Supplementray Table S1. Deteialed information extracted from the reviewed artciles

N	Article information	Article type	Study covering period	Country	Responses on shortage ofhealth care workers	Advantages/Best practices of responses	Disadvantages of lesson learnt from responses
1	Köppen J, Hartl K, Maier CB. Health workforce response to Covid-19: What pandemic preparedness planning and action at the federal and state levels in Germany?: Germany's health workforce responses to Covid-19. Int J Health Plann Manage. 2021;36(S1):71-91.	Research article	May-20	Germany	Recruited medical students/volunteers Recruited retirees/non-practicing HCWs Recruited non-medical workforce Cancelled elective procedures Only urgent or emergency cases were admitted for inpatient care Reallocated staff from other units to critical area Extended working hours to enable HCWs work longer Provided license for foreign-trained healthcare professionals Provided hospital with financial compensation of 560€/day for unoccupied beds enabling HCWs to more focus on COVID-19 related task Some tasks shifted to lower qualified staff	When bed occupancy rate decreases, staff could focus more on patients with Covid-19.	
2	Burau V, Falkenbach M, Neri S, Peckham S, Wallenburg I, Kuhlmann E. Health system resilience and health workforce capacities: Comparing health system responses during the COVID-19 pandemic in six European countries. Int J Health Plann Manage. 2022;37(4):2032-2048.	Research article	Jun-20	England Germany Denmark Netherlands Denmark Austria	Re-organization of healthcare: Cancelled elective procedures, doctors whose scheduled surgeon cancelled involved in ICU Scaling up of existing organizational form: Redefining existing structures for coordinating COVID-19 services Relaxed quality standards Recruited new staff (retiress, new graduates, returnees to clincal practice, foreign health workers) Moved from part time to full time Established a new agreement with wage increase of HCWs	There were signs of improved collaboration between public health doctors and family physicians. There was greater recognition and acknowledgement of public health doctors at both organisational and policy levels. Relaxing quality standard: Instead of distributing medicines and corresponding fluids separately, hospital pharmacists received authorisation to prepare drips to save time.	When attempting to coordinate measures between central government and the regions, there were conflicts between the two levels of government and coordination looks difficult when discussing the measures to contain the pandemic.
3	Rees GH, Peralta Quispe F, Scotter C. The implications of COVID-19 for health workforce planning and policy: the case of Peru. Int J Health Plann Manage. 2021;36(S1):190-197	Special report	Dec-20	Peru	Recruited temporary additional health personnel Provided incentives for HCWs Authorized the extensions of working hours Developed the platform for the national recruitment of human rescource in health Recruited foreign medical personnel Involved resident doctors of their last year in the specialties or subspecialties related to the COVID-19	Hiring the additional contract workers in different settings including rapid response team, clinical monitoring team and humantarian team reflected a movable strategy for shifting to community and hospital-based service needs as the infection spreads throughoutt the country. Created baseline data to identify skill needs of HCWs and this permits Peruvian health workforce planners to identify skilled staff during pandemic.	Maintaining this level of service presents budgetary issues.
4	Bourgeault IL, Maier CB, Dieleman M, et al. The COVID-19 pandemic presents an opportunity to develop more sustainable health workforces. Hum Resour Health. 2020;18(1):83.	Commentary	Dec-20	Netherland Germany Australia Jamaica UK, Canada Mexico, China USA, Australia UK	Recalled inactive health workers Fast tracking trainees Integrating internationally educated health professionals Redeployed doctors and nurses Task shifting Cancelled elective surgeries	Built solidarity to support regions and countries requiring more surge capacity. Leveraged the full scope of skills available within outside of the healthworkforce.	Neglegted short term training, required upskilling and required supervision because redeployed staff are not fully trained Put elder in great risk of exposure to COVID-19 when calling retired HCWs Concern on safety implication Neglected endemic underemployment when supporting internationally educated health professionals Concerned about performance and contract of redeployed HCWs

#	Citation	Type	Date	Country	Strategies	Facilitators/Successes	Challenges
5	Said D, Brinkwirth S, Taylor A, Markwart R, Eckmanns T. The Containment Scouts: First Insights into an Initiative to Increase the Public Health Workforce for Contact Tracing during the COVID-19 Pandemic in Germany. Int J Environ Res Public Health. 2021;18(17):9325	Project report	Jul-21	Germany	Containment Scouts (CS) Initiative (CSI) - More than 500 CSs worked consistently at any one time in 270-380 local health authorities during March to October 2020 on contact tracing, electronic documentation of COVID-19 cases, COVID-19 testing and supporting telephone service. 11.3 million euros was allocated to fund 530 positions as CSs during designated period.	Close cooperation of different institutions at the national, state and local level enabled a clear division of responsibilities, including professional supporyt, recruitment and contract management, funding, allocation of volunteers based on local need. CSI was rewarding program because almost all health authorities were interested in extending the support of CSs indicating that extra workforce was of crucial. Providing a salary and contracts of at least six months to the CSs, the initiative offers longer-term support compared to other volunteer based programmes. CSs are supposed to work full-time, thereby offering substantial support to local health authorities. Training material for CSs to reflect updates on recommendations for contact tracing and contact management was available at website of Robert Koch Institute. Therefore, timely information sharing enabled smooth process. CSI was coordinated by statutory bodies and integrated into the statutory public health system, allowing it to be implemented nationwide, in contrast to programmes that are limited to local or regional areas and not integrated into a national strategy.	There was some concern on qualification of volunteers. 20% of volunteers' qualification was evaluated as "insuffient" by the local health authorities.
6	Waitzberg R, Hernández-Quevedo C, Bernal-Delgado E, et al. Early health system responses to the COVID-19 pandemic in Mediterranean countries: A tale of successes and challenges [published correction appears in Health Policy. 2022 Jun 1;:]. Health Policy. 2022;126(5):465-475	Review	Oct-21	Cyprus, Greece Israel, Italy, Malta, Portugal, Spain	Reallocated HCWs within the public sector from regular hospitals wards to specially designed COVID-19 wards Extended working hours, moving parttime to full time, cancelling leave Recruited new staff Recruited medical studentds, accelareted end of training Recruited retirees, inactive health professional Deployed private sector HCWs to public sector Used of military medical person Used volunteers Increased salary	Through volunteer activities and task shifting, it was noticed that other diseases and non-severe cases could be managed through community settings and home care. Flexibility in being able to utilize a range of potential sources to recruit additional personnel to deliver COVID-19-related services has been a notable success in the Mediterranean countries.	Increasing ICU bed capacity had to be done in coordination with the deployment of adequate and qualified staff in order to be able to use these beds.
7	Winkelmann J, Webb E, Williams GA, Hernández-Quevedo C, Maier CB, Panteli D. European countries' responses in ensuring sufficient physical infrastructure and workforce capacity during the first COVID-19 wave. Health Policy. 2022;126(5):362-372.	Comprehensive review	Feb-21	Albania, Armenia, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Denmark, England, Estonia, France, Germany, Hungary, Iceland, Ireland, Italy, Germany, Lithuania, Luxembourg, Malta, Montenegero, Monaco, Netherlands, Norway, North Macedonia, Poland, Portugal, Romania, Russia, San Marino, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Portugal, Turkey, Ukraine	Redeployed HCWs to other geographic area with greater need Deployed HCWs from armed forces Redeployed from private sector Recruited new health professionals Recruited inactive HCWs Recruited medical students Relaxed rules/visa extension for foreign trained health professionals Provided financial compensation for HCWs	In many countries, emergency legislation paved the way for various approaches to rapid mobilisation and recruitment of health workers. Some responses of temporary task delegation and mobilisation of additional health workforce may provide opportunity and important lessons to strengthen the health workforce in the longer-term in terms of attractiveness and supply of professionals and to enhance skill mix. Some countries developed combined contingency plans that considered capacity of infrastructure and workforce simultaneously, such as Greece or Romania.	No high qualty data on available health system resources types of qualification, skill-mix, mobility and regional distribution of health professionals. The implementation of many of these strategies has necessitated the adoption of emergency legislation.

#	Citation	Type	Date	Country	Intervention	Findings	Barriers/Other
8	Vera San Juan N, Clark SE, Camilleri M, et al. Training and redeployment of healthcare workers to intensive care units (ICUs) during the COVID-19 pandemic: a systematic review. BMJ Open. 2022;12(1)	Review	Feb-21		Redeployed HCWs internally Recruited from outside of the health system Implemented tiered staffing model where critical care physicans or nurses oversaw non-ICU clinicians. For example, experienced renal physicians, together with trainee radiologists developing line insertion teams or orthopaedists and physiotherapists assisted with proning.	The tiered model represented an important shift in ways of working and understanding collaborations between health specialists. The model reduced personnel required for procedures, reduction of aerosolisation of the virus, shorter time dedicated to procedures and minimal or no training required for them to provide assistance.	A key barrier for successful redeployment planning was not being able to measure the need of human resources, that is, identifying which specific roles were in demand and which members of the workforce were available and healthy junior doctors experienced due to working in unfamiliar ICU settings. Training needs is more effort consuming. Redeployed HCWs were also often asked to liaise with families and required training on communicating bad news.
9	Webb E, Winkelmann J, Scarpetti G, et al. Lessons learned from the Baltic countries' response to the first wave of COVID-19. Health Policy. 2022;126(5):438-445	Summary	Mar-21	Latvia, Estonia, Lithuania	Allowed overtime up to 60 hours per week and in return introduced a salary bonus for HCWs. Reassigned health workforce to another health care facility in the same area in case of need, for example if staff became infected and had to self-isolate.	A non-governmental organization set up a database of inactive health workers who could volunteer in a case of need, and hospitals worked together to reassign staff with COVID-19 training.	
10	Satterfield CA, Goodman ML, Keiser P, et al. Rapid Development, Training, and Implementation of a Remote Health Profession's Student Volunteer Corps During the COVID-19 Pandemic. Public Health Rep. 2021;136(6):658-662	Case Reports/Practice	Aug-21	USA	Student volunteerism project - Student volunteers were involved in tracking COVID-19 vaccine supply, distribution, and administration through follow-up with vaccine providers. Volunteer students were offered a scholarship to support working in underservd area and county. The purpose is only reward their hard work.	Felixbility was a key that students can inform any concern via volunteer-wide log or email to staff in charge. No strict work hours, overwhlmed students can regulate their time. A survey and Video of Volunteer experience is produced which enabled volunteers to learn from each other. Volunteer activity is one of eiligibility criteria for scholarship, therefore students were able to use volunteers hours to meet the requirement of their scholarship. Bidirectional engagement between local authority and University of Texas Medical branch that mobilized student volunteers was crucial for success of endevour. Efforts were successful because student volunteer projects met partner-driven and community needs.	A survey and video project of volunteer experiences is being produced to document the impact the volunteering had on students. Ideally, for such long-term events as the COVID-19 pandemic, an evaluation would have been built in from the beginning. Some early volunteers have since graduated and moved on to other opportunities.
11	Nittayasoot N, Suphanchaimat R, Namwat C, Dejburum P, Tangcharoensathien V. Public health policies and health-care workers' response to the COVID-19 pandemic, Thailand. Bull World Health Organ. 2021;99(4):312-318	Policy&Practice	Aug-20	Thailand	Mandatory rural service by graduate doctor to deal with staff shortage at rural area Recruited medial students from rural area Provided financial and non-financial incentives such as social recognition Delegated tasks to less-specialized HCWs such as dentist nurse Redeployed experienced nurses from non-intensive care units within their own hospital or province Recruited volunteers in COVID-19 response- Local administrations mobilized one million existing village health volunteers to boost the capacity of the Surveillance and Rapid Response Teams for contact tracing. Volunteers received 43 hours of public health ministry-funded training in the district health office delivered by local public health personnel.	Sharing the dialect, religion and sociocultural practices of local communities, village health volunteers were invaluable in challenging circumstances such as in the southern provinces, where many Muslim pilgrims were returning from other countries.	
12	Zhu P, Liu X, Wu Q, Loke J, Lim D, Xu H. China's Successful Recruitment of Healthcare Professionals to the Worst-Hit City: A Lesson Learned. Int J Environ Res Public Health. 2021;18(16):8737	Article	Jul-21	China	Recruited healthcare professionals from the least-infected region to the highly infectious Wuhan area	A part of that recognition that they had the opportunity to go to Wuhan to support the COVID-19.	A great fear of COVID-19 infection among redeployed.

#	Author/Citation	Type	Date	Country	Description	Positive aspects	Challenges
13	Muhammad Nur Amir AR, Binti Amer Nordin A, Lim YC, Binti Ahmad Shauki NI, Binti Ibrahim NH. Workforce Mobilization From the National Institutes of Health for the Ministry of Health Malaysia: A COVID-19 Pandemic Response. Front Public Health. 2021;9:574135	Community case study	Jun-20	Malaysia	MOH COVID-19 Mobilization Support Unit, has prepared, organized, and enforced the deployment of human resources and medical countermeasures in the region. MOH has also obtained assistance from medical professionals and volunteers from the private and civil society (non-governmental organizations or NGOs) who have met the same recruitment requirements. Recruited medical students, volunteers from retirees with a medical background as well as non-medical volunteers from other ministries. MOH introduced and implemented various ground-breaking concepts, such as teleconsultations, drive-thru pharmacies, and notifications of waiting numbers via messages or WhatsApp.	The collaborations with NGOs and other agencies, resulting in a seamless distribution of the workforce, food supplies, and personal protective equipment (PPE) all around Malaysia. Collaborations provided an opportunity for medical personnel outside of the MOH to contribute and serve the country. Mobilized team received recognition nationally for their contribution to the country. Developed new methods to manage the COVID-19 pandemic, which were adapted by the MOH Malaysia. For instance, an electronic form was created for a comprehensive data collection on contact tracing. The template has been used in several states in Malaysia along with a density map that inspires modeling with a projection of COVID-19 virus spread based on daily cases and reproduction number. Teleconsultations, drive-thru pharmacies et al., helped to minimize the need for healthcare personnel to be physically present and indirectly limit the interaction and exposure between the healthcare personnel and patients.	Receiving an overwhelming amount of volunteers since the inception of the NIH COVID-19 operation room, the process of screening these volunteers was time-consuming and calling up identified volunteers labor-intensive. The lack of a medical volunteer registry to recruit personnel slowed the process of deployment in the beginning. There were also several challenges with regards to the deployed healthcare personnel's skills and competencies. The personnel themselves were at constant risk of exposure to the virus. This risk is exacerbated by the threat of psychological consequences such as anxiety and depression due to stigma. The situation was exacerbated when requests were received for human resource aid at the latest possible time resulting in engendering personnel to prepare for mobilization inadequately. Regardless, the mobilized team was briefed to equip them mentally and physically, albeit tasks were given by assigned medical facilities independently
14	Dinić M, Šantrić Milićević M, Mandić-Rajčević S, Tripković K. Health workforce management in the context of the COVID-19 pandemic: A survey of physicians in Serbia. Int J Health Plann Manage. 2021;36(S1):92-111.	Article	Dec-20	Serbia	Newly hired 1500 physicians For additional deployment, for a period of 6 months, of 200 health workers was funded by EU funds, amounting to approximately 1 million euros Recruited volunteers and medical students	There are positive aspects of such a practice, that is, recognition of the reassigned workers' hard work by the society, solidarity between colleagues and implementation of supportive policies.	Most frontline physicians fighting against COVID-19, who were dissatisfied with the occupational preparedness for pandemics, relocated due to the pandemic, and from the public sector expressed the need for change in health workforce management.
15	Carroll WD, Strenger V, Eber E, et al. European and United Kingdom COVID-19 pandemic experience: The same but different. Paediatr Respir Rev. 2020;35:50-56	Review	Jun-20	Italy, UK	Italian Government authorised regions to recruit 20,000 health workers, allocating €660 million for the COVID-19 response. Elective surgeries were postponed to free beds and offer human and material resources. Visiting bans were established and strictly controlled in many hospitals and nursing homes with some exceptions. Therefore, HCWs not directly involved in the emergency were redeployed and joined COVID-19 Internal Medicine, Respiratory and Infectious Disease Departments, as well as Emergency Departments, often with gruelling 12-h shifts. General practitioners modified their practice of delivering care, mostly through telephone calls or telehealth.		

16	Bahethi RR, Liu BY, Asriel B, et al. The COVID-19 Student WorkForce at the Icahn School of Medicine at Mount Sinai: A Model for Rapid Response in Emergency Preparedness. Acad Med. 2021;96(6):859-863.	Innovation Report	Dec-20	USA	Well organized and innovative system of volunteer recruitment: - With support of Mount Sinai Hospital System and Ichann School of Medicine at Mount Sinai, the COVID-19 Student WorkForce was establshied with over 530 medical and graduate students.	This approach differs from other medical school student volunteering approaches because it focuses on independence and autonomy. Overall, the WorkForce is grounded in students, leading students with support from the administration. This autonomous approach enables the WorkForce to respond nimbly in real time to new information and updates The independent group structure allows individual WorkForce leaders to become experts in their tasks and share lived experiences with others. Information sharing helps to understand the overarching situation within New York City and react quickly to be a vital part of a coherent and cohesive response. Volunteers submitted weekly report that provided a space for student to reflect. For all students, volunteering in an organized workforce has built a sense of confidence and feeling of contributing to something greater, which can be both "strategic and therapeutic" to avoid burnout.	
17	Divito M, Advincula A, Burgansky A, et al. Intradepartmental redeployment of faculty and staff. Semin Perinatol. 2020;44(6):151299	Unclear	Jul-20	USA	The Department of Obstetrics and Gynecology formed a Redeployment Committee to address departmental needs and utilization of its providers and staff during the escalating pandemic. The goal was to redeploy faculty and staff from relatively inactive areas to critical services, thereby fully utilizing individuals within the Department without unnecessarily pulling resources from the larger institution.	The Department was holding daily calls for all faculty, trainees and staff, and these calls were used as an opportunity to communicate details of the redeployment strategy. Reassured that the expectation was that internal or external redeployment would be within the skill set of the redeployed individual whenever possible.	Fear of COVID-exposure Couldn't engage in the role as it had been stated because of high callout rates during their shifts To avoid fear, by restricting clinical interactions of redeployed staff to known COVID-19 negative patients were able to provide reassurance to these individuals and also protect the health of our redeployed workforce. Night and weekend shifts were less popular and harder to fill than weekday daytimes. Discomfort with inpatient assignments: Many staff used to working in an outpatient environment expressed apprehension and discomfort at the prospect of being redeployed to the hospital to provide support for obstetric patients.
18	Collins GB, Ahluwalia N, Arrol L, et al. Lessons in cognitive unloading, skills mixing, flattened hierarchy and organisational agility from the Nightingale Hospital London during the first wave of the SARS-CoV-2 pandemic. BMJ Open Qual. 2021;10(3):e001415	Narrative review	Feb-21	England	Recruited volunteers including non-medical volunteers whose routine responsibilities were suspended due to COVID-19, for example, academics pursuing postponed non-COVID-19 research, flight attendant, whose flights were deferred were trained to record observations of COVID-19 cases. Volunteers upskilled to support doctors and nurses in ICU. To relieve all clinical staff of an administrative burden, the incident report form was shortened,	Volunteering led to a new staffing models, and heightened sense of enterprneurship at the organization. Having volunteers enabled those who work in critical area to focus on their work that require non-transferrable skill. Traditional hierarchies were weakened emergence of a so-called 'flattened hierarchy transparency in decision-making combined with a system of rapid delegated authority to the most invested stakeholder, and systems of rapid in situ audit, improve ment and re-audit, helped encourage staff autonomy and continuous improvement.	Redeployed workforce are not specifically trained on ICU service.