers with social media platforms. Studies described social media use as a practice of
16
17 knowledge sharing, enabling healthcare workers to access rapidly emerging information
18
19 about the pandemic through informal networks and put this emergent information into
20
21 practice.[52, 54, 65] These networks were identified as constituting experiential evidence
22
23 that could be disseminated and accessed more rapidly than traditional evidence through
24
25 official channels: *“our colleagues who are in the hot areas [...] send out some of their*
26
27 *experiences, how they are managing it, on Facebook or WhatsApp. So, we are just reading to*
28
29 *see if we can incorporate their experience and then go from there.”*[65] However, these
30
31 modes of knowledge sharing were also conceptualised as risky, with the potential to amplify
32
33 misinformation and produce uncertainty through conflicting accounts of successful COVID-
34
35 19 care practices.[52, 54] Accessing information through social media also led some
36
37 participants to feel overwhelmed and anxious, particularly due to the circulation of news of
38
39 patient and healthcare worker deaths.[54, 59, 66]
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47
48 Social media furthermore produced spaces of connection between healthcare
49
50 workers and the public. These spaces enabled the circulation of viral images (such as photos
51
52 of healthcare workers with sores from extended PPE use) and allowed healthcare workers
53
54 to disseminate information and share their personal experiences of working during the
55
56 pandemic.[66] They also created opportunities for both displays of gratitude and support
57
58 from the public and occasionally negative comments and abuse.[52, 65] These virtual spaces
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1
2
3 of public engagement thus constituted potential sites of psychosocial support or anxiety for
4
5 healthcare workers.
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7 8 **Theme 3: Objects of Care** 9

10 Material objects formed a central mechanism of COVID-19 care across the literature. The
11
12 most prominent object of care identified in the literature was PPE; studies described
13
14 shortages of PPE (particularly at the beginning of the pandemic) as a barrier to both the
15
16 safety of healthcare workers and their capacity to delivery care, with inadequate PPE
17
18 supplies causing anxiety and prompting participants to limit patient interactions and re-use
19
20 and/or share PPE [38, 42, 43, 45, 46, 49, 52, 58, 65, 67, 68]: *"I have the same N95 since*
21
22 *March. We also are only allowed one surgical mask for one week. We still are rationing*
23
24 *PPE."*[42] Several studies also identified inequities in PPE distribution, with lower-waged and
25
26 non-acute care roles being more likely to experience shortages.[38, 43, 46, 51, 62] Guidance
27
28 around PPE use was often unclear, inconsistent, or changed from day to day, producing
29
30 anxiety in healthcare workers around the proper use of PPE.[36, 42-46, 67-69] Some studies
31
32 also noted problems related to the size and fit of PPE, especially for women and people with
33
34 facial hair (including people who do not shave for religious reasons).[46, 50, 66, 67]
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41
42 When PPE was available, its use presented a barrier to everyday practices of care.
43
44 Interactions with patients and their families were made more difficult as PPE obscured
45
46 faces, muffled voices, and obstructed body language, thus impacting communication and
47
48 emotional connection[36, 46, 48, 49, 51, 55, 70, 71]: *"I think arriving in full PPE, you're a bit*
49
50 *like an alien or a person from a nuclear reactor or something, and I think it's hard to build a*
51
52 *rapport with that."*[48] Communication with colleagues was also affected by PPE use,
53
54 especially between newer team members, impacting professional relationships and
55
56 increasing the risk of miscommunication in care practice.[36, 46, 49, 63, 71] Attempts to
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1
2
3 bridge these emotional and communication gaps included individually decorating PPE or
4
5 attaching disposable photos of staff faces to gowns, which also had the practical benefit of
6
7 allowing patients and colleagues to differentiate between healthcare workers.[46, 63] The
8
9 literature also described PPE as limiting healthcare workers' senses (e.g. through the fogging
10
11 of glasses and face shields) and dexterity, producing challenges with some patient
12
13 procedures and increasing the risk of healthcare workers missing important health signs in
14
15 patients[40, 46, 48, 55, 62, 63, 67, 69]: *"I had to rely on the anatomical location to find the*
16
17 *femoral artery because I could not feel the pulsation when performing the arterial blood*
18
19 *taken for gas analysis."*[67] Healthcare workers additionally raised concerns about protocols
20
21 in emergency situations, where the time taken to don and doff PPE could leave patients
22
23 waiting longer for vital support.[46, 48, 69]
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30 The wearing of PPE took a significant physical and emotional toll on healthcare
31
32 workers. PPE was described as exhausting, uncomfortable, hot, difficult to breathe in, and
33
34 produced skin damage such as bruising and dermatitis[38, 40, 42, 43, 46, 61, 63, 65, 67-69,
35
36 71]: *"Wearing the whole set of PPEs is very uncomfortable. I have difficulty breathing and*
37
38 *feel very hot and my heart rate speeds up. We keep on sweating and the clothes are*
39
40 *soaked."*[40] Adhering to infection control protocols (e.g. correctly donning and doffing PPE)
41
42 took a considerable amount of time and impacted how long healthcare workers could spend
43
44 with patients and their families.[36, 46, 68, 69] Healthcare workers adopted different
45
46 techniques to combat this issue. Some participants reported that shifts and processes were
47
48 reorganised so that care delivery could be clustered, allowing healthcare workers to visit
49
50 more patients in one go.[36, 68] However, studies also described healthcare workers
51
52 skipping breaks, not drinking water or using the toilet, and wearing adult diapers in an effort
53
54 to avoid donning and doffing (and possibly disposing of) PPE.[38, 43, 45, 46, 67, 68]
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3 In addition to PPE shortages, the literature also revealed shortages of other essential
4 material objects of care (as well as the human resources necessary to use them), including
5 ventilators, dialysis machines, isolation and critical care beds, testing equipment, cleaning
6 supplies, and body bags.[38, 39, 42, 47, 51, 55, 57, 58] Triage became an important part of
7 the allocation of limited resources, however this required healthcare workers to make
8 ethical decisions about which patients were in most need of equipment such as ventilators
9 (which sometimes meant adapting guidelines on a case by case basis)[39, 53, 55, 57]: *"I had
10 to decide if the 88 year old grandma on dialysis gets the ventilator or the 44 year old [in full
11 code]. And even just the weight that you have to carry if that's your decision right? That you
12 just condemned this person to die and not this person."*[53]

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Studies described changes to practice and other innovations that enabled healthcare
workers to adapt to these resource challenges. Patients on ventilators who would normally
receive one-on-one care had nurses working between them, and some patients were put on
travel ventilators.[39] Staff at one hospital developed "grab bags" of equipment to help with
clustered care and created a portable "resus trolley" so that patients did not need to be
moved to a dedicated resuscitation area (which also helped limit virus transmission).[36]
One study even described a healthcare worker's son using a 3D printer to make face shields
and connections for a dialysis machine.[39] Across the literature, however, resource
limitations were described as leading to compromised care: *"Everybody gets a little bit of
bad care."*[39]

In addition to concerns regarding access to necessary material resources for
providing care, much of the literature also described uncertainties around the
appropriateness of the therapies themselves when it came to the acute care of patients
with COVID-19[40, 42, 53, 55, 59, 63, 65, 71]: *"The fact that a medication wasn't proven. We*

1
2
3 *didn't have good data. [...] If you're going to do something that's unproven, you should do it*
4 *within a trial. We could really be doing more harm than good.*"[53] Studies described an
5
6 absence of evidence-based treatment for COVID-19, though often did not make clear
7
8 distinctions between pharmaceutical drugs and other clinical interventions when referring
9
10 to treatment. Similarly, there was an implied but usually unarticulated distinction between
11
12 "good data"[53] and informal knowledge sharing between healthcare professionals. In the
13
14 absence of "proven" pharmaceutical interventions, some studies reported an increase in
15
16 supportive care, which often involved higher patient contact and emotional work, and
17
18 disproportionately impacted nurses (including via increased risk of infection).[50, 70, 72, 73]
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25 A notable motif throughout the literature was the affecting presence of pandemic
26
27 death, which came to be known through the materiality of objects of care such as body bags
28
29 and beds. Many healthcare workers had no experience handling dead bodies prior to the
30
31 pandemic and this lack of knowledge, along with changes to processes for managing death
32
33 in the hospital, meant that bodies were often not prepared in accordance with the religious
34
35 or cultural beliefs of patients.[37, 51, 55, 71] Several studies described the affect generated
36
37 through the object of the body bag or the physical preparation of dead bodies in accordance
38
39 with infection control measures[40, 42, 55, 63]: "*When a patient with an infectious disease*
40
41 *dies, the body is wrapped in several layers of cloth, packed into two bags, which are sprayed*
42
43 *with disinfectant... It is a little hard to accept this form of death.*"[40] One study also
44
45 described the emotional labour of a participant who spent multiple full shifts transporting
46
47 bodies from hospital beds to the morgue.[38] However, an *absence* of bodies could also
48
49 enact the presence of death in the hospital; one study described the experience of dealing
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51 with a shortage of beds one day and arriving at work the next day to see "*rows of empty*
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3 *beds.*"[38] Pandemic death thus distinctively emerged in the literature through its material
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5 relations with/in the COVID-19 context.
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7 8 **DISCUSSION** 9

10 This synthesis demonstrates how material objects, spaces, bodies, and affects entangle in
11
12 care environments to facilitate the doing of healthcare. Because the materiality of the
13
14 healthcare environment shapes care practices, transformations in the environment (both
15
16 intentional and unanticipated) afford differing care experiences, which become 'good,'
17
18 'bad,' 'compromised' or 'good-enough' care. This accentuates the importance of considering
19
20 the material environment as critical to shaping the quality and delivery of care, especially in
21
22 times of emergency and disruption. A systemic approach to care delivery not only sees
23
24 adaptation as a means of working around the constraints of the material environment but
25
26 demands a need for adaptable environments to enable 'good care' to be done. There is a
27
28 tendency to focus on healthcare workers, and their attitudes and practices, as the locus and
29
30 focus of change, rather than on the material environments which constrain or potentiate
31
32 the care that healthcare workers provide. Our analysis, which has relevance for healthcare
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34 delivery beyond situations of emergency, pushes us towards a more systemic adaptation
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36 and change, from attitudes to materials, from individuals to environments.
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45 **Materially Bounded Care Environments** 46

47 The studies examined in this qualitative synthesis were conducted within a range of
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49 healthcare delivery settings including hospitals, clinics, hospices, health centres, continuing
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51 care facilities, community or field settings, patient homes, and other out-of-hospital
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53 environments. Across these settings, healthcare was delivered within in-person, virtual, and
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55 hybrid environments. Though these healthcare delivery contexts were typically defined
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57 through architectural (e.g. the hospital building) and technological (e.g. telephone
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3 conferencing) mechanisms, such definitions inadequately encompass the spaces in which
4
5 healthcare was done. Rather, we find that the boundaries of healthcare environments are
6
7 neither solid nor fixed, as care extends in relations between and beyond these spaces.
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10 Virtual environments brought healthcare into virtual spaces, but also into the homes
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12 of patients and healthcare workers. Virtual care facilitated new and altered ways of
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14 travelling with and to patients and produced (sometimes unwanted) intimacies: the
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16 healthcare worker was able to 'enter the homes' of patients and develop a different kind of
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18 proximity to that which takes place in a hospital or clinic, but so too could patients and
19
20 colleagues enter the homes of healthcare professionals working from home. The latter was
21
22 conceptualised as an undesirable intimacy, which was not understood as facilitating 'better'
23
24 care. Changes in the care encounter also resulted in new care paths and journeys in ways
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26 that were both enabling and produced capacities for harm. A virtual healthcare consult, for
27
28 example, could improve healthcare access for some patients, but produced risks of
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30 overlooked symptoms and postponed healthcare procedures, thus resulting in delayed yet
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32 intensified healthcare needs.
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40 While our analysis reveals the ways in which the spaces of healthcare have spilled
41
42 out beyond healthcare settings, it also identifies more localised spaces and encounters as
43
44 sites of care. Restrictions on visitors and healthcare practices drew attention to sites such as
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46 the bedside, which is normatively understood as a place where care happens. In this context
47
48 the bedside is a site of *touch* and *presence*, both of which were conceptualised in the
49
50 literature as modes of care practice that also facilitated certainty (e.g. physical examinations
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52 as a way of 'being sure' in care decisions). Negotiating the materiality of the healthcare
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54 environment thus became a crucial part of adapted care practice in the pandemic context.
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56 Barriers to touch and presence, produced via alterations in zoning, PPE, care schedules, and
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3 modes of communication, simultaneously enabled and constrained 'good' and 'safe' care.
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5 As touch between bodies became 'risky,' barriers to touch and presence, such as PPE and
6
7 zoning, enabled care to be done. However, these adaptations in the care environment
8
9 generated new risks, as they were also understood as producing 'compromised' care. Virtual
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11 care environments, communication technologies (e.g. whiteboards, radios), hybrid
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13 consultations, and other material innovations (e.g. decorated PPE) produced new
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15 proximities between healthcare worker and patient, thus enabling care to be done
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17 differently.
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23 **Extending Relations of Care**

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25 Our analysis shows that spatial and temporal constraints in healthcare systems are both
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27 created by and navigated through adaptive material practices, which produce 'rippling
28
29 effects' beyond the individual care encounter. For example, hospital infection control
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31 protocols led to changes in hospital zoning, which revealed constraints in the resourcing of
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33 staff, PPE, and other equipment. Individual adaptations in response to these constraints
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35 included healthcare workers reusing PPE, skipping breaks, and spending less time with
36
37 patients. In contrast, adaptations that attended to the spatial or temporal features of the
38
39 material environment allowed for differing ways of doing care. Examples included creating
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41 schedules to facilitate care clustering, developing hybrid consult systems, and implementing
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43 the use of objects such as grab bags, trolleys, and radios. These adaptations allowed for
44
45 altered ways of moving and relating within the hospital, in turn producing new care spaces
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47 and care journeys.
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54 Our mapping of the extending relations of the COVID-19 care environment allows us
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56 to understand the ways through which local care practices—and how these are shaped by
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58 the materiality of care environments—are themselves located in, and shaped by, broader
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3 health systems and ecologies. We saw this, for instance, in how the rippling effects of virtual
4 care encounters impacted upon hospital emergency departments, and how 'experiential
5 evidence' from geographically distant COVID-19 'hot areas' was shared through informal
6 virtual networks and tested in local care environments. Our analysis also points to the ways
7 in which healthcare workers mediated their experiences and knowledge of COVID-19 care
8 through engagement with a global pandemic imaginary. For example, a site of emotional
9 trauma in a hospital might be enclosed by the four walls of a ward and tied to a single event,
10 but this trauma became known through its relations with broader temporal and global
11 pandemic uncertainties. The affects generated in and through the care environment
12 facilitated other forms of knowing as well; (double) body bags, empty beds, social media
13 posts, news media images, and practices of infection control in corpse management all
14 enacted a knowing of pandemic death, distinct from other forms of death in healthcare
15 work. These findings highlight how locally materialised affects and experiences of care
16 connect with broader, as well as global, affects and adaptations generated by pandemic.

37 **Implications for Future Research and Practice**

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39 A pervasive orientation in the literature is emphasising what is absent, or deficient, in care
40 environments. Our analysis, however, testifies to a responsiveness and ingenuity in how
41 healthcare workers and services have adapted within constraining and disruptive care
42 relations to make care environments work in the face of emergency. In turn, our findings
43 emphasise a need for care environments themselves to be made more adaptable and
44 malleable, such that these adaptive potentials can come together to enable 'good' care in
45 times of uncertainty and change. The insights produced through this synthesis thus
46 explicate how and why we might better attend to the material spaces, objects, practices,
47 and affects through which healthcare environments are made (and made differently). This
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3 has practical implications for the building of resilient, responsive, and enabling care
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5 environments. We highlight five implications:

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8 • While the COVID-19 context calls attention to the consequences of insufficiently
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10 flexible healthcare systems, the materiality of care environments is always in the
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12 process of adapting what care is made possible. This gives us insights to build upon,
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14 including for considering how good care is made possible, even in situations of risk
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16 and constraint.
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19 • Interventions for optimising good and better care delivery need to move beyond a
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21 focus on individual practices and better attend to the effects of the material
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23 environment and how this enables or constrains care.
- 24
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26 • Interventions can capitalise on the fluid boundaries of care environments which
27
28 extend beyond local spaces and buildings to connect with more distant as well as
29
30 virtual care experiences.
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33 • Optimising the material care environment to deliver good care, especially in times of
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35 emergency, requires learning from everyday adaptive practices in healthcare
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37 experience, while making material environments more adaptable.
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40 • Mapping how the material effects of healthcare 'ripple out' beyond individual
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42 encounters and beyond particular healthcare environments is an important first step
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44 to designing a more systemic and ecological approach to care.
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50 Thus, in addition to synthesising material adaptations in care environments from within the
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52 specific context of the early COVID-19 pandemic and demonstrating the importance of
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54 noticing these material adaptations, our analysis models interpretive methods which can be
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56 used in future research and appraisal of healthcare systems, during times of emergency and
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58 beyond.
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Strengths and Limitations

The approach we have developed for critical interpretive synthesis (adapted from that proposed by Dixon-Woods et al.[30]) has produced a versatile yet readily comprehensible method for reviewing complex, diverse, and emerging data. We suggest that this method be taken up in the development of future protocols for qualitative review. Given the critical interpretive synthesis approach of our review, this paper is not intended as an exhaustive account of the literature. The strengths of critical interpretive synthesis lie in its capacity to undertake complex analyses of diverse qualitative data, develop insights that move beyond the goals of the original studies, and generate theory that has applicability to both research and practice. Our purposive sampling strategy facilitates these goals through a highly critical and iterative approach to inclusion. It is possible that relevant literature could be missed within this strategy, however our more flexible and inclusive approach to literature searching in the earlier phases of sampling also make it more likely that papers have been captured that would be missed in conventional systematic review methods. The resulting sample may therefore reflect a broader and more diverse range of experiences.

Given the practical orientation of this synthesis, the insights generated through our mapping of the literature offer a starting point for the development of further theoretical work. While the studies included in this synthesis documented material adaptations in the environment, critical analysis of the material effects of these adaptations was in most cases limited. Future research can contribute to new materialist scholarship investigating how care environments are made through their materials and spaces, and the effects of their making in care knowledges and practices,[20, 21, 23, 25-27, 74, 75] by extending our interpretive approach to noticing how care environments adapt (are *re-made*) in the face of uncertainty and in times of emergency.

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There were also some logistical limitations in this synthesis. The global health emergency context of the COVID-19 pandemic resulted in rapid publication of studies across different temporal, geographical, and professional contexts in 2020 and 2021. Though the prominent concerns addressed in this synthesis were found across health contexts, more specific and contextual insights may have been missed. While many publishers have expedited COVID-19-focused studies since the beginning of the pandemic, due to the timing of our writing, the studies included in this synthesis were conducted within the first 18 months of the pandemic (with the majority of data collected in the first 6 months of 2020) and employed methods that could be implemented rapidly, often at a distance, and without producing unnecessary further burden on already-stressed healthcare systems. This resulted in a lack of longitudinal and ethnographic methods (though some papers were linked to larger studies that may include data from such methods). This means that the data assembled through this synthesis were generated via context-specific participant interpretations of the care environment, which have been interpolated by the study authors and via our analysis. Additionally, we have exclusively included studies published in English, as this is the only shared language between the authors.

A final limitation of this synthesis relates to the complexity of defining COVID-19 care. Much of the literature did not distinguish between findings related to COVID-19-specific and non-COVID-19 care, and terms such as 'treatment,' 'therapies,' and 'care' were employed inconsistently in the literature, often without definitions of what these words meant in practice. Many studies implicitly established distinctions between curative medical treatment and symptom management, with the latter framed as care done in the absence of, or while waiting for, 'effective' treatment options. Such a framing presents several issues. First, it delimits the efficacy of supportive care *as care*, and obscures relations

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3 between symptom monitoring or management and health outcomes. Second, it sits at odds
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5 with descriptions of informal knowledge sharing networks, which themselves enact an
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7 efficacy in their shared care practices, however limited, incomplete, or uncertain. Put
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9 another way, framing symptom management practices against *lacking* or *unknown* care
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11 practices de-emphasises what care *is already being done* in these contexts. Finally,
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13 reinforcing distinctions between types of care may not make sense in the provision of care,
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15 but instead reveal an artificial separation in clinical practice.
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20 **CONCLUSIONS**

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22 This paper is the first to synthesise qualitative research investigating healthcare workers'
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24 experiences during the COVID-19 pandemic with an aim to explicate how the materiality of
25
26 the healthcare environment shapes care delivery. The findings of this paper demonstrate
27
28 how the healthcare environment can enable and constrain 'good' care, and how changes in
29
30 this environment produce complex and rippling health effects. The insights generated
31
32 through this synthesis are valuable in supporting healthcare workers, managers, and
33
34 organisations in developing enabling care environments and adapting care practices
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36 through an attention to the materiality of the environment itself.
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48
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54 **AUTHOR CONTRIBUTIONS**

55
56 MH conceptualised and designed the review in consultation with TR and KL. MH conducted
57
58 the literature search, screening, full-text review, and data collection and identified emerging
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2
3 themes. TR and KL contributed to the further development of themes and a synthesising
4
5 argument was generated through discussion between all authors. MH was responsible for
6
7 data analysis, which was refined through discussion with TR and KL. MH drafted the
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9 manuscript. All authors critically revised the manuscript and approved the final version.
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16
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19

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22 None declared.
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25 **DATA AVAILABILITY STATEMENT**

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27 Not applicable.
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30 **ETHICS APPROVAL**

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32 Not required—review.
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