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The good, the bad and the ugly: Resilience in healthcare during the COVID-19 pandemic –a qualitative systematic literature review

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-071828
Article Type:	Original research
Date Submitted by the Author:	16-Jan-2023
Complete List of Authors:	Knutsen Glette, Malin; University of Stavanger Faculty of Health Sciences, SHARE – Center for Resilience in Healthcare, Faculty of Health Siences; Western Norway University of Applied Sciences - Haugesund Campus, Department of health and caring sciences Ludlow , Kristiana; The University of Queensland School of Psychology Wiig, Siri; University of Stavanger, SHARE – Center for Resilience in Healthcare, Faculty of Health Sciences Bates, David ; Harvard Medical School; Brigham and Women's Hospital, Medicine Austin, Elizabeth; Macquarie University, Australian Institute of Health Innovation; Dr
Keywords:	Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, QUALITATIVE RESEARCH, Systematic Review, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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1	The good, the bad and the ugly:
2	Resilience in healthcare during the
3	COVID-19 pandemic –a qualitative
4	systematic literature review
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6	Malin Knutsen Glette ¹ *
7	Kristiana Ludlow ^{2,3}
8	Siri Wiig ¹
9	David Bates ⁴
10	Elizabeth Austin ³
11	
12	*Corresponding author
13	
14	¹ SHARE – Center for Resilience in Healthcare
15	Faculty of Health Sciences
16	² School of Psychology, the University of Queensland
17	³ Australian Institute of Health Innovation, Macquarie University
18	⁴ Harvard Medical School
19	
20	Email addresses:
21	Malinknutsen.glette@nvl.no
22	
23	dbates@bwb.barvard.edu
25	Elizabeth.austin@mg.edu.au
26	
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3	28	
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8 9	31	
10	22	
11 12	32 33	Abstract
13	24	Objective: To identify review and synthesise qualitative literature on boalthcare professionals'
14 15	35	adaptations to changes and challenges resulting from the COVID-19 pandemic.
15 16 17	36	Design: Qualitative systematic review
17	37	Data sources: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science Direct and Scopus
19 20	38	Eligibility criteria: Qualitative or mixed method studies published between 2020 – 2022 investigating
20	39	healthcare professionals' adaptations to changes and challenges resulting from the COVID-19
22	40	pandemic.
23		
24	41	Data extraction and synthesis: Data was extracted individually using a pre-designed data extraction
25	42	form including publication details, setting details, participants, adaptations, and outcomes. Data was
26	43	analysed using thematic analysis.
27	44	Results: Forty-eight studies were included. A range of adaptations crucial to maintain healthcare
28	45	delivery during the nandemic was found including taking on new roles, conducting self and peer
29 30	45 16	education and reorganizing workspaces. Triggers for adaptations included unclear workflows lack of
31	40 17	guidelines increased workload and transition to digital solutions. As challenges arose many health
32	47	professionals reported increased collaboration across wards, healthcare teams, hierarchies, and
33	40	hoalthcare convices
34	49	fieattricare services.
35	50	Conclusion: Healthcare professionals demonstrated a significant adaptive capacity facing the
36	51	challenges imposed by the COVID-19 pandemic. Several adaptations were deemed applicable for
37	52	future organizational healthcare service changes, while others exposed weaknesses in healthcare
38	53	system designs and capacity, leading to dysfunctional adaptations. Experiences gained from the
39 40	54	COVID-19 pandemic present a unique opportunity to learn how healthcare systems rapidly respond
41	55	to changes, and how resilient healthcare services can be built globally.
42		
43 44	50	Reywords: Resilience in healthcare, adaptations, COVID-19, healthcare services
45	5/	Article Summary
46 17	58	 This review protocol was registered at the open science framework (OSF) and followed the
47 48	59	PRISMA-P checklist.
49	60	 A comprehensive search strategy was employed to identify studies focusing on healthcare
50	61	personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic.
51	62	• To ensure inclusion of relevant studies, we used the <i>RiH auality and resilience triager tool</i> to
52	63	capture resilience elements in studies not directly focusing on resilience in healthcare
53	64	The inclusion of articles and overall analysis is limited to qualitative results, and do not
54	65	- include data on patients, port of kin or workers without healthears professional healthears
55	05	The sublity engenties of the budget the set of the test state of the test of test
50 57	66	 The quality appraisal of included literature indicated that 18 out of the 48 included studies
58	67	were considered low quality
59	68	
60	69	Words: 4892
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BACKGROUND

On March 12th 2020, the World Health Organization announced the novel Coronavirus disease (COVID-19) as a pandemic ¹². The pandemic caused serious challenges for healthcare systems worldwide³, including resource limitations (e.g., a lack of equipment, workforce and physical space), surges in the number of patients needing healthcare services, and rapid introduction of infection control procedures ⁴⁻⁶. Decisions had to be made faster than most systems were accustomed to. New work tasks and routines, as well as mastery of new equipment and new technical procedures, were rapidly developed and implemented ⁷. In response to these challenges, healthcare professionals were forced to adapt to ensure that healthcare service delivery was sustained.

Resilience in Healthcare (RiH) is about maintaining stability in the face of expected or unexpected changes, and the system's or the individual's ability to adjust or adapt to these changes or disturbances and return to a stable state 8. In healthcare, workers and leaders adjust work performance to situations as they arise to minimise the impact of system challenges on care delivery and patient outcomes. This ability to adjust or adapt is called performance variability and is described as "adjustments that are the basis for safety and productivity" ⁹. Healthcare professional's capability to respond and evolve is called adaptive capacity, and is defined as "adaptations based on reframing, aligning, coping and innovating, in response to external and internal demands from different organizational levels, in order to ensure quality of care" ¹⁰. RiH argues that performance variability is crucial to ensure system performance and patient safety in the context of a complex and everchanging healthcare system ^{11 12}.

Previous research

There has been a significant amount of research on many aspects of the COVID-19 pandemic including research on healthcare professionals' experiences during the pandemic ¹³⁻¹⁵, infection control and implications for healthcare quality ^{16 17}, recommended and executed measures related to the pandemic (e.g., how to reorganize care, how to apply telehealth/telecare) ¹⁸⁻²⁰ and physical and psychological outcomes of COVID-19 on patients ²¹⁻²³. However, there is limited research examining health personnel's adaptations (c.f. RiH) to the changes caused by the COVID-19 pandemic. RiH seeks to identify, and understand behaviours contributing to a system's ability to respond to the unexpected ²⁴. An increased understanding of adaptive human behaviour can contribute to improvement in current approaches to patient safety ²⁵

Aim and research questions

This study aimed to identify, review and synthesise qualitative literature on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic. Specifically, the study aimed to identify what adaptations was executed and why, from the perspectives of healthcare professionals²⁵. Using the PICO model (Table 1), the review addressed the following research questions:

1. What kind of adaptations were required from healthcare professionals during the COVID-19 pandemic, and why were they necessary?

2. What kind of performance variation did healthcare professionals experience as a result of these adaptations?

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Table 1: The PICO model ²⁶ 112

Participants	Healthcare professionals (definition provided in <i>Clarification of central concepts</i>)
Interventions/Exposures	The COVID-19 pandemic
Comparators	Performance variation before the pandemic
Outcomes	Healthcare professionals' experience of performance variations during the COVID-19 pandemic

114 **METHODS AND DESIGN**

115 Protocol and reporting

116 The protocol of this review was developed following the Preferred Reporting Items for Systematic review and Meta-Analysis—Protocols (PRISMA-P) 2015 checklist (Supplementary file 1) ²⁷. The 117 protocol (Supplementary file 2) has been registered with the Open Science Framework (OCF) register 118 (https://osf.io/pnhby)²⁶ 119

120 Eligibility criteria/study selection

The selection criteria are presented in Table 2. The review is limited to qualitative research, including 121 122 qualitative components of mixed-methods studies, as we sought to identify rich, in-depth information about health professionals' experiences, perceptions, and opinions which are best 123 124 captured through qualitative approaches ²⁸. In addition, qualitative research allows for identifying 125 data concerning performance variability and adaptive capacity in studies foci (e.g., other than RiH)¹⁰ 126 ²⁸. Research published in 2020 or later was included to capture studies about COVID-19. Grey 127 literature, reviews, commentaries, editorials, or other non-empirical materials were not included. 128 Eligible study populations included healthcare professionals, as defined in Table 2. Studies 129 investigating health professionals not providing direct formal care (e.g., policymakers, hospital 130 managers), other personnel working in hospitals/the primary healthcare service (e.g., porters or 131 cleaning staff), or patients and their next of kin were not included as this was beyond this studies' 132 scope. Only studies published in English or Scandinavian languages were included, as the native 133 languages of the author team.

58 59 60 134

135 Table 2. Selection criteria

Criteria Grouping	Inclusion criteria	Exclusion criteria
Participants/context	Studies involving healthcare professionals (as defined below) in somatic clinical settings, for example, hospitals, home care services, nursing homes, and	Studies involving psychiatric or psychological wards or services.
	general practitioner offices. A healthcare professional was defined as a person who maintains humans' health by applying evidence- based principles and procedures of medicine and	Studies involving healthcare professionals not providing direct formal care (e.g., hospital management, policymakers, ward leaders).
	example, nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants/care assistants, auxiliary nurses,	Studies involving non-healthcare personnel working in healthcare settings (e.g., porters, cleaning staff).

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	personal care workers, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwives, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although healthcare personnel working in psychiatric healthcare services are included in WHOs definition of healthcare professionals, they were not included in this review as the focus here was on somatic settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).	Patients, aged care residents, service users (e.g., people receiving home care services), their next of kin or other informal caregivers (neighbours, friends).
Exposure	Studies investigating the COVID-19 pandemic	Studies not concerning the COVID-19 pandemic.
	~	Studies investigating previous pandemics/epidemics (e.g., H1N1, Ebola, Zika).
Outcome	Studies including resilience triggers on a micro-level, for example, individual capacity (knowledge, competence, learning, behavioural strategies) and team/unit capacity (communication, collaboration, and learning), or	Studies investigating larger systems' adaptation capacity (infrastructure, regulation, framework).
	triggers on the macro-level, for example, organizational capacity (resources, organization, culture).	Psychological (individual) resilience, or lack of resilience. This includes psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with protective gear), or healthcare personnel's professional identity.
	Z.	Medical perspectives such as COVID-19 treatment regimes.
	C.	Studies not involving adaptive capacity, for example, studies only focusing on barriers and challenges (not solutions).
Language	English, Norwegian, Danish or Swedish.	Languages other than English, Norwegian, Danish or Swedish.
Year of publication	Studies published between 2019 and 2021.	Studies published before 2019.
Methods	 Studies applying qualitative methods, including qualitative data from mixed method studies. Studies published in peer-reviewed scientific journals. Case studies where adaptation to standard practises were discussed. 	Studies applying quantitative methods only.
Publication type	Peer-reviewed journal articles comprising empirical primary research.	Grey literature, for example, editorials, Government reports, comments, non- scientific publications, conference abstracts, theses/dissertations.

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The RiH Quality and Resilience Trigger tool developed by Aase et al. ²⁹ to screen research projects for
RiH relevance was used to guide the conceptualisation of RiH in the study selection. The RiH triggers
are listed in Table 3 and were particularly useful in identifying resilience elements in studies not
focusing on RiH, specifically. RiH elements that were identified by our review are marked in bold.

	141				
	142				
	140	Table 2. Desiliance triacers			
) 1 2 3 4 5 5	115	Adaptation Adaptation Trade-offs Improvisation Response Complexity Individual capacity (r	eam/unit eapacity eam/unit communication, earning) earnizational eapacity eresources, eam/unit eam/uni	Development Improvement Success Enhancement Growth Recovery Transformation Collaborative	 Stakeholder actions Knowledge- brokering Co-creation Contribution Information Engagement
'		(knowledge, o	rganization,	learning	Teamwork
3		competence, C	ulture)	Work practice	Changes
)		learning,	arger system anacity	Problem	Challenges
		characteristics.	nfrastructure,	solving	Disruption
2		cognitive,	egulation,	Interaction	
;		behavioural fr	ramework		
+		strategies)	onditions)		
; 7	144		Ň.		
3	145				
)) I	146	Data sources, search terms and sea	rch strategy		
2	147	Searches were conducted from Mar	ch to June 2021, using	; the academic databa	ses: Academic Search
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- Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.
- All full texts were evenly and randomly distributed amongst the two pairs of independent reviewers
 All full texts were evenly and randomly distributed amongst the two pairs of independent reviewers
 (MKG screened all publications and KL and EA screened 50% each). Inclusion/exclusion decisions and
 notes supporting the decisions were entered into a pre-designed data extraction form using
- Microsoft Excel (designed by KL). Any disagreement on inclusion decisions was discussed by each
 screening pair. If a consensus could not be reached between a pair, a third screener acted as
 arbitrator ³¹. Two more additional researchers were available for consultation if disagreements were
- 174 arbitration 1. Two more additional researchers were available for consultation in disagreements were available for con
- 14 177

15178 Quality assessment

All included studies underwent a blinded quality appraisal using the Clinical Appraisal Skills Program (CASP) for qualitative studies ³². The CASP enabled a systematic assessment of the trustworthiness, relevance, and results of published qualitative articles ³² The quality of the included studies was appraised by two pairs of independent researchers (with MKG appraising all studies). Disagreements were discussed by the pairs of reviewers after the blinded appraisal. The CASP tool does not include a scoring system of exclusion cut-offs ³³, and therefore, the 18 articles considered low quality were not excluded but were given less weight in the write-up of results ³³.

27 186

28 29 187 DATA EXTRACTION AND ANALYSIS

Data were extracted and quality assessment were conducted simultaneously by one reviewer (MKG), whilst a sample of the data extraction was validated by the co-reviewers ³⁴. The pre-designed data extraction form included publication details, setting details, participants, adaptations, and outcomes. All data of relevance to the research questions were extracted, including quotes (inclusive approach) ³⁴. The analysis was guided by Thomas and Harden ³⁵ three stages of analysis. Stages 1-2 consist of openly coding text and developing descriptive themes (conducted by MKG). Contrary to Thomas and Harden ³⁵ suggestion on coding we first pulled out the text relevant to the research question (as suggested in other thematic analysis literature, e.g., Braun and Clarke ³⁶, before conducting line-by-line coding. Free codes without hierarchical structure were developed, and new codes were added if necessary. This process is referred to as the translation of concepts between studies ³⁵. After the coding process was finalized, the codes were reviewed to check for consistency in interpretation, and to consider the need for additional coding levels. During this process, 34 codes were identified. Differences and similarities between the semantics of codes guided the grouping of codes into a hierarchical tree structure ³⁵. To capture the meaning of groups of codes from the initial coding process, new codes were created (initial cohesive codes were gathered under new appropriate code names), which were then gathered into descriptive themes (see Figure 1. Example of analysis Theme 1, step 1-3). The five identified themes were reviewed by the research team. Stage 3 consisted of generating analytical themes, aiming to "go beyond the findings of the primary studies, and generate additional concepts, understandings and hypothesises" ³⁵. This was conducted as a cyclic process where theme suggestions were processed and refined in multiple rounds. Finally, two main themes, approved by the research team, were identified.

56 209

5960 211 INSERT FIGURE 1. Example of analysis Theme 1, step 1-3

1		
2	212	Detient and will's involvement
4	212	Patient and public involvement
5	213	No patients, patients' next of kin or healthcare personnel other than physicians participated in this
6	213	study
7 0		Stody.
0 9	215	
10		
11	216	RESULTS
12	217	The review resulted in the inclusion of 48 articles (see Figure 2, PRISMA flow diagram and
13 14	218	Supplementary file 5: overview of included studies and quality assessment). The analysis resulted in
15	219	two main themes with five affiliated sub-themes. The results are presented according to identified
16	220	themes and sub-themes.
17		
18	221	
19 20	222	INSERT FIGURE 2 PRISMA flow diagram
21	~~~	
22	223	
23	224	Covid 19 has driven an increased need for individual capacity as well as team capacity to handle
24	224	extreme changes in working conditions
25 26	225	extreme changes in working conditions
27	226	The first theme demonstrated an intensified need for health professionals to handle increased
28	227	responsibilities. At the same time, they were adjusting to constant changes in the organization and
29	228	adapting existing-, as well as creating new collaborations, to handle changing needs.
30 31	220	
32	229	Landling increased responsibilities on an individual level
33	230	Multiple studies highlighted how reless abruptly changed or expanded because of the pandemis and
34	251	described the required adaptations that followed ^{37,45} For example, several studies found that health
35	252	professionals' adjustional roles had become intensified 42 43 45. This included an increased need to
37	235	educate and inform patients about necessary precautions to reduce infection risk ^{42,45} and increased
38	234	responsibility in conveying information from local or nationwide authorities ⁴³
39	235	responsibility in conveying information nonnocal of nationwide autionties .
40	236	Similarly, other studies ^{40 46} reported that health professionals functioned as <i>the patients' lifelines to</i>
41 42	237	the outside world and were filling in the gap of absent relatives by comforting end-of-life patients.
43	238	One study found that newly educated nurses suddenly had to function as the senior professionals,
44	239	even though they were having their first care experiences with COVID-19 patients ⁴⁷ . Nurses also
45	240	reported that they adapted by taking on multiple roles as dietitians (delivering meals), respiratory
46	241	therapists (administering nebulizers) and environmental services (emptying trash bins), because the
47 48	242	primary groups normally responsible for these tasks visited patient rooms less often during the
49	243	pandemic ⁴⁴ . Pharmacists joined the hospital's infection disease team, previously only staffed by
50	244	physicians, to provide expert opinion and guidance on the use of potential treatments for COVID-19
51	245	38.
52 53	246	These changes in health professionals' roles were closely linked to an increased professional role
55 54	240 217	identity ⁴⁸ as they now to a much larger degree, had to function as independent decision makers ⁴⁰
55	241 210	⁴⁸ Many teams had to reorganize themselves to handle the pressure in the healthcare convice. ^{37,39,44}
56	240 210	⁴⁹⁻⁵⁴ This was found to be the case for bospital wards. CD offices /clinics, specific treatment teams
57	243 250	(a.g., diabetes teams) nursing groups and pharmacies. Self-reorganization consisted of forming
58 59	230 251	(c.g., unable constructions), nursing groups and pharmacles. Set reorganization consisted of 10111111g specific teams caring for COVID-19 patients only 49 taking responsibility for task distribution 49
60	201 250	developing appropriate pursing plans for COVID-10 patients holding regular case based cominars ⁵¹
	252	developing appropriate nursing plans for COVID-13 patients, noruning regular case-based seminars

and rearranging facilities to improve infection control ⁵³. Self-reorganization was reportedly needed as the new workflow was unclear ⁵², strategies to care provision were inefficient ⁴⁴, guidelines lacked on how to act ⁵⁰ and the work environment became unstructured and difficult to handle ³⁹. Because health professionals had often not received formal training for many roles (including the expansion of roles), they organized their own education to handle new challenges related to COVID-19 patients. They held training sessions on correct personal protection equipment (PPE) use, shared their acquired knowledge with other health professionals (sometimes acquired from trying and failing), discussed clinical cases with each other, and shared knowledge via social media or by sharing self-produced informational videos ^{47 50 55 56}. They also searched for knowledge by watching YouTube videos and seeking online courses and scientific articles ^{48 55}, reportedly leading to a steep learning The literature frequently reported limited staffing and resources ^{47 58}. Consequently, health professionals were required to handle both expected and unexpected forms of resource limitations, including rationing supplies such as PPE and disinfectants, and redistributing tasks between nurses ⁵³ ^{59 60}. Several studies reported that health professionals turned to non-traditional alternatives to cope with staffing and resource limitations 44 50 52 53 55 59 61. For example, some washed and reuse face masks, while others purchased their own masks because they lacked equipment at work. Some healthcare professionals made their own equipment out of uncertified materials, used painters' masks, printed face shields, or obtained missing equipment through social contacts ^{55 59 61}. One study reported that physicians used unorthodox therapies or nontraditional approaches to care delivery that could be suboptimal or potentially harmful, to avoid having to deny treatment to some patients

Adapting to constant organizational changes

curve during COVID-19 37 47 48 51 57.

Closely related to changes in roles, several studies found that health professionals experienced an increased workload; a changed work scope; changes in workflows, guidelines, work tasks; and had to familiarize themselves with new equipment. The increased workload was a consequence of rising patient numbers, reduced staff, and/or the absence of new hires to reflect the increased workload. For example, staff guarantine requirements forced other staff to take on additional workloads which again required additional work in managing new settings or redeployed staff ^{40 62}. Additionally, health professionals were forced to handle unfamiliar tasks that would normally be done by other health professionals ^{63 64}. For example, surgical nurses became medical nurses ⁵¹, and nurses were transferred from other hospitals and wards with new guidelines and routines ⁴⁸. One study described that a teacher in a medical school was forcefully assigned to treat COVID-19 patients without having the practical knowledge of doing so 55. Changes in work tasks led to feelings of uncertainty and frustration ⁴³. For example, GPs described how their treatment focus had changed towards acute illness and the likely manifestations of COVID-19 infections, while monitoring chronic conditions was seen as less of a priority ⁶⁵.

Constant changes in guidelines caused confusion and insecurity ⁵⁰. There were descriptions of frequent protocol changes, lack of consistency in protocols between healthcare services, and sometimes contradictory indications, leaving health professionals uncertain of what their tasks were ^{38 50 60}. Some adapted to this by starting every day by carefully reading emails to check for changes in protocols and procedures ⁴⁷.

59.

Adapting collaboration to changing needs

1 2 3

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The new challenges that arose in the tide of COVID-19 were reported to lead to better collaboration

4	298	between healthcare professionals as well as across healthcare services. Growth of personal
5	299	relationships and trust, a general willingness to take on other tasks and responsibilities, increased
7	300	solidarity, creation of common protocols across hospitals, and clear agreements on the distribution
8	301	of care were some of the mentioned benefits ^{37 43 66} . Moreover, new non-traditional team
9	302	compositions were created with different departments and health professionals collaborating in
10	202	unusual ways (e.g., collaboration between physicians, caregivers, physiologists, bousekeepers
11	204	instance and technicians). Come studies reported that the feeling of working towards a common goal
12	304	Janitors, and technicians). Some studies reported that the reeling of working towards a common goal
13	305	blurred the hierarchy between the different professions, fostering new and strengthening existing
14	306	work relationships 44 47 62 67. While other studies reported the opposite 42 43 56. For example, home
15	307	palliative care professionals 68 felt that the connection between the healthcare services was lost, as
17	308	their affiliated hospital had been turned into a COVID-19-only hospital.
18	309	
19		
20	310	Covid-19 has led to changes in healthcare organizations which better support health professionals'
21	311	need to implement adaptations
22	212	The second theme described major ergenizational adaptations to handle the challenges of COVID 10
23	312	The second theme described major organizational adaptations to handle the chanenges of COVID-19.
24	313	Consequently, nealth professionals had to adapt to these changes, including managing increased use
25	314	of technology to provide healthcare.
20	315	Overall organizational efforts to handle COVID-19 challenges
28	316	Many studies reported that health professionals experienced rapid changes at their workplace as
29	217	organizations adapted in response to COVID 10 shallonges. Organizations found alternative ways of
30	210	tria sing and accessing notice to covid-19 channeliges. Organizations found alternative ways of
31	318	triaging and assessing patients' needs 3000 and reorganized their physical space to reduce the risk of
32	319	infection (e.g., rearranging waiting rooms or removing unnecessary materials in consultation rooms
33	320	to prevent contamination) ⁴³ . Several studies reported transitioning to digital solutions to provide
34	321	patient care and minimize staff exposures to the virus 65 68-71. In a methadone clinic, health
35	322	professionals described telemedicine as a game changer, and the future of medicine 69. In a maternity
37	323	ward, the rapid development of telehealth increased healthcare access for many women, although
38	324	they depended on reliable access to a phone, video, and the internet. Pharmacists expressed that
39	325	virtual witnessing and assessing of medication could decrease delays and reduce travelling for both
40	326	patients and providers ⁶⁸ . In one study, midwives started practicing case loading (one designated
41	327	midwife caring for one woman throughout the childhearing continuum) which facilitated meeting
42	328	women's needs and resulted in a positive professional experience 7^1 Similarly, nursing home staff
43	220	implemented a primary purcing model which enabled them to provide all around care for their
44	229	nuplemented a primary nursing model which enabled them to provide an-around care for them
45 46	330	patients ". This had previously been impossible because of unravorable nurse-to-patient ratios. A
47	331	fourth example was the introduction of a differentiated labor practice model, which enabled
48	332	pharmacy technicians to pivot rapidly away from multitasking, thereby enhancing resilience and
49	333	improving workplace conditions for staff ⁷² .
50	334	Several studies described that COVID-19 had paved the way for changes in healthcare, which
51	335	previously had been thought impossible ^{54 68 71} , including larger organizational changes. For example,
52	336	leadership modification ⁶¹ , conversion of hospital wards to covid wards ^{37 73} , development of new
53	337	protocols and triage algorithms ⁴¹ and introduction of mobile consultation services ⁷⁴ . Although these
54 55	338	measures were deemed necessary to cope with the covid outbreak, they sometimes created
56	339	confusion, frustration, and logical challenges for healthcare professionals ^{50 71 72} .
57		
58	340	
59	2/11	Managing new and increased use of technology to provide healthcare
60	741	wanaging new and increased use of technology to provide healthcare

Several studies highlighted a spike in the use of different technologies to enable the provision of patient care in different settings ^{38 45 53 54 57 58 68 71 74-77}. Dunleavy and colleague's ⁵⁴ described the adoption of new technology to manage diabetes care during the pandemic such as the use of web-linked glucometers, electronic patient records, online referral systems, and video conferencing tools. These technologies enabled the diabetes teams to identify and consult on patients' needs more rapidly and enabled remote consultation ⁵⁴. As previously stated, telehealth was used by health professionals to continue patient treatment and support patient care teams ^{38 53}. For example, pharmacists ³⁸ and physiotherapists ⁷⁵ made instructional videos to support their patients. One nursing home used Zoom to carry out multidisciplinary rounds/mortality rounds and opened a WhatsApp messaging group to effectively exchange information among health professionals. They also conducted a virtual saying goodbye for terminal patients using open-source video conferencing software ⁵⁴. Several other studies described the use of digital tools to maintain patients' social care when patients were not allowed visitors ^{40 48 60 78 79}.

DISCUSSION

This systematic review demonstrated how COVID-19 triggered multiple adaptations by health professionals to ensure the provision of healthcare services during the pandemic. Health professionals adopted new roles, were given increased organizational responsibilities, and coped with resource limitations. Consequently, health professionals' workload increased, their work scopes and workflow changed, and they learnt to use new equipment while guidelines constantly changed. There were reports of silver linings, for example, increased collaboration between healthcare professionals within and across organizations, as well as changes in the healthcare system to better support healthcare workers' needs.

The resilient healthcare service - adaptations and preparedness

Adaptions identified in this review ^{37 38 44 46 50 63 80} were crucial in maintaining healthcare service delivery during the pandemic, for example, covering shifts due to staff shortages, allowing existing personnel to fill necessary roles, handling new procedures, and reorganizing workspaces to reduce the spread of the virus. Many healthcare systems were able to adjust to a somewhat stable state during the pandemic due to the extensive adaptations by staff, teams, and organisations to the new demands, with some systems adapting more effectively than others.

According to RiH theory ⁸¹, adaptations can be triggered by different factors in the system. These factors may be both internal (e.g., resources, staffing, competence) and external (e.g., budget cuts, regulatory demands)⁸¹. Our review identified examples of adaptations triggered by both internal and external factors with health professionals experiencing a lack of competence, resources, staffing, equipment, information, and guidelines ^{38 47 50 55 63 71 80}. These factors forced health professionals to seek new ways of coping to be able to sustain required performance ⁸¹.

Health professionals' adaptive capacity was found to significantly contribute to the system's resilience. However, system preparedness is also critical for system resilience. The included studies reported varying degrees of preparedness across the different healthcare services. Some health professionals spoke positively about how they had managed to come together and make things work ^{39 47 79}, while others spoke of extreme resource shortages and being overworked ^{41 53 60}. In this context the large variations in how different countries were affected by the pandemic, for example, related to spread of infection in the population, differences in population size, proportion of older adults in the population, population density, and how well-developed a countries' healthcare system was to begin with, must be considered. Thad said, according to Hollnagel⁸², a system must have some sort of readiness if something unexpected happens (e.g., resource allocation to match the

needs of the expected event) to be considered resilient ⁸². A resilient system should further cover
 four resilience potentials (responding, monitoring, anticipation, learning) (Box 1) ⁸².

392 Box 1. Resilience potentials

Resilience potentials

i) **Knowing what to do** (how to <u>respond</u> to disruptions and disturbances by adjusting normal functioning); *ii)* **Knowing what to look for** (<u>monitor</u> what is, or could be future threats); *iii)* **Knowing what to expect** (how to <u>anticipate</u> developments of and threats further into the future); and iv) **Knowing what has happened** (how to <u>learn</u> from experience, particularly the right lessons from the right experiences⁽⁸¹⁾.

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The reported experiences with everchanging guidelines and procedures, as well as limited resources (i.e., staffing and equipment) suggests that most healthcare systems did not have the capacity, or the right measures in place to respond adequately to the disturbance (COVID-19). Similar descriptions have been found in other studies ⁸³⁻⁸⁶. Despite the lack of preparedness of the system, the literature reported significant amounts of adaptive capacity among healthcare professionals, supporting Wear's ⁸⁷ claim that people are the most adaptable element in any complex work system. The adaptations needed to handle the COVID-19 pandemic, should be used for learning and preparation for near and future threats ⁸². As we are still *learning* from this pandemic it is important to understand the adaptations that worked well⁸². Data and learnings from these instances will ensure a more resilient healthcare service when encountering future disturbances such as new pandemics 88.

³⁴ 405 Adaptations – the good, the bad, and the ugly

Some adaptations are effective solutions that can function long-term, thus strengthening the healthcare service and in some instances, resulting in innovations⁸¹. This aligns with RiH characteristic of *learning from what goes well*¹². Although the distinction between long-term adaptations and sustainable innovations was somewhat unclear in the included literature, several of the measures set in place as a response to the pandemic were deemed helpful by health professionals. For example, the introduction of telemedicine and other assistive technology were particularly viewed positively 59 68 71 89, as well as new care models, new procedures, new systems, and new working models ^{45 48 72}. Overall, the focus on innovation development in healthcare had to increase rapidly in response to the COVID-19 pandemic ⁹⁰⁻⁹³, despite the challenges that innovations in healthcare have met in the past ⁹⁴. Successful, targeted innovations can, in the long run, contribute to more effective, more cost-effective and safer healthcare services ^{95 96}, learning from the good adaptations and innovations that COVID-19 brought with it is therefore of great interest for future healthcare services. However, adaptations set in place as survival mechanisms, so-called fire-fighting ⁹⁷ was also identified in the studies (e.g., reuse of PPE) ^{41 50 55 61}. These types of adaptations are often short-time solutions and may have negative impacts on both the healthcare system and healthcare professionals⁸¹. Fire-fighting adaptions can create a false impression of success because it gives the

- illusion that a system is performing better than it is ⁸⁷. Conversely, continuous adaptations to poorly
 functioning systems can be exhausting for the people working within them ^{50 52 71}, resulting in
- 425 inefficient and potentially hazardous systems ⁸⁷.

According to Woods ⁹⁸, all systems have a range of how much they can adapt to unexpected events

based on the resources they hold and the already existing variation in the system. When a system is pushed towards, or over its range of performance, the system can either adapt and expand its performance beyond its range, or it can result in a rapid fall in performance. Woods calls these opposites graceful extensibility and brittleness, where brittleness is the opposite of resilience. A resilient system will handle unexpected changes with graceful extensibility and be able to expand its adaptive capacity when unexpected events happen, while non-resilient systems will not be able to handle being pushed past their performance range, and experience a system collapse (brittleness) 98. The distinction between brittleness and graceful extensibility depends on the general preparedness of a healthcare system and is a reminder of the need to prepare healthcare systems for future crises. How did rapid changes become possible? The path to becoming a more functional and prepared healthcare system includes system-level changes. However, introducing sustainable changes into a system (for example, delivering care in line with new evidence) has in the past proven difficult ⁹⁹. Included studies, however, found that changes that had previously been impossible due to rigid systems became possible in the wake of the pandemic ^{48 54 68 71}. The pandemic created the window of possibility to explore how rapid changes in healthcare systems can be possible. Nilsen et al. ¹⁰⁰ identified three characteristics of successful change: (1) having the opportunity to influence change, (2) being prepared for the change, and (3) valuing the change. Many of the adaptations identified in this review were introduced by frontline health professionals. Opportunities to influence change came when personnel experienced pressure to find novel solutions and adopt high-responsibility roles. Additionally, existing hierarchy in healthcare systems was described to have vanished as health professionals were working towards a common goal ^{44 47 62 79}. The blurring of hierarchy and the development of new collaborations lead to breaches of organizational silos ^{39 49 74}, as well as closer collaboration within existing teams ^{37 42 56 79}. There were descriptions of new team mixes, new collaborations between health professionals from different hospitals ³⁹, and strengthened relationships, collaborations, solidarity, and trust within existing teams ^{37 44 79}. The change was valued, with increased opportunities to discuss problems and find solutions more openly and across hierarchies. The experience of partnership is a crucial factor when making changes or improvements in healthcare systems ¹⁰¹. This is supported by Gergerich and colleagues ¹⁰² who describe the need to work as a team outside the normal hierarchy to successfully make transformation or change, and is in line with research findings showing that humans who experience acute social stress engages in more prosocial behavior such as trust, trustworthiness, and sharing ¹⁰³. Overall, the COVID-19 crisis created the context for partnerships between health professionals to develop through a common goal, and demonstrated that increased collaboration, cooperation, and inclusion across and within professions, roles and hierarchies were crucial to effectively introduce changes into the healthcare system. **STRENGHTS AND LIMITATIONS** This review protocol was registered at the open science framework (OSF) and followed the PRISMA-P checklist. A comprehensive search strategy was employed to identify studies focusing on healthcare personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic. Limitations of the current study stem from our pragmatic choices to not include grey literature and not rerun the search before publication. That said, there are argues that a more purposeful sampling approach aiming to provide a holistic description of a phenomenon, rather than to identify all eligible studies might be more appropriate in qualitative literature reviews ¹⁰⁴

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5 4	4/1	The published literature examining the adaptations made by health professionals may be shaped by
5	472	publication bias, with negative results less likely to be published and the act of publishing in
6	473	academic journals outside of the health professionals' role.
7 8	474	
9	475	CONCLUSION
10 11	476	The COVID-19 pandemic created tremendous disturbances in healthcare systems worldwide,
12	477	demanding rapid adaption to comprehensive changes. COVID-19 triggered the rapid reorganization
13	478	of healthcare services, and through these changes, healthcare systems and health professionals
14	479	demonstrated a significant adaptive capacity. Many of the changes driven by the pandemic led to
15	480	positive and useful alterations to the healthcare system, potentially creating foundations for
16	481	healthcare innovation and sustainable change. The pandemic also exposed weaknesses in healthcare
17	482	system design and capacity ^{105 106} , forcing health professionals to make dysfunctional and potentially
18	483	harmful adaptations. Crucially, few healthcare systems were properly prepared for a pandemic
20	484	event, which does not align characteristics of a resilient healthcare system. The COVID-19 pandemic
20	485	experience represents an opportunity to learn about how our healthcare systems respond to
22	486	unexpected challenges that linger, and how we might build resilient health systems globally ^{107 108} .
23	487	
24	488	Acknowledgments
25	489	The authors acknowledge the University of Stavanger for using their library database for this
26	490	research.
27	491	
20	492	Autor contributions
30	493	MKG, EA, KL, DB and SW participated in the development of the review protocol. MKG and EA
31	494	developed the search string, and MKG, EA and KL conducted the pre-screen to ensure consistency in
32	495	inclusion/exclusion criteria. KL designed the pre-designed data extraction form. Title, abstract and
33	496	full-text review where individually conducted by MKG, EA, and KL, as was the quality appraisal of the
34	497	included studies. SW and DB were available for consultation and provided advice during the
35 26	498	screening process. The analysis was conducted by MKG and was approved by the review team. Lastly,
30	499	MKG prepared the manuscript and EA, KL, DB and SW reviewed and edited.
38	500	
39	501	Competing interests
40	502	The authors have no competing interests to declare
41	503	
42	504	Funding
43	505	The publication fee was covered by the University of Stavanger. The funding body was not involved in
44 45	506	the research process or in writing the manuscript
46	507	
47	508	Data sharing
48	509	Overview of article quality assessment will be provided upon request to corresponding author. All
49	510	other data are freely available
50	511	Ethics anarousl
51	512	Etnics approval
52 53	513	This study does not involve human participants and ethical approval was not required
55 54	514 515	
55	516	Figure 1. Example of analysis Theme 1. step 1-2
56	510	Figure 2. DRISMA flow diagram
57	510 510	I BUIC 2. FINDIVIA HOW UIABIAHI
58	510	Supplementary file 1 Protocols (PRISMA_P) 2015 checklist
59	520	Supplementary file 2. The original protocol of the study
00	520	Supplementary file 2. The original protocol of the study

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3	521	Supplementary file 3. Overview of searches				
4	522	Supplementary file 4. Overview of excluded articles and reason for exclusion				
5	523	Supplementary file 5: Overview of included articles and quality assessment				
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2	PRISM	MA 20	020 Checklist	
3 1 -	Section and Topic	ltem #	Checklist item	Location where item is reported
5	TITLE			
7	Title	1	Identify the report as a systematic review.	Title
3	ABSTRACT			
)	Abstract	2	See the PRISMA 2020 for Abstracts checklist.	х
0	INTRODUCTION			
1 1	Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3
Z	Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3
4	METHODS			
5	Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
6 7	Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted identify studies. Specify the date when each source was last searched or consulted.	Page 6
8	Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used	Sup. File 1
9 20 21	Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many including how m	Sup. File 2, Table 2 and page 4 -5
22 23 24	Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each repert, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, deta of automation tools used in the process.	Page 7-8
25 26	Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with gach outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which gesues to collect.	Page 7 -8
27 28		10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, and g sources). Describe any assumptions made about any missing or unclear information.	Page 4 and 13
80 81	Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 7 and sup. File 2
32	Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 8 - 10
83 84 85	Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the stude intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 6 – 7 and sup. File 2
86 87		13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing sumpary statistics, or data conversions.	N/A
88		13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Fig. 1
39 10		13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Fig 1. And page 7-8
11		13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analy as, meta-regression).	N/A
+2 12		13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 7 -8
14 15	Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting bias). For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	Page 13 -14



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PRISMA 2020 Checklist

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PRIS	MA 20	020 Checklist	y copyrig	Sen-2023-(
Section and Topic	ltem #	Checklist item	nt, inclu	071828	Location where item
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	uding f	8 20 20	NA
RESULTS			or u		
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search the review, ideally using a flow diagram.	tes r	number of studies included in	Figure 2.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they	w ei Ee	zcluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	ement ed to	023. D	Sup. 4
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Superieur text and da	ownloadeo	Overview of quality assessment on request
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) (e.g. confidence/credible interval), ideally using structured tables or plots.	()#BES anir	t estimate and its precision	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	s) . Jing, Al trai	http://bmic	Overview of quality assessment on request
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summa confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the summa confidence/credible interval and measures of statistical heterogeneity.	ar y est e cti on	mate and its precision (e.g. of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	and	3	page 8 - 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	sir	ŝ	Page 13 -14
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis	asses	ed.	Page 13 -14
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	r techr		Page 13 - 14
DISCUSSION			0		
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	, gies.	. 2025	Page 11 - 13
	23b	Discuss any limitations of the evidence included in the review.		at Ac	Page 13 - 14
	23c	Discuss any limitations of the review processes used.			Page 13 - 14
	23d	Discuss implications of the results for practice, policy, and future research.		Bib	Page 14
OTHER INFORMAT	TION			0	
Registration and	24a	Provide registration information for the review, including register name and registration number, or state that	the re	wew was not registered.	Page 4
protocol	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.		Ď.	Page 4

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1	PRISMA PRI	SMA 2	020 Checklist	v convria	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	
3 4 5	Section and Topic	ltem #	Checklist item	nt. inclu	74838	Location where item is reported
6	Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in	he r	ęview.	Page 14
7 8	Competing interests	26	Declare any competing interests of review authors.	a for L	0 0	Page 14
9 10 11	Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection form studies; data used for all analyses; analytic code; any other materials used in the review.	Enseigne	a extracted from included	Page 14
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13 14 15 16	From: Page MJ, Mcł	Kenzie JE, I	Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting system For more information, visit: <u>http://www.prisma-statement.org/</u>	at Superie	eviews. BMJ 2021;372:n71. doi: 10	.1136/bmj.n71
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Resilience in healthcare during the COVID-19 pandemic: A protocol for a qualitative systematic literature review

Background

The 12th of March 2020, The World Health Organization announced the novel Coronavirus disease (COVID-19) a pandemic due to the growing numbers of countries affected by the viral respiratory infection (WHO, 2020a). The virus was discovered in December 2019 after an accumulation of patients with viral pneumonia in the city of Wuhan, People's Republic of China (WHO, 2020b). By 8th of February 2021, there were reported over 100 million confirmed cases of COVID -19 infections worldwide, with over 2 million confirmed deaths (Worldometer, 2021), and these numbers are still increasing. The pandemic has caused great challenges for healthcare systems worldwide (Khalid & Ali, 2020) including limited resources (e.g. lack of equipment, staff or physical space), a surge of patients needing healthcare services, and the need to reorganize parts of the healthcare system to maintain infection control. Additionally, healthcare workers have been forced to handle new work-tasks, master new equipment and new technical procedures (Liu et al., 2020). All these aspects have forced healthcare personnel to make major adjustments to changes induced by the pandemic, both on organizational- and individual-levels.

Resilience in Healthcare (RiH) is about maintaining stability in the face of expected or unexpected changes (e.g. changes induced by the Covid-19 pandemic) and the systems' or the individual's ability to adjust or adapt to these changes or disturbances, and return to a stable state (Wiig & Fahlbruch, 2019). In this perspective the ability healthcare workers have, to adjust to the situation they are in (e.g. master new equipment in a short time), are what makes the healthcare system function, both during normal operation and under special circumstances. The ability to adjust to expected and unexpected events is called performance variability, and is according to RiH, crucial to ensure adequate performance, and maintain patient safety, due to the complex and everchanging nature of the healthcare system (Hollnagel, 2015; Hollnagel et al., 2015). An important aspect of RiH is further, to observe and understand the thing that goes well when everyday adaptations are being made. This is needed to understand the things that do not go well (e.g. adverse events), which is a different perspective than traditional patient safety work, were the main focus has been on the thing that goes wrong (Jeffcott et al., 2009).

In the context of the COVID-19 pandemic, which brought with it a cascade of changes and new challenges (e.g. pressured resources, increased patient flow, unknown medical procedures), performance variability is about making adjustments to the current situation and keep the healthcare services running in a safe and professional manner, despite these changes and subsequent challenges (Jovanović et al., 2020).

Despite the novelty of the COVID-19 pandemic, large amounts of research on the topic has already been conducted. This includes research on healthcare personnel's experiences during the pandemic (Chamboredon et al., 2020; Halcomb et al., 2020; Xu et al., 2020), infection control and implications for healthcare quality (Coma et al., 2020; Kirkevold et al., 2020) recommended and executed

measures related to the pandemic (Krist et al., 2020; Mills et al., 2020; Morreel et al., 2020) and studies about physical and psychological outcomes of COVID-19 patients (Carfi et al., 2020; Sahoo et al., 2020; Wang et al., 2020). There are in other words much evidence on the different aspects of the pandemic, and how it affects the healthcare service, healthcare professionals and patients. As of our knowledge, limited research have, however, directly targeted health personnel's ability to adapt (c.f. Resilience in Healthcare) to the changes induced by the COVID-19 pandemic. Moreover, RiH's positive outlook on how health professionals handle challenges in the delivery of healthcare (focusing on the things that goes well, rather than focusing on the things that do not work), is an important perspective to illuminate in a time where health personnel's efforts has been extraordinary. Lastly, increased knowledge on how health personnel handled, and adjusted to, changes induced by the COVID-19 pandemic situation is useful in understanding how patient safety is being maintained in unanticipated situations and can be beneficial in handling future similar situations.

The aim of the study is to identify and review qualitative studies focusing on healthcare personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic. Moreover, the systematic review aims to identify what adaptations are being executed and why, from the perspectives of health personnel's experiences.

Methods and design

This protocol was developed in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis—Protocols (PRISMA-P) 2015 checklist (Moher et al., 2015). The protocol will be registered with the Open Science Framework (OCF) when approved by all authors.

Review question

The review will be conducted as a qualitative systematic review to answer the research question:

What kind of adaptation were required from healthcare professionals during the COVID-19 pandemic? What kind of performance variation did healthcare professionals experience resulted from these adaptations?

The components of PICO are as following:

Participants: Healthcare professionals

Interventions/Exposures: The COVID-19 pandemic

Comparators: Performance variation before the pandemic

Outcomes: Healthcare personnel's experience of performance variations during the COVID-19 pandemic

Qualitative systematic reviews integrate or compare findings from qualitative studies, and further, look for themes or constructs in and across individual studies (Booth et al., 2016). A qualitative systematic review design will allow for the identification of a wide range of valuable experiences of adaptations in response to the COVID-19 pandemic, as qualitative research is used to explore meanings of social phenomena (changes induced by the COVID-19 outbreak) as experienced by individuals (healthcare professionals) in their natural context (the healthcare services) (Malterud, 2001). This will enable us to provide an in-depth understanding of the meanings health professionals assign to changes induced by the pandemic and the required adjustments to these changes

(Holloway & Galvin, 2017). Synthesizing qualitative evidence, further, provides an opportunity for interpretating and identifying new knowledge of subjectivity and meaning in qualitative studies (Malterud, 2017), implying that interpretation of existing qualitative data will provide an opportunity to find other meanings i.e., finding data about performance variation (c.f. resilience in healthcare) in studies not necessarily having this as the main focus.

Eligibility criteria

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All primary, qualitative studies coved by the selection criteria (Table I. Selection criteria) will be eligible for inclusion. Quantitative studies are considered non-eligible in this review due to their inability to cover the "outcome" (i.e., identify in-depth information about health personnel's experiences) and because quantitative studies limit the possibility for new interpretations of health professionals experiences, and the possibility to identify data about adaptive capacity in studies with other main focuses'. Studies conducted before 2019 will not be eligible as the "exposure" (COVID-19), cannot be addressed. Grey literature, including reviews, commentaries, editorials or other nonempirical materials will not be included. Eligible study populations will include healthcare professionals within the definition stated below. hospital Studies concerning health personnel not providing direct formal care (e.g., policy makers, hospital managers), other personnel working in hospitals/the primary healthcare service (e.g., porters or cleaning staff) or patients and their next of kin will not be included in the review. Studies written in other languages than English, Norwegian, Swedish, or Danish will not be included as these are the languages mastered by the research team.

Clarification of central concepts

A healthcare professional is in this context defined as a person who maintain human's health through applying principles and procedures of evidence medicine and caring. Health professionals provide advice and apply preventive and curative measures (WHO, 2013). Examples of healthcare professionals are: nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwifes, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although health personnel working in psychiatric healthcare services are included in the healthcare professional definition, they will not be included in this review as the focus here is on somatic healthcare settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).

RiH Quality and Resilience Trigger tool will help circling eligible studies involving adaptations cf. Resilience in Healthcare. This tool was developed by Aase et al., (2020) to screen research projects for RiH relevance as a part a large longitudinal, cross country study. RiH is in this context, connected to actions, activities, and processes (resilience as a verb). RiH trigger tool, consist of a double screening process, were the first part involve identifying on or more of the four quality dimensions (patient experiences, patient safety, clinical effectiveness and care coordination) and the second part involve identifying eventual resilience triggers such as:

- Adaptation
- Variation
- trade-offs

- Development
- Improvement
- success

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- improvisation •
- response •
- complexity •
- Individual capacity (knowledge, • competence, learning, personal characteristics, cognitive, behavioral strategies)
- Team/unit capacity (communication, ٠ collaboration, learning)
- Organizational capacity (resources, organization, culture)
- Larger system capacity (infrastructure, ٠ regulation, framework conditions)
- Changes •
- Challenges •
- Disruption •

- enhancement •
- growth
- Recovery
- Transformation
- Collaborative learning
- work practice
- teamwork
- problem solving
- interaction
- Stakeholder actions
- knowledge-brokering
- co-creation
- contribution
- information
- engagement •

Table	I.	Se	lection	criteria
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ChallengesDisruption	engagement		
able I. Selection criteria	33		
Criteria Grouping	Inclusion criteria	Exclusion criteria	
Participants/ context	Studies involving healthcare professionals (as defined above) in somatic clinical settings e.g., hospitals, home care services, nursing homes, General practitioners (GP) offices.	Studies involving psychiatric wards/institutions.	
	Studies involving nurses, certified nurse assistants (CNA), healthcare assistant, nursing home physicians, pharmacists, physiotherapists, assistants, Licensed practical	Studies involving healthcare personnel not providing direct formal care (e.g., hospital management, policy makers, ward leaders)	
	nurses (LPNs), or other healthcare personnel working in clinical settings	Studies involving other personnel working in healthcare settings providing other services than direct formal care (e.g., porters, cleaning staff, management)	
		Patients, aged care residents, service users (e.g., people receiving home care services), their next of kin or other informal care givers (neighbors, friends)	

Exposure	Studies investigating the COVID-19 pandemic	Studies not concerning the COVID-19 pandemic
		Studies investigating previous pandemics/epidemics (e.g.,
Outcome	Studies including resilience triggers on a micro-level e.g., individual capacity (knowledge, competence, learning, 	H1N1, Ebola, Zika) Studies investigating Larger systems' adaptation capacity (infrastructure, regulation, framework)
		Psychological (individual) resilience or lack of resilience, such as psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with protective gear), or healthcare personnel's professional identity.
		Medical perspectives such as COVID-19 treatment regimes

		Studies not involving adaptive capacity such as studies only focusing on barriers and challenges (not solutions)
Language and year of	English, Norwegian, Danish or	Other languages
publication	Swedish	
		Studies published before 2019
	Studies published between	
	2019 and 2021	
Method	Studies applying qualitative	Studies applying quantitative
	methods that are published in	methods. Grey literature, e.g.,
	peer-reviewed scientific	editorials, comments, non-
	journals	scientific publications

Data sources, search terms and search strategy

The search strategy will involve searches in the databases: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science direct and Scopus using the key words and MESH terms listed in Table II. These were identified through the National Library of Medicine's (NIH) Medical Subject Headings (MeSH) browser, an electronic thesaurus (www.thesaurus.com, 2021), through years of studying RiH literature, and initial searches conducted by MKN (Fig 1. provides an example of a possible eligible study identified in the initial searches). After conducting searches in the listed databases, secondary searches will be conducted in the included articles (a review of the reference list of included articles in the search for eligible articles), and moreover, hand searches will be conducted in current journals (current journals will be identified through the included articles).

Available Medical Subject Headings (MeSH) terms will be applied to simplify and ensure accurate searches in current databases (e.g. to cover all versions of the term COVID-19). In Ovid platforms, MeSH-terms is shown with a "/ "after the term. In CINAHL and on the EBSCO platform, "MH" is used to indicate the search of a subject heading. Where MeSH terms are not available, relevant key words linked to the research question at hand will be applied. On the OVID platform, key words will search across a range of fields including title, abstract and subject heading words while in the CINAHL platform, the keyword search is in the abstract, title and subject heading fields. Truncations (*) will be applied on relevant search words (e.g., challenge, issue, problem) to retrieve any alternative endings e.g., singular and plurals of words. The use of truncations is, however, not recommended in PubMed and may disturb the identification of subject headings (this will be taken into account). Phrase searching (e.g., performance variability, assisted living) will be completed by using quotation marks "..." to ensure that keywords are searched as phrases. Boolean operators AND and OR will be used to combine the search words to widen or broaden the searches. For example: COVID-19 AND Safety II OR Safety-II AND "Primary healthcare service" AND challenge* (LibGuides, 2021)

Searches compromising all possible combinations of the three clusters will systematically be conducted. An overview of all conducted searches in all databases will be provided as a supplementary file.

Table II. Key word clusters

Cluster I	Cluster II	Cluster III	Cluster IIII
1. COVID-19/ MH	2. "Resilience in	15. "primary health	36. Challenge*
	healthcare"	care services"	37. Issue*
	3. "safety II"	16. Primary	38. problem*
	4. "Safety-II"	healthcare/ MH	39. Concern*
	5. adaptation*	17. "Primary health-	40. Difficulty*
	adjustment*	care"	41. Constraint*
	7. re-organization	18 "Primary care"	42. Obstacle*
	8. Re-organisation	19. "Primary	43. Hindrance*
	9. trade-off*	healthcare"	44. Barrier*
	10. "performance	20 "Primary health-	45. Problem solving
	variability"	care"	46. Maintain
	 variation* 	21 "Care homes"	47. solution*
	12.improvisation*	22 "Residential aged	48. Manage (ing)
	13. response*	care"	Managed
	14. complexity	23 "Long-term care"	49. Handle (ing)
		24 "Long term care"	50. Cope (ing)
		25. "nursing homes"	51. endure
		26. "assisted living"	52. coordinate (ing)
		27. "facility	53.Organize (ing)/
		retirement"	54.Organise (ing)
		28. "facility home	
		care"	
		29. "home care	
		services"	
		30. "Home care"	
		31. "home based care"	
		32.Hospital*	
		33."Emergency	
		room"*	
		34 Emergency	
		service/MH	
		35. Clinic*	
Fig. 1 Example of eligible article

Example of possible eligible article

The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study Liu et al, 2020). <u>https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30204-7/fulltext</u>

Examples of relevant findings

- Physicians and nurses followed the diagnosis and treatment guidelines released by the National Health Commission, while drawing on previous clinical experience and learning through exploration
- They discussed the guidelines with other colleagues to understand their experience in treating patients with COVID-19, then transformed this knowledge and experience to use in patient care
- Many wards that were not designed for infectious diseases were modified into isolation wards within a short period of time
- They needed to learn and master new technical procedures in a short time
- They had to rapidly find ways to work together efficiently

Selection of eligible studies

Identified studies will be managed in the reference manager Zotero 5.0. Duplicates will be removed and references uploaded in Rayyan QCRI, which is an application that enable all researchers of the study to review abstracts and titles, and select articles for inclusion (Ouzzani et al., 2016). Abstracts will be screened against the selection criteria and studies assed for inclusion. Full text articles will be uploaded in Zotero 5.0, a tool for collection, organizing, citing and sharing research (*Zotero*, 2021).

Quality assessment

Each study will be assessed for quality using the Clinical Appraisal Skills Program (CASP) for qualitative studies (Clinical Apprasial Skills Programme, 2018). CASP enables a systematic assessment of the trustworthiness, relevance and results of published articles. It consists of ten yes/no questions, with additional prompts, reminding the reviewer of the importance of each question. If the answer

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to the first two questions¹ are "no", the study will be assessed as biased, and will not be included in the review (Clinical Apprasial Skills Programme, 2018). The CASP tool do not include a scoring system (where low scores exclude articles), but do however, guide each reader to appropriate assessments of the quality of each study. In other words, the reader needs to individually assess the studies based on the control questions. Relevant experience within qualitative research will, in this case, be an advantage.

Data extraction and synthesis

The following data will be extracted from included articles: details about the variation in performance (cf. resilience in healthcare); how adaptations were executed; reasons for adaptation execution. Study characteristics (e.g., title, year, method, setting, informants) will be extracted and listed in a table to provide an overview of included studies. The qualitative analysis tool NVivo Pro will be use to facilitate a thematic analysis and synthesis as described by Thomas & Harden (2008). The studies' results will be uploaded into Nvivo or entered into the program verbatim. Further, the text will be coded inductively, sentence by sentence, according to its meaning and context by two researchers. The codes will be structured in a three form (hierarchical structure) to display the relationship between different codes. Codes with similar meaning will be assembled under broader categories (going through several phases of organization and reorganization to ensure accurate placement). Lastly themes will be developed based on the content of the different codes, and their descriptive, and possible, latent (analytic) meanings (Ring et al., 2011; Thomas & Harden, 2008). To ensure accurate themes, they will be discussed among the researchers.

Strategy for presentation of the results

The search strategy will be presented in the protocol as an attachment. The PRISMA flow diagram will be used to provide an overview of the study selection and review process. A summary of the included studies will be provided as a table along with an excerpt of the analysis. The results will, in the protocol, be presented theme by theme (in the order of the identified themes of the analysis).

Researchers

The research team comprise researchers with experience from a variety of relevant fields within health services research:

Dr. Malin Knutsen Glette, SHARE, University of Stavanger

E-mail: Malinknutsen.glette@hvl.no

https://www.uis.no/nb/profile/2373

Professor Siri wiig, SHARE, University of Stavanger

E-mail: Siri.wiig@uis.no

¹ 1. Was there a clear statement of the aims of the research?

^{2.} Is a qualitative methodology appropriate

- Dr. Kristiana Ludlow, AIHI, Macquarie University
- E-mail: kristiana.ludlow@mq.edu.au
- https://researchers.mq.edu.au/en/persons/kristiana-ludlow

Professor, MD, David Bates, Harvard Medical School

E-mail: dbates@bwh.harvard.edu

https://www.hsph.harvard.edu/ecpe/faculty/david-w-bates/

Dr. Elizabeth Austin, AIHI, Macquarie University

E-mail: elizabeth.austin@mq.edu.au

https://researchers.mq.edu.au/en/persons/elizabeth-austin

Work distribution and schedule

Time	Task	Work distribution
January - February	Develop project protocol	MKN with input from EA, SW,
	(defining the purpose, topic,	DB and KL
	scope, research question(s)	
	and analytic framework,	
	determining	-
	inclusion/exclusion criteria)	
	Identify eligible researchers/	MKN & EA
	build a team	Do Siri have any suggestions
		from UIS?
	Finalize scope	MKN, EA, SW
	Preliminary literature	MKN
	searches	
February- April	Main Searches, including hand	MKN
	searches and secondary	
	searches	
	Reference management	MKN
	Study selection	MKN, EA & KL (?)
May - July	Quality assessment	MKN, EA & KL with input from
	Data extraction	SW and DB

Table III. Schedule, tasks and work distribution (inspired by Nelson, 2014)

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	Qualitative analysis	
July - September	preparing the report	MKN (full draft), EA, KL, SW & DB
September/October	Article Submission	

*MKN= Malin Knutsen Glette, SW= Siri Wiig, DB = David Bates, KL= Kristina Ludlow, EA= Elizabeth Austin

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Data base and date of searches	search specifications	Search strings	828 or	Identified control articles*	Search results
Academic search elite	Peer reviewed, academic journals, 2019 – 2021, English, no fields selected	S1: covid-19 OR coronavirus OR 2019-ncov OR sars-cov-2 cov-19 (71, 505 hits) S2: patient OR patient safety (590,078) S3: nurs* OR physician* OR health personnel OR health professionals OR healthcare OR health care OR hospital Of health services OR health facilities (741,307 hits) S4: resilience OR adaptation OR ability OR managing OR coping OR difficulties OR issue OR challenges OR new correct S5: qualitative research OR qualitative study OR qualitative methods OR interview OR case study (572,703 hits) S6: S1 AND S2 AND S3 AND S4 AND S5	1 20 September 2023. Downloade	Jia at al., 2021; Ness et al., 2021; Szabo et al., 2021; Tanzi et al., 2021; Catiana et al., 2020 (the other control articles were not available in this database)	Hits: 258
CINAHL (via EBSCO host)	Academic journals, 2019 – 2021, English, Selected field: TX (all text)	S1: covid-19 OR coronavirus OR 2019-ncov OR sars-cov- cov-19 (53,118 hits) S2: patient OR patient safety (372 486 hits) S3: nurs* OR TX physician* OR health personnel OR health professionals or health care OR health care or hospital or health services or health facilities (527 051 hits) S4: resilience OR adaptation OR ability OR managing OR coping OR difficulties OR issue OR challenges OR new context (150,284 hits) S5: qualitative research OR qualitative study or qualitative methods or interview or case study (117,168 hits) S6: S1 AND S2 AND S3 AND S4 AND S5	d from http://bmjopen.bmj.com/ o	Jia et al., 2021, Tanzi et al., 2021, Catiana et al., 2020 (the other control articles was not available in this database)	Hits: 279
MEDLINE (via EBSCOhost)	English, peer reviewed, year: 2019 – 2021, Academic journals, no field selected	S1: covid-19 OR coronavirus OR 2019-ncov OR sars-cov-2 cov-19 (101,359 hits) S2: patient OR patient safety (971,970 hits) S3: nurs* OR physician* OR health personnel OR health professionals OR healthcare OR health care OR hospital of health services OR health facilities (1,179,122 hits) S4: resilience OR adaptation OR ability OR managing OR coping OR difficulties OR issue OR challenges OR new context (454,809 hits) S5: qualitative research OR qualitative study OR qualitative methods OR interview OR case study (152,223 hits) S6: S1 AND S2 AND S3 AND S4 AND S5	n June 11, 2025 at Agence Biblio	all control articles identified	Hits: 491
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	Title/Author	Method	Setting	Partisipants Cuding fo	20 Se	Qualit assesr
1	To be or not to be in the ward': The Impact of Covid-19 on the Role of Hospital-Based Clinical Pharmacists - A Qualitative Study (Cheong, 2020)	Qualitative	Hospital	Pharmacists eignement sup to text	prember 2023. Down	High
2	A National Study of Community Health Centers' Readiness to Address COVID-19 (Damian et al., 2021)	Mixed method	Community health centers	Primary care employed at a grad	USA USA	High
3	A qualitative examination of quarantine work experience of nurses in Saudi Arabia (Alhamidi et al., 2020)	Qualitative	Quarantine centers	Nurses g	Saudi Arabia	High
4	A qualitative study of physician perceptions and experiences of caring for critically ill patients in the context of resource strain during the first wave of the COVID- 19 pandemic (Parsons Leigh et al., 2021)	Qualitative	ICU	Physicians <u>g</u> , and similar technologies.	Canada 	High
5	A Qualitative Study of Primary Care Physicians' Experiences With Telemedicine During COVID-19 (Gomez et al., 2021	Qualitative	Primary care		A USA Agence Bibli	High

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6	Adapting to the unexpected: Problematic work situations and resilience strategies in healthcare institutions during the COVID-19 pandemic's first wave (Juvet et al., 2021)	Mixed method	Hospital	Nurses and other caregivers for uses	28 Switzerland on 20 Septemb	High
7	An Experience of Otorhinolaryngologists as Frontline Worker with Novel Coronavirus: A Qualitative Analysis (Kaur et al., 2021)	Qualitative	Hospital	Otorhinolaryngologisted to text and data	97 2023. Downloaded fr	High
8	At Home, with Care": Lessons from New York City Home-based Primary Care Practices Managing COVID-19 (Franzosa et al., 2021)	Qualitative	Home-based primary care	HBPC leadership including clinical/medial directors, program managers, nurse practitioners/nursing coordinators, and social workers/social work	USA USA http://bmjopen.bmj.co	High
9	Changes to care delivery at nine international pediatric diabetes clinics in response to the COVID-19 global pandemic (Sarteau et al., 2021)	Qualitative	Diabetes clinics	Healthcare providers milar technolog	USA, Australia, Sweden, India	Low
10	Clinician Perspectives on Caring for Dying Patients During he Pandemic A Mixed-Methods Study (Cook et al., 2021)	Mixed method	Hospital	Patients, family 🥳 members, clinicians	2025 at Agence	High

3			BMJ Open	ву соруг	pen-2023	
11 Clinician perspe service delivery telemedicine du pandemic: A qu (Hunter et al., 2	ectives on methadone and the use of uring the COVID-19 alitative study 021)	Qualitative	Methadone clinic	physicians, physician assistants, and nurse practitioner	071828 ON 20 Septem	High
12 Covid-19 chang Experiences of a (Szabo et al., 20	es to maternity care: Australian doctors 121)	Mixed method	Maternity wards	Doctors to	seignement Su	Hig
13 COVID-19 Impa Supportive Serv Use Drugs (PWI (Vicknasingam)	ct on Healthcare and rices for People Who JDs) in Malaysia et al., 2021)	Qualitative	Healthcare and non- governmental organizations	Medical personnel of methadone maintena treatment programs a HIV clinics	nloaded from ht	Low
14 COVID-19: How pharmacies get through the (Gregory & Aus	did community first wave? tin, 2020)	Qualitative	Pharmacies	Pharmacists	Canada	Low
15 Delivering Virtu Rehabilitation F During the First COVID-19 Pand Multimethod St (Lopez et al., 20	al Cancer Programming 90 Days of the emic: A cudy 21)	Multi method	Cancer center	Oncology healthcare	Canada	Hig
16 Effect of COVID integration in the Netherlands: a (Minderhout et)	-19 on health system ne mixed-methods study al., 2021)	Mixed method	Acute care	Clinicians, managers, administrators, and insurance company representatives	े Netherlands अस् Age	Hig
17 Emerging Pallia in the ED: A	tive Care Innovations	Qualitative	Emergency department	Emergency departmen and Palliative care clinicians	t Ce USA Bibliog	Higl

	Qualitative Analysis of Programmatic Elements During the COVID-19 Pandemic (Aaronsen et al., 2021)			ncluding for u	08 on 20 Sen	
18	Feasibility of an online platform delivery of pulmonary rehabilitation for individuals with chronic respiratory disease (Lewis et al., 2021)	Mixed method	Community Respiratory Team	physiotherapist, nurses and exercise instructor latent of the second sec	fember 2023 Down	Low
19	Front-line nurses' responses to organisational changes during the COVID-19 in Spain: A qualitative rapid appraisal (2021)	Qualitative	Hospital and community health settings	Nurses and data mining, A	Spain	High
20	Healthcare providers' challenges during the coronavirus disease (COVID-19) pandemic: A qualitative approach (Ness et al., 2021)	Qualitative	Hospital	Nurses training, and s	USA	High
21	Healthcare workers during the COVID-19 pandemic: Experiences of doctors and nurses in Bangladesh (Hussain et al., 2021)	Qualitative	Hospital	Doctors and nurses milar technolog	Bangladesh	High
22	Home palliative care professionals perception of challenges during the Covid-19 outbreak: A qualitative study (Franchini et al., 2021)	Qualitative	An Italian non-profit organization	Home care profession	italy Anonce Riblin	High

Page 65 of 68				BMJ Open	d by copyri		
1 2 3	23	How the experience of medical	Qualitative	Providers of Medical	명, 여 in Physicians and nurse 단	Canada	High
4 5 6 7 8		assistance in dying changed during the COVID-19 pandemic in Canada: a qualitative study of providers		assistance in dying	practitioners din g of constraints of users		
9 10 11 12 13 14 15 16 17 18	24	Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in Flemish GPs (Verhoeven et al., 2020)	Qualitative	GP practices	GPs GPs	Belgium	High
19 20 21 22 23 24 25	25	Inpatient Diabetes Care during the COVID-19 Pandemic: A Diabetes UK rapid review of health care professionals' experiences using semi-structured interviews (Burr et al., 2021)	Qualitative	Hospital	Diabetes consultants, diabetes specialist numers and allied health professionals involved in delivery of diabetes inpatient care	UK	Low
26 27 28 29 30	26	Lessons from Italian front-line nurses' experiences during the COVID-19 pandemic: A qualitative descriptive study (Catania et al., 2021)	Qualitative	Hospital	Nurses d similar techno	Italia	High
31 32 33 34 35 36 37 38 39	27	Management and patient safety of complex elderly patients in primary care during the COVID-19 pandemic in the UK— Qualitative Assessment (Alboksmaty et al., 2021)	Qualitative	Primary care	GPs gies		High
40 41 42 43 44		F	or peer review only - ht	tp://bmjopen.bmj.com/sit	e/about/guidelines.xhtml		

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28	Midwives' experiences of providing maternity care during the COVID-19 pandemic in Australia	Mixed method	Hospital	лі Сц Midwifes for us m	Australia	High
29	Missing the human connection: A rapid appraisal of healthcare workers' perceptions and experiences of providing palliative care during the COVID-19 pandemic (Mitchinson et al., 2021)	Qualitative	Hospital	Healthcare workers (dieticians, pharmacisted nurses) to text and data	UK UK 2023. Downloaded fr	High
30	Nurses' ethical challenges caring for people with COVID-19: A qualitative study (Jia et al., 2021)	Qualitative	Hospital	Nurses ning Nurses ning Al train	China China	High
31	Nurses' experiences of being recruited and transferred to a new sub-intensive care unit devoted to COVID-19 patients (Danielis et al., 2021)	Qualitative	Hospital (intensive care unit for COVID- 19 patients)	Nurses g, and similar techno	Italy	High
32	Nurses' experiences regarding shift patterns in isolation wards during the COVID-19 pandemic in China: A qualitative study (Gao et al., 2020)	Qualitative	Hospital	Nurses	China 2025 at Agen	High
33	Nursing home staff perceptions of challenges and coping strategies during COVID-19 pandemic in China	Qualitative	Home care	Nurses	China Bio China	High

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	(7hao et al. 2021)				· 828		
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34	Nursing perspectives on care delivery during the early stages of the covid-19 pandemic: A qualitative study (Shroeder et al., 2020)	Qualitative	Urban academic medical center	Nurses g for uses relat	20 September 20 Enseigne	USA	Hig
35	Person-centered communication between healthcare professionals and COVID-19 infected older adults in acute care settings: Findings from Wuhan, China (Li et al., 2021)	Qualitative	Hospital	Nurses and physicians of the second s	223. Downloadec	China	Hig
36	Preparedness of Our Emergency Department During the Coronavirus Disease Outbreak from the Nurses' Perspectives: A Qualitative Research Study (Hou et al., 2020)	Qualitative	Emergency department	Nurses a mining, Al training,	from http://bmjopen.t (ABES)	China	Hig
37	Preservation of Person-Centered Care Through Videoconferencing for Patient Follow-up During the COVID-19 Pandemic: Case Study of a Multidisciplinary Care Team (Silsand et al., 2021)	Qualitative	PACT team (transitional phase between hospital and primary care)	Healthcare workers in a similar technolog	mj.com/ on June 11, 2	Norway	Hig
38	Provision of clinical pharmacy services during the COVID-19 pandemic: Experiences of pharmacists from 16 European countries Paudyal et al., 2021)	Qualitative	Hospital, community pharmacy, primary care	Pharmacists 🦉	2025 at Agence Biblio	Belgium, Croatia, Czech Republic, Denmark, England, Estonia, France, Ireland, Netherlands, Portugal, Serbia.	Hig

				ncluding fo	Spain, Switzerland, Turkey	
39	Rapid response system adaptations at 40 US hospitals during the COVID- 19 pandemic (Mitchell et al., 2021)	Mixed method	Hospitals	Clinicians rus rate s reio	USA	Low
40	Resilience in the time of pandemic: The experience of community pharmacists during COVID-19 (Austin & Gregory, 2021)	Qualitative	Pharmacies	Pharmacists ated to text and		High
41	The impact of COVID-19 on chronic care according to providers: a qualitative study among primary care practices in Belgium (Danhieux et al., 2020)	Qualitative	Primary care	Doctors, nurses, dieticians Al training, Al traini	Belgium	High
42	Restructuring in a GP practice during the COVID- 19 pandemic – a focus- group study (Renaa & Brekke, 2021)	Qualitative	GP practise	Nurses and medical g secretaries and s	Norway	High
43	The Lived Experience of ICU Clinicians During the Coronavirus Disease 2019 Outbreak: A Qualitative Study (Kentish-Barnes et al., 2021)	Qualitative	ICU	Physicians, nurses, nursing assistants, respiratory therapist	France	High
44	US Clinicians' Experiences and Perspectives on Resource Limitation and Patient Care During the COVID- 19 Pandemic (Butler et al., 2020)	Mixed method	Hospitals/clinics	Nurses, nurse 🦻 practitioners, physicians	USA	High
45	Experiences of nursing students as healthcare aid during the COVID-19	Qualitative	Hospital	Nursing students	Spain	High

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2 3 4 5 6		pandemic in Spain: A phemonenological research study (Casafont et al., 2021)			2 	t. including for		
7 8 9 10 11 12 13 14 15 16 17	46	Necessity is the mother of invention': Specialist palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021)	Mixed method	Inpatient palliative care units, home nursing services, hospital and home palliative care teams	Healthcare workers	Dember 2023. Downloaded fr Enseignement Superieur (A uses related to text and data	Europe, UK, rest of the world	High
18 19 20 21 22 23	47	"To be or not to be in the ward": The impact of COVID-19 on the role of hospital-based clinical pharmacists— A qualitative study (Cheong, 2020)	Qualitative	Hospital	Pharmacists	om nup://pmjopen. BES) . mining. Al training.	Malaysia	High
24 25 26 27 28	48	The Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic	Qualitative	Heart function clinic	Patients, clinicians, st	ff similar	Canada	High
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44	L	Fo	or peer review only - ht	tp://bmjopen.bmj.com/site	e/about/guidelines.xhtml	technologies.		

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A resilience in healthcare perspective on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic – a Meta-synthesis

Journal:	BMJ Open					
Manuscript ID	bmjopen-2023-071828.R1					
Article Type:	Original research					
Date Submitted by the Author:	24-Apr-2023					
Complete List of Authors:	Knutsen Glette, Malin; University of Stavanger Faculty of Health Sciences, SHARE – Center for Resilience in Healthcare, Faculty of Health Siences; Western Norway University of Applied Sciences - Haugesund Campus, Department of health and caring sciences Ludlow , Kristiana; The University of Queensland School of Psychology Wiig, Siri; University of Stavanger, SHARE – Center for Resilience in Healthcare, Faculty of Health Sciences Bates, David ; Harvard Medical School; Brigham and Women's Hospital, Medicine Austin, Elizabeth; Macquarie University, Australian Institute of Health Innovation; Dr					
Primary Subject Heading :	Health services research					
Secondary Subject Heading:	Health services research					
Keywords:	Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, QUALITATIVE RESEARCH, Systematic Review, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT					
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1	A resilience in healthcare perspective
2	on healthcare professionals'
3	adaptations to changes and
4	challenges resulting from the COVID-
5	19 pandemic – a Meta-synthesis
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8	Malin Knutsen Glette ¹ *
9	Kristiana Ludlow ^{2,3}
10	Siri Wiig ¹
11	David Bates ⁴
12	Elizabeth Austin ³
13	
14	*Corresponding author
15	
10	-SHARE – Center for Resilience in Healthcare
1/	Faculty of Health Sciences
18	- School of Psychology, the University of Queensland

- ³Australian Institute of Health Innovation, Macquarie University
- 9 20 ⁴Harvard Medical School
- 2 22 Email addresses:

- 4 23 <u>Malinknutsen.glette@hvl.no</u>
- 6 24 <u>k.ludlow@uq.edu.au</u>
- 8 25 <u>Siri.Wiig@uis.no</u>
- 59
6026dbates@bwh.harvard.edu

1		
2 3	27	Elizabeth austin@mg_edu.au
4	20	
5 6	28	
7	29 20	Abstract
8 9	50	
10 11	31 32	Objective: To identify, review, and synthesise qualitative literature on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic.
12 13	33	Design: Qualitative systematic review
14 15	34	Data sources: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science Direct and Scopus
16 17 18 19	35 36 37	Eligibility criteria: Qualitative or mixed method studies published between 2020 – 2022 investigating healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic.
20 21 22 23	38 39 40	Data extraction and synthesis: Data was extracted individually using a pre-designed data extraction form including publication details, setting details, participants, adaptations, and outcomes. Data was analysed using thematic analysis.
24 25 26 27 28 29 30	41 42 43 44 45 46	Results: Forty-seven studies were included. A range of adaptations crucial to maintain healthcare delivery during the pandemic was found, including taking on new roles, conducting self and peer education, and reorganizing workspaces. Triggers for adaptations included unclear workflows, lack of guidelines, increased workload, and transition to digital solutions. As challenges arose, many health professionals reported increased collaboration across wards, healthcare teams, hierarchies, and healthcare services.
31 32 33 34 35 36 37	47 48 49 50 51 52	Conclusion: Healthcare professionals demonstrated a significant adaptive capacity facing the challenges imposed by the COVID-19 pandemic. Several adaptations were deemed applicable for future organizational healthcare service changes, while others exposed weaknesses in healthcare system designs and capacity, leading to dysfunctional adaptations. Experiences gained from the COVID-19 pandemic present a unique opportunity to learn how healthcare systems rapidly respond to changes, and how resilient healthcare services can be built globally.
38 39	53	Keywords: Resilience in healthcare, adaptations, COVID-19, healthcare services
40 41	54	
42 43	55	Strengths and limitations
44 45	56	• This review protocol was registered at the open science framework (OSF) and followed the
46	57	PRISMA-P checklist.
47	58	 A comprehensive search strategy was employed to identify studies focusing on healthcare
48	59	personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic.
49 50	60	• To ensure inclusion of relevant studies, we used the RiH quality and resilience trigger tool to
51	61	capture resilience elements in studies not directly focusing on resilience in healthcare.
52	62	• The inclusion of articles and overall analysis is limited to qualitative results, and do not
53	63	include data on patients, next of kin or workers without healthcare professional background
54	64	• The quality appraisal of included literature indicated that 18 out of the 48 included studies
55 56	65	were considered low quality
57	66	
58 59	67	Words: 5497
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BACKGROUND

On March 12th 2020, the World Health Organization announced the novel Coronavirus disease (COVID-19) as a pandemic ¹². The pandemic caused serious challenges for healthcare systems worldwide³, including resource limitations (e.g., a lack of equipment, workforce and physical space), surges in the number of patients needing healthcare services, and rapid introduction of infection control procedures ⁴⁻⁶. Decisions had to be made faster than most systems were accustomed to. New work tasks and routines, as well as mastery of new equipment and new technical procedures, were rapidly developed and implemented ⁷. In response to these challenges, healthcare professionals were forced to adapt to ensure that healthcare service delivery was sustained.

Resilience in Healthcare (RiH) is a subset of the Safety-II perspective within patient safety theory. In addition to focusing on the absence of unwanted outcomes (Safety-I), Safety-II focuses on the things that go well because of healthcare professionals' ability to adjust their work to match current working conditions⁸. RiH is about maintaining stability in the face of expected or unexpected changes, and the system's or the individual's ability to adjust or adapt to these changes or disturbances and return to a stable state 9. In healthcare, workers and leaders adjust work

- performance to situations as they arise to minimise the impact of system challenges on care delivery and patient outcomes. This ability to adjust or adapt is called performance variability and is described as "adjustments that are the basis for safety and productivity" ¹⁰. Healthcare professional's capability to respond and evolve is called adaptive capacity, and is defined as "adaptations based on reframing, aligning, coping and innovating, in response to external and internal demands from different organizational levels, in order to ensure quality of care"¹¹. RiH argues that performance variability is crucial to ensure system performance and patient safety in the context of a complex and
- everchanging healthcare system⁸¹².

Previous research

There has been a significant amount of research on many aspects of the COVID-19 pandemic including research on healthcare professionals' experiences during the pandemic ¹³⁻¹⁵, infection control and implications for healthcare quality ^{16 17}, recommended and executed measures related to the pandemic (e.g., how to reorganize care, how to apply telehealth/telecare) ¹⁸⁻²⁰ and physical and psychological outcomes of COVID-19 on patients ²¹⁻²³. However, there is limited research examining health personnel's adaptations (c.f. RiH) to the changes caused by the COVID-19 pandemic. RiH seeks to identify, and understand behaviours contributing to a system's ability to respond to the unexpected ²⁴. An increased understanding of adaptive human behaviour can contribute to improvement in current approaches to patient safety ²⁵

Aim and research questions

This study aimed to identify, review and synthesise qualitative literature on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic (c.f. RiH). Specifically, the study aimed to identify what adaptations was executed and why, from the perspectives of healthcare professionals ²⁵. Using the PICO model (Table 1), the review addressed the following research questions:

109 1. What kind of adaptations were required from healthcare professionals during the COVID-19

110 pandemic (c.f. RiH), and why were they necessary?

2. What kind of performance variation did healthcare professionals experience as a result of theseadaptations?

113 Table 1: The PICO model ²⁶

Participants	Healthcare professionals (definition provided in <i>Clarification of central concepts</i>)
Interventions/Exposures	The COVID-19 pandemic
Comparators	Performance variation before the pandemic
Outcomes	Healthcare professionals' experience of performance variations during the COVID-19 pandemic

3 115 **METHODS AND DESIGN**

5 116 Protocol and reporting

117 The protocol of this review was developed following the Preferred Reporting Items for Systematic
 118 review and Meta-Analysis—Protocols (PRISMA-P) 2015 checklist (Supplementary file 1) ²⁷. The
 119 protocol (Supplementary file 2) has been registered with the Open Science Framework (OCF) register
 120 (https://osf.io/pnhby) ²⁶

2 121 Eligibility criteria/study selection

The selection criteria are presented in Table 2. The review is limited to qualitative research, including qualitative components of mixed-methods studies, as we sought to identify rich, in-depth information about health professionals' experiences, perceptions, and opinions which are best captured through qualitative approaches ²⁸. In addition, qualitative research allows for identifying data concerning performance variability and adaptive capacity in studies foci (e.g., other than RiH)¹¹ ²⁸. Research published in 2020 or later was included to capture studies about COVID-19. Grey literature, reviews, commentaries, editorials, or other non-empirical materials were not included. Eligible study populations included healthcare professionals, as defined in Table 2. Studies investigating health professionals not providing direct formal care (e.g., policymakers, hospital managers), other personnel working in hospitals/the primary healthcare service (e.g., porters or cleaning staff), or patients and their next of kin were not included as this was beyond this studies' scope. Only studies published in English or Scandinavian languages were included, as the native languages of the author team.

50 135

136 Table 2. Selection criteria

Criteria Grouping	Inclusion criteria	Exclusion criteria
Participants/context	Studies involving healthcare professionals (as defined	Studies involving psychiatric or
	below) in somatic clinical settings, for example, hospitals, home care services, nursing homes, and	psychological wards or services.

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	A healthcare professional was defined as a person who maintains humans' health by applying evidence- based principles and procedures of medicine and caring, through formal paid services (WHO, 2013). For example, nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants/care assistants, auxiliary nurses, personal care workers, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwives, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although healthcare personnel working in psychiatric healthcare professionals, they were not included in this review as the focus here was on somatic settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).	not providing direct formal care (e.g., hospital management, policymakers, ward leaders). Studies involving non-healthcare personnel working in healthcare settings (e.g., porters, cleaning staff). Patients, aged care residents, service users (e.g., people receiving home care services), their next of kin or other informal caregivers (neighbours, friends).
Exposure	Studies investigating the COVID-19 pandemic	Studies not concerning the COVID-19 pandemic. Studies investigating previous pandemics/epidemics (e.g., H1N1, Ebola, Zika).
Outcome	Studies including resilience triggers on a micro-level, for example, individual capacity (knowledge, competence, learning, behavioural strategies) and team/unit capacity (communication, collaboration, and learning), or triggers on the macro-level, for example, organizational capacity (resources, organization, culture).	Studies investigating larger systems' adaptation capacity (infrastructure, regulation, framework). Psychological (individual) resilience, or lack of resilience. This includes psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with
		protective gear), or healthcare personnel's professional identity. Medical perspectives such as COVID-19 treatment regimes. Studies not involving adaptive capacity, for example, studies only focusing on barriers and challenges (not solutions).
Language	English, Norwegian, Danish or Swedish.	Languages other than English, Norwegian, Danish or Swedish.
Year of publication	Studies published between 2019 and 2021.	Studies published before 2019.
Methods	 Studies applying qualitative methods, including qualitative data from mixed method studies. Studies published in peer-reviewed scientific journals. Case studies where adaptation to standard practises were discussed. 	Studies applying quantitative methods only.
Publication type	Peer-reviewed journal articles comprising empirical primary research.	Grey literature, for example, editorials, Government reports, comments, non-

2			
3			scientific publications, conference
4	407		abstracts, theses/dissertations.
с С	137		
7	138	The RiH Quality and Resilience Trigger tool developed by Aase et a	²⁹ to screen research projects for
8	139	RiH relevance was used to guide the concentualisation of RiH in th	e study selection. The RiH triggers
9	140	are listed in Table 2 and were particularly useful in identifying resil	iance elements in studies not
10	140	for the second	lence elements in studies not
11 12	141	Tocusing on KiH, specifically.	
13	142		
14 15	143		
16 17	144	Table 3. Resilience triggers	
18		Adaptation Team/unit Develo	ppment • Stakeholder
19		Variation capacity Improv	vement actions
20		Trade-offs (communication, • Success	s • Knowledge-
21		Improvisation Collaboration, Fnhan	cement brokering
22		Response learning) Growt	h • Co-creation
23		Complexity Organizational Recovery	erv • Contribution
24		Individual capacity Transfer	ormation • Information
25		capacity (resources, Collab	prative • Engagement
26		(knowledge, organization, learning	• Teamwork
27		competence, culture) • Work	practice • Changes
28		learning, • Larger system • Proble	m solving • Challenges
29		personal capacity	tion • Disruption
20 21		characteristics, (infrastructure,	
27		cognitive, regulation,	
32		behavioural framework	
34		strategies) conditions)	
35 36	145		
37	146		
38	1.0		
39 40	147	Data sources, search terms and search strategy	
41	148	Scoping searches were conducted from March to June 2021, using	the academic databases:
42	149	Academic Search Elite, CINAHI, MEDI INF, PubMed, Science Direct	and Scopus. The main search was
43	150	carried out on May 21, 2021, in all databases. A search string was	developed using keywords from
44	150	five electors related to the review tenior COVID 10, national (national	safatu haalthaara (haalth
45	121	nve clusters related to the review topic. COVID-19, patient/patient	Sarety, nearing and hereign
40 47	152	protessionals, resilience, and qualitative research, including related	a iviesh terms and synonyms.
4/ ⊿0	153	Multiple test searches using different search combinations in the s	elected databases combined with
40 10	154	multiple team discussions resulted in the establishment of the sea	rch string. The search string was
50	155	run in the included databases (Supplementary file 3. Overview of s	earches).
51			
52	156	Selection of eligible studies	
53	157	The identified publications (p. 2,120) were developed at the	and in EndNote 20 Durlister
54	12/	The identified publications (n= 3,139) were downloaded and mana	geu in Enuivole 20. Duplicates
55	158	were removed (n=/05) and the remaining references were upload	ed into Rayyan QCRI; an online
56	159	mobile and web-based application for abstract and title review ³⁰ .	Abstracts underwent a three-step
57	160	blinded screening process. First, a random 10% excerpt of publicat	ions was independently screened
58	161	by all reviewers (MKG, KL, and EA) to ensure that the application o	f inclusion and exclusion criteria
59	162	was consistent. After multiple conflicts arose, a group discussion, i	ncluding a thorough clarification of
60	-		

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the selection criteria, was conducted. Second, a new random 10% sample of publications was independently screened by reviewers (MKG, KL, and EA), giving more uniform results with some discrepancies. These were resolved through a second round of discussion and clarifications of criteria. A title and abstract review of remaining publications was carried out by two pairs of independent researchers (MKG, KL and EA), where MKG reviewed all abstracts, resulting in 171 records undergoing full-text screening. If there was ambiguity about whether a publication met the inclusion criteria, it was progressed to the full-text review (e.g., if the methods were unclear in the abstract).

All full texts were evenly and randomly distributed amongst the two pairs of independent reviewers (MKG screened all publications and KL and EA screened 50% each). Inclusion/exclusion decisions and notes supporting the decisions were entered into a pre-designed data extraction form using Microsoft Excel (designed by KL). The resilience triggers (Table 3.) were used as decision support when the resilience perspective was unclear. Any disagreement on inclusion decisions was discussed by each screening pair. If a consensus could not be reached between a pair, a third screener acted as arbitrator ³¹. Two more additional researchers were available for consultation if disagreements were unresolved (SW and DB) (see supplementary file 4 for an overview of excluded articles and reasons for exclusion).

Quality assessment

All included studies underwent a blinded quality appraisal using the Clinical Appraisal Skills Program (CASP) for qualitative studies ³². The CASP enabled a systematic assessment of the trustworthiness, relevance, and results of published qualitative articles ³² The quality of the included studies was appraised by two pairs of independent researchers (with MKG appraising all studies). If articles had several methodological weaknesses, such as a poorly described research design in combination with a poorly described recruitment strategy and ethical considerations, they were deemed low quality. Disagreements were discussed by the pairs of reviewers after the blinded appraisal. The CASP tool does not include a scoring system of exclusion cut-offs ³³, and therefore, the 18 articles considered low quality were not excluded but were given less weight in the write-up of results ³³.

DATA EXTRACTION AND ANALYSIS

Data were extracted and quality assessment were conducted simultaneously by one reviewer (MKG), whilst a sample of the data extraction was validated by the co-reviewers ³⁴. The pre-designed data extraction form included publication details, setting details, participants, adaptations, and outcomes. All data of relevance to the research questions were extracted, including quotes (inclusive approach) ³⁴. The analysis was guided by Thomas and Harden ³⁵ three stages of analysis. Stages 1-2 consist of openly coding text and developing descriptive themes (conducted by MKG). Contrary to Thomas and Harden ³⁵ suggestion on coding we first pulled out the text relevant to the research question (as suggested in other thematic analysis literature, e.g., Braun and Clarke ³⁶, before conducting line-by-line coding. Free codes without hierarchical structure were developed, and new codes were added if necessary. This process is referred to as the translation of concepts between studies ³⁵. After the coding process was finalized, the codes were reviewed to check for consistency in interpretation, and to consider the need for additional coding levels. During this process, 34 codes were identified. Differences and similarities between the semantics of codes guided the grouping of codes into a hierarchical tree structure ³⁵. To capture the meaning of groups of codes from the initial coding

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3 4	207	process, new codes were created (initial cohesive codes were gathered under new appropriate code
5	208	names), which were then gathered into descriptive themes (see Figure 1. Example of analysis Theme
6	209	1, step 1-3). The five identified themes were reviewed by the research team. Stage 3 consisted of
7	210	generating analytical themes, aiming to "go beyond the findings of the primary studies, and generate
8	211	additional concepts, understandings and hypothesises" ³⁵ . This was conducted as a cyclic process
9	212	where theme suggestions were processed and refined in multiple rounds. Finally, two main themes,
10	213	approved by the research team, were identified.
12	24.4	
13	214	
14	215	
15		
16	216	INSERT FIGURE 1. Example of analysis Theme 1, step 1-3
1/ 10		
10 19	217	Patient and public involvement
20		
21	218	No patients, patients' next of kin or healthcare personnel participated in this study.
22		
23	219	
24 25	220	RESULTS
25	220	
27	221	The review resulted in the inclusion of 47 articles (see Figure 2. PRISMA flow diagram and
28	222	Supplementary file 5: overview of included studies and quality assessment). The analysis resulted in
29	223	two main themes with five affiliated sub-themes. The results are presented according to identified
30	224	themes and sub-themes.
31 32		
33	225	
34	226	INSERT FIGURE 2. PRISMA flow diagram
35		
36	227	
3/	228	Covid-19 has driven an increased need for individual capacity as well as team capacity to handle
30 39	220	extreme changes in working conditions
40	225	
41	230	The first theme demonstrated an intensified need for health professionals to handle increased
42	231	responsibilities. At the same time, they were adjusting to constant changes in the organization and
43	232	adapting existing-, as well as creating new collaborations, to handle changing needs.
44 45	• • • •	
46	233	
47	234	Handling increased responsibilities on an individual level
48	235	Multiple studies highlighted how roles abruptly changed or expanded because of the pandemic and
49	236	described the required adaptations that followed ³⁷⁻⁴⁵ . For example, several studies found that health
50	237	professionals' educational roles had become intensified ^{42 43 45} . This included an increased need to
51 52	238	educate and inform patients about necessary precautions to reduce infection risk ^{42 45} and increased
52	239	responsibility in conveying information from local or nationwide authorities ⁴³ .
54	240	Similarly, other studies 40.46 reported that health professionals functioned as the patients' lifelines to
55	240	the outside world and were filling in the gap of abcent relatives by comforting and of life nationts
56	241 2/12	One study found that newly educated purses suddenly had to function as the conjor professionals
57	242 212	one study found that newly couldated nurses suddenly had to full the second professionals, $\frac{47}{100}$ by wore baying their first care experiences with COVID 10 patients $\frac{47}{100}$ by the second
50 59	243 244	even mough mey were having men mist care experiences with COVID-19 patients ". Nurses also
60	244	therepiete (administering pobulizers) and environmental convicts (delivering meals), respiratory
-	245	therapists (auministering nebulizers) and environmental services (emptying trash bins), because the

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246 primary groups normally responsible for these tasks visited patient rooms less often during the
 247 pandemic ⁴⁴. Pharmacists joined the hospital's infection disease team, previously only staffed by
 248 physicians, to provide expert opinion and guidance on the use of potential treatments for COVID-19
 249 ³⁸.

These changes in health professionals' roles were closely linked to an increased professional role identity ⁴⁸ as they now, to a much larger degree, had to function as independent decision-makers ⁴⁰ ⁴⁸. Many teams had to reorganize themselves to handle the pressure in the healthcare service ^{37 39 44} ⁴⁹⁻⁵⁴. This was found to be the case for hospital wards, GP offices/clinics, specific treatment teams (e.g., diabetes teams), nursing groups and pharmacies. Self-reorganization consisted of forming specific teams caring for COVID-19 patients only ⁴⁹, taking responsibility for task distribution ⁴⁹, developing appropriate nursing plans for COVID-19 patients, holding regular case-based seminars ⁵¹ and rearranging facilities to improve infection control ⁵³. Self-reorganization was reportedly needed as the new workflow was unclear ⁵², strategies to care provision were inefficient ⁴⁴, guidelines lacked on how to act ⁵⁰ and the work environment became unstructured and difficult to handle ³⁹.

Because health professionals had often not received formal training for many roles (including the expansion of roles), they organized their own education to handle new challenges related to COVID-19 patients. They held training sessions on correct personal protection equipment (PPE) use, shared their acquired knowledge with other health professionals (sometimes acquired from trying and failing), discussed clinical cases with each other, and shared knowledge via social media or by sharing self-produced informational videos ^{47 50 55 56}. They also searched for knowledge by watching YouTube videos and seeking online courses and scientific articles ^{48 55}, reportedly leading to a steep learning curve during COVID-19 37 47 48 51 57.

The literature frequently reported limited staffing and resources ^{47 58}. Consequently, health professionals were required to handle both expected and unexpected forms of resource limitations, including rationing supplies such as PPE and disinfectants, and redistributing tasks between nurses ⁵³ ^{59 60}. Several studies reported that health professionals turned to non-traditional alternatives to cope with staffing and resource limitations ^{44 50 52 53 55 59 61}. For example, some washed and reuse face masks, while others purchased their own masks because they lacked equipment at work. Some healthcare professionals made their own equipment out of uncertified materials, used painters' masks, printed face shields, or obtained missing equipment through social contacts 55 59 61. One study reported that physicians used unorthodox therapies or nontraditional approaches to care delivery that could be suboptimal or potentially harmful, to avoid having to deny treatment to some patients 59.

4546 279 Adapting to constant organizational changes

Closely related to changes in roles, several studies found that health professionals experienced an increased workload; a changed work scope; changes in workflows, guidelines, work tasks; and had to familiarize themselves with new equipment. The increased workload was a consequence of rising patient numbers, reduced staff, and/or the absence of new hires to reflect the increased workload. For example, staff quarantine requirements forced other staff to take on additional workloads which again required additional work in managing new settings or redeployed staff ^{40 62}. Additionally, health professionals were forced to handle unfamiliar tasks that would normally be done by other health professionals ^{63 64}. For example, surgical nurses became medical nurses ⁵¹, and nurses were transferred from other hospitals and wards with new guidelines and routines ⁴⁸. One study described that a teacher in a medical school was forcefully assigned to treat COVID-19 patients without having the practical knowledge of doing so 55. Changes in work tasks led to feelings of uncertainty and frustration ⁴³. For example, GPs described how their treatment focus had changed towards acute

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3 4 5	292 293	illness and the likely manifestations of COVID-19 infections, while monitoring chronic conditions was seen as less of a priority ⁶⁵ .
6	294	Constant changes in guidelines caused confusion and insecurity ⁵⁰ . There were descriptions of
7	295	frequent protocol changes lack of consistency in protocols between healthcare services and
8	205	sometimes contradictory indications, leaving health professionals uncertain of what their tasks were
9	290	^{38,50,60} Some adapted to this by starting overy day by sarefully reading emails to shack for shanges in
10 11	297	protocols and procedures ⁴⁷
12	290	protocols and procedures ".
13	299	
14	200	
15	300	Adapting collaboration to changing needs
10 17	301	The new challenges that arose in the tide of COVID-19 were reported to lead to better collaboration
18	302	between healthcare professionals as well as across healthcare services. Growth of personal
19	303	relationships and trust, a general willingness to take on other tasks and responsibilities, increased
20	304	solidarity, creation of common protocols across hospitals, and clear agreements on the distribution
21	305	of care were some of the mentioned benefits ^{37 43 66} . Moreover, new non-traditional team
22	306	compositions were created with different departments and health professionals collaborating in
23	307	unusual ways (e.g., collaboration between physicians, caregivers, physiologists, housekeepers,
24 25	308	janitors, and technicians). Some studies reported that the feeling of working towards a common goal
26	309	blurred the hierarchy between the different professions, fostering new and strengthening existing
27	310	work relationships ^{44 47 62 67} . While other studies reported the opposite ^{42 43 56} . For example, home
28	311	palliative care professionals 68 felt that the connection between the healthcare services was lost, as
29	312	their affiliated hospital had been turned into a COVID-19-only hospital.
30 21	313	
32		
33	314	Covid-19 has led to changes in healthcare organizations which better support health professionals'
34	315	need to implement adaptations
35	316	The second theme described major organizational adaptations to handle the challenges of COVID-19.
36	317	Consequently, health professionals had to adapt to these changes, including managing increased use
37 38	318	of technology to provide healthcare.
39	010	
40	319	Overall organizational efforts to handle COVID-19 challenges
41	320	Many studies reported that health professionals experienced rapid changes at their workplace as
42	321	organizations adapted in response to COVID-19 challenges. Organizations found alternative ways of
43	322	triaging and assessing patients' needs ^{58 69} and reorganized their physical space to reduce the risk of
44	323	infection (e.g., rearranging waiting rooms or removing unnecessary materials in consultation rooms
46	324	to prevent contamination) ⁴³ . Several studies reported transitioning to digital solutions to provide
47	325	patient care and minimize staff exposures to the virus ^{65 68-71} . In a methadone clinic, health
48	326	professionals described telemedicine as <i>a game changer</i> , and the <i>future of medicine</i> ⁶⁹ . In a maternity
49	327	ward, the rapid development of telehealth increased healthcare access for many women, although
50 51	328	they depended on reliable access to a phone, video, and the internet. Pharmacists expressed that
52	329	virtual witnessing and assessing of medication could decrease delays and reduce travelling for both
53	330	patients and providers ⁶⁸ . In one study, midwives started practicing case loading (one designated
54	331	midwife caring for one woman throughout the childhearing continuum) which facilitated meeting
55	337	women's needs and resulted in a nositive professional experience 71 Similarly pursing home staff
56	222	implemented a primary pursing model which enabled them to provide all-around care for their
57 59	221	nations 48. This had previously been impossible because of unfavorable purse to patient ratios.
58 59	22E	fourth example was the introduction of a differentiated labor practice model, which enabled
60	555	iourn example was the introduction of a unreferitiated labor practice model, which enabled
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3	336	pharmacy technicians to pivot rapidly away from multitasking, thereby enhancing resilience and
4	337	improving workplace conditions for staff ⁷² .
5	338	Several studies described that COVID-19 had paved the way for changes in healthcare, which
7	339	previously had been thought impossible ^{54 68 71} , including larger organizational changes. For example,
8	340	leadership modification ⁶¹ , conversion of hospital wards to covid wards ^{37 73} , development of new
9	341	protocols and triage algorithms ⁴¹ and introduction of mobile consultation services ⁷⁴ . Although these
10	342	measures were deemed necessary to cone with the covid outbreak they sometimes created
11	3/2	confusion frustration and logical challenges for healthcare professionals 507172
12	545	contrasion, indication, and logical chanenges for healthcare professionals
13 14	344	
14		
16	345	Managing new and increased use of technology to provide healthcare
17	346	Several studies highlighted a spike in the use of different technologies to enable the provision of
18	347	patient care in different settings ^{38 45 53 54 57 58 68 71 74-77} . Dunleavy and colleague's ⁵⁴ described the
19	348	adoption of new technology to manage diabetes care during the pandemic such as the use of web-
20	349	linked glucometers, electronic patient records, online referral systems, and video conferencing tools.
21	350	These technologies enabled the diabetes teams to identify and consult on patients' needs more
22	351	rapidly and enabled remote consultation ⁵⁴ . As previously stated, telehealth was used by health
23	352	professionals to continue patient treatment and support patient care teams ^{38 53} . For example,
25	353	pharmacists ³⁸ and physiotherapists ⁷⁵ made instructional videos to support their patients. One
26	354	nursing home used Zoom to carry out multidisciplinary rounds/mortality rounds and opened a
27	355	WhatsApp messaging group to effectively exchange information among health professionals. They
28	256	also conducted a virtual squing goodbue for terminal nations using open source video conferencing
29	250	also conducted a virtual saying goodbye for terminal patients using open-source video conferencing
30	357	software ³⁴ . Several other studies described the use of digital tools to maintain patients social care
21 22	358	when patients were not allowed visitors 4048 00 7875.
33	359	
34	360	DISCUSSION
35	361	This systematic review demonstrated how COVID-19 triggered multiple adaptations by health
36	362	professionals to ensure the provision of healthcare services during the pandemic. Health
37	363	professionals adopted new roles, were given increased organizational responsibilities, and coped
38	364	with resource limitations. Consequently, health professionals' workload increased, their work scopes
39 40	365	and workflow changed, and they learnt to use new equipment while guidelines constantly changed.
41	366	There were reports of silver linings, for example, increased collaboration between healthcare
42	367	professionals within and across organizations, as well as changes in the healthcare system to better
43	368	support healthcare workers' needs.
44	369	
45	370	The resilient healthcare service - adaptations and preparedness
40 47	371	Adaptions identified in this review ^{37 38 44 46 50 63 80} were crucial in maintaining healthcare service
48	372	delivery during the pandemic, for example, covering shifts due to staff shortages, allowing existing
49	373	personnel to fill necessary roles, handling new procedures, and reorganizing workspaces to reduce
50	374	the spread of the virus. Many healthcare systems were able to adjust to a somewhat stable state
51	375	during the pandemic, due to the extensive adaptations by staff, teams, and organisations to the new
52	376	demands with some systems adapting more effectively than others. This support Hollpagels'
53	277	statement that performance variability is crucial to ensure system performance and patient safety in
54 55	377 970	statement that performance variability is crucial to ensure system performance and patient safety in
55	5/0	Changing work systems .
57	379	According to RiH theory ⁸¹ , adaptations can be triggered by different factors in the system. These
58	380	factors may be both internal (e.g., resources, staffing, competence) and external (e.g., budget cuts.
59	381	regulatory demands) ⁸¹ . Our review identified examples of adaptations triggered by both internal and
60	-	

external factors with health professionals experiencing a lack of competence, resources, staffing, equipment, information, and guidelines ^{38 47 50 55 63 71 80}. These factors forced health professionals to seek new ways of coping to be able to sustain required performance ⁸¹.

Health professionals' adaptive capacity was found to significantly contribute to the system's resilience. However, system preparedness is also critical for system resilience. The included studies reported varying degrees of preparedness across the different healthcare services. Some health professionals spoke positively about how they had managed to come together and make things work ^{39 47 79}, while others spoke of extreme resource shortages and being overworked ^{41 53 60}. In this context the large variations in how different countries were affected by the pandemic, for example, related to spread of infection in the population, differences in population size, proportion of older adults in the population, population density, and how well-developed a countries' healthcare system was to begin with, must be considered. Thad said, according to Hollnagel ⁸², a system must have some sort of readiness if something unexpected happens (e.g., resource allocation to match the needs of the expected event) to be considered resilient ⁸². A resilient system should further cover four resilience potentials (responding, monitoring, anticipation, learning) (Box 1) 82.

Box 1. Resilience potentials

Resilience potentials

i) Knowing what to do (how to respond to disruptions and disturbances by adjusting normal functioning); ii) Knowing what to look for (monitor what is, or could be future threats); iii) Knowing what to expect (how to anticipate developments of and threats further into the future); and iv) Knowing what has happened (how to learn from experience, particularly the right lessons from the right experiences (81).

The reported experiences with everchanging guidelines and procedures, as well as limited resources (i.e., staffing and equipment) suggests that most healthcare systems did not have the capacity (e.g., a large enough PPE-storage or back-up staffing), or the right measures in place to respond adequately to the disturbance (COVID-19) (e.g., adequate contingency plans). Similar descriptions have been found in other studies ⁸³⁻⁸⁶. Despite the lack of preparedness of the system, the literature reported significant amounts of adaptive capacity among healthcare professionals, supporting Wear's ⁸⁷ claim that people are the most adaptable element in any complex work system. The adaptations needed to handle the COVID-19 pandemic, such as greater freedom for healthcare professionals to incorporate their adaptive capacity in patient care, and a stronger focus on changing the organization of healthcare based on health professionals suggestions and needs should be used for learning and preparation for near and future threats ⁸². As we are still *learning* from this pandemic it is important to understand the adaptations that worked well ⁸². Data and learnings from these instances will ensure a more resilient healthcare service when encountering future disturbances such as new pandemics⁸⁸.

Adaptations – the good, the bad, and the ugly

Some adaptations are effective solutions that can function long-term, thus strengthening the healthcare service and in some instances, resulting in innovations ⁸¹. This aligns with RiH characteristic of *learning from what goes well*⁸. Although the distinction between long-term adaptations and sustainable innovations was somewhat unclear in the included literature, several of the measures set in place as a response to the pandemic were deemed helpful by health

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professionals. For example, the introduction of telemedicine and other assistive technology were particularly viewed positively ^{59 68 71 89}, as well as new care models, new procedures, new systems, and new working models ^{45 48 72}. Overall, the focus on innovation development in healthcare had to increase rapidly in response to the COVID-19 pandemic ⁹⁰⁻⁹³, despite the challenges that innovations in healthcare have met in the past ⁹⁴. Successful, targeted innovations can, in the long run, contribute to more effective, more cost-effective and safer healthcare services ^{95 96}, learning from the good adaptations and innovations that COVID-19 brought with it is therefore of great interest for future healthcare services. However, adaptations set in place as survival mechanisms, so-called fire-fighting ⁹⁷ was also identified in the studies (e.g., reuse of PPE) ^{41 50 55 61}. These types of adaptations are often short-time

solutions and may have negative impacts on both the healthcare system and healthcare professionals⁸¹. Fire-fighting adaptions can create a false impression of success because it gives the illusion that a system is performing better than it is ⁸⁷. Conversely, continuous adaptations to poorly functioning systems can be exhausting for the people working within them ^{50 52 71}, resulting in inefficient and potentially hazardous systems, posing threats to patient safety and healthcare quality. 87.

According to Woods ⁹⁸, all systems have a range of how much they can adapt to unexpected events based on the resources they hold and the already existing variation in the system. When a system is pushed towards, or over its range of performance, the system can either adapt and expand its performance beyond its range, or it can result in a rapid fall in performance. Woods calls these opposites graceful extensibility and brittleness, where brittleness is the opposite of resilience. A resilient system will handle unexpected changes with graceful extensibility and be able to expand its adaptive capacity when unexpected events happen, while non-resilient systems will not be able to handle being pushed past their performance range, and experience a system collapse (brittleness) ⁹⁸. The distinction between brittleness and graceful extensibility depends on the general preparedness of a healthcare system and is a reminder of the need to prepare healthcare systems for future crises.

36 446 How did rapid changes become possible?

The path to becoming a more functional and prepared healthcare system includes system-level changes. However, introducing sustainable changes into a system (for example, delivering care in line with new evidence) has in the past proven difficult ⁹⁹. Included studies, however, found that changes that had previously been impossible due to rigid systems became possible in the wake of the pandemic ^{48 54 68 71}. The pandemic created the window of possibility to explore how rapid changes in healthcare systems can be possible.

Nilsen et al. ¹⁰⁰ identified three characteristics of successful change: (1) having the opportunity to influence change, (2) being prepared for the change, and (3) valuing the change. Many of the adaptations identified in this review were introduced by frontline health professionals. Opportunities to influence change came when personnel experienced pressure to find novel solutions and adopt high-responsibility roles. Additionally, existing hierarchy in healthcare systems was described to have vanished as health professionals were working towards a common goal 44 47 62 79. The blurring of hierarchy and the development of new collaborations lead to breaches of organizational silos ^{39 49 74}, as well as closer collaboration within existing teams ^{37 42 56 79}. There were descriptions of new team mixes, new collaborations between health professionals from different hospitals ³⁹, and strengthened relationships, collaborations, solidarity, and trust within existing teams ^{37 44 79}. The change was valued, with increased opportunities to discuss problems and find solutions more openly and across hierarchies. The experience of partnership is a crucial factor when making changes or improvements in healthcare systems ¹⁰¹. This is supported by Gergerich and colleagues ¹⁰² who describe the need to work as a team outside the normal hierarchy to successfully make transformation or change, and is in 467 line with research findings showing that humans who experience acute social stress engages in more
468 prosocial behavior such as trust, trustworthiness, and sharing ¹⁰³.

469 Overall, the COVID-19 crisis created the context for partnerships between health professionals to
 470 develop through a common goal, and demonstrated that increased collaboration, cooperation, and
 471 inclusion across and within professions, roles and hierarchies were crucial to effectively introduce
 472 changes into the healthcare system.

12 473

474 IMPLICATIONS FOR POLICY AND PRACTISE

This review demonstrated that adaptive capacity among healthcare professionals played a major part in keeping healthcare services running during the extreme conditions that the COVID-19 pandemic induced. The study findings indicate the benefits of giving health professionals greater freedom in adapting their work when handling the complexities and changing systems of healthcare services. At the same time, awareness is needed to identify and address malfunctioning adaptations resulting from poor system designs. Previously, poorly functioning system designs in healthcare have proven difficult to change ⁹⁹. However, this review found that during the pandemic, healthcare services changed rapidly and often for the benefit of patients and workflows for. The changes described in this review where often induced or suggested by healthcare professionals, or based on their needs, once again highlighting the need to involve health professionals' in organizing and restructuring healthcare services to a greater extent than has previously been done.

487 IMPLICATIONS FOR RESEARCH

The organizational changes executed during the pandemic have created a window of possibility to explore how rapid changes in healthcare systems can be possible. Changes in healthcare systems are needed to improve patient safety, quality of care and efficiency. However, it is becoming more difficult to redesign systems with the increasing complexity of healthcare services. It is therefore pivotal to seize the opportunity to learn about health system change in the aftermath of the pandemic peak. Moreover, this study revealed skills in cooperation across healthcare institutions, healthcare professionals and other professional groups. Health professionals' ability to cross healthcare silos to deliver care should be further investigated. Lastly, to improve healthcare systems' preparedness and resilience, it would be useful to further investigate what factors in healthcare systems facilitate positive adaptations and innovations and what factors result in poorly functioning adaptations.

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49500STRENGTHS AND LIMITATIONS

This review protocol was registered at the open science framework (OSF) and followed the PRISMA-P checklist. A comprehensive search strategy was employed to identify studies focusing on healthcare personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic. Limitations of the current study stem from our pragmatic choices to not include grey literature and not rerun the search before publication. That said, there are arguments that a more purposeful sampling approach aiming to provide a holistic description of a phenomenon, rather than to identify all eligible studies might be more appropriate in qualitative literature reviews ¹⁰⁴ Moreover, the search strategy was developed by a committee of subject matter experts and not a database search specialist. The committee consisted of three researchers with experience in search strategy

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development, and the strategy was later reviewed by two independent researchers with broad

experience within the researched field. It is possible that the search strategy could have been strengthened by a database search strategy. In addition, the published literature examining the adaptations made by health professionals may be shaped by publication bias, with negative results less likely to be published and the act of publishing in academic journals outside of the health professionals' role.	
CONCLUSION	
The COVID-19 pandemic created tremendous disturbances in healthcare systems worldwide, demanding rapid adaption to comprehensive changes. COVID-19 triggered the rapid reorganization of healthcare services, and through these changes, healthcare systems and health professionals demonstrated a significant adaptive capacity. Many of the changes driven by the pandemic led to positive and useful alterations to the healthcare system, potentially creating foundations for healthcare innovation and sustainable change. The pandemic also exposed weaknesses in healthcare system design and capacity ^{105 106} , forcing health professionals to make dysfunctional and potentially harmful adaptations. Crucially, few healthcare systems were properly prepared for a pandemic event, which does not align characteristics of a resilient healthcare systems respond to unexpected challenges that linger, and how we might build resilient health systems globally ^{107 108} .	Protected by copyright, including fo
Acknowledgments The authors acknowledge the University of Stavanger for using their library database for this research.	Enseig r uses rel
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MKG, EA, KL, DB and SW participated in the development of the review protocol. MKG and EA developed the search string, and MKG, EA and KL conducted the pre-screen to ensure consistency in inclusion/exclusion criteria. KL designed the pre-designed data extraction form. Title, abstract and full-text review where individually conducted by MKG, EA, and KL, as was the quality appraisal of the included studies. SW and DB were available for consultation and provided advice during the screening process. The analysis was conducted by MKG and was approved by the review team. Lastly, MKG prepared the manuscript and EA, KL, DB and SW reviewed and edited.	ent Superieur (ABES) . to text and data mining,
Competing interests The authors have no competing interests to declare	Al training
Funding The publication fee was covered by the University of Stavanger. The funding body was not involved in the research process or in writing the manuscript	, and similar
Data sharing Overview of article quality assessment will be provided upon request to corresponding author. All other data are freely available	r technologie
Ethics approval This study does not involve human participants and ethical approval was not required	ŝ
FIGURES AND SUPPLEMENTARY FILES Figure 1. Example of analysis Theme 1, step 1-3 Figure 2. PRISMA flow diagram	I

less likely to be published and the act of p professionals' role. CONCLUSION The COVID-19 pandemic created tremend demanding rapid adaption to comprehens of healthcare services, and through these demonstrated a significant adaptive capa positive and useful alterations to the heal healthcare innovation and sustainable cha system design and capacity ¹⁰⁵ ¹⁰⁶, forcing harmful adaptations. Crucially, few health event, which does not align characteristic experience represents an opportunity to unexpected challenges that linger, and ho Acknowledgments The authors acknowledge the University of research. Autor contributions MKG, EA, KL, DB and SW participated in th developed the search string, and MKG, EA inclusion/exclusion criteria. KL designed t full-text review where individually conduct included studies. SW and DB were availab screening process. The analysis was cond MKG prepared the manuscript and EA, KL **Competing interests** The authors have no competing interests Funding The publication fee was covered by the U the research process or in writing the ma **Data sharing**

- Overview of article quality assessment will other data are freely available
- **Ethics approval**

This study does not involve human partici

FIGURES AND SUPPLEMENTARY FILES

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- Figure 2. PRISMA flow diagram

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PRIS	MA 2	020 Checklist	
Section and Topic	ltem #	Checklist item	Location where item is reported
6 TITLE			
7 Title	1	Identify the report as a systematic review.	Title
8 ABSTRACT			
9 Abstract	2	See the PRISMA 2020 for Abstracts checklist.	х
10 INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3
Dbjectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3
14 METHODS			
15 Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
16 Information 17 sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted identify studies. Specify the date when each source was last searched or consulted.	Page 6
18 Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used 23	Sup. File 1
19 20 21	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how make independently, and if applicable, details of automation tools used in the process.	Sup. File 2, Table 2 and page 4 -5
22 23 Data collection 24 process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each repert, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, deta of automation tools used in the process.	Page 7-8
25 26	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which esuits to collect.	Page 7 -8
27 28	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, and g sources). Describe any assumptions made about any missing or unclear information.	Page 4 and 13
30 Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 7 and sup. File 2
B1 Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presantation of results.	Page 8 - 10
33 Synthesis 34 methods 35	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the studie intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 6 – 7 and sup. File 2
36 37	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing sum	N/A
38	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Fig. 1
39 40	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Fig 1. And page 7-8
41	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analy as, meta-regression).	N/A
4Z 43	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 7 -8
44 Reporting bias 45 assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting bias). For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	Page 13 -14
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15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome	di

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6 7	Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
8 RESULTS				
9 10	Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the search to the search to the review, ideally using a flow diagram.	Figure 2.
11		16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they w	N/A
12 13	Study characteristics	17	Cite each included study and present its characteristics.	Sup. 4
14 15 16 17	Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Overview of quality assessment on request
18 19	Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) and the stimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
20 21 22 23	Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Overview of quality assessment on request
24 25		20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summare restinate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
26		20c	Present results of all investigations of possible causes of heterogeneity among study results.	page 8 - 11
27 28		20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 13 -14
29	Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 13 -14
30 31	Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Page 13 - 14
32	DISCUSSION			
33 34	Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 11 - 13
35 36		23b	Discuss any limitations of the evidence included in the review.	Page 13 - 14
37 38		23c	Discuss any limitations of the review processes used.	Page 13 - 14
39 40		23d	Discuss implications of the results for practice, policy, and future research.	Page 14
41	OTHER INFORMA	TION		
42	Registration and	24a	Provide registration information for the review, including register name and registration number, or state that the redew was not registered.	Page 4

Indicate where the review protocol can be accessed, or state that a protocol was not prepared.

Describe and explain any amendments to information, provided at registration or in the protocol. For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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1 2	PR	ISMA 2	020 Checklist	en-2023-(/ copyrig	
3 4 5	Section and Topic	ltem #	Checklist item	071828 ht, inclu	Location where item is reported
5	Support	25	Describe sources of financial or non-financial support for the review, and the role	e of the funders or sponsors in the review.	Page 14
7 8	Competing interests	26	Declare any competing interests of review authors.		Page 14
9 10 11	Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found studies; data used for all analyses; analytic code; any other materials used in the	I: template data collection forms אַ הְשָּׁהָ בּשָּׁם e review.	included Page 14
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Resilience in healthcare during the COVID-19 pandemic: A protocol for a qualitative systematic literature review

Background

The 12th of March 2020, The World Health Organization announced the novel Coronavirus disease (COVID-19) a pandemic due to the growing numbers of countries affected by the viral respiratory infection (WHO, 2020a). The virus was discovered in December 2019 after an accumulation of patients with viral pneumonia in the city of Wuhan, People's Republic of China (WHO, 2020b). By 8th of February 2021, there were reported over 100 million confirmed cases of COVID -19 infections worldwide, with over 2 million confirmed deaths (Worldometer, 2021), and these numbers are still increasing. The pandemic has caused great challenges for healthcare systems worldwide (Khalid & Ali, 2020) including limited resources (e.g. lack of equipment, staff or physical space), a surge of patients needing healthcare services, and the need to reorganize parts of the healthcare system to maintain infection control. Additionally, healthcare workers have been forced to handle new work-tasks, master new equipment and new technical procedures (Liu et al., 2020). All these aspects have forced healthcare personnel to make major adjustments to changes induced by the pandemic, both on organizational- and individual-levels.

Resilience in Healthcare (RiH) is about maintaining stability in the face of expected or unexpected changes (e.g. changes induced by the Covid-19 pandemic) and the systems' or the individual's ability to adjust or adapt to these changes or disturbances, and return to a stable state (Wiig & Fahlbruch, 2019). In this perspective the ability healthcare workers have, to adjust to the situation they are in (e.g. master new equipment in a short time), are what makes the healthcare system function, both during normal operation and under special circumstances. The ability to adjust to expected and unexpected events is called performance variability, and is according to RiH, crucial to ensure adequate performance, and maintain patient safety, due to the complex and everchanging nature of the healthcare system (Hollnagel, 2015; Hollnagel et al., 2015). An important aspect of RiH is further, to observe and understand the thing that goes well when everyday adaptations are being made. This is needed to understand the things that do not go well (e.g. adverse events), which is a different perspective than traditional patient safety work, were the main focus has been on the thing that goes wrong (Jeffcott et al., 2009).

In the context of the COVID-19 pandemic, which brought with it a cascade of changes and new challenges (e.g. pressured resources, increased patient flow, unknown medical procedures), performance variability is about making adjustments to the current situation and keep the healthcare services running in a safe and professional manner, despite these changes and subsequent challenges (Jovanović et al., 2020).

Despite the novelty of the COVID-19 pandemic, large amounts of research on the topic has already been conducted. This includes research on healthcare personnel's experiences during the pandemic (Chamboredon et al., 2020; Halcomb et al., 2020; Xu et al., 2020), infection control and implications for healthcare quality (Coma et al., 2020; Kirkevold et al., 2020) recommended and executed measures related to the pandemic (Krist et al., 2020; Mills et al., 2020; Morreel et al., 2020) and studies about physical and psychological outcomes of COVID-19 patients (Carfi et al., 2020; Sahoo et al., 2020; Wang et al., 2020). There are in other words much evidence on the different aspects of the pandemic, and how it affects the healthcare service, healthcare professionals and patients. As of our knowledge, limited research have, however, directly targeted health personnel's ability to adapt (c.f. Resilience in Healthcare) to the changes induced by the COVID-19 pandemic. Moreover, RiH's positive outlook on how health professionals handle challenges in the delivery of healthcare (focusing on the things that goes well, rather than focusing on the things that do not work), is an important perspective to illuminate in a time where health personnel's efforts has been extraordinary. Lastly, increased knowledge on how health personnel handled, and adjusted to, changes induced by the COVID-19 pandemic situation is useful in understanding how patient safety is being maintained in unanticipated situations and can be beneficial in handling future similar situations.

The aim of the study is to identify and review qualitative studies focusing on healthcare personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic. Moreover, the systematic review aims to identify what adaptations are being executed and why, from the perspectives of health personnel's experiences.

Methods and design

This protocol was developed in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis—Protocols (PRISMA-P) 2015 checklist (Moher et al., 2015). The protocol will be registered with the Open Science Framework (OCF) when approved by all authors.

Review question

The review will be conducted as a qualitative systematic review to answer the research question:

What kind of adaptation were required from healthcare professionals during the COVID-19 pandemic? What kind of performance variation did healthcare professionals experience resulted from these adaptations?

The components of PICO are as following:

Participants: Healthcare professionals

Interventions/Exposures: The COVID-19 pandemic

Comparators: Performance variation before the pandemic

Outcomes: Healthcare personnel's experience of performance variations during the COVID-19 pandemic

Qualitative systematic reviews integrate or compare findings from qualitative studies, and further, look for themes or constructs in and across individual studies (Booth et al., 2016). A qualitative systematic review design will allow for the identification of a wide range of valuable experiences of adaptations in response to the COVID-19 pandemic, as qualitative research is used to explore meanings of social phenomena (changes induced by the COVID-19 outbreak) as experienced by individuals (healthcare professionals) in their natural context (the healthcare services) (Malterud, 2001). This will enable us to provide an in-depth understanding of the meanings health professionals assign to changes induced by the pandemic and the required adjustments to these changes

(Holloway & Galvin, 2017). Synthesizing qualitative evidence, further, provides an opportunity for interpretating and identifying new knowledge of subjectivity and meaning in qualitative studies (Malterud, 2017), implying that interpretation of existing qualitative data will provide an opportunity to find other meanings i.e., finding data about performance variation (c.f. resilience in healthcare) in studies not necessarily having this as the main focus.

Eligibility criteria

All primary, qualitative studies coved by the selection criteria (Table I. Selection criteria) will be eligible for inclusion. Quantitative studies are considered non-eligible in this review due to their inability to cover the "outcome" (i.e., identify in-depth information about health personnel's experiences) and because quantitative studies limit the possibility for new interpretations of health professionals experiences, and the possibility to identify data about adaptive capacity in studies with other main focuses'. Studies conducted before 2019 will not be eligible as the "exposure" (COVID-19), cannot be addressed. Grey literature, including reviews, commentaries, editorials or other non-empirical materials will not be included. Eligible study populations will include healthcare professionals within the definition stated below. hospital Studies concerning health personnel not providing direct formal care (e.g., policy makers, hospital managers), other personnel working in hospitals/the primary healthcare service (e.g., porters or cleaning staff) or patients and their next of kin will not be included in the review. Studies written in other languages than English, Norwegian, Swedish, or Danish will not be included as these are the languages mastered by the research team.

Clarification of central concepts

A healthcare professional is in this context defined as a person who maintain human's health through applying principles and procedures of evidence medicine and caring. Health professionals provide advice and apply preventive and curative measures (WHO, 2013). Examples of healthcare professionals are: nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwifes, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although health personnel working in psychiatric healthcare services are included in the healthcare professional definition, they will not be included in this review as the focus here is on somatic healthcare settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).

RiH Quality and Resilience Trigger tool will help circling eligible studies involving adaptations cf. Resilience in Healthcare. This tool was developed by Aase et al., (2020) to screen research projects for RiH relevance as a part a large longitudinal, cross country study. RiH is in this context, connected to actions, activities, and processes (resilience as a verb). RiH trigger tool, consist of a double screening process, were the first part involve identifying on or more of the four quality dimensions (patient experiences, patient safety, clinical effectiveness and care coordination) and the second part involve identifying eventual resilience triggers such as:

- Adaptation
- Variation
- trade-offs

- Development
- Improvement
- success

- improvisation •
- response •

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- complexity •
- Individual capacity (knowledge, competence, learning, personal characteristics, cognitive, behavioral strategies)
- Team/unit capacity (communication, • collaboration, learning)
- Organizational capacity (resources, organization, culture)
- Larger system capacity (infrastructure, regulation, framework conditions)
- Changes •
- Challenges •
- Disruption •

- enhancement
- growth
- Recovery
- Transformation
- Collaborative learning
- work practice •
- teamwork •
- problem solving
- interaction •
 - Stakeholder actions
- knowledge-brokering
- co-creation
- contribution
- information •
- engagement

ChangesChallengesDisruption	informengage	nation ement
able I. Selection criteria		_ Fuchaion exiteria
Participants/ context	Studies involving healthcare professionals (as defined above) in somatic clinical settings e.g., hospitals, home care services, nursing homes, General practitioners (GP) offices.	Studies involving psychiatric wards/institutions.
	Studies involving nurses, certified nurse assistants (CNA), healthcare assistant, nursing home physicians, pharmacists, physiotherapists, assistants, Licensed practical	Studies involving healthcare personnel not providing direc formal care (e.g., hospital management, policy makers, ward leaders)
	nurses (LPNs), or other healthcare personnel working in clinical settings	Studies involving other personnel working in healthcare settings providing other services than direct formal care (e.g., porters, cleaning staff, management)
		Patients, aged care residents, service users (e.g., people receiving home care services) their next of kin or other informal care givers (neighbors, friends)

Exposure	Studies investigating the COVID-19 pandemic	Studies not concerning the COVID-19 pandemic	
		Studies investigating previou pandemics/epidemics (e.g., H1N1, Ebola, Zika)	
Outcome	Studies including resilience triggers on a micro-level e.g., individual capacity (knowledge, competence, learning, behavioral strategies) and team/unit capacity (communication, collaboration and learning) and triggers on macro-levels e.g., organizational capacity (resources, organization, culture) Examples of triggers related to the above are: healthcare personnel's adaptions to changes in work routines, tasks or work environment/work groups, handling challenges, finding solutions to problems, coping with staffing difficulties, equipment shortage, or lack of competence/knowledge	Studies investigating Larger systems' adaptation capacity (infrastructure, regulation, framework)	
		Psychological (individual) resilience or lack of resilience such as psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with protective gear), or healthcare personnel's professional identity.	
		Medical perspectives such a COVID-19 treatment regime	

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		Studies not involving adaptive capacity such as studies only focusing on barriers and challenges (not solutions)
Language and year of	English, Norwegian, Danish or	Other languages
publication	Swealsh	Studies published before 2019
	Studies published between	
	2019 and 2021	
Method	Studies applying qualitative	Studies applying quantitative
	methods that are published in	methods. Grey literature, e.g.,
	peer-reviewed scientific	editorials, comments, non-
	journals	scientific publications

Data sources, search terms and search strategy

The search strategy will involve searches in the databases: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science direct and Scopus using the key words and MESH terms listed in Table II. These were identified through the National Library of Medicine's (NIH) Medical Subject Headings (MeSH) browser, an electronic thesaurus (www.thesaurus.com, 2021), through years of studying RiH literature, and initial searches conducted by MKN (Fig 1. provides an example of a possible eligible study identified in the initial searches). After conducting searches in the listed databases, secondary searches will be conducted in the included articles (a review of the reference list of included articles in the search for eligible articles), and moreover, hand searches will be conducted in current journals (current journals will be identified through the included articles).

Available Medical Subject Headings (MeSH) terms will be applied to simplify and ensure accurate searches in current databases (e.g. to cover all versions of the term COVID-19). In Ovid platforms, MeSH-terms is shown with a "/ "after the term. In CINAHL and on the EBSCO platform, "MH" is used to indicate the search of a subject heading. Where MeSH terms are not available, relevant key words linked to the research question at hand will be applied. On the OVID platform, key words will search across a range of fields including title, abstract and subject heading words while in the CINAHL platform, the keyword search is in the abstract, title and subject heading fields. Truncations (*) will be applied on relevant search words (e.g., challenge, issue, problem) to retrieve any alternative endings e.g., singular and plurals of words. The use of truncations is, however, not recommended in PubMed and may disturb the identification of subject headings (this will be taken into account). Phrase searching (e.g., performance variability, assisted living) will be completed by using quotation marks "..." to ensure that keywords are searched as phrases. Boolean operators AND and OR will be used to combine the search words to widen or broaden the searches. For example: COVID-19 AND Safety II OR Safety-II AND "Primary healthcare service" AND challenge* (LibGuides, 2021)

Searches compromising all possible combinations of the three clusters will systematically be conducted. An overview of all conducted searches in all databases will be provided as a supplementary file.

Table II. Key word clusters

Cluster I	Cluster II	Cluster III	Cluster IIII
1. COVID-19/ MH	2. "Resilience in	15. "primary health	36. Challenge*
	healthcare"	care services"	37. Issue*
	3. "safety II"	16. Primary	38. problem*
	4. "Safety-II"	healthcare/ MH	39. Concern*
	5. adaptation*	17. "Primary health-	40. Difficulty*
	adjustment*	care"	41. Constraint*
	7. re-organization	18 "Primary care"	42. Obstacle*
	8. Re-organisation	19. "Primary	43. Hindrance*
	9. trade-off*	healthcare"	44. Barrier*
	10. "performance	20 "Primary health-	45. Problem solving
	variability"	care"	46. Maintain
	11. variation*	21 "Care homes"	47. solution*
	12.improvisation*	22 "Residential aged	48. Manage (ing)
	 response* 	care"	Managed
	14. complexity	23 "Long-term care"	49. Handle (ing)
		24 "Long term care"	50. Cope (ing)
		25. "nursing homes"	51. endure
		26. "assisted living"	52. coordinate (ing)
		27. "facility	53.Organize (ing)/
		retirement"	54.Organise (ing)
		28. "facility home	
		care"	
		29. "home care	
		services"	
		30. "Home care"	
		31. "home based care"	
		32.Hospital*	
		33."Emergency	
		room"*	
		34 Emergency	
		service/MH	
		35. Clinic*	

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Fig. 1 Example of eligible article

Example of possible eligible article

The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study Liu et al, 2020). <u>https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30204-7/fulltext</u>

Examples of relevant findings

- Physicians and nurses followed the diagnosis and treatment guidelines released by the National Health Commission, while drawing on previous clinical experience and learning through exploration
- They discussed the guidelines with other colleagues to understand their experience in treating patients with COVID-19, then transformed this knowledge and experience to use in patient care
- Many wards that were not designed for infectious diseases were modified into isolation wards within a short period of time
- They needed to learn and master new technical procedures in a short time
- They had to rapidly find ways to work together efficiently

Selection of eligible studies

Identified studies will be managed in the reference manager Zotero 5.0. Duplicates will be removed and references uploaded in Rayyan QCRI, which is an application that enable all researchers of the study to review abstracts and titles, and select articles for inclusion (Ouzzani et al., 2016). Abstracts will be screened against the selection criteria and studies assed for inclusion. Full text articles will be uploaded in Zotero 5.0, a tool for collection, organizing, citing and sharing research (*Zotero*, 2021).

Quality assessment

Each study will be assessed for quality using the Clinical Appraisal Skills Program (CASP) for qualitative studies (Clinical Apprasial Skills Programme, 2018). CASP enables a systematic assessment of the trustworthiness, relevance and results of published articles. It consists of ten yes/no questions, with additional prompts, reminding the reviewer of the importance of each question. If the answer
to the first two questions¹ are "no", the study will be assessed as biased, and will not be included in the review (Clinical Apprasial Skills Programme, 2018). The CASP tool do not include a scoring system (where low scores exclude articles), but do however, guide each reader to appropriate assessments of the quality of each study. In other words, the reader needs to individually assess the studies based on the control questions. Relevant experience within qualitative research will, in this case, be an advantage.

Data extraction and synthesis

The following data will be extracted from included articles: details about the variation in performance (cf. resilience in healthcare); how adaptations were executed; reasons for adaptation execution. Study characteristics (e.g., title, year, method, setting, informants) will be extracted and listed in a table to provide an overview of included studies. The qualitative analysis tool NVivo Pro will be use to facilitate a thematic analysis and synthesis as described by Thomas & Harden (2008). The studies' results will be uploaded into Nvivo or entered into the program verbatim. Further, the text will be coded inductively, sentence by sentence, according to its meaning and context by two researchers. The codes will be structured in a three form (hierarchical structure) to display the relationship between different codes. Codes with similar meaning will be assembled under broader categories (going through several phases of organization and reorganization to ensure accurate placement). Lastly themes will be developed based on the content of the different codes, and their descriptive, and possible, latent (analytic) meanings (Ring et al., 2011; Thomas & Harden, 2008). To ensure accurate themes, they will be discussed among the researchers.

Strategy for presentation of the results

The search strategy will be presented in the protocol as an attachment. The PRISMA flow diagram will be used to provide an overview of the study selection and review process. A summary of the included studies will be provided as a table along with an excerpt of the analysis. The results will, in the protocol, be presented theme by theme (in the order of the identified themes of the analysis).

Researchers

The research team comprise researchers with experience from a variety of relevant fields within health services research:

Dr. Malin Knutsen Glette, SHARE, University of Stavanger

E-mail: Malinknutsen.glette@hvl.no

https://www.uis.no/nb/profile/2373

Professor Siri wiig, SHARE, University of Stavanger

E-mail: Siri.wiig@uis.no

¹ 1. Was there a clear statement of the aims of the research?

^{2.} Is a qualitative methodology appropriate

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https://www.uis.no/nb/profile/1838

Dr. Kristiana Ludlow, AIHI, Macquarie University

E-mail: kristiana.ludlow@mq.edu.au

https://researchers.mq.edu.au/en/persons/kristiana-ludlow

Professor, MD, David Bates, Harvard Medical School

E-mail: dbates@bwh.harvard.edu

https://www.hsph.harvard.edu/ecpe/faculty/david-w-bates/

Dr. Elizabeth Austin, AIHI, Macquarie University

E-mail: elizabeth.austin@mq.edu.au

https://researchers.mq.edu.au/en/persons/elizabeth-austin

Work distribution and schedule

Time	Task	Work distribution
January - February	Develop project protocol	MKN with input from EA_SW/
Sundary - rebradry	(defining the purpose tenic	DR and KI
	(denning the purpose, topic,	DB allu KL
	scope, research question(s)	
	and analytic framework,	
	determining	
	inclusion/exclusion criteria)	
	Identify eligible researchers/	MKN & EA
	build a team	Do Siri have any suggestions
		from UIS?
	Finalize scope	MKN, EA, SW
	Preliminary literature	MKN
	searches	
February- April	Main Searches, including hand	MKN
	searches and secondary	
	searches	
	Reference management	MKN
	Study selection	MKN, EA & KL (?)
May - July	Quality assessment	MKN, EA & KL with input from
	Data extraction	SW and DB

Table III. Schedule, tasks and work distribution (inspired by Nelson, 2014)

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	Qualitative analysis	
July - September	preparing the report	MKN (full draft), EA, KL, SW & DB
September/October	Article Submission	
*MKN= Malin Knutsen Glette Elizabeth Austin	e, SW= Siri Wiig, DB = David Bates,	KL= Kristina Ludlow, EA=

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	Title/Author	Method	Setting	Partisipants du ing fo	20 Se	Qualit assesi
1	To be or not to be in the ward': The Impact of Covid-19 on the Role of Hospital-Based Clinical Pharmacists - A Qualitative Study (Cheong, 2020)	Qualitative	Hospital	Pharmacists eignement related to text	Malaysia Eember 2023. Down	High
2	A National Study of Community Health Centers' Readiness to Address COVID-19 (Damian et al., 2021)	Mixed method	Community health centers	Primary care employed data data data data data data data da	USA USA	High
3	A qualitative examination of quarantine work experience of nurses in Saudi Arabia (Alhamidi et al., 2020)	Qualitative	Quarantine centers	Nurses g, Al traini	Saudi Arabia	High
4	A qualitative study of physician perceptions and experiences of caring for critically ill patients in the context of resource strain during the first wave of the COVID- 19 pandemic (Parsons Leigh et al., 2021)	Qualitative	ICU	Physicians g, and similar technologies.	n. Canada n.bmj.com/ on June 11, 2025 at	High
5	A Qualitative Study of Primary Care Physicians' Experiences With Telemedicine During COVID-19 (Gomez et al., 2021	Qualitative	Primary care		A USA Bibli	High

6	Adapting to the unexpected: Problematic work situations and resilience strategies in healthcare institutions during the COVID-19 pandemic's first wave (Juvet et al., 2021)	Mixed method	Hospital	Nurses and other caregivers for uses	28 Switzerland on 20 Septemb	High
7	An Experience of Otorhinolaryngologists as Frontline Worker with Novel Coronavirus: A Qualitative Analysis (Kaur et al., 2021)	Qualitative	Hospital	Otorhinolaryngologisted to text and data	97 2023. Downloaded fr	High
8	At Home, with Care": Lessons from New York City Home-based Primary Care Practices Managing COVID-19 (Franzosa et al., 2021)	Qualitative	Home-based primary care	HBPC leadership including clinical/medial directors, program managers, nurse practitioners/nursing coordinators, and social workers/social work	USA USA http://bmjopen.bmj.co	High
9	Changes to care delivery at nine international pediatric diabetes clinics in response to the COVID-19 global pandemic (Sarteau et al., 2021)	Qualitative	Diabetes clinics	Healthcare providers milar technolog	USA, Australia, Sweden, India	Low
10	Clinician Perspectives on Caring for Dying Patients During he Pandemic A Mixed-Methods Study (Cook et al., 2021)	Mixed method	Hospital	Patients, family 🥳 members, clinicians	2025 at Agence	High

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	Clinician perspectives on methadone service delivery and the use of telemedicine during the COVID-19 pandemic: A qualitative study (Hunter et al., 2021)	Qualitative	Methadone clinic	physicians, physician clu assistants, and nurse in practitioner	-071828 on 20 Septem	High
12	Covid-19 changes to maternity care: Experiences of Australian doctors (Szabo et al., 2021)	Mixed method	Maternity wards	Doctors ted	Australia Australia 2023. Dow	Higl
13	COVID-19 Impact on Healthcare and Supportive Services for People Who Use Drugs (PWUDs) in Malaysia (Vicknasingam et al., 2021)	Qualitative	Healthcare and non- governmental organizations	Medical personnel of a second	Malaysia Malaysia from htt	Low
14	COVID-19: How did community pharmacies get through the first wave? (Gregory & Austin, 2020)	Qualitative	Pharmacies	Pharmacists A trainin g	Canada	Low
15	Delivering Virtual Cancer Rehabilitation Programming During the First 90 Days of the COVID-19 Pandemic: A Multimethod Study (Lopez et al., 2021)	Multi method	Cancer center	Oncology healthcare and providers similar technolog	Canada	Hig
16	Effect of COVID-19 on health system integration in the Netherlands: a mixed-methods study (Minderhout et al., 2021)	Mixed method	Acute care	Clinicians, managers, 🖁 administrators, and insurance company representatives	Netherlands at Agen	Higl
17	Emerging Palliative Care Innovations in the ED: A	Qualitative	Emergency department	Emergency department and Palliative care clinicians	e USA Bibliog	Higl

	Qualitative Analysis of Programmatic Elements During the COVID-19 Pandemic (Aaronsen et al., 2021)			ncluding for u	08 on 20 Sen	
18	Feasibility of an online platform delivery of pulmonary rehabilitation for individuals with chronic respiratory disease (Lewis et al., 2021)	Mixed method	Community Respiratory Team	physiotherapist, nurses and exercise instructor latent of the second sec	fember 2023 Down	Low
19	Front-line nurses' responses to organisational changes during the COVID-19 in Spain: A qualitative rapid appraisal (2021)	Qualitative	Hospital and community health settings	Nurses and data mining, A	Spain	High
20	Healthcare providers' challenges during the coronavirus disease (COVID-19) pandemic: A qualitative approach (Ness et al., 2021)	Qualitative	Hospital	Nurses training, and s	USA	High
21	Healthcare workers during the COVID-19 pandemic: Experiences of doctors and nurses in Bangladesh (Hussain et al., 2021)	Qualitative	Hospital	Doctors and nurses milar technolog	Bangladesh	High
22	Home palliative care professionals perception of challenges during the Covid-19 outbreak: A qualitative study (Franchini et al., 2021)	Qualitative	An Italian non-profit organization	Home care profession	italy Anonce Riblin	High

Page 67 of 70				BMJ Open	d by copyri		
1 2 3	23	How the experience of medical	Qualitative	Providers of Medical	명, · · · Physicians and nurse 은 ·	canada	High
4 5 6 7 8		assistance in dying changed during the COVID-19 pandemic in Canada: a qualitative study of providers		assistance in dying	practitioners din g for us manual		
9 10 11 12 13 14 15 16 17 18	24	Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in Flemish GPs (Verhoeven et al., 2020)	Qualitative	GP practices	GPs GPs	Belgium	High
19 20 21 22 23 24 25	25	Inpatient Diabetes Care during the COVID-19 Pandemic: A Diabetes UK rapid review of health care professionals' experiences using semi-structured interviews (Burr et al., 2021)	Qualitative	Hospital	Diabetes consultants, diabetes specialist numers and allied health professionals involved in delivery of diabetes inpatient care	UK	Low
26 27 28 29 30	26	Lessons from Italian front-line nurses' experiences during the COVID-19 pandemic: A qualitative descriptive study (Catania et al., 2021)	Qualitative	Hospital	Nurses di similar techno	Italia	High
31 32 33 34 35 36 37 38 39	27	Management and patient safety of complex elderly patients in primary care during the COVID-19 pandemic in the UK— Qualitative Assessment (Alboksmaty et al., 2021)	Qualitative	Primary care	GPs gies.		High
40 41 42 43 44		F	or peer review only - ht	tp://bmjopen.bmj.com/sit	e/about/guidelines.xhtml		

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28	Midwives' experiences of providing maternity care during the COVID-19 pandemic in Australia (Bradfield et al., 2022)	Mixed method	Hospital	Midwifes for use	Australia 20 Septem	High
29	Missing the human connection: A rapid appraisal of healthcare workers' perceptions and experiences of providing palliative care during the COVID-19 pandemic (Mitchinson et al., 2021)	Qualitative	Hospital	Healthcare workers (dieticians, pharmacists) nurses) to text and data ta ta t	UK UK 1023. Downloaded fr	High
30	Nurses' ethical challenges caring for people with COVID-19: A qualitative study (Jia et al., 2021)	Qualitative	Hospital	Nurses nining, Al traini	China China	High
31	Nurses' experiences of being recruited and transferred to a new sub-intensive care unit devoted to COVID-19 patients (Danielis et al., 2021)	Qualitative	Hospital (intensive care unit for COVID- 19 patients)	Nurses g, and similar techno	en.bmj.com/ on June	High
32	Nurses' experiences regarding shift patterns in isolation wards during the COVID-19 pandemic in China: A qualitative study (Gao et al., 2020)	Qualitative	Hospital	Nurses G.	Thina China 2025 at Agen	High
33	Nursing home staff perceptions of challenges and coping strategies during COVID-19 pandemic in China	Qualitative	Home care	Nurses	China Bibliog	High

	(Zhao et al., 2021)			nclu	828	
				uding	on 2	_
34	Nursing perspectives on care delivery during the early stages of the covid-19 pandemic: A qualitative study (Shroeder et al., 2020)	Qualitative	Urban academic medical center	Nurses g for uses relations	0 September 2	Hig
35	Person-centered communication between healthcare professionals and COVID-19 infected older adults in acute care settings: Findings from Wuhan, China (Li et al., 2021)	Qualitative	Hospital	Nurses and physicians to text and care of the second secon	223 China 225 Download	Hi
36	Preparedness of Our Emergency Department During the Coronavirus Disease Outbreak from the Nurses' Perspectives: A Qualitative Research Study (Hou et al., 2020)	Qualitative	Emergency department	Nurses ta mining, Al training,	China China	Hig
37	Preservation of Person-Centered Care Through Videoconferencing for Patient Follow-up During the COVID-19 Pandemic: Case Study of a Multidisciplinary Care Team (Silsand et al., 2021)	Qualitative	PACT team (transitional phase between hospital and primary care)	Healthcare workers ind PACT team similar technolog	Norway on June 11,	Hi
38	Provision of clinical pharmacy services during the COVID-19 pandemic: Experiences of pharmacists from 16 European countries Paudyal et al., 2021)	Qualitative	Hospital, community pharmacy, primary care	Pharmacists	Belgium, Croatia, Czech Republic, Denmark, England, Estonia, France, Ireland, Netherlands, Portugal, Serbia,	Hi

39	Rapid response system adaptations	Mixed method	Hospitals	Clinicians	Spain, Switzerland, Turkey USA	Low
	at 40 US hospitals during the COVID- 19 pandemic (Mitchell et al., 2021)			Jses re	tembe	
40	Resilience in the time of pandemic: The experience of community pharmacists during COVID-19 (Austin & Gregory, 2021)	Qualitative	Pharmacies	Pharmacists lated to text and to text and the second secon	r 2023. Downloa	High
41	The impact of COVID-19 on chronic care according to providers: a qualitative study among primary care practices in Belgium (Danhieux et al., 2020)	Qualitative	Primary care	Doctors, nurses, dieticians	ded from http://bmjop	High
42	Restructuring in a GP practice during the COVID- 19 pandemic – a focus- group study (Renaa & Brekke, 2021)	Qualitative	GP practise	Nurses and medical gest secretaries	Norway	High
43	The Lived Experience of ICU Clinicians During the Coronavirus Disease 2019 Outbreak: A Qualitative Study (Kentish-Barnes et al., 2021)	Qualitative	ICU	Physicians, nurses, nursing assistants, respiratory therapist	France on June 11, 2	High
44	US Clinicians' Experiences and Perspectives on Resource Limitation and Patient Care During the COVID- 19 Pandemic (Butler et al., 2020)	Mixed method	Hospitals/clinics	Nurses, nurse 🥳 practitioners, physicians	USA 1025 at Agend	High
45	Experiences of nursing students as healthcare aid during the COVID-19	Qualitative	Hospital	Nursing students	ë Spain	High

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1 2					/rignt, ir	23-0/18		
3 4 5 6 7		pandemic in Spain: A phemonenological research study (Casafont et al., 2021)			cluding for	28 on 20 Seb		
7 8 9 10 11 12 13 14 15 16 17	46	Necessity is the mother of invention': Specialist palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021)	Mixed method	Inpatient palliative care units, home nursing services, hospital and home palliative care teams	Healthcare workers estated to text and data	Enseignement Superieur (A	Europe, UK, rest of the world	High
17 18 19 20 21	47	The Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic	Qualitative	Heart function clinic	Patients, clinicians, sta	BES)	Canada	High
23 24 25 26 27 28 29 30 31 32 33 34 35 36					ning, and similar technologies.	open.bmj.com/ on June 11, 2025 at Ager		
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BMJ Open

A resilience perspective on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic – a meta-synthesis

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-071828.R2
Article Type:	Original research
Date Submitted by the Author:	09-Aug-2023
Complete List of Authors:	Knutsen Glette, Malin; University of Stavanger Faculty of Health Sciences, SHARE – Center for Resilience in Healthcare, Faculty of Health Siences; Western Norway University of Applied Sciences - Haugesund Campus, Department of health and caring sciences Ludlow , Kristiana; The University of Queensland School of Psychology Wiig, Siri; University of Stavanger, SHARE – Center for Resilience in Healthcare, Faculty of Health Sciences Bates, David ; Harvard Medical School; Brigham and Women's Hospital, Department of Medicine Austin, Elizabeth; Macquarie University, Australian Institute of Health Innovation
Primary Subject Heading :	Health services research
Secondary Subject Heading:	Health services research
Keywords:	Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, QUALITATIVE RESEARCH, Systematic Review, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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1	A resilience perspective on
2	healthcare professionals' adaptations
3	to changes and challenges resulting
4	from the COVID-19 pandemic – a
5	meta-synthesis
6	
7	
8	Malin Knutsen Glette ¹ *
9	Kristiana Ludlow ^{2,3}
10	Siri Wiig ¹
11	David W. Bates ⁴
12	Elizabeth Austin ³
13	
14	*Corresponding author
15	
16	¹ SHARE – Center for Resilience in Healthcare
17	Faculty of Health Sciences
18	² School of Psychology, the University of Queensland
19	³ Australian Institute of Health Innovation, Macquarie University
20 21	⁴ Division of General Internal Medicine and Primary Care, Department of Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA
22	
23	Email addresses:
24	malin.k.glette@uis.no*
25	<u>k.ludlow@uq.edu.au</u>

59 26 <u>siri.Wiig@uis.no</u>

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5 6	28	elizabeth.austin@mq.edu.au
7	29	
o 9	30	
10	31	Abstract
11 12 12	32 33	Objective: To identify, review, and synthesise qualitative literature on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic.
15 14 15	34	Design: Systematic review with meta-synthesis
15 16	35	Data sources: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science Direct and Scopus
17 18	36	Fligibility criteria: Qualitative or mixed-method studies published between 2019 – 2021 investigating
19	37	healthcare professionals' adaptations to changes and challenges resulting from the COVID-19
20	38	pandemic.
21		
22	39	Data extraction and synthesis: Data were extracted using a pre-designed data extraction form that
23	40	included details about publication (e.g., authors, setting, participants, adaptations, and outcomes).
24 25	41	Data were analysed using thematic analysis.
26	42	Results: Forty-seven studies were included. A range of adaptations crucial to maintaining healthcare
27	43	delivery during the COVID-19 pandemic were found, including taking on new roles, conducting self
28	44	and peer education, and reorganizing workspaces. Triggers for adaptations included unclear
29	45	workflows, lack of guidelines, increased workload, and transition to digital solutions. As challenges
30 21	46	arose, many health professionals reported increased collaboration across wards, healthcare teams,
21 22	47	hierarchies, and healthcare services.
33		
34	48	Conclusion: Healthcare professionals demonstrated significant adaptive capacity when faced with
35	49	challenges imposed by the COVID-19 pandemic. Several adaptations were identified as beneficial for
36	50	future organizational healthcare service changes, while others exposed weaknesses in healthcare
37	51	system designs and capacity, leading to dysfunctional adaptations. Healthcare professionals'
38	52	experiences working during the COVID-19 pandemic present a unique opportunity to learn how
39	53	healthcare systems rapidly respond to changes, and how resilient healthcare services can be built
40	54	globally.
41	55	Kowwords: Resilience in healthcare, adaptations, COVID-19, healthcare services
42 43	55	Reywords. Resilience in neutricare, adaptations, covid 15, neutricare services
44	56	
45 46	57	Strengths and limitations
47	52	• This review protocol was registered at the open science framework (OSE) and followed
48	50	PDISMA Diguidelines
49	59	PRISIVIA-P guidelines.
50	60	A comprehensive search strategy was employed to identify studies focusing on healthcare
51	61	professional's adaptations to changes and challenges resulting from the COVID-19 pandemic.
5∠ 53	62	• To ensure inclusion of relevant studies, we used the <i>RiH quality and resilience trigger tool</i> to
54	63	capture resilience elements in studies not directly focusing on resilience in healthcare.
55	64	• The inclusion of articles and analysis were limited to qualitative results, and do not include
56	65	data on patients, next of kin or employees without a healthcare professional background.
57	66	• The quality appraisal indicated that 18 out of the 48 included studies were considered low
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69 Words: 5493

71 BACKGROUND

On March 12th 2020, the World Health Organization announced the novel Coronavirus disease (COVID-19) as a pandemic (1, 2). The pandemic caused serious challenges for healthcare systems worldwide (3), including resource limitations (e.g., a lack of equipment, workforce and physical space), surges in the number of patients needing healthcare services, and rapid introduction of infection control procedures (4-6). Decisions had to be made faster than most systems were accustomed to. New work tasks and routines, as well as mastery of new equipment and new technical procedures, were rapidly developed and implemented (7). In response to these challenges, healthcare professionals were forced to adapt to ensure that healthcare service delivery was sustained.

Resilience in Healthcare (RiH) is a subset of the Safety-II perspective within patient safety theory. In addition to focusing on the absence of unwanted outcomes (Safety-I), Safety-II focuses on the things that go well because of healthcare professionals' ability to adjust their work to match current working conditions (8). RiH is about maintaining stability in the face of expected or unexpected changes, and the system's or the individual's ability to adjust or adapt to these changes or disturbances and return to a stable state (9). In healthcare, workers and leaders adjust work performance to situations as they arise to minimise the impact of system challenges on care delivery and patient outcomes. This ability to adjust or adapt is called performance variability and is described as "adjustments that are the basis for safety and productivity" (10). Healthcare professional's capability to respond and evolve is called adaptive capacity, and is defined as "adaptations based on reframing, aligning, coping and innovating, in response to external and internal demands from different organizational levels, in order to ensure quality of care" (11). RiH argues that performance variability is crucial to ensure system performance and patient safety in the context of a complex and everchanging healthcare system (8, 12).

39 95 Previous research

There has been a significant amount of research on different aspects of the COVID-19 pandemic, including research on healthcare professionals' experiences during the pandemic (13-15), infection control and implications for healthcare quality (16, 17), recommended and executed measures related to the pandemic (e.g., how to reorganize care, how to apply telehealth/telecare) (18-20) and physical and psychological outcomes of COVID-19 on patients (21-23). However, there is limited research examining health professionals' adaptations (c.f. RiH) to the changes caused by the COVID-19 pandemic. RiH seeks to identify and understand behaviours contributing to a system's ability to respond to the unexpected (24). An increased understanding of adaptive human behaviour can contribute to improvements in current approaches to patient safety (25).

55 106 Aim and research questions

This study aimed to identify, review and synthesise qualitative literature on healthcare professionals'
 adaptations to changes and challenges resulting from the COVID-19 pandemic (c.f. RiH). Specifically,
 the study aimed to identify what adaptations were executed and why, from the perspectives of

10	healthcare professionals (25).	Using the PICO model (Table 1), the review addressed the following
11	research questions:	
.2	1. What kind of adaptations w	vere required from healthcare professionals during the COVID-19
3	pandemic (c.f. RiH), and why	were they necessary?
4	2. What kind of performance	variation did healthcare professionals experience as a result of these
5	adaptations?	
6	Table 1: The PICO model (26)	
	Participants	Healthcare professionals (definition provided in <i>Clarification of central concepts</i>)
	Interventions/Exposures	The COVID-19 pandemic
	Comparators	Performance variation before the pandemic
	Outcomes	Healthcare professionals' experience of performance variations during the COVID-19 pandemic
,		0
3	METHODS AND DESIGN	
9	Protocol and reporting	
0	A review protocol was develo	ped following the Preferred Reporting Items for Systematic review a
1	Meta-Analysis—Protocols (PR	ISMA-P) 2015 guidelines (Supplementary file 1) (27). The protocol
2	(Supplementary file 2) is regis	tered with the Open Science Framework (OCF) register
3	(https://osf.io/pnhby) (26)	L.
1	Eligibility criteria/study selec	tion
5	The selection criteria are pres	ented in Table 2. The review was limited to qualitative research
5	(including qualitative compon	ents of mixed-methods studies), as we sought to identify rich, in-de
7	information about health pro	fessionals' experiences, perceptions, and opinions which are best
8	captured through qualitative	approaches (28). In addition, qualitative research allows for identify
9	data concerning performance	variability and adaptive capacity in studies foci (e.g., other than RiH
0	(11, 28). Research published 2	2020 or later was included to capture studies about COVID-19. Grey
1	literature, reviews, commenta	aries, editorials, and other non-empirical publications were not
2	included. Eligible study popul	ations included healthcare professionals, as defined in Table 2. Stud
3	investigating health professio	nals not providing direct formal care (e.g., policymakers, hospital
4	managers), other personnel w	vorking in hospitals/the primary healthcare service (e.g., porters or
5	cleaning staff). and patients a	nd their next of kin were not included in this review as this was bev
6	the study's scope. Only studie	s published in English or Scandinavian languages were included as
7	these are the native language	s of the author team.
8		
£	Table 2. Selection criteria	

Criteria Grouping	Inclusion criteria	Exclusion criteria
Participants/context	Studies involving healthcare professionals (as defined	Studies involving psychiatric or
	below) in somatic clinical settings, for example, hospitals, home care services, nursing homes, and	psychological wards or services.

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	general practitioner offices. A healthcare professional was defined as a person who maintains humans' health by applying evidence- based principles and procedures of medicine and	Studies involving healthcare professionals not providing direct formal care (e.g., hospital management, policymakers, ward leaders).
	caring, through formal paid services (WHO, 2013). For example, nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants/care assistants, auxiliary nurses,	Studies involving non-healthcare personnel working in healthcare settings (e.g., porters, cleaning staff).
	personal care workers, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwives, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although healthcare personnel working in psychiatric healthcare services are included in WHOs definition of healthcare professionals, they were not included in this review as the focus here was on somatic settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).	Patients, aged care residents, service users (e.g., people receiving home care services), their next of kin or other informal caregivers (family, neighbours, friends).
Exposure	Studies investigating the COVID-19 pandemic.	Studies not concerning the COVID-19 pandemic.
		Studies investigating previous pandemics/epidemics (e.g., H1N1, Ebola, Zika).
Outcome	Studies including resilience triggers on a micro-level, for example, individual capacity (knowledge, competence, learning, behavioural strategies) and team/unit capacity (communication, collaboration, and learning), or	Studies investigating larger systems' adaptation capacity (infrastructure, regulation, framework).
	triggers on the macro-level, for example, organizational capacity (resources, organization, culture).	Psychological (individual) resilience, or lack of resilience. This includes psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with protective gear), or healthcare personnel's professional identity. Medical perspectives, such as COVID-19 treatment regimes.
		Studies not involving adaptive capacity, for example, studies only focusing on barriers and challenges (not solutions).
Language	English, Norwegian, Danish or Swedish.	Languages other than English, Norwegian, Danish or Swedish.
Year of publication	Studies published between 2019 and 2021.	Studies published before 2019.
Methods	 Studies applying qualitative methods, including qualitative data from mixed method studies. Studies published in peer-reviewed scientific journals. Case studies where adaptation to standard practises were discussed. 	Studies applying quantitative methods only.
Publication type	Peer-reviewed journal articles comprising empirical primary research.	Grey literature, for example, editorials, Government reports, comments, non-

		scientific publications, conference abstracts, theses/dissertations.
0 1 2 3 4	140 141 142 143 144 145 145	The RiH Quality and Resilience Trigger tool developed by Aase et al. (29) to screen research projects for RiH relevance was used to guide the conceptualisation of RiH in the study selection. The RiH triggers are listed in Table 3 and were particularly useful in identifying resilience elements in studies not focusing on RiH specifically.
5 6 7	147	Table 3. Resilience triggers
, 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4		 Adaptation Team/unit capacity Trade-offs Improvisation Response Complexity Organizational capacity Individual capacity Interaction Interaction Interaction Interaction Interaction Interaction Interaction Interaction Interaction
5 6	148	
7 8	149	
9	150	Data sources, search terms and search strategy
1	151	Scoping searches were conducted from March to June 2021, using the academic databases:
3	152 152	Academic Search Elite, CINAHL, MEDLINE, PubMed, Science Direct and Scopus. The main search was
4 5	153 154	five clusters related to the review topic: COVID-19. patient/patient safety, healthcare/health
6	155	professionals, resilience, and qualitative research, including related MeSH terms and synonyms.
7 8	156	Multiple test searches using different search combinations in the selected databases combined with
.9	157 159	multiple team discussions resulted in the establishment of the search string. The final search string
0 1	100	was full in the included databases (supplementary file 5. Overview of searches).
2	159	Selection of eligible studies
3 4	160	The identified publications (n= 3,139) were downloaded and managed in EndNote 20. Duplicates
5	161	were removed (n=705) and the remaining references were uploaded into Rayyan QCRI; an online
6 7	162 162	mobile and web-based application for abstract and title review (30). Abstracts underwent a three-
, B	164	screened by all reviewers (MKG, KL, and FA) to ensure that the application of inclusion and exclusion
9	165	criteria was consistent. After multiple conflicts arose, a group discussion, including a thorough
0	-	

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clarification of the selection criteria, was conducted. Second, a new random 10% sample of publications was independently screened by reviewers (MKG, KL, and EA), giving more uniform results with some discrepancies. These were resolved through a second round of discussion and clarifications of criteria. A title and abstract review of remaining publications was carried out by two pairs of independent researchers (MKG, KL and EA), where MKG reviewed all abstracts, resulting in 171 records undergoing full-text screening. If there was ambiguity about whether a publication met the inclusion criteria, it was progressed to the full-text review (e.g., if the methods were unclear in the abstract).

All full texts were evenly and randomly distributed amongst the two pairs of independent reviewers (MKG screened all publications and KL and EA screened 50% each). Inclusion/exclusion decisions and notes supporting the decisions were entered into a pre-designed data extraction form using Microsoft Excel (designed by KL). The resilience triggers (Table 3) were used as decision support when the resilience perspective was unclear. Any disagreement on inclusion decisions was discussed by each screening pair. If a consensus could not be reached between a pair, the third screener acted as arbitrator (31). Two more additional researchers were available for consultation if disagreements were unresolved (SW and DB) (see supplementary file 4 for an overview of excluded articles and reasons for exclusion).

Quality assessment

All included studies underwent a blinded quality appraisal using the Clinical Appraisal Skills Program (CASP) for qualitative studies (32). The CASP enabled a systematic assessment of the trustworthiness, relevance, and results of published qualitative articles (32). The quality of the included studies was appraised by two pairs of independent researchers (with MKG appraising all studies). If articles had several methodological weaknesses, such as a poorly described research design in combination with a poorly described recruitment strategy and ethical considerations, they were deemed low quality. Disagreements were discussed by the pairs of reviewers after the blinded appraisal. The CASP tool does not include a scoring system of exclusion cut-offs (33), and therefore, the 18 articles considered low quality were not excluded but were given less weight in the write-up of results (33).

DATA EXTRACTION AND ANALYSIS

Data were extracted and quality assessments were conducted simultaneously by one reviewer (MKG), whilst a sample of the data extraction was validated by the co-reviewers (KL and EA) (34). The pre-designed data extraction form included publication details, setting, participants, adaptations, and outcomes. All data relevant to the research questions were extracted, including quotes (inclusive approach) (34). The analysis was guided by Thomas and Harden (35) three stages of analysis. Stages 1-2 consisted of openly coding text and developing descriptive themes (conducted by MKG). Contrary to Thomas and Harden (35) suggestion regarding coding, we first extracted the text relevant to the research question (as suggested in other thematic analysis literature, e.g., Braun and Clarke (36)), before conducting line-by-line coding. Free codes without hierarchical structure were developed, and new codes were added if necessary. This process is referred to as the translation of concepts between studies (35). After the coding process was finalized, the codes were reviewed to check for consistency in interpretation and to consider the need for additional coding levels. During this process, 34 codes were identified. Differences and similarities between the semantics of codes guided the grouping of codes into a hierarchical tree structure (35). To capture patterns in the data,

2		
3	210	similar codes were grouped to form <i>descriptive</i> themes (see Figure 1. Example of analysis Theme 1,
4	211	step 1-3). The five identified themes were reviewed by the research team. Stage 3 consisted of
5	212	generating analytical themes, aiming to "go beyond the findings of the primary studies, and generate
6	212	additional concents understandings and hypothesises" (25). This was conducted as a cyclic process
/	213	additional concepts, understandings and hypothesises (55). This was conducted as a cyclic process
ð	214	where theme suggestions were processed and refined in multiple rounds. Finally, two main themes
9 10	215	and five sub-themes were identified and approved by the research team.
11	216	
12	210	
13	217	
14		
15	218	INSERT FIGURE 1. Example of analysis Theme 1, step 1-3
16		
17	219	Patient and public involvement
18		
19	220	No patients, patients' next of kin or healthcare professionals participated in this study.
20		
21	221	
22	221	
23	222	RESULTS
25		
26	223	The review resulted in the inclusion of 47 articles (see Figure 2. PRISMA flow diagram and
27	224	Supplementary file 5: overview of included studies and quality assessment). The analysis resulted in
28	225	two main themes with five affiliated sub-themes. The results are presented according to identified
29	226	themes and sub-themes.
30		
31	227	
32	220	INSERT FICURE 2. DRISMA flow diagram
33 24	228	INSERT FIGURE 2. PRISIVIA HOW diagram
34	229	
36		
37	230	Covid-19 has driven an increased need for individual and team capacity to handle extreme changes
38	231	in working conditions
39		
40	232	The first theme demonstrated an intensified need for health professionals to handle increased
41	233	responsibilities. At the same time, they were adjusting to constant changes in the organization and
42	234	adapting existing collaborations, as well as creating new collaborations, to handle changing needs.
43	225	
44 45	235	
46	236	Handling increased responsibilities on an individual level
47	237	Multiple studies highlighted how roles abruptly changed or expanded due to the pandemic and
48	207	described the required adaptations that followed (27.45). For example, soveral studies found that
49	230	the set to a set of the set of th
50	239	nealth professionals educational roles had become intensified (42, 43, 45). This included an
51	240	increased need to educate and inform patients about necessary precautions to reduce infection risk
52	241	(42, 45) and increased responsibility in conveying information from local or nationwide authorities
53	242	(43).
54 57	242	Continue = the extended (AO, AC) are extended by the threshold on the structure of the the structure of the structure of the the structure of the structure of the the structure of the structu
55 56	243	Similarly, other studies (40, 46) reported that health professionals functioned as the patients' lifelines
50 57	244	to the outside world and were filling in the gap of absent relatives by comforting end-of-life patients.
58	245	One study found that newly educated nurses suddenly had to function as the senior professionals,
59	246	even though they were having their first care experiences with COVID-19 patients (47). Nurses also
60	247	reported that they adapted to changing work conditions by taking on multiple roles, for example, as

dietitians (delivering meals), respiratory therapists (administering nebulizers) and environmental services (emptying trash bins), because the primary groups normally responsible for these tasks visited patient rooms less often during the pandemic (44). Pharmacists joined the hospital's infection disease team, previously only staffed by physicians, to provide expert opinion and guidance on the use of potential treatments for COVID-19 (38).

These changes in health professionals' roles were closely linked to increased professional role identity (48) as they now, to a much larger degree, had to function as independent decision-makers (40, 48). Many healthcare teams had to reorganize themselves to handle the pressure that originated in the healthcare service (37, 39, 44, 49-54). This was found to be the case for hospital wards, GP offices/clinics, specific treatment teams (e.g., diabetes teams), nursing groups and pharmacies. Self-reorganization consisted of forming specific teams caring for COVID-19 patients only (49), taking responsibility for task distribution (49), developing appropriate nursing plans for COVID-19 patients, holding regular case-based seminars (51) and rearranging facilities to improve infection control (53). Self-reorganization was reportedly needed as the new workflow was unclear (52), strategies to care provision were inefficient (44), there was a lack of guidelines on how to act and respond (50), and the work environment became unstructured and difficult to handle (39).

As health professionals had often not received formal training for many roles (including the expansion of roles), they organized their own education to handle new challenges related to caring for COVID-19 patients. They held training sessions on correct personal protection equipment (PPE) use, shared their acquired knowledge with other health professionals (sometimes acquired from trying and failing), discussed clinical cases with each other, and shared knowledge via social media or by sharing self-produced informational videos (47, 50, 55, 56). They also searched for knowledge by watching YouTube videos and seeking online courses and scientific articles (48, 55), reportedly leading to a steep learning curve during COVID-19 (37, 47, 48, 51, 57).

The literature frequently reported limited staffing and resources during the pandemic(47, 58). Consequently, health professionals were required to handle both expected and unexpected forms of resource limitations, including rationing supplies such as PPE and disinfectants, and redistributing tasks between nurses (53, 59, 60). Several studies reported that health professionals turned to non-traditional alternatives to cope with staffing and resource limitations (44, 50, 52, 53, 55, 59, 61). For example, some washed and reuse face masks, while others purchased their own masks because they lacked equipment at work. Some healthcare professionals made their own equipment out of uncertified materials, used painters' masks, printed face shields, or obtained missing equipment through social contacts (55, 59, 61). One study reported that physicians used unorthodox therapies or nontraditional approaches to care delivery that could be suboptimal or potentially harmful, to avoid having to deny treatment to some patients (59).

48 283 Adapting to constant organizational changes49

Closely related to changes in roles, several studies found that health professionals experienced an increased workload; a changed work scope; changes in workflows, guidelines, work tasks; and had to familiarize themselves with new equipment. The increased workload was a consequence of rising patient numbers, reduced staff, and/or the absence of new hires to reflect the increased workload. For example, staff quarantine requirements forced other staff to take on additional workloads which again required additional work in managing new settings or redeployed staff (40, 62). Additionally, health professionals were forced to handle unfamiliar tasks that would normally be done by other health professionals (63, 64). For example, surgical nurses became medical nurses (51), and nurses were transferred from other hospitals and wards with new guidelines and routines (48). One study

1		
2		
3 ⊿	293	described that a teacher in a medical school was forcefully assigned to treat COVID-19 patients
5	294	without having the practical knowledge of doing so (55). Changes in work tasks led to feelings of
6	295	uncertainty and frustration (43). For example, GPs described how their treatment focus had changed
7	296	towards acute illness and the likely manifestations of COVID-19 infections, while monitoring chronic
8	297	conditions was seen as less of a priority (65).
9	200	Constant changes in suidelines could confusion and inconvitu (50) . There were descriptions of
10	298	Constant changes in guidelines caused confusion and insecurity (50). There were descriptions of
12	299	trequent protocol changes, lack of consistency in protocols between healthcare services, and
13	300	sometimes contradictory indications, leaving health professionals uncertain of what their tasks were
14	301	(38, 50, 60). Some healthcare professionals adapted to this uncertainty by starting every day carefully
15	302	reading emails to check for changes in protocols and procedures (47).
16	303	
1/	505	
10 19	304	Adapting collaboration to changing needs
20	205	The new shallowers that was in the tide of COVID 10 were reported to load to better collaboration
21	305	The new challenges that arose in the tide of COVID-19 were reported to lead to better collaboration
22	306	between healthcare professionals as well as improved collaboration across healthcare services.
23	307	Growth of personal relationships and trust, a general willingness to take on other tasks and
24	308	responsibilities, increased solidarity, creation of common protocols across hospitals, and clear
25 26	309	agreements on the distribution of care were some of the mentioned benefits (37, 43, 66). Moreover,
20	310	new non-traditional team compositions were created with different departments and health
28	311	professionals collaborating in unusual ways (e.g., collaboration between physicians, caregivers,
29	312	physiologists, housekeepers, janitors, and technicians). Some studies reported that the feeling of
30	313	working towards a common goal blurred the hierarchy between the different professions, fostering
31	314	new relationships and strengthening existing work relationships (44, 47, 62, 67). Other studies
32 33	315	reported the opposite (42, 43, 56), for example, home palliative care professionals (68) felt that the
34	316	connection between healthcare services was lost as their affiliated hospital had been turned into a
35	317	COVID-19-only hospital.
36	210	
37	318	
38	319	Covid-19 has led to changes in healthcare organizations which better support health professionals'
39 40	320	need to implement adaptations
41		
42	321	The second theme described major organizational adaptations to handle the challenges of COVID-19.
43	322	Consequently, health professionals had to adapt to these changes, including managing increased use
44	323	of technology to provide healthcare.
45 46	324	Overall organizational efforts to handle COVID-19 challenges
47	225	
48	325	Many studies reported that health professionals experienced rapid changes at their workplace as
49 50	326	organizations adapted to COVID-19 challenges. Organizations found alternative ways of triaging and
50 51	327	assessing patients' needs (58, 69) and reorganized their physical space to reduce the risk of infection
52	328	(e.g., rearranging waiting rooms or removing unnecessary materials in consultation rooms to prevent
53	329	contamination) (43). Several studies reported transitioning to digital solutions to provide patient care
54	330	and minimize staff exposures to the virus (65, 68-71). In a methadone clinic, health professionals
55	331	described telemedicine as a "game changer", and the "future of medicine" (69). In a maternity ward,
56	332	the rapid development of telehealth increased healthcare access for many women, although they
57 58	333	depended on reliable access to a phone, video, and the Internet ⁷¹ . Pharmacists expressed that
59	334	virtual witnessing and assessing of medication could decrease delays and reduce travelling for both
60	335	patients and providers (68). In one study, midwives started practicing case loading (one designated

midwife caring for one woman throughout the childbearing continuum) which facilitated meeting women's needs and resulted in a positive professional experience (71). Similarly, in one study, nursing home staff implemented a primary nursing model which enabled them to provide all-around care for residents This had previously been impossible because of unfavorable nurse-to-patient ratios(48). A further example was the introduction of a differentiated labor practice model, which enabled pharmacy technicians to pivot rapidly away from multitasking, thereby enhancing resilience and improving workplace conditions for staff (72). Several studies described that COVID-19 had paved the way for changes in healthcare, which previously had been thought impossible (54, 68, 71), including larger organizational changes. For example, leadership modification (61), conversion of hospital wards to covid wards (37, 73), development of new protocols and triage algorithms (41) and the introduction of mobile consultation services (74). Although these measures were deemed necessary to cope with the covid outbreak, they sometimes created confusion, frustration, and logistical challenges for healthcare professionals (50, 71, 72). Managing new and increased use of technology to provide healthcare Several studies highlighted a spike in the use of different technologies to enable the provision of patient care in different settings (38, 45, 53, 54, 57, 58, 68, 71, 74-77). Dunleavy and colleagues (54)

described the adoption of new technology to manage diabetes care during the pandemic such as the use of web-linked glucometers, electronic patient records, online referral systems, and video conferencing tools. These technologies enabled diabetes teams to identify and consult on patients' needs more rapidly and enabled remote consultation (54). As previously stated, telehealth was used by health professionals to continue patient treatment and support patient care teams (38, 53). For example, pharmacists (38) and physiotherapists (75) made instructional videos to support their patients. One nursing home used Zoom to carry out multidisciplinary rounds/mortality rounds and opened a WhatsApp messaging group to effectively exchange information among health professionals ⁵⁴. They also conducted a virtual saying goodbye for terminal patients using open-source video conferencing software (54). Several other studies described the use of digital tools to maintain patients' social care when patients were not allowed visitors (40, 48, 60, 78, 79).

DISCUSSION

This systematic review demonstrated how COVID-19 triggered multiple adaptations by health professionals to ensure continued provision of healthcare services during the pandemic. Health professionals adopted new roles, were given increased organizational responsibilities, and coped with resource limitations. Consequently, health professionals' workload increased, their work scopes and workflow changed, and they learnt to use new equipment, while guidelines constantly changed. There were reports of silver linings, for example, increased collaboration between healthcare professionals within and across organizations, as well as changes in the healthcare system to better support healthcare workers' needs.

The resilient healthcare service - adaptations and preparedness

Adaptions identified in this review (37, 38, 44, 46, 50, 63, 80) were crucial in maintaining healthcare service delivery during the pandemic, for example, covering shifts due to staff shortages, allowing existing personnel to fill necessary roles, handling new procedures, and reorganizing workspaces to reduce the spread of the virus. Many healthcare systems were able to adjust to a somewhat stable

state during the pandemic, due to the extensive adaptations by staff, teams, and organisations to the new demands, with some systems adapting more effectively than others. This support Hollnagels' assertion that performance variability is crucial to ensure system performance and patient safety in changing work systems (8). According to RiH theory (81), adaptations can be triggered by different factors in the system. These factors may be both internal (e.g., resources, staffing, competence) and external (e.g., budget cuts, regulatory demands) (81). Our review identified examples of adaptations triggered by both internal and external factors with health professionals experiencing a lack of competence, resources, staffing, equipment, information, and guidelines (38, 47, 50, 55, 63, 71, 80). These factors forced health professionals to seek new ways of coping to be able to sustain required performance (81). Health professionals' adaptive capacity was found to significantly contribute to healthcare systems' resilience. However, system preparedness is also critical for system resilience. The included studies reported varying degrees of preparedness across different healthcare services. Some health professionals spoke positively about how they had managed to "come together and make things work" (39, 47, 79), while others spoke of extreme resource shortages and being overworked (41, 53, 60). In this context, variations in how different countries were affected by the pandemic should be considered, for example, the rate of spread of infection in a population, differences in population size, proportion of older adults in the population, population density, and how well-developed a country's healthcare system was to begin with. That being said, according to Hollnagel (82), a system must have some sort of readiness if something unexpected happens (e.g., resource allocation to

403404 Box 1. Resilience potentials

Resilience potentials

i) **Knowing what to do** (how to <u>respond</u> to disruptions and disturbances by adjusting normal functioning); *ii)* **Knowing what to look for** (<u>monitor</u> what are, or could be future threats); *iii)* **Knowing what to expect** (how to <u>anticipate</u> developments of threats and threats further into the future); and *iv*) **Knowing what has happened** (how to <u>learn</u> from experience, particularly the right lessons from the right experiences ⁽⁸¹⁾.

match the needs of the expected event) to be considered resilient (82). A resilient system should

further cover four resilience potentials (responding, monitoring, anticipation, learning) (Box 1) (82).

44 405

Reported experiences of healthcare professionals grappling with everchanging guidelines and procedures, as well as limited resources (i.e., staffing and equipment), suggest that most healthcare systems did not have the capacity (e.g., a large enough PPE-storage or back-up staffing), or the right measures in place (e.g., adequate contingency plans), to respond adequately to the disturbance (COVID-19). Similar descriptions have been found in related reviews and quantitative studies (83-86). Despite the lack of preparedness of the system, the literature reported significant amounts of adaptive capacity among healthcare professionals, supporting Wear's (87) claim that people are the most adaptable element in any complex work system. The adaptations needed to cope with the COVID-19 pandemic, such as greater freedom for healthcare professionals to incorporate their adaptive capacity in patient care and a stronger focus on changing the organization of healthcare based on health professionals' suggestions and needs, should be used for learning and preparation for near and future threats (82). As we are still learning from this pandemic, it is important to

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- understand adaptations that have worked well (82) to ensure more resilient healthcare services
 when encountering future disturbances including pandemics (88).

6 420 Adaptations – the good, the bad, and the ugly

Some adaptations are effective solutions that can function long-term, thus strengthening the healthcare service and in some instances, resulting in innovations (81). This aligns with RiH characteristic of learning from what goes well (8). Although the distinction between long-term adaptations and sustainable innovations was somewhat unclear in the included literature, several of the measures set in place as a response to the pandemic were deemed helpful by health professionals. For example, the introduction of telemedicine and other assistive technology were particularly viewed positively (59, 68, 71, 89), as well as new care models, new procedures, new systems, and new working models (45, 48, 72). Overall, the focus on innovation development in healthcare had to increase rapidly in response to the COVID-19 pandemic (90-93), despite the challenges that innovations in healthcare have met in the past (94). Successful, targeted innovations can, in the long run, contribute to more effective, more cost-effective and safer healthcare services (95, 96). Learning from the 'good' adaptations and innovations resulting from COVID-19 is therefore of great interest to improve healthcare services into the future.

- However, adaptations set in place as survival mechanisms—so-called 'fire-fighting' (97)—were also identified by included studies (e.g., reuse of PPE) (41, 50, 55, 61). These types of adaptations are often short-term solutions and may have negative impacts on both the healthcare system and healthcare professionals (81). Fire-fighting adaptions can create a false impression of success because it gives the illusion that a system is performing better than it is (87). Conversely, continuous adaptations to poorly functioning systems can be exhausting for the people working within them (50, 52, 71), resulting in inefficient and potentially hazardous systems, as well as threats to patient safety and healthcare quality. (87).
- According to Woods (98), all systems have a range of how much they can adapt to unexpected events based on the resources they hold and the already existing variation in the system. When a system is pushed towards, or over its range of performance, the system can either adapt and expand its performance beyond its range, or it can result in a rapid fall in performance. Woods calls these opposites graceful extensibility and brittleness, where brittleness is the opposite of resilience. A resilient system will handle unexpected changes with graceful extensibility and be able to expand its adaptive capacity when unexpected events happen, while non-resilient systems will not be able to handle being pushed past their performance range, and experience a system collapse (brittleness) (98). The distinction between brittleness and graceful extensibility depends on the general preparedness of a healthcare system and is a reminder of the need to prepare healthcare systems for future crises.

48 453 How did rapid changes become possible?

The path to becoming a more functional and prepared healthcare system includes system-level changes. However, introducing sustainable changes into a system (for example, delivering care in line with new evidence) has proven difficult in the past (99). However, some included studies found that changes that had previously been impossible due to rigid systems became possible in the wake of the pandemic (48, 54, 68, 71). The pandemic created a window of possibility to explore how rapid changes in healthcare systems can be made possible.

Nilsen et al. (100) identified three characteristics of successful change: (1) having the opportunity to
 influence change, (2) being prepared for the change, and (3) valuing the change. Many of the
 adaptations identified in this review were introduced by frontline health professionals. Opportunities
 to influence change came when personnel experienced pressure to find novel solutions and adopt

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high-responsibility roles. Additionally, existing hierarchies in healthcare systems were described to have vanished as health professionals worked towards a common goal (44, 47, 62, 79). The blurring of hierarchy and the development of new collaborations lead to breaches of organizational silos (39, 49, 74), as well as closer collaboration within existing teams (37, 42, 56, 79). There were reports of new team mixes, new collaborations between health professionals from different hospitals (39), and strengthened relationships, collaborations, solidarity, and trust within existing teams (37, 44, 79). These changes were found to be valued by healthcare professionals, with increased opportunities to discuss problems across hierarchies and find solutions more openly. The experience of partnership is a crucial factor when making changes or improvements in healthcare systems (101). This is supported by Gergerich and colleagues (102) who described the need to work as a team outside the normal hierarchy to successfully make transformation or change, and is in line with research findings showing that humans who experience acute social stress engage in more prosocial behavior such as trust, trustworthiness, and sharing (103). Overall, the COVID-19 pandemic created the context for partnerships between health professionals to develop through a common goal, and demonstrated that increased collaboration, cooperation, and inclusion across and within professions, roles and hierarchies were crucial to effectively introduce changes into the healthcare system. IMPLICATIONS FOR POLICY AND PRACTICE This review demonstrated that adaptive capacity among healthcare professionals played a major part in keeping healthcare services running during the extreme conditions that the COVID-19 pandemic induced. The study findings indicate the benefits of giving health professionals greater freedom in adapting their work when handling the complexities and changing systems of healthcare services. At the same time, awareness is needed to identify and address maladaptions resulting from poor system designs. Previously, poorly functioning system designs in healthcare have proven difficult to change (99). However, this review found that during the pandemic, healthcare services changed

rapidly and often for the benefit of patients and workflows. The changes described in this review
 were often initiated or suggested by healthcare professionals, or based on their needs, once again
 highlighting the need to involve health professionals' in organizing and restructuring healthcare
 services to a greater extent than has previously been done.

41 493

43 494 IMPLICATIONS FOR RESEARCH

The organizational changes executed during the pandemic have created an opportunity to explore how rapid changes in healthcare systems can be possible. Changes in healthcare systems are needed to improve patient safety, quality of care and efficiency. However, it is becoming more difficult to redesign systems with the increasing complexity of healthcare services. It is therefore pivotal to seize the opportunity to learn about health system change in the aftermath of the pandemic peak. Moreover, this study revealed skills in cooperation across healthcare institutions, healthcare professionals and other professional groups. Health professionals' ability to cross healthcare silos to deliver care should be further investigated. Lastly, to improve healthcare systems' preparedness and resilience, it would be useful to further investigate what factors in healthcare systems facilitate positive adaptations and innovations and what factors result in poorly functioning adaptations.

57 505 STRENGTHS AND LIMITATIONS

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- This review protocol was registered at the open science framework (OSF) and followed PRISMA-P guidelines. A comprehensive search strategy was employed to identify studies focusing on healthcare professionals' adaptations to changes and challenges resulting from the COVID-19 pandemic. Limitations of the current study stem from our pragmatic choices to not include grey literature and not rerun the search before publication. That said, there are arguments that a more purposeful sampling approach aiming to provide a holistic description of a phenomenon, rather than to identify all eligible studies might be more appropriate in qualitative literature reviews (104). Moreover, the search strategy was developed by a committee of subject matter experts and not a database search specialist. The committee consisted of three researchers with experience in search strategy development, and the strategy was later reviewed by two independent researchers with broad experience within the researched field. It is possible that the search strategy could have been strengthened by an expert in database search strategies (e.g., a clinical librarian). In addition, published literature examining adaptations made by health professionals may be shaped by publication bias, with negative results less likely to be published. CONCLUSION
- The COVID-19 pandemic created tremendous disturbances in healthcare systems worldwide, demanding rapid adaption to comprehensive changes. COVID-19 triggered the rapid reorganization of healthcare services, and through these changes, healthcare systems and health professionals demonstrated significant adaptive capacity. Many of the changes driven by the pandemic led to positive and useful alterations to the healthcare system, potentially creating foundations for healthcare innovation and sustainable change. The pandemic also exposed weaknesses in healthcare system design and capacity (105, 106), forcing health professionals to make dysfunctional and potentially harmful adaptations. Crucially, few healthcare systems were properly prepared for a pandemic event, which does not align with characteristics of a resilient healthcare system. Healthcare professionals' experiences of the COVID-19 pandemic represent an opportunity to learn about how healthcare systems respond to unexpected challenges that linger, and how we might build resilient health systems globally (107, 108).

Acknowledgments

The authors acknowledge the University of Stavanger for using their library database for this research.

Autor contributions

MKG, EA, KL, DB and SW participated in the development of the review protocol. MKG and EA developed the search string, and MKG, EA and KL conducted the pre-screen to ensure consistency in inclusion/exclusion criteria. KL designed the pre-designed data extraction form. Title, abstract and full-text review where individually conducted by MKG, EA, and KL, as was the quality appraisal of the included studies. SW and DB were available for consultation and provided advice during the screening process. The analysis was conducted by MKG and was approved by the review team. Lastly, MKG prepared the manuscript and EA, KL, DB and SW reviewed and edited.

Competing interests

The authors have no competing interests to declare.

Funding

The publication fee was covered by the University of Stavanger. The funding body was not involved in the research process or in writing the manuscript.

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3	555	Data sharing
4	556	Overview of article quality assessment will be provided upon request to corresponding author. All
5	557	other data are freely available.
7	558	
, 8	559	Ethics approval
9	560	This study does not involve human participants and ethical approval was not required.
10	561	
11	562	FIGURES AND SUPPLEMENTARY FILES
12	563	Figure 1. Example of analysis Theme 1. step 1-3
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19 20	570	Supplementary file 5: Overview of included articles and reason for exclusion
20	570	Supplementary me 5. Overview of included articles and quality assessment
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3 4 5	Section and Topic	ltem #	Checklist item	Location where item is reported	
5	TITLE				
7	Title	1	Identify the report as a systematic review.	Title	
8	ABSTRACT				
9	Abstract	2	See the PRISMA 2020 for Abstracts checklist.	х	
10	INTRODUCTION				
11	Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3	
12	Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3	
14	METHODS	1			
15	Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4	
16 17	Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted identify studies. Specify the date when each source was last searched or consulted.	Page 6	
18	Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used 2	Sup. File 1	
19 20 21	Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many discussion criteria and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Sup. File 2, Table 2 and page 4 -5	
22 23 24	Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each repert, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, deta of automation tools used in the process.	Page 7-8	
25 26	Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which esuits to collect.	Page 7 -8	
27 28		10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, and g sources). Describe any assumptions made about any missing or unclear information.	Page 4 and 13	
29 30 31	Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 7 and sup. File 2	
32	Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 8 - 10	
33 34 35	Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the stude intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 6 – 7 and sup. File 2	
36 37		13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing sum	N/A	
38		13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Fig. 1	
39 40		13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Fig 1. And page 7-8	
41		13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analy as, meta-regression).	N/A	
42 43		13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 7 -8	
44 45	Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting bias). For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	Page 13 -14	



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PRISMA 2020 Checklist

		BMJ Open	cted b		Page 26 of 6
PRIS	MA 20	020 Checklist	y copyrig	Sen-20023-0	
Section and Topic	ltem #	Checklist item	nt, inclu	808177	Location where item
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	uding f		NA
RESULTS			oru		
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search the review, ideally using a flow diagram.	tes r	number of studies included in	Figure 2.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they w	୶ୄୖୄୄଢ଼ୖୄଢ଼	cluded.	N/A
Study characteristics	17	Cite each included study and present its characteristics.	ement ed to	D 233 D	Sup. 4
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Superieur text and da		Overview of quality assessment on request
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) a (e.g. confidence/credible interval), ideally using structured tables or plots.	an ABBES	t estimate and its precision	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	s) . hing, Al trai	http://htmic	Overview of quality assessment on request
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summa confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the summa confidence/credible interval and measures of statistical heterogeneity.	ar y est	mate and its precision (e.g. of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	and	3	page 8 - 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	sir		Page 13 -14
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis	asses	ed.	Page 13 -14
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	r techr		Page 13 - 14
DISCUSSION			00		
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	, _u)gies.	0 0 0 2	Page 11 - 13
	23b	Discuss any limitations of the evidence included in the review.			Page 13 - 14
	23c	Discuss any limitations of the review processes used.			Page 13 - 14
	23d	Discuss implications of the results for practice, policy, and future research.	l		Page 14
OTHER INFORMAT	TION				
Registration and	24a	Provide registration information for the review, including register name and registration number, or state that	the re	ew was not registered.	Page 4
protocol 24b Indicate where the review protocol can be accessed, or state that a protocol was not prepared.		Page 4			
	240				

Pag	e 27 of 69		BMJ Open		F 3 5	
1	PRI	SMA 2	020 Checklist			
3 4 5	Section and Topic	ltem #	Checklist item	nt inclu	74 8328	Location where item is reported
6	Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in	he r	ęview.	Page 14
7 8	Competing interests	26	Declare any competing interests of review authors.	n for l	2 0 2	Page 14
9 10 11	Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection form studies; data used for all analyses; analytic code; any other materials used in the review.	Enseigne	a extracted from included	Page 14
12					2 2	
13 14 15 16 17	From: Page MJ, Mck	(enzie JE, I	Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting system For more information, visit: <u>http://www.prisma-statement.org/</u>	B text and d	aviews. BMJ 2021;372:n71. doi: 10	.1136/bmj.n71
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Resilience in healthcare during the COVID-19 pandemic: A protocol for a qualitative systematic literature review

Background

The 12th of March 2020, The World Health Organization announced the novel Coronavirus disease (COVID-19) a pandemic due to the growing numbers of countries affected by the viral respiratory infection (WHO, 2020a). The virus was discovered in December 2019 after an accumulation of patients with viral pneumonia in the city of Wuhan, People's Republic of China (WHO, 2020b). By 8th of February 2021, there were reported over 100 million confirmed cases of COVID -19 infections worldwide, with over 2 million confirmed deaths (Worldometer, 2021), and these numbers are still increasing. The pandemic has caused great challenges for healthcare systems worldwide (Khalid & Ali, 2020) including limited resources (e.g. lack of equipment, staff or physical space), a surge of patients needing healthcare services, and the need to reorganize parts of the healthcare system to maintain infection control. Additionally, healthcare workers have been forced to handle new work-tasks, master new equipment and new technical procedures (Liu et al., 2020). All these aspects have forced healthcare personnel to make major adjustments to changes induced by the pandemic, both on organizational- and individual-levels.

Resilience in Healthcare (RiH) is about maintaining stability in the face of expected or unexpected changes (e.g. changes induced by the Covid-19 pandemic) and the systems' or the individual's ability to adjust or adapt to these changes or disturbances, and return to a stable state (Wiig & Fahlbruch, 2019). In this perspective the ability healthcare workers have, to adjust to the situation they are in (e.g. master new equipment in a short time), are what makes the healthcare system function, both during normal operation and under special circumstances. The ability to adjust to expected and unexpected events is called performance variability, and is according to RiH, crucial to ensure adequate performance, and maintain patient safety, due to the complex and everchanging nature of the healthcare system (Hollnagel, 2015; Hollnagel et al., 2015). An important aspect of RiH is further, to observe and understand the thing that goes well when everyday adaptations are being made. This is needed to understand the things that do not go well (e.g. adverse events), which is a different perspective than traditional patient safety work, were the main focus has been on the thing that goes wrong (Jeffcott et al., 2009).

In the context of the COVID-19 pandemic, which brought with it a cascade of changes and new challenges (e.g. pressured resources, increased patient flow, unknown medical procedures), performance variability is about making adjustments to the current situation and keep the healthcare services running in a safe and professional manner, despite these changes and subsequent challenges (Jovanović et al., 2020).

Despite the novelty of the COVID-19 pandemic, large amounts of research on the topic has already been conducted. This includes research on healthcare personnel's experiences during the pandemic (Chamboredon et al., 2020; Halcomb et al., 2020; Xu et al., 2020), infection control and implications for healthcare quality (Coma et al., 2020; Kirkevold et al., 2020) recommended and executed

measures related to the pandemic (Krist et al., 2020; Mills et al., 2020; Morreel et al., 2020) and studies about physical and psychological outcomes of COVID-19 patients (Carfi et al., 2020; Sahoo et al., 2020; Wang et al., 2020). There are in other words much evidence on the different aspects of the pandemic, and how it affects the healthcare service, healthcare professionals and patients. As of our knowledge, limited research have, however, directly targeted health personnel's ability to adapt (c.f. Resilience in Healthcare) to the changes induced by the COVID-19 pandemic. Moreover, RiH's positive outlook on how health professionals handle challenges in the delivery of healthcare (focusing on the things that goes well, rather than focusing on the things that do not work), is an important perspective to illuminate in a time where health personnel's efforts has been extraordinary. Lastly, increased knowledge on how health personnel handled, and adjusted to, changes induced by the COVID-19 pandemic situation is useful in understanding how patient safety is being maintained in unanticipated situations and can be beneficial in handling future similar situations.

The aim of the study is to identify and review qualitative studies focusing on healthcare personnel's adaptations to changes and challenges resulting from the COVID-19 pandemic. Moreover, the systematic review aims to identify what adaptations are being executed and why, from the perspectives of health personnel's experiences.

Methods and design

This protocol was developed in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis—Protocols (PRISMA-P) 2015 checklist (Moher et al., 2015). The protocol will be registered with the Open Science Framework (OCF) when approved by all authors.

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Review question

The review will be conducted as a qualitative systematic review to answer the research question:

What kind of adaptation were required from healthcare professionals during the COVID-19 pandemic? What kind of performance variation did healthcare professionals experience resulted from these adaptations?

The components of PICO are as following:

Participants: Healthcare professionals

Interventions/Exposures: The COVID-19 pandemic

Comparators: Performance variation before the pandemic

Outcomes: Healthcare personnel's experience of performance variations during the COVID-19 pandemic

Qualitative systematic reviews integrate or compare findings from qualitative studies, and further, look for themes or constructs in and across individual studies (Booth et al., 2016). A qualitative systematic review design will allow for the identification of a wide range of valuable experiences of adaptations in response to the COVID-19 pandemic, as qualitative research is used to explore meanings of social phenomena (changes induced by the COVID-19 outbreak) as experienced by individuals (healthcare professionals) in their natural context (the healthcare services) (Malterud, 2001). This will enable us to provide an in-depth understanding of the meanings health professionals assign to changes induced by the pandemic and the required adjustments to these changes

(Holloway & Galvin, 2017). Synthesizing qualitative evidence, further, provides an opportunity for interpretating and identifying new knowledge of subjectivity and meaning in qualitative studies (Malterud, 2017), implying that interpretation of existing qualitative data will provide an opportunity to find other meanings i.e., finding data about performance variation (c.f. resilience in healthcare) in studies not necessarily having this as the main focus.

Eligibility criteria

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All primary, qualitative studies coved by the selection criteria (Table I. Selection criteria) will be eligible for inclusion. Quantitative studies are considered non-eligible in this review due to their inability to cover the "outcome" (i.e., identify in-depth information about health personnel's experiences) and because quantitative studies limit the possibility for new interpretations of health professionals experiences, and the possibility to identify data about adaptive capacity in studies with other main focuses'. Studies conducted before 2019 will not be eligible as the "exposure" (COVID-19), cannot be addressed. Grey literature, including reviews, commentaries, editorials or other nonempirical materials will not be included. Eligible study populations will include healthcare professionals within the definition stated below. hospital Studies concerning health personnel not providing direct formal care (e.g., policy makers, hospital managers), other personnel working in hospitals/the primary healthcare service (e.g., porters or cleaning staff) or patients and their next of kin will not be included in the review. Studies written in other languages than English, Norwegian, Swedish, or Danish will not be included as these are the languages mastered by the research team.

Clarification of central concepts

A healthcare professional is in this context defined as a person who maintain human's health through applying principles and procedures of evidence medicine and caring. Health professionals provide advice and apply preventive and curative measures (WHO, 2013). Examples of healthcare professionals are: nurses, hospital physicians, general practitioners (GPs), certified nurse assistants (CNA), healthcare assistants, nursing home physicians, pharmacists, physiotherapists, licensed practical nurses (LPNs), bioengineers, occupational therapists, health secretaries, midwifes, clinical nutritionists and radiographs (Health Personnel Act, 2020). Although health personnel working in psychiatric healthcare services are included in the healthcare professional definition, they will not be included in this review as the focus here is on somatic healthcare settings (healthcare related to the body as distinguished from the psyche) (Shiel, 2018).

RiH Quality and Resilience Trigger tool will help circling eligible studies involving adaptations cf. Resilience in Healthcare. This tool was developed by Aase et al., (2020) to screen research projects for RiH relevance as a part a large longitudinal, cross country study. RiH is in this context, connected to actions, activities, and processes (resilience as a verb). RiH trigger tool, consist of a double screening process, were the first part involve identifying on or more of the four quality dimensions (patient experiences, patient safety, clinical effectiveness and care coordination) and the second part involve identifying eventual resilience triggers such as:

- Adaptation
- Variation
- trade-offs

- Development
- Improvement
- success

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- improvisation •
- response •
- complexity •
- Individual capacity (knowledge, • competence, learning, personal characteristics, cognitive, behavioral strategies)
- Team/unit capacity (communication, ٠ collaboration, learning)
- Organizational capacity (resources, organization, culture)
- Larger system capacity (infrastructure, ٠ regulation, framework conditions)
- Changes •
- Challenges •
- Disruption •

- enhancement •
- growth
- Recovery
- Transformation
- Collaborative learning
- work practice
- teamwork
- problem solving
 - interaction
 - Stakeholder actions
- knowledge-brokering

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- co-creation
- contribution
- information
- engagement •

Table	I. Se	lection	criteria
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ChallengesDisruption	• engage	engagement		
able I. Selection criteria	000			
Criteria Grouping	Inclusion criteria	Exclusion criteria		
Participants/ context	Studies involving healthcare professionals (as defined above) in somatic clinical settings e.g., hospitals, home care services, nursing homes, General practitioners (GP) offices.	Studies involving psychiatric wards/institutions.		
	Studies involving nurses, certified nurse assistants (CNA), healthcare assistant, nursing home physicians, pharmacists, physiotherapists, assistants, Licensed practical	Studies involving healthcare personnel not providing direct formal care (e.g., hospital management, policy makers, ward leaders)		
	nurses (LPNs), or other healthcare personnel working in clinical settings	Studies involving other personnel working in healthcare settings providing other services than direct formal care (e.g., porters, cleaning staff, management)		
		Patients, aged care residents, service users (e.g., people receiving home care services), their next of kin or other informal care givers (neighbors, friends)		

Exposure	Studies investigating the COVID-19 pandemic	Studies not concerning the COVID-19 pandemic
		Studies investigating previous pandemics/epidemics (e.g., H1N1 Ebola Zika)
Outcome	Studies including resilience triggers on a micro-level e.g., individual capacity (knowledge, competence, learning, behavioral strategies) and team/unit capacity (communication, collaboration and learning) and triggers on macro-levels e.g., organizational capacity (resources, organization, culture) Examples of triggers related to the above are: healthcare personnel's adaptions to changes in work routines, tasks or work environment/work groups, handling challenges, finding solutions to problems, coping with staffing difficulties, equipment shortage, or lack of competence/knowledge	H1N1, Ebola, Zika) Studies investigating Larger systems' adaptation capacity (infrastructure, regulation, framework)
		Psychological (individual) resilience or lack of resilience, such as psychological or physical difficulties experienced by healthcare personnel (e.g., sleep deprivation, tiredness, difficulties with protective gear), or healthcare personnel's professional identity.
		COVID-19 treatment regimes

		Studies not involving adaptive capacity such as studies only focusing on barriers and challenges (not solutions)
Language and year of	English, Norwegian, Danish or	Other languages
publication	Swedish	
		Studies published before 2019
	Studies published between	
	2019 and 2021	
Method	Studies applying qualitative	Studies applying quantitative
	methods that are published in	methods. Grey literature, e.g.,
	peer-reviewed scientific	editorials, comments, non-
	journals	scientific publications

Data sources, search terms and search strategy

The search strategy will involve searches in the databases: Academic Search Elite, CINAHL, MEDLINE, PubMed, Science direct and Scopus using the key words and MESH terms listed in Table II. These were identified through the National Library of Medicine's (NIH) Medical Subject Headings (MeSH) browser, an electronic thesaurus (www.thesaurus.com, 2021), through years of studying RiH literature, and initial searches conducted by MKN (Fig 1. provides an example of a possible eligible study identified in the initial searches). After conducting searches in the listed databases, secondary searches will be conducted in the included articles (a review of the reference list of included articles in the search for eligible articles), and moreover, hand searches will be conducted in current journals (current journals will be identified through the included articles).

Available Medical Subject Headings (MeSH) terms will be applied to simplify and ensure accurate searches in current databases (e.g. to cover all versions of the term COVID-19). In Ovid platforms, MeSH-terms is shown with a "/ "after the term. In CINAHL and on the EBSCO platform, "MH" is used to indicate the search of a subject heading. Where MeSH terms are not available, relevant key words linked to the research question at hand will be applied. On the OVID platform, key words will search across a range of fields including title, abstract and subject heading words while in the CINAHL platform, the keyword search is in the abstract, title and subject heading fields. Truncations (*) will be applied on relevant search words (e.g., challenge, issue, problem) to retrieve any alternative endings e.g., singular and plurals of words. The use of truncations is, however, not recommended in PubMed and may disturb the identification of subject headings (this will be taken into account). Phrase searching (e.g., performance variability, assisted living) will be completed by using quotation marks "..." to ensure that keywords are searched as phrases. Boolean operators AND and OR will be used to combine the search words to widen or broaden the searches. For example: COVID-19 AND Safety II OR Safety-II AND "Primary healthcare service" AND challenge* (LibGuides, 2021)

Searches compromising all possible combinations of the three clusters will systematically be conducted. An overview of all conducted searches in all databases will be provided as a supplementary file.

Table II. Key word clusters

Cluster I	Cluster II	Cluster III	Cluster IIII
1. COVID-19/ MH	2. "Resilience in	15. "primary health	36. Challenge*
	healthcare"	care services"	37. Issue*
	3. "safety II"	16. Primary	38. problem*
	4. "Safety-II"	healthcare/ MH	39. Concern*
	5. adaptation*	17. "Primary health-	40. Difficulty*
	adjustment*	care"	41. Constraint*
	7. re-organization	18 "Primary care"	42. Obstacle*
	8. Re-organisation	19. "Primary	43. Hindrance*
	9. trade-off*	healthcare"	44. Barrier*
	10. "performance	20 "Primary health-	45. Problem solving
	variability"	care"	46. Maintain
	 variation* 	21 "Care homes"	47. solution*
	12.improvisation*	22 "Residential aged	48. Manage (ing)
	13. response*	care"	Managed
	14. complexity	23 "Long-term care"	49. Handle (ing)
		24 "Long term care"	50. Cope (ing)
		25. "nursing homes"	51. endure
		26. "assisted living"	52. coordinate (ing)
		27. "facility	53.Organize (ing)/
		retirement"	54.Organise (ing)
		28. "facility home	
		care"	
		29. "home care	
		services"	
		30. "Home care"	
		31. "home based care"	
		32.Hospital*	
		33."Emergency	
		room"*	
		34 Emergency	
		service/MH	
		35. Clinic*	

Fig. 1 Example of eligible article

Example of possible eligible article

The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study Liu et al, 2020). <u>https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(20)30204-7/fulltext</u>

Examples of relevant findings

- Physicians and nurses followed the diagnosis and treatment guidelines released by the National Health Commission, while drawing on previous clinical experience and learning through exploration
- They discussed the guidelines with other colleagues to understand their experience in treating patients with COVID-19, then transformed this knowledge and experience to use in patient care
- Many wards that were not designed for infectious diseases were modified into isolation wards within a short period of time
- They needed to learn and master new technical procedures in a short time
- They had to rapidly find ways to work together efficiently

Selection of eligible studies

Identified studies will be managed in the reference manager Zotero 5.0. Duplicates will be removed and references uploaded in Rayyan QCRI, which is an application that enable all researchers of the study to review abstracts and titles, and select articles for inclusion (Ouzzani et al., 2016). Abstracts will be screened against the selection criteria and studies assed for inclusion. Full text articles will be uploaded in Zotero 5.0, a tool for collection, organizing, citing and sharing research (*Zotero*, 2021).

Quality assessment

Each study will be assessed for quality using the Clinical Appraisal Skills Program (CASP) for qualitative studies (Clinical Apprasial Skills Programme, 2018). CASP enables a systematic assessment of the trustworthiness, relevance and results of published articles. It consists of ten yes/no questions, with additional prompts, reminding the reviewer of the importance of each question. If the answer

to the first two questions¹ are "no", the study will be assessed as biased, and will not be included in the review (Clinical Apprasial Skills Programme, 2018). The CASP tool do not include a scoring system (where low scores exclude articles), but do however, guide each reader to appropriate assessments of the quality of each study. In other words, the reader needs to individually assess the studies based on the control questions. Relevant experience within qualitative research will, in this case, be an advantage.

Data extraction and synthesis

The following data will be extracted from included articles: details about the variation in performance (cf. resilience in healthcare); how adaptations were executed; reasons for adaptation execution. Study characteristics (e.g., title, year, method, setting, informants) will be extracted and listed in a table to provide an overview of included studies. The qualitative analysis tool NVivo Pro will be use to facilitate a thematic analysis and synthesis as described by Thomas & Harden (2008). The studies' results will be uploaded into Nvivo or entered into the program verbatim. Further, the text will be coded inductively, sentence by sentence, according to its meaning and context by two researchers. The codes will be structured in a three form (hierarchical structure) to display the relationship between different codes. Codes with similar meaning will be assembled under broader categories (going through several phases of organization and reorganization to ensure accurate placement). Lastly themes will be developed based on the content of the different codes, and their descriptive, and possible, latent (analytic) meanings (Ring et al., 2011; Thomas & Harden, 2008). To ensure accurate themes, they will be discussed among the researchers.

Strategy for presentation of the results

The search strategy will be presented in the protocol as an attachment. The PRISMA flow diagram will be used to provide an overview of the study selection and review process. A summary of the included studies will be provided as a table along with an excerpt of the analysis. The results will, in the protocol, be presented theme by theme (in the order of the identified themes of the analysis).

Researchers

The research team comprise researchers with experience from a variety of relevant fields within health services research:

Dr. Malin Knutsen Glette, SHARE, University of Stavanger

E-mail: Malinknutsen.glette@hvl.no

https://www.uis.no/nb/profile/2373

Professor Siri wiig, SHARE, University of Stavanger

E-mail: Siri.wiig@uis.no

¹ 1. Was there a clear statement of the aims of the research?

^{2.} Is a qualitative methodology appropriate
- Dr. Kristiana Ludlow, AIHI, Macquarie University
- E-mail: kristiana.ludlow@mq.edu.au

https://researchers.mq.edu.au/en/persons/kristiana-ludlow

Professor, MD, David Bates, Harvard Medical School

E-mail: dbates@bwh.harvard.edu

https://www.hsph.harvard.edu/ecpe/faculty/david-w-bates/

Dr. Elizabeth Austin, AIHI, Macquarie University

E-mail: elizabeth.austin@mq.edu.au

https://researchers.mq.edu.au/en/persons/elizabeth-austin

Work distribution and schedule

Time	Task 💦	Work distribution
January - February	Develop project protocol	MKN with input from EA, SW,
	(defining the purpose, topic,	DB and KL
	scope, research question(s)	
	and analytic framework,	
	determining	
	inclusion/exclusion criteria)	
	Identify eligible researchers/	MKN & EA
	build a team	Do Siri have any suggestions
		from UIS?
	Finalize scope	MKN, EA, SW
	Preliminary literature	MKN
	searches	
February- April	Main Searches, including hand	MKN
	searches and secondary	
	searches	
	Reference management	MKN
	Study selection	MKN, EA & KL (?)
May - July	Quality assessment	MKN, EA & KL with input from
	Data extraction	SW and DB

Table III. Schedule, tasks and work distribution (inspired by Nelson, 2014)

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	Qualitative analysis	
July - September	preparing the report	MKN (full draft), EA, KL, SW & DB
September/October	Article Submission	

*MKN= Malin Knutsen Glette, SW= Siri Wiig, DB = David Bates, KL= Kristina Ludlow, EA= Elizabeth Austin

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	Title/Author	Method	Setting	Partisipants Cluding for	828 Country on 20 Se	Quality assesmen
1	To be or not to be in the ward': The Impact of Covid-19 on the Role of Hospital-Based Clinical Pharmacists - A Qualitative Study (Cheong, 2020)	Qualitative	Hospital	Pharmacists eignement sup related to text	Plember 2023. Dowr	High
2	A National Study of Community Health Centers' Readiness to Address COVID-19 (Damian et al., 2021)	Mixed method	Community health centers	Primary care employed are date date minimer	USA USA	High
3	A qualitative examination of quarantine work experience of nurses in Saudi Arabia (Alhamidi et al., 2020)	Qualitative	Quarantine centers	Nurses g. Al traini	Saudi Arabia	High
4	A qualitative study of physician perceptions and experiences of caring for critically ill patients in the context of resource strain during the first wave of the COVID- 19 pandemic (Parsons Leigh et al., 2021)	Qualitative	ICU	Physicians g, and similar technologies.	n. Canada n.bmj.com/ on June 11, 2025 at	High
5	A Qualitative Study of Primary Care Physicians' Experiences With Telemedicine During COVID-19 (Gomez et al., 2021	Qualitative	Primary care		A USA Biblio	High

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1 2 3 4 5 6 7 8	6	Adapting to the unexpected: Problematic work situations and resilience strategies in healthcare institutions during the COVID-19 pandemic's first wave (Juvet et al.,	Mixed method	Hospital	Nurses and other caregivers for uses	Switzerland	High	
9 10 11 12 13 14 15 16	7	2021) An Experience of Otorhinolaryngologists as Frontline Worker with Novel Coronavirus: A Qualitative Analysis (Kaur et al., 2021)	Qualitative	Hospital	eignement Superior relignement Superieur (A otorhinolaryngologisted to text and data	India	High	
17 18 19 20 21 22 23 24 25 26	8	At Home, with Care": Lessons from New York City Home-based Primary Care Practices Managing COVID-19 (Franzosa et al., 2021)	Qualitative	Home-based primary care	HBPC leadership including clinical/medical directors, program managers, nurse practitioners/nursing coordinators, and social workers/social work	USA	High	
27 28 29 30 31	9	Changes to care delivery at nine international pediatric diabetes clinics in response to the COVID-19 global pandemic (Sarteau et al., 2021)	Qualitative	Diabetes clinics	Healthcare providers lar technolog	USA, Australia, Sweden, India	Low	
32 33 34 35 36 37	10	Clinician Perspectives on Caring for Dying Patients During he Pandemic A Mixed-Methods Study (Cook et al., 2021)	Mixed method	Hospital	Patients, family members, clinicians	Canada	High	
38 39 40 41 42 43 44		F	or peer review only - ht	tp://bmjopen.bmj.com/site	e/about/guidelines.xhtml		· · · · · · · · · · · · · · · · · · ·	

11	Clinician perspectives on methadone service delivery and the use of telemedicine during the COVID-19 pandemic: A qualitative study (Hunter et al., 2021)	Qualitative	Methadone clinic	physicians, physician clud assistants, and nurse ng practitioner of use n		High
12	Covid-19 changes to maternity care: Experiences of Australian doctors (Szabo et al., 2021)	Mixed method	Maternity wards	Doctors seignement Su Doctors to text	Australia	High
13	COVID-19 Impact on Healthcare and Supportive Services for People Who Use Drugs (PWUDs) in Malaysia (Vicknasingam et al., 2021)	Qualitative	Healthcare and non- governmental organizations	Medical personnel of a re- methadone maintena treatment programs and HIV clinics	Malaysia	Low
14	COVID-19: How did community pharmacies get through the first wave? (Gregory & Austin, 2020)	Qualitative	Pharmacies	Pharmacists A training	Canada	Low
15	Delivering Virtual Cancer Rehabilitation Programming During the First 90 Days of the COVID-19 Pandemic: A Multimethod Study (Lopez et al., 2021)	Multi method	Cancer center	Oncology healthcare and similar technology	Canada	High
16	Effect of COVID-19 on health system integration in the Netherlands: a mixed-methods study (Minderhout et al., 2021)	Mixed method	Acute care	Clinicians, managers, administrators, and insurance company representatives	Netherlands	High
17	Emerging Palliative Care Innovations in the ED: A	Qualitative	Emergency department	Emergency department and Palliative care clinicians		High

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		Qualitative Analysis of Programmatic Elements During the COVID-19 Pandemic (Aaronsen et al., 2021)			ht, including for	071828 on 20 Sep		
0 1 2 3	18	Feasibility of an online platform delivery of pulmonary rehabilitation for individuals with chronic respiratory disease (Lewis et al., 2021)	Mixed method	Community Respiratory Team	physiotherapist, nurses En and exercise instructor and to t Sup	UK UK 2023. Down	Low	
4 5 6 7 8 9 0	19	Front-line nurses' responses to organisational changes during the COVID-19 in Spain: A qualitative rapid appraisal (2021)	Qualitative	Hospital and community health settings	Nurses and data mining, A	Spain Gaded from http://	High	
1 2 3 4 5 6	20	Healthcare providers' challenges during the coronavirus disease (COVID-19) pandemic: A qualitative approach (Ness et al., 2021)	Qualitative	Hospital	Nurses training, and s	USA USA	High	
7 8 9 0 1	21	Healthcare workers during the COVID-19 pandemic: Experiences of doctors and nurses in Bangladesh (Hussain et al., 2021)	Qualitative	Hospital	Doctors and nurses milar technolog	Bangladesh	High	
2 3 4 5 6 7 8 9	22	Home palliative care professionals perception of challenges during the Covid-19 outbreak: A qualitative study (Franchini et al., 2021)	Qualitative	An Italian non-profit organization	Home care profession (nurses and physicians)	Italy 2025 at Agence Biblio	High	
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23	How the experience of medical assistance in dying changed during	Qualitative	Providers of Medical assistance in dying	Physicians and nurse club practitioners	canada	High
	the COVID-19 pandemic in Canada: a qualitative study of providers			y for use	0	
24	Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in Flemish GPs (Verhoeven et al., 2020)	Qualitative	GP practices	GPs GPs	Belgium	High
25	Inpatient Diabetes Care during the COVID-19 Pandemic: A Diabetes UK rapid review of health care professionals' experiences using semi-structured interviews (Burr et al., 2021)	Qualitative	Hospital	Diabetes consultants, diabetes specialist numers and allied health professionals involved in delivery of diabetes	UK	Low
26	Lessons from Italian front-line nurses' experiences during the COVID-19 pandemic: A qualitative descriptive study (Catania et al., 2021)	Qualitative	Hospital	Nurses d similar techno	Italia	High
27	Management and patient safety of complex elderly patients in primary care during the COVID-19 pandemic in the UK— Qualitative Assessment (Alboksmaty et al., 2021)	Qualitative	Primary care	GPs ogies.		High

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28	Midwives' experiences of providing maternity care during the COVID-19 pandemic in Australia (Bradfield et al., 2022)	Mixed method	Hospital	Midwifes ding for use	Australia 20 Septen	High
29	Missing the human connection: A rapid appraisal of healthcare workers' perceptions and experiences of providing palliative care during the COVID-19 pandemic (Mitchinson et al., 2021)	Qualitative	Hospital	Healthcare workers (eg dieticians, pharmacista, nurses) to	UK UK Der 2023. Downloaded fri sekanement Suberleur (Al	High
30	Nurses' ethical challenges caring for people with COVID-19: A qualitative study (Jia et al., 2021)	Qualitative	Hospital	Nurses nin ng, Al traini	Gin http://bmjop	High
31	Nurses' experiences of being recruited and transferred to a new sub-intensive care unit devoted to COVID-19 patients (Danielis et al., 2021)	Qualitative	Hospital (intensive care unit for COVID- 19 patients)	Nurses ng, and similar techno	en.bmj.com/ on June	High
32	Nurses' experiences regarding shift patterns in isolation wards during the COVID-19 pandemic in China: A qualitative study (Gao et al., 2020)	Qualitative	Hospital	Nurses ge	T, 2025 at Agen	High
33	Nursing home staff perceptions of challenges and coping strategies during COVID-19 pandemic in China	Qualitative	Home care	Nurses	China Biblio	High

	(Zhao et al., 2021)			includi	828 on	
34	Nursing perspectives on care delivery during the early stages of the covid-19 pandemic: A qualitative study (Shroeder et al., 2020)	Qualitative	Urban academic medical center	ng for uses relat	20 USA USA	High
35	Person-centered communication between healthcare professionals and COVID-19 infected older adults in acute care settings: Findings from Wuhan, China (Li et al., 2021)	Qualitative	Hospital	Nurses and physicians of experient text and call the superieur and call the superieur	023. China Downloaded	High
36	Preparedness of Our Emergency Department During the Coronavirus Disease Outbreak from the Nurses' Perspectives: A Qualitative Research Study (Hou et al., 2020)	Qualitative	Emergency department	Nurses ta mining, Al training,	from http://bmjopen.l	High
37	Preservation of Person-Centered Care Through Videoconferencing for Patient Follow-up During the COVID-19 Pandemic: Case Study of a Multidisciplinary Care Team (Silsand et al., 2021)	Qualitative	PACT team (transitional phase between hospital and primary care)	Healthcare workers in a similar technolog	Morway	High
38	Provision of clinical pharmacy services during the COVID-19 pandemic: Experiences of pharmacists from 16 European countries Paudyal et al., 2021)	Qualitative	Hospital, community pharmacy, primary care	Pharmacists	Belgium, Croatia, Czech Republic, Denmark, England, Estonia, France, Ireland, Netherlands, Portugal, Serbia.	High

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2 3 4 5						bt including	Spain, Switzerland, Turkey	
6 7 8 9	39	Rapid response system adaptations at 40 US hospitals during the COVID- 19 pandemic (Mitchell et al., 2021)	Mixed method	Hospitals	Clinicians	Septembe	USA	Low
10 11 12 13 14	40	Resilience in the time of pandemic: The experience of community pharmacists during COVID-19 (Austin & Gregory, 2021)	Qualitative	Pharmacies	Pharmacists	r 2023. Downloa		High
16 17 18 19 20 21 22	41	The impact of COVID-19 on chronic care according to providers: a qualitative study among primary care practices in Belgium (Danhieux et al., 2020)	Qualitative	Primary care	Doctors, nurses, dieticians	eur (ABES) .	Belgium	High
23 24 25 26	42	Restructuring in a GP practice during the COVID- 19 pandemic – a focus- group study (Renaa & Brekke, 2021)	Qualitative	GP practise	Nurses and medical	en.omj.co	Norway	High
27 28 29 30 31	43	The Lived Experience of ICU Clinicians During the Coronavirus Disease 2019 Outbreak: A Qualitative Study (Kentish-Barnes et al., 2021)	Qualitative	ICU	Physicians, nurses, nursing assistants, respiratory therapist	milar tooboolog	France	High
33 34 35 36	44	US Clinicians' Experiences and Perspectives on Resource Limitation and Patient Care During the COVID- 19 Pandemic (Butler et al., 2020)	Mixed method	Hospitals/clinics	Nurses, nurse g	iuzo at Ageno	USA	High
37 38	45	Experiences of nursing students as healthcare aid during the COVID-19	Qualitative	Hospital	Nursing students	ce Blo	Spain	High
 39 40 41 42 43 44 		F	or peer review only - ht	tp://bmjopen.bmj.com/sit	e/about/guidelines.xhtml	liographique de l	-	·

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The Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic	Qualitative	Heart function clinic	Patients, clinicians, st	Ca from http://bm ABES) . http://bm	anada	High	
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-	 pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Necessity is the mother of invention': Specialist palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021) The Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic 	pandemic in Spain: A phemonenological research study (Casafont et al., 2021)Mixed methodNecessity is the mother of invention': Specialist palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021)Mixed methodThe Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function ClinicQualitative	pandemic in Spain: A phemonenological research study (Casafont et al., 2021)Inpatient palliative care units, home nursing services, home nursing services, hospital and home palliative care teamspandemic in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021)Mixed methodThe Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function ClinicQualitativeHeart Function ClinicHeart Function clinic	pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Inpatient palliative care service innovation and practice care units, home nursing services, hospital and home palliative care teams Healthcare workers Pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Mixed method Inpatient palliative care units, home nursing services, hospital and home palliative care teams Healthcare workers Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Qualitative Heart function clinic Patients, clinicians, states The Resilience of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic Qualitative Heart function clinic Patients, clinicians, states	pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Mixed method Inpatient palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Mixed method Inpatient palliative care teams Healthcare workers Superior of the service innovation and practice care units, home nursing services, hospital and home palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Qualitative Heart function clinic Patients, clinicians, stating, A training, and similar technologies The Resilience of Cardiac Care Qualitative Heart function clinic Patients, clinicians, stating, A training, and similar technologies of a Heart Function Clinic Finance of Cardiac Care Qualitative Heart function clinic Patients, clinicians, stating, A training, and similar technologies	pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Mixed method Inpatient palliative care units, home nursing services, hospital and home palliative care teams Healthcare workers Europe, UK, rest of the world Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Mixed method Inpatient palliative care units, home palliative care teams Healthcare workers Europe, UK, rest of the world The Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Qualitative Heart function clinic Patients, clinicians, stimular of a Heart Function Clinic Canada	pandemic in Spain: A phemonenological research study (Casafont et al., 2021) Mixed method Inpatient palliative care units, home nursing services, hospital and home palliative care service innovation and practice change in response to COVID-19. Results from a multinational survey (CovPall) (Dunleavy et al., 2021) Mixed method Inpatient palliative care units, home nursing services, hospital and home palliative care teams Healthcare workers Europe, UK, rest of the world High The Resillence of Cardiac Care Through Virtualized Services During the COVID-19 Pandemic: Case Study of a Heart Function Clinic Qualitative Heart function clinic Patients, clinicians, stating, at a entities, study of a Heart Function Clinic High