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A qualitative analysis of health service problems and the strategies used to manage them in the COVID-19 pandemic: exploiting generic and context-specific approaches

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Abstract

Background The COVID-19 pandemic disrupted health systems around the globe. Lessons from health systems responses to these challenges may help design effective and sustainable health system responses for future challenges. This study aimed to 1/ identify the broad types of health system challenges faced during the pandemic and 2/ develop a typology of health system response to these challenges.

Methods Semi-structured one-on-one online interviews explored the experience of 19 health professionals during COVID-19 in a large state health system in Australia. Data were analysed using constant comparative analysis utilising a sociotechnical system lens.

Results Participants described four overarching challenges: 1/ System overload, 2/ Barriers to decision-making, 3/ Education or training gaps, and 4/ Limitations of existing services. The limited time often available to respond meant that specific and well-designed strategies were often not possible, and more generic strategies that relied on the workforce to modify solutions and repair unexpected gaps were common. For example, generic responses to system overload included working longer hours, whilst specific strategies utilised pre-existing technical resources (e.g. converting non-emergency wards into COVID-19 wards).

Conclusion During the pandemic, it was often not possible to rely on mature strategies to frame responses, and more generic, emergent approaches were commonly required when urgent responses were needed. The degree to which specific strategies were ready-to-hand appeared to dictate how much a strategy relied on such generic approaches. The workforce played a pivotal role in enabling emergent responses that required dealing with uncertainties.

Keywords Health services, Resilience, COVID-19, Standards, Sociotechnical systems

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Background

The COVID-19 pandemic has posed a significant challenge to health systems worldwide, and many have struggled to cope, especially in the early stages [1]. The global consequences of COVID-19 on health systems are measured in loss or impairment of lives [2], healthcare professional burnout [3], reduced services, and delayed care [4, 5].

Unfortunately, it is highly probable that health systems will confront many more such crises, with climate change risks amongst these [6]. Understanding what was common to successful COVID-19 strategies, and what was shared amongst failed ones could be instructive as we prepare for the future. The pandemic affected every aspect of operations from planning and procurement to care delivery [7, 8]. Services, processes and tools were repurposed or created ad hoc, often from the ground up [9, 10]. Hospitals for instance, responded by repurposing existing facilities and wards, and implementing strategies to cope with sudden rises in patient numbers that overwhelmed existing critical care services such as intensive care units [11, 12]. The initial phase of the pandemic witnessed immediate actions, some of which succeeded such as the development of mRNA vaccines [13] and others that failed such as certain COVID-19 contact tracing applications [14].

The challenges healthcare professionals experienced during the COVID-19 pandemic has had some attention in the research literature. For example, a 2021 systematic review examining the COVID-19 burden on healthcare workers from nine different countries identified four main challenges of inadequate preparedness; emotional challenges; insufficient equipment and information; and work burnout [15].

This study goes beyond describing the challenges faced, and examines the responses to these problems using the lens of sociotechnical system theory (STS) [16]. STS thinking sees system processes as the emergent outcome of interactions between people and technology [16].

Using first-hand stories from healthcare professionals, this study first describes the different health service problems experienced by health professionals during the pandemic. Next, we attempt to categorise the different strategies they employed to deal with these problems, exploring how people and technologies came together to craft responses to these problems during the pandemic. We develop a typology of responses that identifies the different roles for generic (general-purpose strategies), and specific (local or health service-specific) approaches. Identifying the circumstances in which each of these strategy types was used may assist in preparedness and guide future crisis responses.

Methods

Design

A series of semi-structured interviews explored the first-hand experiences of healthcare professionals in either developing or making COVID-19 pandemic responses. We utilised a qualitative and interpretive approach, which aims to generate new hypotheses by exploring emergent relationships between descriptions of phenomena [17, 18]. This manuscript follows the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines (See Additional file 1 for the checklist).

Participants and setting

Health system staff from a variety of professional groups and levels of seniority were recruited. Health professionals who had been involved in the pandemic response in New South Wales (NSW) were eligible for interviews. These included medical specialists (e.g. respiratory physicians), nurses and midwives, general practitioners (GPs), allied health workers (e.g. physiotherapists working in ICUs), health service executives and administrative staff, and paramedics. Participants were selected from a diverse range of health professions and services, including hospitals, public health organisations, and laboratories, in both public and private sectors as well as rural and urban settings. Our target sample size of 20 was informed by a systematic review of 14 qualitative studies that explored the experiences of healthcare professionals during the pandemic and concluded that on average, past studies reached data saturation with approximately 15 participants [19].

NSW is an Australian state with over eight million people. It includes about 9,600 full-time equivalent GPs [20] and 2000 registered pharmacies [21] governed by the federal government [22]. Further, NSW Health is the public health system for the state and includes NSW Ambulance, NSW Health Pathology, eHealth NSW, Health Protection NSW (public health legislation and surveillance), and Local Health Districts (LHDs) [23]. LHDs encompass hospitals, home hospitals, hospital pharmacies, aged health and disabilities, mental health, aboriginal health, drug health, and public health including immunisation [24]. During 2020-21, NSW had a total of 228 public hospitals and 210 private hospitals [25], and over 150 pathology collection centres [26]. Participants in this study were from general practices and community pharmacies, as well as NSW Health, including NSW Ambulance, Health Pathology (including COVID-19 testing centres), eHealth NSW, hospitals, hospital pharmacies, and immunisation services.

The research team (E.C., B.S., T.S., F.M.) initiated purposive recruitment with a convenience sample [27, 28], identifying potential participants within their health system networks. Once enrolled, we used snowballing where

participants were asked to forward the study invitation email to others who might be interested. Participants did not have any pre-existing relationship with the interviewer (H.R.-A.) who invited them via email. Transcripts were deidentified by H.R.-A. before sharing them with the other core analysis team (E.C., F.M).

Ethics and consent

Ethics approval was obtained from the Macquarie University Ethics Committee (ID: 11187) prior to commencing the study. Participants provided written informed consent prior to data collection.

Data collection

Data were collected between April and September 2022. At the time of the interview, the COVID-19 vaccine was freely available to the community, and health services in NSW have been providing in-person services in addition to tele-consultation. One-on-one interviews were conducted online using videoconferencing software (Zoom Video Communications, Inc. 2023) with each session lasting an average of 51 min (range: 27–73 min). One of the researchers (H.R-A.) with experience in qualitative interviews was responsible for conducting the interviews. Interviews were transcribed using an AI-based transcription tool (rev.com). A subset of four transcripts were manually checked for transcription accuracy (H.R-A.). Data collection and preliminary analysis were concurrent, with emerging themes from initial analysis reshaping subsequent interview questions and recruitment. Emerging themes about the use of different types of strategies led to new probe questions about strategy and whether such responses were new to the setting. The bulk of the analysis was conducted after data collection.

After the interviewer introduced herself and the reasons for conducting the research (identifying potential approaches for a crises ready health system) participants were asked about: (1) The challenges they faced while providing clinical services during the entire stages of the pandemic; (2) Specific health service responses that they were involved with and (3) what they did differently to pre COVID-19 practices (See Additional file 2 for the initial version of the interview guide).

Data analysis

Data were analysed using constant comparative analysis [29]. Two early transcripts were open-coded line-by-line to identify emerging concepts and themes (By H.R-A.). To ensure generalisability, these early codes were discussed and refined with a second analyst (E.C.). Codes were further refined and extended during the study by comparing similar categories across participants. An axial coding approach was taken, looking at connections between categories in terms of causation, strategies, consequences, context, and related conditions [29]. This process continued until all transcripts were coded. Both inductive and deductive approaches were utilised for coding and conceptualising the themes and frameworks.

Data coding was supported by QRS International NVivo® 12 Software. Visualisation of code connections, codes and data was undertaken using Microsoft Excel. Some codes were grouped into more general constructs, and others were separated into several distinct codes. H.R-A. created memos of each transcript including key quotes, cross-indexed back to the transcripts and documented all process changes in an audit trail.

Reflexivity

Authors (E.C., B.S., T.S.; males) have a clinical background (medical doctors) and two are currently in clinical practice (B.S., T.S.). E.C. (PhD), F.M. (PhD, female) and H.R-A. (PhD, female) were academic researchers at the time of the study. All authors are experienced health system researchers, with prior experience in qualitative research. The interviewer and principal analyst (H.R.-A.) who had no previous contact with any of the participants, deidentified the transcripts before sharing them with other team members. Three participants were willing to provide feedback on the initial analyses.

Analytic framework

We analysed data to identify the types of (1) problems faced by participants or their health services during the COVID-19 pandemic; and (2) the type of health service responses employed to manage these problems. The analysis of health service responses was undertaken using the lens of STS theory which emphasises that system processes are the inevitable consequence of interaction between the people and technology, and that studying either in isolation leads to reductionism that fails to explain how the real world works adequately [16]. Thus, technological processes were analysed alongside human processes, each shaping the other in a continuous process of human-technology interaction [30, 31]. For example, if a participant discussed technology, we probed for human processes related to the technology. We sought to understand the context that led to different social and technical response patterns with specific attention to human and technology interactions. Two researchers (H. R-A. and E.C.) analysed the health service responses reported by interviewees, and differences in interpretation were resolved by discussion.

Results

Participant characteristics

Of 28 invited health professionals, 19 participated in our study. Participants who were involved in the pandemic response were GPs ($n=2$), pharmacists ($n=2$), specialists

(e.g. emergency physician and respiratory physician), ($n=3$), nurses and midwives ($n=3$), allied health workers (e.g. physiotherapist and social worker working in ICU) ($n=3$), pathologists ($n=2$), a paramedic ($n=1$), a clerical officer ($n=1$) and public health implementation officer/managers ($n=2$).

Health service problem types

Participants identified four broad classes of challenges faced by their health services during COVID-19. A summary of challenges is provided below, and a detailed description with example quotes from participants available in Additional File 3.

1. *Health system overload*. The ability for health services to meet the needs of the population as the pandemic unfolded was often compromised because of an imbalance between the supply and demand for resources. System overload was often the result.
2. *Barriers to decision-making*: In the rapidly unfolding pandemic, evidence was not being generated and distributed as quickly as health services required, and the communication pathways to share information were sometimes suboptimal.
3. *Education and training gaps*: The need to train the public and health service staff as services responded to the pandemic was triggered both by the arrival of new evidence and best-practice guidance needing to be shared widely, or by staff working in roles that were new to them.
4. *Limitations of existing services*: Faced with multiple and concurrent challenges, many existing services or care models were found to be inadequate.

Health service response types

Respondents provided a rich account of the different strategies employed to meet the problems faced during the early years of the pandemic, with multiple examples across all four problem types (Additional file 4).

High-level analysis of these responses identified that human organisational responses were apparently shaped by the degree of technology maturity and availability. We observed differences in the use of generic responses (applicable to many settings) and specific responses (designed to serve a given service, its unique characteristics and the problems it faced). In this section below, we contrast examples of general and specific responses, presented for each problem type to explore why these strategic differences might have been adopted. Example responses are cross-referenced to relevant quote IDs in brackets, indicating each code's cell address and item number in the Excel sheet - Additional file 4 as "([Cell address]#[item number when available])".

Health system overload

Generic overload management strategies: Respondents described increasing the hours worked by staff (quote IDs H03#1, H20, H21), redeploying staff to critical services (quote ID H03#2), hiring new staff (quote IDs H03#3, H20#2, H21#4) or retraining existing staff (quote IDs H14#3, H15#2) to address imbalances between service supply and demand. Work pattern changes included delaying non-urgent care (quote IDs H03#9, H13#7, H66), altering staff/patient ratios in hospitals (quote IDs H03#12, H35#2,6,7), and fast-tracking patient discharge in tandem with home monitoring and support packs for COVID-19 patients (quote ID H03#11). Clinical staff working under difficult circumstances or longer hours were supported with access to accommodation, peer and mental health support (quote IDs H15#7, H21#3, H27#2, H35#5).

The choice of generic responses appeared to be driven by time constraints necessitating immediate solutions (quote ID H20#2). For example, outsourcing recruitment was more expedient than developing new internal processes: "*they hired an external company to I guess source more [staff who] didn't have the experience that we had it was yeah that's what effectively led for those long [vaccine] lines… the expectation was the training would come in the same day… the workforce was ignored… it would be much helpful to know that like in two months we're wrapping up to be 1500 [vaccinations] yeah we would have tried extra hard to train more people [Pharmacist – 14].*"

Specific overload management strategies: Overload strategies were sometimes quite specific to the health service experiencing stress. Batch testing of pooled samples for polymerase chain reaction (PCR) tests was undertaken to improve the throughput of otherwise overloaded laboratory services (quote ID H07#1). Rapid antigen tests (RATs) were used in hospitals to reduce the number of PCR tests for likely-negative individuals and for symptomatic positive patients, and allow ill patients to receive COVID-19 treatment without delay (quote ID H07#2):

> *What a rapid test would do with someone who is symptomatic would be that if you turn positive on a RAT you are COVID positive, so what that would end up doing was then that would decrease the amount of PCR that we were doing… If we had access to them [RATs] in Delta [variant phase] a testing capacity for PCRs would have dropped, identification of COVID positive patients who have been much faster, and that would have changed our treatment or discharge plans for these patients a lot quicker [ICU Nurse – 13].*

Other specific responses were increasing hospital capacity by converting non-emergency wards into COVID-19

wards (quote ID H08#1), creating temporary wards (e.g. tents in hospital car parks) (quote ID H18), and facilitating hospital discharge by providing bus services to take patients home (quote ID H55). Emergency co-ordination centres assisted in identifying beds for patients across a region (quote ID H03#10), and respiratory clinics were set up in the community to support keeping patients at home (quote ID H60#2).

Barriers to decision-making

Generic decision-making strategies: Health services adopted several generic strategies to improve data capture, and dissemination of new evidence and local data. A respondent explained how a generic electronic medical record system (EMR) was customised to capture COVID-19 specific information (quote ID H56). "*We had to make EMR kind of work for us [Emergency physician – 09].*" The respondent and their colleagues "*had to sort of come up with a process … to mark that you've had COVID and then not test you*." General purpose strategies required staff to be vigilant for problems during their application: *"people were good at that. It was just realising that it [problem] was coming. So sort of working out. Oh hang on this is going to be a problem as we go forward. So what do we do? [Emergency physician – 09]."*

Non-specific technologies such as email, Zoom, and Microsoft Teams were often used to enhance team communication. Communication processes were also enhanced by scheduling regular daily staff meetings at hospitals (quote IDs H09#1, H14#11), and weekly meetings for GPs to speak directly with those involved in pandemic management from the public health system (quote ID H09#4). Microsoft SharePoint was used to gather information about staff activities, such as where and when they treated COVID-19 patients, to assist with infection control and for patient managements (quote IDs H47, H48#2, H49).

Specific decision-making strategies: To provide local best practice guidance, expert support teams were created to assist with troubleshooting (quote ID H09#3), local protocols were developed and updated potentially daily (quote IDs H09#2, H68#1,), and interdisciplinary collaborations (e.g. pharmacists working with nurses) developed local workflow models (quote ID H17#1). Such activities required significant effort (quote ID H09#2): "*a working group that met like daily seven days a week for months and months and months to put together the [local protocol and updates] response [Transplant nephrologist – 18].*"

Education and training gaps

Generic training strategies: Virtual training packages were used to maximise the dissemination of educational materials where local training was not feasible (quote ID H57). Peer support networks were developed to support information sharing where training was not available (quote IDs H03#4, H34 #5, H15#2). Adaptations of such solutions required significant human effort e.g. peer support meant senior staff had to be *"there every step of the way [Emergency nurse – 13]."*

Specific training strategies: Many of the responses designed to educate the health system workforce and the community were highly targeted (quote ID H15#2). Specific training programs were instituted to meet urgent needs, e.g. training clinicians in the use of PPE and hand hygiene. Consumers received highly targeted educational messages, such as requests to avoid unnecessary calling of ambulances, and simple social distancing rules and masking advice (quote IDs H22, H25, H26). Pharmacies provided in-house RATs for members of the public who did not understand the testing process (quote ID H25).

Limitations of existing services

Generic service strategies: The early stages of the pandemic saw a flurry of new or extended health services, often implemented under significant time and resource limitations. Periods of public health mandated lockdowns and work-from-home arrangements relied upon general purpose technologies (quote IDs H3#13, H14#5). Virtual consultations were delivered over channels of varying sophistication from telephone to online telecare products (quote IDs H13#3, H44#2, H52#1, H62#1). When there was lack of supply or limited access to manufactured PCR kits for COVID-19, specialised experts using general PCR techniques *"try and put together a rapid PCR type of [solution/reagent] which they didn't have [Pathology manager – 26]*" (quote ID H64#2).

Specific service strategies: Context-specific responses to service limitations included massive expansion of contact tracing capabilities, new measures such as routine COVID-19 surveillance of clinical staff (quote ID H14#6), and the use of QR (quick response) codes in public venues to support rapid contact tracing (quote ID H14#15). COVID-19 focussed respiratory clinics (quote ID H60#2) and PCR testing facilities appeared in the community for the first time. Specialist vaccination hubs and expanded community pharmacy services such as home delivery of medications were other specific responses. Hospital emergency services expanded their triage functions by creating specialised COVID-19 assessment areas with staff in full PPE, either using repurposed hospital space or in carparks outside the emergency departments or clinics (quote ID H03#11, H13#1,2, H14#13). Laboratories took advantage of manufactured PCR kits when available (quote ID H064#4): *"you just opened the box and you put it together and you go [Pathology manager – 26]."*

General to specific strategies. Many early responses to the pandemic involved the use of general strategies that

sought to optimise responses from existing services (such as reconfiguring rostering or using general-purpose software):

- The use of general solutions seemed to coincide with urgency and lack of time or resources to craft a more specific local solution (e.g. quote ID H20#2).
- General solutions also could thus be seen to "buy time" whilst uncertainty remained about the best way forward, and better more specific solutions were being developed (e.g. quote IDs H03#13, H14#5). Pre-existing SARS infection control protocols were widely used early on and adapted to local circumstances or evolving knowledge. Generic information and communication tools were used to patch together information processes whilst more sophisticated solutions could be developed (e.g. quote IDs H13#3, H44#2, H52#1, H62#1) [32].
- It is the nature of such generic responses that they are never a perfect fit to a specific task or context. Consequently, some adaptation or localisation is required to better meet these local needs. Such "fitting work" [33] often fell to local staff, and could take the form of workarounds (e.g. to make standard computer systems work in a new setting) or the addition of local changes (e.g. to a PPE protocol [34]) (e.g. quote IDs H47, H48#2, H49, H56).
- The need for fitting work imposes additional load on staff (e.g. quote IDs H03#1, H20, H21) to "*make things work here right now*" and could be a contributor to the high levels of staff burnout reported through the pandemic.

Specific to general strategies. Highly local solutions to pandemic challenges were often needed where services provided highly specialised services. For example, the details of changes to the workflow for laboratory processing of high volumes of PCR tests would not have wide applicability beyond the laboratory setting.

- The use of specific solutions appeared to coincide with unique local problems, or some capacity to develop new specific solutions whilst generic solutions "*held the fort*" (quote ID H64 #2).
- Nonetheless, general lessons from such specific responses can sometimes be drawn e.g. in the approach taken to agree upon the specific solution and how it is subsequently communicated. For example, public health services had to rapidly expand their workforce in support of contact tracing, and their use of external recruitment agencies could be adopted by very different parts of the health system.

Discussion

This study has examined the challenges faced during the COVID-19 pandemic, and health system responses to those challenges in Australia.

Clearly the challenges faced during the pandemic were not uniform, and different health services found themselves better or less well prepared or capable of responding than others [35]. Our analysis of these responses identified what appeared to be two quite different response pathways that played distinct roles in crisis management – the adoption of general strategies which could be used across a wide variety of settings, or the use or creation of highly targeted context specific responses.

What lessons can be learned from these broad responses? Given the nature of crises, each will bring novel and likely unanticipated challenges.

When faced with requirements to dramatically alter the duties and workflows of existing health services, especially when constrained by time, resource or knowledge, health services can turn to general-purpose strategies to reconfigure their existing workforce, and adopt ready to hand general purpose technologies. Whilst not ideal, these strategies support quick responses and buy time for more targeted solutions to emerge.

Crisis preparedness could thus focus on understanding the range of general-purpose tools and processes that can quickly be brought to hand. Adaptation protocols might provide guidance on localisation processes that optimise speed, quality, impact on staff, or cost. For example, protocols might describe processes of problem identification, workaround development, and team communication approaches that facilitate these tasks. In developing such protocols, we should not forget that while some services must develop highly localised solutions, they nevertheless can be a rich source of lessons about general approaches to identifying issues, designing solutions, and enacting them effectively. During the pandemic, innovations commonly involved combining pre-existing services.

Theoretical frameworks for system resilience describe the importance of flexibility and adaptability to respond to unexpected and escalating situations [36, 37]. Generic competencies are often team-based and include information management, communication and coordination, decision-making, and effect control [36]. Responses when managing the early phase of health emergencies should be simple and generic, such as using generic international guidance [38]. The Interactive Systems Framework (ISF) for dissemination and implementation distinguishes innovation-specific capacity and general capacity [39]. Various implementation frameworks suggest general organisational capacity building is an essential step in the early phase of implementation [40]. Such approaches emphasise that stabilising a situation and

maintaining organizational function are key to managing uncertainty while developing specific responses.

Limitations

The problems and system responses reported in this study may lack representativeness because of the small sample size of interviewees, the focus on a single albeit large health system in Australia, and the potential for recruitment biases introduced by convenience and snowballing sampling. Different nations had distinct experiences during COVID-19, such as variations in public health measures adopted, access to vaccines, lockdowns, government policy, and health impacts of the virus on their population. Thus, these findings may not be generalisable to other health system settings. Respondents detailed challenges and system responses with many examples. We anticipated achieving theoretical saturation with 20 participants but during the analysis phase did not do so. This may be due to the richness of innovations during COVID-19 or the diverse selection of participants [41, 42]. Failure to saturate suggests that interviewing additional participants could likely identify new examples and issues that might have uncovered additional issues. However, the concept of data saturation in qualitative studies is currently under debate [43].

Conclusion

Health services have a range of different response strategies available to them when faced with novel challenges, and selection of a strategy can be guided by the circumstances and the availability of ready-to-hand specific strategies. The workforce is pivotal in enabling emergent responses that require dealing with uncertainties. Recognising the important role that general purpose strategies play when time is short (e.g. emergencies) and specific solutions are not yet available suggests that health services can invest in formalising protocols for solution design and focus on workforce support, including team communication and supporting solution implementation. Such capabilities should enhance health system preparedness for crises such as new pandemics or climate-change triggered events. Much can also be learnt about the construction of context-specific solutions, a deeper exploration of when to employ such approaches and how to support them to best prepare for future crises.

Abbreviations

EMR Electronic medical record system
GP General practitioner
ICU Intensive care unit
PCR Polymerase Chain Reaction
PPE Personal protective equipment, RAT: Rapid antigen tests
STS Sociotechnical system

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Author contributions

E.C., B.S., T.S. and F.M. conceptualised the study. H.R.-A. developed the study protocol and collected data, E.C. and H.R.-A. analyzed the data. E.C. and H.R.-A. prepared the original draft, and all authors contributed to the final drafts of the manuscript.

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Data availability

The complete datasets generated and analysed during the current study are not publicly available because consent was not obtained from study participants for data to be made public but are available from the corresponding author on reasonable request subject to approval from the Macquarie University Ethics Committee. Part of the deidentified data is provided as a supplementary file.

Declarations

Ethics approval and consent to participate

Ethics approval was obtained from the Macquarie University Ethics Committee prior to commencing the study (ID: 11187). All participants provided written informed consent prior to data collection.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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