

COMMENTARY

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Health research versus the virus: strengthening systems, saving lives

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Abstract

For this Commentary, we selected papers from those in this journal's Thematic Series on health research systems' pandemic response. The calling notice for papers suggested possible use of a WHO framework for analysing health research systems (HRSs). Whilst it was not widely used in the reported studies, it did provide the basis for the two main, overlapping, topics for analysis in this Commentary. These, in turn, informed the selection criteria for papers. First, we selected papers that described the contributions made towards meeting the needs for pandemic-related research in at least one area we could classify as being one of the nine components of a HRS, and did so in at least one jurisdiction. Second, we identified papers that could contribute to an analysis of how comprehensive HRSs facilitated progress in meeting the needs for pandemic-related research.

Using the selection criteria, we included 13 papers in the Commentary covering research in 22 named countries, and many others unnamed. For the first topic, we found that for each of the nine components, we could identify at least two of the included papers, usually more, as having in some ways analysed the contributions made towards meeting the needs for pandemic-related research. Examples included, for coordination, the first HRS component, a paper describing a pandemic preparedness program in Australia. For other HRS components, some papers analysed prioritization systems in the United Kingdom and Iran, and another, research ethics governance across Central American countries. For the finance component, a US paper covered Operation Warp Speed's substantial funding. Papers showed existing capacity for conducting trials contributed to rapid progress on new drugs and vaccines in Brazil, the United Kingdom and the United States. Included papers showed how capacity was mobilized for knowledge production and how evidence, often locally produced, was used in many countries across the income range. Papers cited studies showing pandemic research had saved millions of lives through vaccines and repurposed drugs. For the second topic, evidence suggested that where there was a comprehensive HRS, especially with an overall strategy, considerable progress was made.

The Commentary's added value lies in it extracting, collating and organizing data from the 13 papers to facilitate analysis of HRSs. Collectively, the papers provide evidence about the benefits of strengthening HRSs, and challenges (including resource waste) when HRSs were not well developed. This can justify a recommendation to give serious consideration to WHO's call in 2013 for a comprehensive approach to developing health research systems as fully as possible, in as many countries as possible. This could be particularly important before any future pandemics.

Keywords COVID-19, Ethics, Financing, Health research system (HRS), Policymaking, Prioritization, Publications, Research coordination, Vaccines, World Health Organization

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“All nations should be producers of research as well as consumers...To make the best use of limited resources, systems are needed to develop national research agendas, to raise funds, to strengthen research capacity, and to make appropriate and effective use of research findings.” WHO, World Health Report, 2013 [1].

As soon as word began seeping out of Wuhan, China about a new virus, leading scientists were on the case. As early as 7 January 2020 a network of scientists from across China led by Yong-Zhen Zhang, along with their colleague Eddie Holmes from the University of Sydney, Australia, submitted a paper to *Nature* describing the genome sequence of what was subsequently labelled severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) [2, 3], but there was great demand for the sequence and Holmes arranged for it to be released on a specialist website in the United Kingdom very early on Saturday, 11 January 2020.

Almost instantly, the health research system (HRS) in Australia activated the pre-planned research platform of the Australian Partnership for Preparedness Research on Infectious Disease Emergencies (APPRISE) [4], and elsewhere health researchers across the globe sprang into action informed by the sequence. By the end of January 2020, a network of European scientists led by a team from Germany had developed the polymerase chain reaction test [5, 6]; expert teams were using the sequence to inform development of new vaccines, including in the United Kingdom [7–9], Germany [10–12] and the United States [10, 11, 13]; and a Canadian company called AbCellera started successful research searching for a monoclonal antibody (mAb) against coronavirus disease 2019 (COVID-19) [13, 14].

All this activity, and much more, in January 2020 gathered pace and scope in the following months – contributions to 2020 COVID-19 publications were made by authors from 158 countries across the income spectrum [15]. In a 2020 editorial in *Health Research Policy and Systems*, Turner and El-Jardali noted, “It turns out that, when the going gets tough, researchers get productive, collaborative and impact focused” [16].

The brief account above is extracted from parts of a wide-ranging article by Hanney and colleagues (2022) entitled: “Saving millions of lives but some resources squandered: emerging lessons from health research system pandemic achievements and challenges” [13]. That paper analysed the response of (HRSs) in seven nations, as a contribution to a Thematic Series of papers in *Health Research Policy and Systems* called: “The role of the health research system during the COVID-19 epidemic: experiences, challenges and future vision”.

The calling notice for the above Thematic Series of papers [17] identified the four HRS functions from the

WHO framework for analysing national HRSs, and their accompanying nine operational components [18], as a possible framework to use in studies to be included in the Series, or Collection. The framework identified the four HRS functions as stewardship, financing, capacity-building and production and use of knowledge [18]. This was part of WHO’s major *Knowledge for Better Health* initiative to boost national HRSs, which it had launched in 2000. Publication of the framework was soon followed by the *Knowledge for Better Health* report on the importance of health research [19]. Then in 2013, and highly relevant for the subsequent COVID-19 pandemic research response, the WHO’s major annual publication, the World Health Report, focussed on health research, and included the opening statement above [1]. Further analysis was organized around an updated version of the framework – with the concept of governance being used for the first function. It reviewed ways of strengthening HRSs, and was published just as the pandemic was beginning [20]. A slightly revised version of the framework was used by Hanney and colleagues [13], and is presented as Table 1.

In launching the series in late 2020, Yazdizadeh and colleagues reinforced the message from the original call for papers about the importance of analysing the various building blocks or functions of a HRS. Using the Self-Assessment Tool for Research Institutes (SATORI) framework, they categorized the suggestions for strengthening resilience of HRSs in four areas: choosing research questions, conducting research, active dissemination and promoting use of evidence. The team also described some early specific approaches that had already been adopted in Iran, or elsewhere, related to each building block [21].

The Thematic Series published a wide range of papers containing research, and/or analysis, on responses to the pandemic, including several on aspects of the health system’s response, and others on policy responses. Of the papers that most clearly focussed primarily on the achievement of the research system, just the papers led by Yazdizadeh and by Hanney focussed on all functions/components of a HRS, with the others covering one, or a small number, of areas that could be defined as being HRS components. In general, however, they did not specifically refer to the framework.

Strengthening systems, saving lives

In this Commentary, we aimed to apply the WHO’s HRS framework to selected papers from the Thematic Series. We hoped to examine the importance of HRSs in tackling the pandemic by analysing actions in all nine components within the four functions, and explore how the selected papers might help build the case for strengthening HRSs.

Table 1 The four functions and nine components of a health research system

Function	Operational component
Stewardship/governance	1. Coordinate the system; and define and articulate vision for a health research system 2. Identify appropriate health research priorities and coordinate adherence to them 3. Set and monitor ethical standards for health research and research partnerships 4. Monitor and evaluate the health research system
Financing	5. Secure research funds and allocate them accountably
Creating and sustaining resources	6. Build, strengthen and sustain the human and physical capacity to conduct, absorb and utilize health research
Producing and using research	7. Produce scientifically valid research outputs 8. Promote the use of research to develop new tools (drugs, vaccines, devices and other applications) to improve health 9. Translate and communicate research to inform health policy, strategies, practices and public opinion

Adapted from Pang et al. [18], Hanney et al. [20] and Hanney et al. [13]

Therefore, we aimed to analyse the included papers on two broad dimensions. First, for each specific component of the HRS, in turn, we sought to identify papers included from the Thematic Series that provided us with examples of HRSs that used preexisting, and/or rapidly strengthened, arrangements to contribute to meeting the needs for pandemic-related research and mobilization of valid evidence. Second, at the overall level we analysed the papers included from the Thematic Series that provided examples of whether, and how, substantially comprehensive national HRSs (and/or subnational systems) helped facilitate progress in successfully meeting the needs for pandemic-related research and mobilization of valid evidence.

These issues, therefore, drove our selection criteria for a subset of papers that we thought were the most relevant to analyse. Papers from the series were included in the Commentary if their main focus was on describing/analysing activities specifically intended to produce and/or mobilize research intended to tackle the pandemic. This could be either through activities that we could explicitly categorize as relating to one (or more) components of one (or more) HRSs, or through an approach that deliberately applied all (or most) of the components to analyse the overall contribution made by one (or more) HRSs.

Applying the selection criteria for this specific Commentary resulted in the inclusion of 13 papers [13, 21–32]. In order of publication, they are listed in Table 2, which for each paper shows the countries covered, the authors' key issues that are relevant for our analysis and the main HRS component(s) that we identified as being a focus of the paper.

In the Thematic Series, the whole point of the paper led by Hanney was to show the response of entire HRSs [13]. Therefore, for that paper all nine components were checked in Table 2, as they were for components in the paper led by Yazdizadeh (2000), made compatible with

the WHO framework for the purposes of Table 2 because it advocated for a comprehensive approach, albeit using a somewhat different framework [21]. Inevitably in the text, we had to be selective rather than comprehensively describing everything in the selected papers. However, to provide as full a picture as possible of key analysis related to each component, in addition to drawing on selected papers from the series, we also inevitably drew considerably on some examples cited in the more comprehensive papers led by Yazdizadeh [21] and Hanney [13].

Below, we consider each component in turn, and for each component use the relevant selected papers to analyse key progress, and/or sometimes challenges. We then consider lessons from the papers that covered all nine components. Finally, as far as possible within the limitations of the data available, we draw some lessons related to each of the main areas of analysis to highlight the contribution made by the Commentary, and conclude with a recommendation.

Stewardship or governance function

Component 1: Coordinate the system; and define and articulate vision for a HRS

The first of the two overall areas of analysis involved considering all nine components, in turn, starting with the first of four components of the WHO framework related to the stewardship or governance function. Hanney and colleagues used a broad interpretation for this first component, and described it as being coordination, and analysed how it could take various forms [13, 33–40]. There were some important examples of pre-pandemic coordination undertaken as preparation for a possible pandemic. In Australia the APPRISE platform for research for infectious disease emergencies was activated on 13 January 2020, which meant a series of institutions could fast-track valuable relevant research [4, 33].

Table 2 The 13 selected papers – countries, research question and components covered by each paper; components 1–9 from the WHO framework

Paper	Countries	Key research question(s) or focus considered in the paper that were most relevant for this commentary	1: coordination	2: priority	3: ethics	4: impact	5: funding	6: capacity	7: knowledge	8: products	9: policies
Yazdizadeh, [21]	Iran	Lessons learned from the pandemic for the health research system (HRS) in Iran to deal with crises	X	X	X	X	X	X	X	X	X
Fleury Rosa, [22]	Brazil	How did the Brazilian scientific community respond to health system/population needs in the pandemic				X	X	X		X	
Rooke, [23]	United Kingdom	What was the option value of the Oxford Biomedical Research Centre infrastructure's pandemic response		X			X			X	
Henderson, [24]	United Kingdom	The rapid research response from the Oxford Centre showed readiness to repurpose existing resources	X			X	X	X		X	
Yazdizadeh, [25]	Iran	What were the key COVID-19 research priorities in Iran to meet local needs and best manage resources		X		X					
Faulkner-Gurstein [26]	United Kingdom	How did one hospital trust's pre-existing embedded research capacity mobilize to meet national priorities	X	X	X		X				
Koehlmoos, [27]	United States	How did the centralized US Military Health System contribute to the US pandemic research response				X			X	X	X

Table 2 (continued)

Paper	Countries	Key research question(s) or focus considered in the paper that were most relevant for this commentary	1: coordination	2: priority	3: ethics	4: impact	5: funding	6: capacity	7: knowledge	8: products	9: policies
Hanney, [13]	Australia, Brazil, Canada, Germany, New Zealand, United Kingdom, United States	How effectively were 7 HRSs mobilized across the 9 components of the WHO framework for HRSs to save lives in the pandemic but avoid waste of resources	X		X	X	X	X	X	X	X
Ananthkrishnan, [28]	Included: Ghana, India, Kenya, Laos, Philippines, Singapore, Thailand	How can health technology assessment support health systems' policy responses to the pandemic					X	X	X		X
Canario Guzmán, [29]	Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Panama	Strengthening often weak research ethics systems across countries in Central America in the pandemic		X							
Hennessey, [30]	Studies in 114 WHO member countries	Insights from WHO's Unity Study initiative that supported countries' seroepidemiologic studies				X	X	X	X		
Palese, [31]	Italy	Lessons from an Italian multidisciplinary longitudinal study of COVID-19 patients to improve future studies							X		
Smits, [32]	Canada: Quebec province	Lessons from the pandemic connections between the HRS and decision-making in Quebec province					X	X			X

Hanney and colleagues also identified some examples of preexisting health research strategies, as in the Australian state of New South Wales (NSW) [35], New Zealand [36] and the United Kingdom [37], along with a nascent one in the Canadian province of British Columbia [38]. These proved to be valuable across a spectrum of research activities in various components of the relevant HRS [13]. We shall explore some of those further when discussing those components. In the United Kingdom, the HRS strategy used to create the NIHR [37] reflected most of the components of the WHO framework [18]. In various parts of their paper, Hanney and colleagues described how various components were brought together with some degree of coordination, and this was an important factor in the success achieved in producing lifesaving research [13].

Supplementing the multinational paper led by Hanney that covered all components, the papers in the Thematic Series by Falkner-Gurstein and colleagues (2022) [26], and the one by Henderson and colleagues (2022) [24], provided further details of how aspects of this coordinated National Institute for Health Research (NIHR) strategy operated in practice so beneficially in the United Kingdom. The research paper by Faulkner-Gurstein and colleagues [26], and a parallel paper [39], described the response from one major research-intensive hospital trust in South London. Both these papers, and Henderson and colleagues, identified a crucial governance context point – the high level of coordination in the UK HRS resulting from the NIHR being embedded into the National Health Service (NHS). The latter is a public, free-at-the-point-of-delivery healthcare system that covers all residents of the United Kingdom. As noted below, this embedded NIHR capacity facilitated extremely rapid research progress on identifying the first effective therapy for COVID-19 [40].

In other cases, important research coordination rapidly occurred in response to the outbreak of the pandemic. The paper led by Hanney additionally showed that in the United States, whilst there were various individual streams of research that started rapidly, the overall coordination took longer than in the United Kingdom. However, once the coordination with the Operation Warp Speed (OWS) was established, it did entail large-scale coordination of parts of the HRS [13]. In Brazil, physician scientists collaborated to create the Coalition COVID-19 Brazil initiative that brought together more than 70 centres across the country to conduct 11 randomized clinical trials. As Hanney and colleagues reported, it was claimed in December 2020: “Brazil is a developing country....for which this level of coordination is unprecedented. In fact, rarely has it been achieved in developed countries”. [34].

Component 2: Identify appropriate health research priorities and coordinate adherence to them

In health crises, research prioritization and adherence to the priorities – the second component of a HRS – become especially important, both in countries with larger research resources and in countries with limited and unstable research resources. The overall opening paper by Yazdizadeh and colleagues in 2020 [21] identified the importance of the Global Research Collaboration for Infectious Disease Preparedness and Response (GLOPID-R) [41]. On 11–12 February 2020, the WHO held a meeting with it to collect and assess current knowledge about COVID-19, and reach a consensus on critical research questions [41]. In the first 3 months of the pandemic in Iran, Yazdizadeh and colleagues (2022) conducted a detailed priority-setting project that had been requested by an Iranian research funding agency, and was reported in a research study in the Thematic Series [25]. Yazdizadeh's team undertook a complex multilayered analysis, including interviews with stakeholders and media analysis, to combine the WHO/GLOPID-R findings with local input to ensure the priorities were relevant for the context and needs of Iran [25].

The papers led by Faulkner-Gurstein [26] and Hanney [13] highlighted the success of the strong centralized prioritization of key COVID-19 projects in the United Kingdom. This was implemented not only by controlling public funding of research, but also, initially, through a statement that research involving patients was only allowed access to patients in the United Kingdom's health system, if it was one of the very small number of key projects on top topics that were prioritized. Crucially, therefore, the United Kingdom displayed both parts of this component: not only prioritization, but also strong mechanisms to ensure adherence to the identified priorities. The United Kingdom was an example of where the HRS already had a highly developed system of prioritization to meet the needs of the healthcare system, but this was greatly intensified early in the pandemic. Hanney and colleagues remarked: “While the concept of prioritising research on the needs of the healthcare system was not new in the UK, the mechanisms through which it was undertaken at the start of the pandemic were very different from usual” [13, p. 9]. Thus, by focussing all the resources on a small number of projects, the UK HRS facilitated very rapid progress in trials such as the Randomised Evaluation of COVID-19 Therapy (RECOVERY) trial. Globally, RECOVERY became the largest trial of repurposed drugs for COVID-19, and rapidly identified the first treatment, dexamethasone, proven to reduce mortality in critically ill patients [40, 42, 43].

Furthermore, these two papers led by Faulkner-Gurstein [26] and Hanney [13] in the Thematic Series

also showed how the UK HRS succeeded at several levels. It facilitated rapid trials for the AstraZeneca/Oxford vaccine [7–9]. Additionally, it avoided the duplication, waste and much slower progress experienced elsewhere in identifying drugs that could be effectively repurposed to treat COVID. These papers further noted that leading medical academics in Australia (despite the initial prioritization linked to APPRISE [4]), Canada, the United States and across Europe had all written articles in major national medical journals highlighting the advantages of the UK system of coordination and prioritization (and embedded research capacity – see below) compared with their own when it came to adaptive platform trials of existing drugs that could potentially be repurposed [44–47]. Even though there was some later progress with prioritization in countries such as the United States, the preexisting prioritization mechanisms in the United Kingdom, as well as the dramatic steps taken to build on them and crucially, to ensure the adherence part of the second component, were much more successful in avoiding waste than the approaches in most other countries.

Hanney and colleagues [13] also noted how prioritization on locally policy-relevant topics, including ones related to the needs of First Nation communities, was quite effective in systems which already had a HRS strategy that highlighted the importance of focussing on local policy needs. Such systems included those in New Zealand [36] and New South Wales [35].

Component 3: Set and monitor ethical standards for health research and research partnerships

For the third component, ethical approval, Yazdizadeh and colleagues' 2020 paper [21] in the series had noted the importance attached by WHO to research ethics during the pandemic [48]. The research paper in the series by Canario Guzmán and colleagues (2022) described efforts to strengthen research ethics governance and regulatory oversight in Central America and the Dominican Republic in response to COVID-19 [29]. This study was explicitly set in the context of ethics being a component of the governance function of WHO's framework for HRSs [18], and subsequent work by the Pan-American Health Organization (PAHO) to strengthen such systems [49]. The study included participants from Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras and Panama. It reported that "Countries with more established systems before COVID-19 were better organized and prepared to respond. This finding argues against improvisation and supports further work on strengthening governance of research ethics systems" [29, p. 1]. The team prepared a policy brief to promote this, and it is a crucial finding that supports the case for building strong HRSs including through regional collaboration,

and endorses the earlier work by PAHO to strengthen such systems; this work, in turn, had been highlighted in the earlier WHO review of approaches to strengthening HRSs [20].

Hanney and colleagues reported how the United Kingdom's well-coordinated system not only had established procedures for ethics approval and data-access, but also how the system was able to build on existing strengths to accelerate and enhance procedures in response to the pandemic [13]. In addition to facilitating rapid progress with the RECOVERY and Oxford/AstraZeneca vaccine trials, the various components of the UK system meant that the international Randomized, Embedded, Multifactorial Adaptive Platform trial for Community-Acquired Pneumonia (REMAP-CAP) made much greater progress in the United Kingdom than elsewhere [13]. This included just 9 days for approval, compared with an average of about 3 months across European Union countries [46].

Component 4: Monitor and evaluate the HRS

Roope and colleagues' (2021) paper in the Thematic Series explained the likely increased importance of being able to justify research funding at a time when governments would be dealing with the fallout from the economic damage caused by the pandemic [23]. In particular, the team suggested the research infrastructure in terms of capacity and funding within the NIHR's Oxford Biomedical Research Centre (BRC) provided "option value" because they could be redeployed at short notice in a health emergency to help provide human and financial resources for a rapid research response to address the emerging crisis. Generally, such resources were not so immediately readily available elsewhere [23]. It was claimed this had contributed to the rapid development of the Oxford (AstraZeneca) COVID-19 vaccine. Furthermore, Roope and colleagues, writing in December 2020, suggested that if such development resulted in the ending of the hugely economically damaging measures to combat COVID-19 even by a short period of time, such impact would be worth many times more than the whole budget for the Oxford BRC from 2017 to 2022, though detailed calculations would be necessary [23]. His "simple calculation" was that "if BRC infrastructure sped up the development of an effective vaccine by just 1 day, the value to the global economy would be up to US\$ 15 billion" [23, p. 2].

Roope and colleagues also pointed to the role of the Oxford BRC in helping the rapid establishment of the RECOVERY trial. The concept of the "option value" of extensive NIHR research capacity was taken up in the subsequent paper in the Thematic Series by Faulkner-Gurstein and colleagues about their research-intensive hospital trust being able to focus so rapidly on UK

priority studies such as RECOVERY, though with considerable reorganization of the clinical research staff embedded in the hospital [26].

The rapid progress of the RECOVERY trial and trials of the Oxford/AstraZeneca vaccine were linked, as noted, to various other health research components in the United Kingdom, and progress with vaccines in general was linked to the research financing component discussed below. Hanney and colleagues collated examples of the rapid work from authors who began to consider the impact of the research contribution in terms of lives saved, including rapidly in the UK where researchers were used to the assessment of research impact being a component of HRSs [13]. This included estimates of the millions of deaths averted by the widespread adoption of dexamethasone in the United Kingdom and elsewhere following the funding of the RECOVERY trial [43, 50], and the use of vaccines in 2021 in Brazil [51], the United States [52, 53] and across countries in the WHO Europe Region [54]. The estimated number of lives saved by vaccines in some specific studies included more than 1 million in the United States by December 2021 [53], and about 470,000 people aged 60+ across 33 countries in WHO's European Region by November 2021 [54].

Financing function

Component 5: Secure research funds and allocate them accountably

Securing financing, the second function and fifth component of a HRS, and doing so at scale, was a major reason for the greatly accelerated vaccine development programs during COVID. Globally, by far the largest source of funding for the pandemic research came from the OWS initiative in the United States. Whilst its role is widely known, the paper from Koehlmoos and colleagues (2022) in the Thematic Series described the relatively less often described part played in this by the US Military Health System, including in its research capacity, and the Department of Defense (DoD) [27]. This paper explained that in addition to the financial contributions towards the initially US\$ 10 billion OWS initiative, “the role of the DoD as a co-lead was to provide leadership through logistical expertise, including program management and contracting proficiency” [27, p. 3]. OWS played a key role in the rapid success of various counter-measures.

Hanney and colleagues' analysis [13] showed how the success with counter-measures included through OWS funding some trials of monoclonal antibodies (mAbs), such as that developed by AbCellera, and through funding trials and early manufacturing support for vaccines such as Moderna, and through early support for manufacturing (but not trials) of the vaccine that BioNTech developed with its partner, the US

company Pfizer [13, 55]. The analysis [13] also drew on papers from 2020 that explained the central role that the unprecedentedly large-scale financing was having on the acceleration of vaccine development. This was through helping vaccine developers undertake various stages in parallel rather than the traditional approach in which each stage is undertaken after the previous one has been completed, perhaps with a period of analysis between each stage [56, 57]. Again, here in the Commentary, we can bring together an outline of what is, in this case, quite detailed analysis in Hanney and colleagues of diverse funding sources in the United States, with the account from Koehlmoos and colleagues of the role of one of the major contributors to, and partners in, the OWS [27].

Important funding for COVID-19 research was also organized through international organizations. The evaluation of WHO's Unity Studies initiative by Hennessey and colleagues (2023) was published in the Thematic Series and showed how various national systems, including that of the German Federal Ministry of Health, provided financial support for the international organization [30].

Hanney and colleagues collated funding information for the seven countries' studies, and found that after the United States, the largest levels for COVID-19 research were in the United Kingdom, Canada and Germany [13, 58]. Two announcements by the Canadian Prime Minister collated many diverse public sector streams of funding for an array of COVID-19 research, including support for AbCellera, in a way that seemed more comprehensive than achieved elsewhere [13]. As noted, there was recognition in countries such as Australia, Canada and New Zealand of the importance in the pandemic of funding research programs to identify and address the particular needs of minority communities, especially Indigenous populations (outside of Europe), but with the exception of the United States [59], these programs were generally quite small [13]. The overall funding identified from the United Kingdom included a donation in March 2020 of GBE 210 million to the Coalition for Epidemic Preparedness Innovations, the leading international organization supporting the development of vaccines intended to be available throughout the world [60]. In their paper in the Thematic Series, Henderson and colleagues described the important role of the Oxford BRC in “pump priming” funding for the Oxford-based RECOVERY trial and vaccine development [24].

In their paper on Iran, Yazdizadeh and colleagues (2022) highlighted the importance of research prioritization on local needs, as described in Component 2, for the best management of local research funding and other resources [25].

Hanney and colleagues also described various examples of where adequate funding was a major challenge [13]. Given the sums required for vaccine development, this included funding for the early steps in developing the vaccine at Oxford, and in Germany, where despite some earlier funding from the government and the EU, BioNTech decided the main work on the vaccine would be conducted in partnership with the US company Pfizer, with whom they were already working on other potential vaccines.

In a Brazilian paper in the Thematic Series, Fleury Rosa and colleagues (2021) described the challenges facing researchers in the country in obtaining finance for their crucial pandemic research. They claimed that the research, development and innovation sectors had been facing severe budget cuts since 2018 [22].

Capacity, or creating and sustaining resources, function
Component 6: Build, strengthen and sustain the human and physical capacity to conduct, absorb and utilize health research

Fleury Rosa and colleagues also highlighted how the health research capacity built up by the Brazilian HRS over many years meant researchers were able to make a significant contribution despite the financial challenges [22]. On the basis of the known research capacity in Brazil, the vaccine team from Oxford, along with AstraZeneca, their commercial partner, made an agreement with Brazilian researchers to conduct a major human trial of their vaccine in Brazil and a similar arrangement was agreed upon with a Chinese company [7, 22]. Several papers described the crucial role of existing research capacity in the UK HRS. For example, Faulkner-Gurstein and colleagues highlighted the importance of existing research capacity being embedded in the healthcare system [26]. Henderson and colleagues claimed that the contribution of the Oxford BRC to the development of the Oxford/AstraZeneca vaccine and RECOVERY trials “illustrate ‘capacity’, ‘readiness’ and capability at an organizational level to respond to the global pandemic” [24, p. 2]. Roope and colleagues made similar points [23].

The evaluation by Hennessey and colleagues showed how WHO’s Unity Studies initiative assisted especially low- and middle-income countries (LMICs) in conducting seroepidemiological studies in the pandemic [30]. It did this by boosting capacity with items including protocols and free test kits and establishing a number of operational partnerships, including with the Africa Centres for Disease Control and Prevention, Pasteur Institute and the US Centers for Disease Control. The evaluation concluded with valuable lessons, claiming that: “The Unity Studies initiative created a highly valued community of practice, contributed to study implementation

and research equity, and serves as a valuable framework for future pandemics” [30, p. 1]. A global perspective on research capacity was also taken in a paper in the Thematic Series by Ananthakrishnan and colleagues (2022), who presented examples of how Health Technology Assessment (HTA) Organizations, mostly in LMICs, had adapted and helped manage the Covid-19 Public Health Emergency (PHE) [28]. The team advocated “for HTA capacity to be further developed globally and for increased institutional acceptance of these methods as a building block for preparedness and response to future PHEs” [28, p. 1].

Overall, the Commentary presents various papers that highlight the importance of existing health research capacity in many countries, but also often further steps within the HRS for this to be most effectively mobilized. This illustrates the advantages of taking a systems’ approach. The many examples of capacity mobilization given across the countries covered by Hanney and colleagues [13] included the infectious disease emergencies research in Australia. This was an example of coordination, because the preplanned strategy enabled effective and rapid mobilization of capacity [4]. Similarly, despite the large amount of wasted resources in the United States, there was also effective application of key parts of the extensive existing capacity, and this was effectively mobilized through increased coordination and by the enormous OWS funding described in Component 5 [13]. The Commentary further facilitates such analysis by combining evidence from several papers on the same country. For example, in relation to Component 1, Hanney and colleagues showed how the Brazilian researchers built on their existing capacity to collaborate in a coordinated way to conduct vital trials. Here, in relation to capacity, Component 6, we can also quote Fleury Rosa and colleagues as saying that despite the recent financial challenges noted above, “universities and public research centres have remained focused on their social responsibility and have continued to work diligently to help control and mitigate the COVID-19 pandemic, using a voluntary work force and the existing research infrastructure in a clear demonstration of strong institutional resilience” [22, p. 2].

Producing and using research function

Component 7: Produce scientifically valid research outputs

Knowledge production, the seventh component of the nine in a HRS, is the first of three in the final function, that is, production and use of knowledge, in which the components can tend to merge into one another. An enormous amount of knowledge was produced and rapidly published (at least online) about all aspects of the pandemic, including a series of major papers, some

of which were described in Hanney and colleagues [13] and highlighted above [2, 6, 42]. Further highly cited papers are also described in the next component, analysing how the knowledge production was rapidly used in product development, including vaccines, and the final component provides examples of papers on policy-relevant research that were used in various systems, including in New Zealand and NSW state of Australia [61–65].

A considerable and diverse amount of valuable knowledge was also produced on specific aspects of the pandemic. Koehlmoos and colleagues described how research by the Military Hospitals Service conducted in their own sites produced findings about different testing strategies and ways to mitigate the spread of the virus in close quarters that could be applied to prisons and civilian college dormitories [27]. In a paper in the Thematic Series from Italy, Palese and colleagues (2023) provided a detailed account of the many challenges faced and lessons learnt when conducting a longitudinal study of patients with COVID-19 who were infected during the first wave in March 2020 and followed up for 3 years [31]. Lessons learnt by the researchers included the importance of broadening the research aims by listening to patients and reflecting on their own practice. Methodological lessons for any future pandemic included the importance of including psychological/psychiatric dimensions that were informed by the emerging knowledge about post-COVID-19 mental health issues [31].

Yazdizadeh and colleagues' initial paper in 2020 described how the WHO's adaptive platform solidarity trial was rapidly established to produce good quality evidence [21]. An interviewee from WHO's HQ told Hennessey's team conducting the evaluation of the Unity Study initiative that "The data has been helpful. We see high seroprevalence in Africa and it is good to have this information" [30, p. 7]. Ananthakrishnan and colleagues gave various examples of HTA agencies producing early useful evidence, including in Kenya, Thailand and Singapore, about which combination of vaccines and nonpharmaceutical interventions (NPIs) "would best address their respective countries' health-care needs" [28, p. 3].

The Commentary includes a small part of the range of knowledge production that usefully contributed to tackling the pandemic. Nevertheless, it indicates the range of high-, middle- and low-income countries where local knowledge production played a role. Furthermore, it illustrates that rapid knowledge production was extremely important, but also that careful long-term studies were needed for fuller understanding.

Component 8: Promote the use of research to develop new tools (drugs, vaccines, devices and other applications) to improve health

As noted, Hanney and colleagues reported that a range of highly cited papers published in leading journals described the knowledge produced, which was then, for reasons explored above [13, 56, 57], immediately used in steps that led to the production of the major vaccines in a matter of months. There was a series of publications (showing both knowledge production and its rapid translation into products) in *Nature* and *The New England Journal of Medicine* about mRNA vaccines trialled mostly in the United States, but also Germany, from both BioNTech/Pfizer [66, 67] and Moderna [68–71], and in *Nature* and *The Lancet* about the Oxford/AstraZeneca vaccine (with trial sites in the United Kingdom and also in Brazil and South Africa) [72–74]. These papers further illustrate how progress in the later stages is influenced to a considerable extent by activities in the earlier components, such as prioritization, finance and capacities. Analysis published in *Health Research Policy and Systems* even before the Thematic Series was launched illustrated how various existing, and/or rapidly created, features of some components of certain major HRSs came together to facilitate the unprecedentedly speedy progress [56].

Other papers describing aspects of this include Fleury Rosa and colleagues' paper [22], which reported that the Oxford/AstraZeneca agreement with Brazil also included a technology transfer agreement, if the trials were successful, to manufacture the vaccine in Brazil. A similar arrangement was agreed with the Chinese company [22]. As described by Hanney and colleagues, these trials were successful and vaccine production was started [13]. Roope's paper [23] on the economic value of the successful research in the United Kingdom was based on the account of the development of the AstraZeneca vaccine against COVID, and Henderson and colleagues noted: "Work to develop this vaccine first began in January 2020, and the vaccine was approved in January 2021 at unprecedented speed" [24, p. 2].

In addition to the rapidly identified repurposed drugs and vaccines, there was considerable work to turn research into drugs and devices needed in the pandemic. Examples included, in the United States, antivirals and the mAbs from the Canadian company AbCellera and others, and in Brazil, improved masks [13, 27].

Component 9: Translate and communicate research to inform health policy, strategies, practices and public opinion

For the ninth component, translation of research to inform health policymaking, practice and public opinion, there were various examples where preexisting structures at the health research/policymaking

interface proved valuable. Koehlmoos and colleagues reported that the production and distribution of the clinical practice guidelines for the treatment of COVID-19 in the United States military health system was built on the existing platforms of the centralized system, thus “enabling rapid development and dissemination of guidelines on a system-wide level” [27, p. 2]. According to Ananthakrishnan and colleagues, the various existing HTA organizations helped inform policies on COVID-19 technologies, including in the Philippines where the unit helped generate critical evidence on rapid antigen kits for COVID-19 diagnosis and on the Oxford/AstraZeneca vaccine [28].

Yazdizadeh and colleagues (2020) described several examples where existing structures and/or capacity for knowledge translation played a useful role during the pandemic [21]. Examples included knowledge translation (KT) platforms, which the team running the platform in the Lebanon showed could undertake a series of important roles including contextualizing and disseminating actionable evidence to stakeholders and building trust [75].

Examples of challenges with this component were described in several papers. In a paper in the Thematic Series from the Canadian province of Quebec, Smits and colleagues provided a detailed account of how the many public health decisions that had to be made during the pandemic highlighted the importance of the “ecosystem perspective” [32, p. 1]. This is “the interconnection of an academic research system and decision-making spaces”, where flaws and challenges often existed in areas such as the collection, as well as the integration, of hard and soft data. According to Smits, “Resources dedicated to the ecosystem of evidence-informed decisions are non-existent or invisible in Quebec” [32, p. 5]. On the contrary, Hanney and colleagues described how COVID-19 Evidence Network to support Decision-making (COVID-END), an international collaboration led from Canada to synthesize evidence and produce guidelines, was developed [13]. This was an important part of the way in which the existing expert capacity in these fields in Canada was mobilized during the pandemic [13]. Canadian researchers also led on the production of the WHO living guidelines on COVID-19 drugs, using, in particular, the evidence from studies noted above such as Coalition COVID-19 Brazil, RECOVERY, REMAP-CAP and Solidarity [76]. Further analysis of COVID-19 research that informed policies in systems such as New Zealand, Australia (including NSW), and British Columbia are considered in the next section because they are related to analyses of the benefits from having a comprehensive HRS organized around an existing strategy.

The value of strong HRSs covering many components

In considering the Commentary’s second area of analysis, regarding the value of comprehensive HRSs, we start with the paper by Hanney and colleagues because that considered all nine components [13]. However, before that paper could consider the value of having a comprehensive HRS, it analysed what a well-functioning HRS might look like during the pandemic. To do this, it addressed two main sets of issues for each of the seven countries considered. First, how far the structures and capacities of the HRS contributed “to generating life-saving knowledge available globally, and its translation into products” [12, p. 3]. Of course, it was recognized that in practice there were severe challenges to achieving globally equitable access to all the products. However, the key distinction was between this global perspective, and the second issue of how far the structures and capacities of the HRS contributed to the utilization of evidence “to inform the development of healthcare practice and policies to save lives, including non-pharmaceutical interventions (NPIs) primarily within the relevant jurisdiction” [13, p. 3].

Most of the nine components have some relevance when considering both issues, however, whilst countries such as the United Kingdom, United States and Brazil had considerable success in producing knowledge used to save lives globally, other systems such as New Zealand, Australia (especially states such as NSW) and to some extent Canada (especially provinces such as British Columbia) had success in utilizing evidence to inform and communicate policies to save lives within their own jurisdiction. Of course, there were many complexities. These included the position of countries such as Germany, which had some success in producing knowledge of global importance, but also faced challenges with vaccine development, and initial success in using evidence to inform life-saving NPIs, but faced challenges in sustaining the success [13].

Hanney and colleagues brought together the two issues and the analysis around the nine components. The lesson from New Zealand, NSW state in Australia and the United Kingdom is that considerable progress was made where there was an overall strategy for the HRS [35–37], and this had been earlier identified as a key mechanism for strengthening a HRS in the review for WHO on strengthening HRSs [20]. In relation to the pandemic, however, the lesson about the value of an overall HRS strategy is complicated by the very different events that occurred in the respective systems [13]. In New Zealand and NSW, this progress was particularly strong in the component on using research evidence to inform and communicate policies. This is broadly consistent with the structures and culture encouraged by the strategies, and seen in the coordination, prioritization and production

of valid knowledge components, with the result that when combined with factors such as location, in the first 2 years of the pandemic these jurisdictions had some of the planet's lowest COVID-19 death rates [13]. In New Zealand, Prime Minister Ardern encouraged the policy-making system to work closely with scientific and communications experts in the HRS [61–63]. In NSW the already close relations between the research system and government officials were enhanced to tackle the pandemic [64, 65].

In the United Kingdom, as noted, the overall strategy of the research system embedded into the healthcare system, along with accepted mechanisms for prioritization, meant that considerable progress had been made prior to the pandemic on many of the components, and they provided a very strong baseline on which further steps could be taken during the pandemic. Several papers from the Thematic Series described how diverse aspects of this helped to ensure trials such as RECOVERY were started and progressed rapidly [13, 23, 24, 26], and helped ensure that the United Kingdom did not have the level of research waste seen elsewhere. However, when it came to component nine, policymakers in the United Kingdom sometimes seemed less willing than those in New Zealand to adopt evidence-informed policies and communication strategies to avert deaths [3, 13, 77]. This highlights that the context within which health research is conducted is always a critical factor, with the attitude politicians adopt towards the use of evidence being very important.

The contribution from this Commentary to building the case for strengthening HRSs

This Commentary draws on the most relevant 13 papers selected from the Thematic Series. Between them 22 named countries are covered to very varying extents, and three subnational systems from two of the countries are also considered. Furthermore, most, if not all, of the unnamed 114 WHO Member States that had at least one study aligned with the WHO's Unity initiative, described by Hennessy and colleagues [30], would have been additional countries. The Commentary analysed the papers in relation to the framework for HRSs developed by the WHO [18], as had been suggested in the calling notice for the series [17]. Nevertheless, one set of papers in one journal cannot provide sufficient evidence to fully inform an analysis of how HRSs globally responded to COVID. To have been able to have undertaken a full evidence synthesis, as had been conducted for the WHO on strengthening HRSs just prior to the pandemic [20], whereas this paper is just a Commentary. Furthermore, Table 2 indicates that even for most of the 22 countries

included, only a minority of the HRS's nine components were covered. Therefore, the Commentary cannot provide sufficient data even on the majority of the 22 specific systems to immediately inform a detailed analysis of each of those HRSs.

Taken as a whole, however, the Commentary illustrates the importance and role of each component of a HRS, and the benefits for nations (and subnational jurisdictions) of taking a systems approach to health research. This can contribute to building the case for strengthening HRSs. In various ways the Commentary notes that the paper by Hanney and colleagues [13] allows analysis of how, in relation to each of the nine components, actions in at least several of the seven national HRSs (and/or two subnational ones) contributed towards facilitating research that played a part in saving lives during the pandemic. However, crucially, the Commentary also adds additional papers. As explicitly spelt out in several sections of the Commentary, there is added value in having additional papers covering each component because it means the analysis by Hanney and colleagues [13] can be supplemented and a fuller picture emerge. This is both in terms of more details about aspects of some of the components in some of the seven HRSs included by Hanney and colleagues, and also points from additional HRSs beyond the seven.

Especially given this fuller and more diverse body of data, we are able to highlight a consistent theme that emerges in relation to most, if not all, components. This is that having elements of the HRS in place prior to the pandemic was beneficial when the COVID-19 pandemic hit nations. Table 3 briefly highlights examples from Thematic Series' papers included in earlier sections. It describes actions during the pandemic that were based on having elements of the HRS in place when the pandemic hit (and challenges when they were not in place). Along with some of the earlier analysis, Table 3 illustrates that activities in some components can make a large impact on the level of success in other components.

Several of the examples given above have wider significance. The paper by Canario Guzmán and colleagues in relation to systems for ethics governance in Central American countries [29], plus the one by Ananthakrishnan and colleagues about the contribution from HTA, mostly in LMICs [30], also help highlight the importance of the quote from the WHO at the start of the Commentary about the desirability of all countries being consumers and producers of health research. This message is reinforced by the findings from the evaluation by Hennessy and colleagues of the WHO's Unity Studies initiative that covered 114 countries [30].

Furthermore, Hennessy's paper also highlighted the importance of the role that could be played by

Table 3 Analysing examples of the progress in each HRS component from having relevant HRS elements in place when the pandemic hit, and challenges if they were not in place

HRS component	Examples of progress in each HRS component from having relevant HRS elements in place at start of pandemic	Examples of challenges from not having relevant elements in place at start of pandemic
1. Coordinate the system; and define and articulate vision for a health research system	Coordination enabled very speedy reaction from the Australian ARTSIC initiative [13]; the United Kingdom's clinical research system embedded in the unified healthcare system facilitated rapid findings from RECOVERY [13, 24, 26]; and preexisting HRS strategies in New Zealand and NSW state contributed to the prioritization, conduct and use of policy-relevant research [13]	Challenges particularly likely to arise where there was a lack of overall coordination, especially when combined with a lack of prioritization. Initial challenges in United States partly addressed by OWS, in Germany took longer [13]
2. Identify appropriate health research priorities and coordinate adherence to them	The United Kingdom's existing system of prioritization was rapidly intensified and implemented, which also facilitated the success of the RECOVERY trial and the Oxford/AstraZeneca vaccine [13, 26]. Iran and many systems had the capacity to conduct rapid prioritization [13, 21, 25]	In systems without a developed and rigorously administered prioritization system there was waste on trials that were too small and duplicated others [13]
3. Set and monitor ethical standards for health research and research partnerships	Analysis in a range of LMICs in Central America showed the advantages of developing ethics governance systems prior to the pandemic arriving for HRSs to make as useful a research contribution as possible [29]	Challenges to progress were faced by Central American HRSs where ethics governance had not had much prior attention [29]
4. Monitor and evaluate the health research system	The value of the United Kingdom's rapid response in terms of vaccines and therapies was measured in terms of the "option value" of having existing UK research infrastructure capacity that could be mobilized [23]	HRSs without similar flexible research infrastructure to that in the United Kingdom did not have the same option value analysis [13, 23]
5. Secure research funds and allocate them accountably	In the UK, the Oxford Biomedical Research Centre "pump-primed" key COVID research [23, 24]. US funding for AbCellera in Canada was important in facilitating the rapid response, as intended [13]	In some other cases, rapid HRS initial progress was limited by challenges in securing the funding required [13, 22]
6. Build, strengthen and sustain the human and physical capacity to conduct, absorb and utilize health research	Brazil's HRS had built up capacity earlier – it effectively self-mobilized given the urgent need, despite limited funding [22]; existing HTA capacity mobilized in many countries [28]; the embedded UK capacity in clinical research made a major contribution to the success of RECOVERY [13, 23, 24, 26]; existing Canadian reviewing strengths were mobilized for global benefit [13]	While many HRSs had capacity to conduct at least some COVID research, Quebec and some others had not made much progress in developing capacity to absorb and use research [13, 32]
7. Produce scientifically valid research outputs	Researchers who had been working for many years on vaccine development in Germany, the United Kingdom and the United States rapidly produced very valuable knowledge published in papers later highly-cited [13, 26]; existing US military research capacity produced importance evidence [27]; HTA agencies, for example, in Kenya, Thailand and Singapore, conducted early HTAs for potential COVID vaccines [28]	Insufficient coordination or prioritization resulted in many duplicate studies in various HRSs on possible therapies such as hydroxychloroquine that were too small to be able to produce valid findings and led to waste [13]
8. Promote the use of research to develop new tools (drugs, vaccines, devices and other applications) to improve health	Some of the knowledge produced from the long-standing vaccine research then very rapidly led to effective vaccines [13, 23, 24, 26]. Similarly, expertise in identifying mAbs at the Canadian company AbCellera, which received US and Canadian public funding, led to rapid development of a mAb against COVID [13]	Funding issues meant much of the later research and development in turning the key German vaccine research into the Biontech/Phizer vaccine was conducted in the United States [13]

Table 3 (continued)

HRS component	Examples of progress in each HRS component from having relevant HRS elements in place at start of pandemic	Examples of challenges from not having relevant elements in place at start of pandemic
9. Translate and communicate research to inform health policy, strategies, practices and public opinion	Existing HTA capacity was effectively mobilized to produce findings that informed policies across several LMICs, including the Philippines [28]; some LMIC KT platforms mobilized [21]; existing platforms in the US centralized military health system ensured the rapid development and dissemination of guidelines for the treatment of COVID across that system [27]; in systems such as New Zealand and NSW, strategies that contributed to effective policy-relevant research also helped the effective use of research to inform NPIs [13]	There were challenges in using research evidence to inform COVID policies in Quebec where there had been insufficient investment to build up connections between an academic research system and decision-making spaces [32], with similar problems reported elsewhere [13]

WHO-driven collaboration in the development of a HRS's capacity [30]. WHO's collaborative work during the pandemic was also described in the papers led by Yazdizadeh in relation to pandemic research prioritization [21, 25]. Collaboration had been recommended in the earlier WHO review as a way of strengthening HRSs [20], albeit that the collaboration described and recommended in the review was primarily at the regional level. In the Commentary, such regional collaboration, organized in this case by PAHO, was indeed a feature of the analysis and recommendations by Canario Guzmán and colleagues in relation to ethics governance in Central American countries [29].

Strengthening a HRS through developing a comprehensive strategy was another approach identified and further recommended in the WHO review of ways to strengthen HRSs [20]. As noted, that was conducted before the pandemic and published in early 2020 [20]. It had stated: "New Zealand's strategy is a good example of a comprehensive health research strategy that includes statements about the respective responsibilities of the health and business ministries and the health research council" [20, p. 19]. In the Commentary, we have seen how New Zealand illustrated the benefits from having a comprehensive, well-organized, HRS in place prior to the pandemic, even if it was small.

The detailed analysis in Hanney and colleagues claimed New Zealand's HRS operated effectively during the pandemic in relation to many components, and used international and local research so effectively to combat the pandemic and save lives, even though the system inevitably made only a tiny contribution to the research that informed the development of vaccines and therapies [13]. Hanney and colleagues supported their analysis of the New Zealand HRS by quoting the Chief Executive of the Health Research Council of New Zealand, who said in November 2021: "New Zealand's relatively small health research workforce has worked tirelessly with other health professionals to provide fast and accurate information to try to minimize the impact of COVID-19 on our communities" [13].

The analysis in the Commentary also contributes support for the continuing theme in *Health Research Policy and Systems* about the importance of strengthening HRSs. In 2013, an Editorial in this journal highlighted "both the complexity, but also the appropriateness, of taking a systems approach to health research...in order to enhance the opportunities for benefitting to the maximum extent from the investments made in health research. This will remain a key theme for HARPS [Health Research Policy and Systems]" [78]. This prophetic statement has proven to be particularly appropriate for the extraordinary crisis of the COVID-19

pandemic. Furthermore, the WHO continues to promote the importance of taking a systems approach towards research and its use in countries, including steps to institutionalize the routine use of evidence in the policy process [79, 80].

Going forward, it seems likely that the type of thinking collated in this Commentary will help encourage a continuing focus on developing HRSs. In particular, the Commentary's emphasis on showing the advantages of having a HRS in place, covering as many of the components as possible prior to the pandemic, highlights the importance of taking steps to strengthen HRSs. A 2024 report from the Royal Society of Canada Working Group on HRS recovery after the pandemic made many actionable recommendations to address the challenges it identified. As part of its consideration of related work, it noted that this journal had published a Thematic Series dedicated "to the role of health research systems in the control and management of COVID-19, so that the experiences of countries and their lessons learned could be shared" [81].

Conclusions

This Commentary has focussed on the lessons learnt from selected papers in the Thematic Series about how HRSs made a major contribution to saving lives during the COVID-19 pandemic as a result of the research structures and capacity that existed at the start of the pandemic, and the rapid additional steps taken. Here, there has inevitably not been room to describe all the challenges highlighted in these and other papers in the Thematic Series, or all the detailed proposal for strengthening each component as described by Hanney and colleagues [13].

We believe, however, that there is considerable evidence in the papers discussed (and, of course, many others) to show that each component of a HRS can play a valuable role in helping the production of the research evidence required to improve health, including tackling a pandemic. Furthermore, various challenges were identified as arising when countries did not have well-developed mechanisms in relation to certain components. Additionally, this Commentary illustrates the value ordinarily, and especially during a pandemic, of having a comprehensive HRS supported by a strategy. Combined, therefore, these two themes perhaps provide sufficient evidence about the value of strengthening HRSs to justify a recommendation to give serious consideration, possibly after wider analysis, to supporting the WHO's advocacy, as in 2013, for a comprehensive approach to developing HRSs as fully as possible in as many countries as possible [17]. This could be particularly important before any future pandemics, especially in light

of the evidence showing the importance of having components of the HRS in place when COVID-19 arrived.

Abbreviations

APPRISE	Australian partnership for preparedness research on infectious disease emergencies
BRC	Biomedical research centre
COVID-END	COVID-19 evidence network to support decision-making
DoD	Department of Defense
GLOPID-R	Global research collaboration for infectious disease preparedness and response
HTA	Health technology assessment
KT	Knowledge translation
LMICs	Low- and middle-income countries
mAb	Monoclonal antibodies
mRNA	Messenger ribonucleic acid
NHS	National Health Service
NIH	National Institutes of Health
NIHR	National Institute for Health Research
NPI	Nonpharmaceutical interventions
NSW	New South Wales
OWS	Operation Warp Speed
PHE	Public Health Emergency
RECOVERY	Randomised evaluation of COVID-19 therapy
REMAP-CAP	Randomized, embedded, multifactorial adaptive platform trial for community-acquired pneumonia
SATORI	Self-Assessment tool for research institutes
SARS-COV-2	Severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

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References

- World Health Organization. The World Health Report 2013: research for universal health coverage. Geneva: WHO; 2013. https://apps.who.int/iris/bitstream/handle/10665/85761/9789240690837_eng.pdf?sequence=2. Accessed 19 March 2025.
- Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. *Nature*. 2020;579:265–9. <https://doi.org/10.1038/s41586-020-2008-3>.
- Farrar J, Ahuja A. Spike—The virus vs the people. The inside story. London: Profile Books; 2021.
- National Health and Medical Research Council (NHMRC). Australian partnership for preparedness research on infectious disease emergencies. 2020. <https://www.nhmrc.gov.au/about-us/news-centre/australian-partnership-preparedness-research-infectious-disease-emergencies>. Accessed 19 March 2025.
- Charité. Researchers develop first diagnostic test for novel coronavirus in China. Press release. Charité – Universitätsmedizin Berlin. 2020. https://www.charite.de/en/service/press_reports/artikel/detail/researchers_develop_first_diagnostic_test_for_novel_coronavirus_in_china/. Accessed 19 March 2025.
- Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DKW, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. *Euro Surveill*. 2020. <https://doi.org/10.2807/1560-7917.ES.2020.25.3.2000045>.
- Gilbert S, Vaxxers GC. The inside story of the Oxford AstraZeneca vaccine and the race against the virus. London: Hodder and Stoughton; 2021.
- Lane R, Sarah Gilbert: carving a path towards a COVID-19 vaccine. *Lancet*. 2020. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30796-0/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30796-0/fulltext).
- Gallagher J. Oxford vaccine: how did they make it so quickly? BBC. 2020. <https://www.bbc.com/news/health-55041371>. Accessed 19 March 2025.
- Allen A. For billion-dollar COVID vaccines, basic government-funded science laid the groundwork. Kaiser Health Newsletter. 2020. <https://www.scientificamerican.com/article/for-billion-dollar-covid-vaccines-basic-government-funded-science-laid-the-groundwork/>. Accessed 19 March 2025.
- Dolgin E. The tangled history of mRNA vaccines. *Nature*. 2021. <https://www.nature.com/articles/d41586-021-02483-w>.
- Roberts J. Q&A: BioNTech vaccine is only 'mRNA 1.0'. This is just the beginning, say co-founders <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/qa-biontech-vaccine-only-mrna-1-0-just-beginning-say-co-founders>. Accessed 19 March 2025.
- Hanney SR, Straus SE, Holmes BJ. Saving millions of lives but some resources squandered: emerging lessons from health research system pandemic achievements and challenges. *Health Res Policy Sys*. 2022;20:99. <https://doi.org/10.1186/s12961-022-00883-6>.
- AbCellera. AbCellera is mobilizing a response to the novel coronavirus outbreak as part of its DARPA P3 program. AbCellera press release, 28 Jan 2020. <https://investors.abcellera.com/news-releases/2020/AbCellera-is-mobilizing-a-response-to-the-novel-coronavirus-outbreak-as-part-of-its-DARPA-P3-program/default.aspx>. Accessed 19 March 2025.
- Kim K, Cho KT. A review of global collaboration on COVID-19 research during the pandemic in 2020. *Sustainability*. 2021. <https://doi.org/10.3390/su13147618>.
- Turner T, El-Jardali F. The crucible of COVID-19: what the pandemic is teaching us about health research systems. *Health Res Policy Sys*. 2020. <https://doi.org/10.1186/s12961-020-00573-1>.
- Yazdizadeh B (Ed.). Calling Notice: the role of the health research system during the COVID-19 epidemic: experiences, challenges and future vision. *Health Res Policy Sys*. 2020. <https://www.biomedcentral.com/collections/HRPSCovid>. Accessed 19 March 2025.
- Pang T, Sadana R, Hanney S, Bhutta ZA, Hyder AA, Simon J. Knowledge for better health: a conceptual framework and foundation for health research systems. *Bull World Health Organ*. 2003;81(11):815–20.
- World Health Organization. World report on knowledge for better health: strengthening health systems. Geneva: WHO. 2004. <https://apps.who.int/iris/bitstream/handle/10665/43058/9241562811.pdf?sequence=1&isAllowed=y>. Accessed 19 March 2025.
- Hanney S, Kanya L, Pokhrel S, Jones J, Boaz A. What is the evidence on policies, interventions and tools for establishing and/or strengthening national health research systems and their effectiveness? Copenhagen:

- WHO Regional Office for Europe. 2020. <https://iris.who.int/handle/10665/331703>.
21. Yazdizadeh B, Majdzadeh R, Ahmadi A, Mesgarpour B. Health research system resilience: lesson learned from the COVID-19 crisis. *Health Res Policy Sys.* 2020. <https://doi.org/10.1186/s12961-020-00667-w>.
 22. Fleury Rosa MF, da Silva EN, Pacheco C, Millett C, Gadelha CAG, Santos LMP. Direct from the COVID-19 crisis: research and innovation sparks in Brazil. *Health Res Policy Sys.* 2021. <https://doi.org/10.1186/s12961-020-00674-x>.
 23. Roope LSJ, Candio P, Kiparoglou V, McShane H, Duch R, Clarke PM. Lessons from the pandemic on the value of research infrastructure. *Health Res Policy Sys.* 2021;19:54. <https://doi.org/10.1186/s12961-021-00704-2>.
 24. Henderson LR, McShane H, Kiparoglou V. Rapid research response to the COVID-19 pandemic: perspectives from a National Institute for Health Biomedical Research Centre. *Health Res Policy Sys.* 2022;20:24. <https://doi.org/10.1186/s12961-022-00827-0>.
 25. Yazdizadeh B, Ehsani-Chimeh E, Zendehele K, et al. Knowledge gaps and national research priorities for COVID-19 in Iran. *Health Res Policy Sys.* 2022;20:25. <https://doi.org/10.1186/s12961-021-00805-y>.
 26. Faulkner-Gurstein R, Wyatt D, Cowan H, Hare N, Harris C, Wolfe C. The organization and impacts of clinical research delivery workforce redeployment during the COVID-19 pandemic: a qualitative case study of one research-intensive acute hospital trust. *Health Res Policy Sys.* 2022;20:68. <https://doi.org/10.1186/s12961-022-00876-5>.
 27. Koehlmoos TP, Korona-Bailey J, Janvri ML, et al. The collaborative research and service delivery partnership between the United States health-care system and the U.S. Military Health System during the COVID-19 pandemic. *Health Res Policy Sys.* 2022;20:81. <https://doi.org/10.1186/s12961-022-00885-4>.
 28. Ananthakrishnan A, Luz ACG, Sarin KC, et al. How can health technology assessment support our response to public health emergencies? *Health Res Policy Sys.* 2022;20:124. <https://doi.org/10.1186/s12961-022-00925-z>.
 29. Canario Guzmán JA, Orlich J, Mendizábal-Cabrera R, et al. Strengthening research ethics governance and regulatory oversight in Central America and the Dominican Republic in response to the COVID-19 pandemic: a qualitative study. *Health Res Policy Sys.* 2022;20:138. <https://doi.org/10.1186/s12961-022-00933-z>.
 30. Hennessey K, Pezzoli L, Mantel C. A framework for seroepidemiologic investigations in future pandemics: insights from an evaluation of WHO's Unity Studies initiative. *Health Res Policy Sys.* 2023;21:34. <https://doi.org/10.1186/s12961-023-00973-z>.
 31. Palese A, Chiappinotto S, Fonda F, et al. Lessons learnt while designing and conducting a longitudinal study from the first Italian COVID-19 pandemic wave up to 3 years. *Health Res Policy Sys.* 2023;21:111. <https://doi.org/10.1186/s12961-023-01055-w>.
 32. Smits P, Cambourieu C, Ouimet M. Connections between health research systems and decision-making spaces: lessons from the COVID-19 pandemic in the province of Québec. *Canada Health Res Policy Sys.* 2023;21:116. <https://doi.org/10.1186/s12961-023-01053-y>.
 33. APPRISE. Fast-tracked funding for the COVID-19 pandemic to support critical research areas. APPRISE. 2020. <https://www.apprise.org.au/fast-tracked-funding-for-the-covid-19-pandemic-to-support-critical-research-areas/>. Accessed 19 March 2025.
 34. Zimmerman A, Lopes RD, D'Ávila A, Rohde LE, Zimmerman L. COVID-19 in Brazil: the headlines should be about science (letter). *Lancet.* 2020. [https://doi.org/10.1016/S0140-6736\(20\)32375-8](https://doi.org/10.1016/S0140-6736(20)32375-8).
 35. Centre for Epidemiology and Evidence. Population Health Research Strategy 2018–2022. Population and Public Health Division. Sydney: NSW Ministry of Health. 2019. <https://www.health.nsw.gov.au/research/Publications/research-strategy-2018-2022.pdf>. Accessed 19 March 2025.
 36. Ministry of Business, Innovation and Employment (MBIE)/Ministry of Health. New Zealand health research strategy 2017–2027. Wellington: Ministry of Business, Innovation and Employment/Ministry of Health. 2017. <https://www.health.govt.nz/publication/new-zealand-health-research-strategy-2017-2027>. Accessed 19 March 2025.
 37. Department of Health. Best research for best health: a new national health research strategy. The NHS contribution to health research in England. London: Department of Health. 2006. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/568772/dh_4127152_v2.pdf. Accessed 19 March 2025.
 38. Michael Smith Foundation for Health Research. Directions for Health Research in British Columbia. Vancouver, BC, MSFHR; 2014 Directions for Health Research in BC by MSFHR (issuu.com). Accessed 18 March 2025.
 39. Wyatt D, Faulkner-Gurstein R, Cowan H, Wolfe CDA. Impacts of COVID19 on clinical research in the UK: a multi-method qualitative case study. *PLoS ONE.* 2021. <https://doi.org/10.1371/journal.pone.0256871>.
 40. Horby P, Mullard A. RECOVERY 1 year on: a rare success in the COVID-19 clinical trial landscape. *Nat Rev Drug Discov.* 2021. <https://doi.org/10.1038/d41573-021-00068-w>.
 41. World Health Organization, the Global Research Collaboration for Infectious Disease Preparedness and Response (GLOPID-R). A coordinated Global Research Roadmap. 2020. <https://www.who.int/publications/m/item/a-coordinated-global-research-roadmap>. Accessed 19 March 2025.
 42. RECOVERY Collaborative Group. Dexamethasone in hospitalized patients with COVID-19. *N Engl J Med.* 2021. <https://doi.org/10.1056/NEJMoa2021436>.
 43. Águas R, Mahdi A, Shretta R, Horby P, Landray M, White L, et al. Potential health and economic impacts of dexamethasone treatment for patients with COVID-19. *Nat Commun.* 2021. <https://doi.org/10.1038/s41467-021-21134-2>.
 44. Angus DC, Gordon AC, Bauchner H. Emerging lessons from COVID-19 for the US clinical research enterprise. *JAMA.* 2021. <https://doi.org/10.1001/jama.2021.3284.101>.
 45. Bowen AC, Tong SYC, Davis JS. Australia needs a prioritized national research strategy for clinical trials in a pandemic: lessons learned from COVID-19. *Med J Aust.* 2021. <https://doi.org/10.5694/mja2.51143>.
 46. Goossens H, Derde L, Horby P, Bonten M. The European clinical research response to optimise treatment of patients with COVID-19: lessons learned, future perspective, and recommendations. *Lancet Infect Dis.* 2021. [https://doi.org/10.1016/S1473-3099\(21\)00705-2](https://doi.org/10.1016/S1473-3099(21)00705-2).
 47. Lamontagne F, Rowan KM, Guyatt G. Integrating research into clinical practice: challenges and solutions for Canada. *CMAJ.* 2021. <https://doi.org/10.1503/cmaj.202397>.
 48. World Health Organization. COVID 19 public health emergency of international concern (PHEIC). Global research and innovation forum: towards a research roadmap. 2020. <https://www.who.int/docs/default-source/coronaviruse/global-research-and-innovation-forum-towards-a-research-roadmap.pdf>. Accessed 19 March 2025.
 49. Becerra-Posada F, Minayo M, Quental C, de Haan S. National research for health systems in Latin America and the Caribbean: moving towards the right direction? *Health Res Policy Sys.* 2014;12:13. <https://doi.org/10.1186/1478-4505-12-13>.
 50. NHS England. COVID treatment developed in the NHS saves a million lives. News. 2021. <https://www.england.nhs.uk/2021/03/covid-treatment-developed-in-the-nhs-saves-a-million-lives/#:~:text=Dexamethasone%2C%20an%20inexpensive%20and%20widely,clinical%20trial%20in%20the%20NHS>. Accessed 19 March 2025.
 51. Victora PC, Castro PMC, Gurmenda S, Medeiros AC, Franca GVA, Barros AJD. Estimating the early impact of vaccination against COVID-19 on deaths among elderly people in Brazil: analyses of routinely-collected data on vaccine coverage and mortality. *EclinicalMedicine.* 2021. <https://doi.org/10.1016/j.eclinm.2021.101036>.
 52. Gupta S, Cantor J, Simon KI, Bento AI, Wing C, Whaley CM. Vaccinations against COVID-19 may have averted up to 140,000 deaths in the United States. *Health Aff (Millwood).* 2021. <https://doi.org/10.1377/hlthaff.2021.00619>.
 53. Schneider EC, Shah A, Sah P, Moghadas SM, Vilches T, Galvani A. The U.S. COVID-19 vaccination program at one year: how many deaths and hospitalizations were averted? *Commonwealth Fund* 2021. <https://doi.org/10.26099/3542-5n54>. Accessed 25 Nov 2023.
 54. Meslé MM, Brown J, Mook P, Hagen J, Pastore R, Bundle N, et al. Estimated number of deaths directly averted in people 60 years and older as a result of COVID-19 vaccination in the WHO European Region, December 2020 to November 2021. *Euro Surveill.* 2021. <https://doi.org/10.2807/1560-7917.ES.2021.26.47.2101021>.
 55. Slaoui M, Greene SE, Woodcock J. Bridging the gap at warp speed—Delivering options for preventing and treating Covid-19. *NEJM.* 2020. <https://doi.org/10.1056/NEJMp2028535>.
 56. Hanney SR, Wooding S, Sussex J, Grant J. From COVID-19 research to vaccine application: why might it take 17 months not 17 years and what are

- the wider lessons? *Health Res Policy Sys.* 2020. <https://doi.org/10.1186/s12961-020-00571-3>.
57. Lurie N, Saville M, Hatchett R, Halton J. Developing covid-19 vaccines at pandemic speed. *N Engl J Med.* 2020. <https://doi.org/10.1056/NEJMp2005630>.
 58. Norton A, Bucher A, Antonio E, Advani N, Grund H, Mburu S, et al. A living mapping review for COVID-19 funded research projects: nine-month update [version 4; peer review: 2 approved]. *Wellcome Open Research.* 2021. <https://doi.org/10.12688/wellcomeopenres.16259.4>.
 59. NIH. NIH to assess and expand COVID-19 testing for underserved communities (RADx-UP). NIH. 30 September 2020. <https://www.nih.gov/news-events/news-releases/nih-assess-expand-covid-19-testing-under-served-communities>. Accessed 19 March 2025
 60. Prime Minister's Office. PM announces record funding to find a coronavirus vaccine. 2020. <https://www.gov.uk/government/news/pm-announces-record-funding-to-find-a-coronavirus-vaccine>. Accessed 19 March 2025
 61. Ardern J. Opening Remarks. In: Mahi Tah 2. Annual report 2020. Auckland, New Zealand: Office of the Prime Minister's Chief Scientific Advisor. 2020. https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/f/688/files/2020/01/PMCSA-Annual-Report-2020-web-version_-_to-upload-v4.pdf. Accessed 19 March 2025.
 62. Baker MG, Wilson N, Anglemeyer A. Successful elimination of COVID-19 transmission in New Zealand. *N Engl J Med.* 2020. <https://doi.org/10.1056/NEJMc2025203>.
 63. Geoghegan JL, Moreland NJ, Le Gros G, Ussher JE. New Zealand's science-led response to the SARS-CoV-2 pandemic. *Nat Immunol.* 2021. <https://doi.org/10.1038/s41590-021-00872-x>.
 64. Campbell D, Edwards B, Milat A, Thackway S, Whittaker E, Goudswaard L, et al. NSW Health COVID-19 emergency response priority research program: a case study of rapid translation of research into health decision making. *Public Health Res Pract.* 2021;31(4):e3142124. <https://doi.org/10.17061/phrp3142124>.
 65. Centre for Epidemiology and Evidence. NSW Health COVID-19 research program impact evaluation report 2021. Sydney: NSW Ministry of Health. 2021. <https://www.health.nsw.gov.au/research/Publications/covid-impact-evaluation-interim.pdf>. Accessed 19 March 2025.
 66. Şahin U, Muik A, Derhovanessian E, Vogler I, Kranz ML, Vohrmehr M, et al. COVID-19 vaccine BNT162b1 elicits human antibody and TH1 T cell responses. *Nature.* 2020. <https://doi.org/10.1038/s41586-020-2814-7>.
 67. Polark FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and efficacy of the BNT162b2 mRNA COVID-19 vaccine. *N Engl J Med.* 2020. <https://doi.org/10.1056/NEJMoa2034577>.
 68. Jackson LA, Anderson EJ, Roupahel NG, Roberts PC, Makhene M, Coler RN, et al. An mRNA vaccine against SARS-CoV-2—Preliminary report. *N Engl J Med.* 2020;383:1920–31.
 69. Corbett KS, Flynn B, Foulds KE, Boyoglu-Barnum S, Werner AP, et al. Evaluation of the mRNA-1273 vaccine against SARS-CoV-2 in nonhuman primates. *N Engl J Med.* 2020;383:1544–55.
 70. Anderson EJ, Roupahel NG, Widge AT, Jackson LA, Roberts PC, Makhene M, et al. Safety and immunogenicity of SARS-CoV-2 mRNA-1273 vaccine in older adults. *N Engl J Med.* 2020;383:2427–38.
 71. Baden LR, El Sahly HM, Essink B, Kotloff K, Frey S, Novak R, et al. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *N Engl J Med.* 2021. <https://doi.org/10.1056/NEJMoa2035389>.
 72. van Doremalen N, Lambe T, Spencer A, Belij-Rammerstorfer S, Purushotham JN, Port JR, et al. ChAdOx1 nCoV-19 vaccine prevents SARS-CoV-2 pneumonia in rhesus macaques. *Nature.* 2020. <https://doi.org/10.1038/s41586-020-2608-y>.
 73. Ramasamy M, Minassian AM, Ewer KJ, Flaxman AL, Folegatti PM, Owens DR, et al. Safety and immunogenicity of ChAdOx1 nCoV-19 (AZD1222) vaccine administered in a primeboost regimen in older adults (COV002): a phase 2/3 single blind, randomised controlled trial. *Lancet.* 2020. [https://doi.org/10.1016/S0140-6736\(20\)32466-1](https://doi.org/10.1016/S0140-6736(20)32466-1).
 74. Voysey M, Clements SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *Lancet.* 2021. [https://doi.org/10.1016/S0140-6736\(20\)32661-1](https://doi.org/10.1016/S0140-6736(20)32661-1).
 75. El-Jardali F, Bou-Karroum L, Fadlallah R. Amplifying the role of knowledge translation platforms in the COVID-19 pandemic response. *Health Res Policy Syst.* 2020;18(1):58. <https://doi.org/10.1186/s12961-020-00576-y>.
 76. Lamontagne F, Agoritsas T, Macdonald H, Leo YS, Diaz J, Agarwal A. A living WHO guideline on drugs for covid-19. *BMJ.* 2020. <https://doi.org/10.1136/bmj.m3379>.
 77. Mazey S, Richardson J. Lesson-drawing from New Zealand and COVID-19: the need for anticipatory policy making. *Polit Q.* 2020;91:561–70. <https://doi.org/10.1111/1467-923X.12893>.
 78. Hanney SR, González-Block MA. Organising health research systems as a key to improving health: the World Health Report 2013 and how to make further progress. *Health Res Policy Sys.* 2013;1:47. <https://doi.org/10.1186/1478-4505-11-47>.
 79. World Health Organization. Supporting the routine use of evidence during the policy-making process: a WHO checklist. Geneva: World Health Organization. 2023; Licence: CC BY-NC-SA 3.0 IGO <https://iris.who.int/bitstream/handle/10665/366181/9789240056145-eng.pdf?sequence=1>. Accessed 19 March 2025.
 80. Kuchenmüller T, Boeira L, Oliver S, et al. Domains and processes for institutionalizing evidence-informed health policy-making: a critical interpretive synthesis. *Health Res Policy Sys.* 2022;20:27. <https://doi.org/10.1186/s12961-022-00820-7>.
 81. Straus SE, Beckett R, Fahim C, et al. Royal Society of Canada working group on health research system recovery: strengthening Canada's health research system after the COVID-19 pandemic. *FACETS.* 2024;9:1–44. <https://doi.org/10.1139/facets-2023-0233>.

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