

Mapping regional funding for COVID-19 research in the Asia-Pacific region

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ABSTRACT

Introduction The Global Research Collaboration for Infectious Disease Preparedness (GloPID-R) is a network of funders supporting research on infectious diseases of epidemic/pandemic potential. GloPID-R is establishing regional hubs to strengthen stakeholder engagement particularly among low-income and middle-income countries. The first pilot hub, led from Republic of Korea (South Korea), has been launched in the Asia-Pacific region, a region highly prone to outbreaks of emerging infectious diseases. We present findings of mapping research undertaken in support of the hub's development.

Methods We analysed five COVID-19 research databases in September 2022 to identify research funders and intermediary funding sources supporting research in infectious diseases in the Asia-Pacific region. This was complemented with an in-depth analysis of the UK Collaborative on Development Research (UKCDR) and GloPID-R COVID-19 Research Project Tracker to assess the alignment of funded projects in the region to the WHO COVID-19 research priorities.

Results We identified 453 funders and funding sources supporting COVID-19 research in the Asia-Pacific Region including public, private and philanthropic organisations and universities. However, these organisations were clustered in few countries in the region. The in-depth analysis of the UKCDR and GloPID-R COVID-19 Research project Tracker found limited research involving Asia-Pacific countries with the 117 funders supporting these projects investing at least US\$604m in COVID-19 research in the region. Social Sciences was the dominant theme on which funded projects focused whereas the priority areas with the least number of projects were research on 'animal and environmental health' and 'ethics considerations for research'.

Conclusion Our analyses show the diversity of funding sources for research on infectious diseases in the Asia-Pacific region. Engagement between multiple actors in the health research system is likely to promote enhanced coordination for greater research impact. GloPID-R's Asia-Pacific regional hub aims to support activities for the enhancement of preparedness for outbreaks of emerging infectious diseases in the region.

BACKGROUND

Historically, the Asia-Pacific region has been the epicentre of numerous infectious diseases

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Assessments of the global research response to COVID-19 have shown a highly fragmented research landscape and uncoordinated efforts by various actors including research funders.
- ⇒ There are no studies mapping the scope of COVID-19 research and research funders in the Asia-Pacific region, a major hotspot for the emergence and spread of epidemic-prone pathogens.

WHAT THIS STUDY ADDS

- ⇒ In this work, we show the diverse funders and sources of funding for COVID-19 research in the Asia-Pacific region as well as the alignment of the funded research to global COVID-19 research priorities.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ The landscape of funders and funding sources in the Asia-Pacific region is complex. Engaging the actors identified through initiatives geared at promoting enhanced coordination can strengthen preparedness for the next pandemic.

outbreaks.¹ The region sits at the crossroads of multiple exogenous factors which increase the propensity for the emergence and spread of infectious diseases of epidemic potential. The Asia-Pacific region is a vibrant economic hub with dense trade activities and is a major hub for international travel. These factors facilitate close contact between people, animals and nature and increase the risk of rapid spread of emerging infections beyond the region.^{2,3}

SARS-CoV-1, Nipah Virus (NiV) and numerous influenza subtypes are among pathogens first detected in the region.⁴ NiV was first identified in Malaysia in 1998, and has caused several outbreaks in South and Southeast Asia.⁵ NiV outbreaks were also reported in India and Bangladesh in early 2001.⁵ Seasonal outbreaks have since been reported in Bangladesh with the most recent outbreak detected in February, 2023.⁶ Evidence also suggests an

increased threat of the emergence of artemisinin resistant malaria parasites from the Greater Mekong Subregion of South Asia. This poses a significant risk of large malaria outbreaks in Asia and other world regions where malaria is endemic.⁷

In 2019, a novel coronavirus (SARS-CoV-2) outbreak was detected in Wuhan, China. By March 2020, WHO declared the outbreak constituted a global pandemic. COVID-19, the disease resulting from SARS-CoV-2 infection, had caused over 761 million infections and over 6.8 million deaths globally as of April 2023.⁸ In the WHO South-East Asia and Western Pacific regions, an estimated 60.8 and 201.8 million cases, respectively, were reported.⁸ There is likely an underestimation of the disease burden due to potential under-reporting of COVID-19 cases as witnessed globally during the pandemic. The COVID-19 Cumulative Infection Collaborators estimate cumulative infections in both WHO regions to be about 1.6 billion in 2022.⁹ While public health responses were varied globally, Asia had more stringent policy responses, favouring lockdowns and movement restrictions with extensive testing and isolation.¹⁰

WHO has led global research efforts in response to the COVID-19 pandemic. In February 2020 WHO partnered with the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R), a collaboration of funders of research on emerging and re-emerging infectious diseases of epidemic and pandemic potential, to identify global COVID-19 research priorities.^{11 12} Following this, GloPID-R and UK Collaborative on Development Research (UKCDR) developed the UKCDR and GloPID-R COVID-19 Research Project Tracker.¹³ This is a live database of globally funded COVID-19 research across multiple disciplines and research funders. All projects in the database are mapped to the WHO research priority areas and regular analyses show the scope of funded COVID-19 research globally.¹³ As of 15 July 2022, a total of 17 995 COVID-19 research projects had been funded by 345 funders with at least US\$6.5bn invested in research.¹³ Other global efforts tracking COVID-19 research efforts include World Report, COVID NMA initiative, Policy Cures R&D Tracker etc.^{14–16}

Although assessments of the global research response showed noteworthy successes including the rapid development of vaccines and therapeutics, inefficiencies in the conduct of research were also evident.¹⁷ In a 2020 review of clinical trials, Bugin and Woodcock found almost 95% of interventional therapeutic clinical trials registered in the WHO International Clinical Trial Registry Platform were underpowered and likely to yield inconclusive results.¹⁸ Other reviews suggest significant duplication of research efforts, funding of poor-quality research and underfunding of some crucial research areas.¹⁷ A review of the funded projects in Africa in 2020 to gauge the alignment of funded COVID-19 research to the WHO and Africa research priorities and identify research gaps, showed limited investments in COVID-19 research in Africa.¹⁹

These findings underscore the need for enhanced coordination of major players in the global health research

system including researchers and funders, who have a key role to play in the direction of resources for research. Being a collaborative network of research funders, GloPID-R has a mandate to strengthen collaboration among its funder members for enhanced effectiveness of funding invested in research on epidemics and pandemics.

To deliver on this mandate and strengthen its capacity as a meta-organisation, GloPID-R is transforming from its centralised structure to a devolved hub-and-spoke structure. Four regional hubs are envisaged for: the African continent, the Asia-Pacific region, Latin America and a combined region of North America and Europe. The Asia-Pacific hub was the first among these to initiate pilot activities.

In 2022, the Korea Research Institute of Bioscience and Biotechnology (KRIBB)/National Research Foundation launched the Asia-Pacific Infectious diseases Shield (APIS) supported by a 3-year grant from Ministry of Science and ICT, South Korea. APIS seeks to establish and support a sustainable Asia-Pacific research network for collaborative preparedness against emerging and re-emerging infectious diseases in Asia-Pacific region. Under this project, the GloPID-R Asia-Pacific regional hub pilot was launched.

To support the pilot phase of the GloPID-R Asia-Pacific regional hub, a study to map the research funders active during the COVID-19 pandemic in the Asia-Pacific region was undertaken via a review of five global COVID-19 research databases. As a funder organisation GloPID-R's membership comprises diverse funders directly supporting research in infectious diseases of epidemic/pandemic potential. However, we acknowledge that there are likely to be more downstream funders, such as intermediaries administering funds received from primary funders, which might be involved in research funding in the Asia-Pacific region (eg, universities funding research projects from core government grants). In this work, we considered all funding sources designated as funders within the databases analysed, including both direct funders and more downstream entities supporting research.

To our knowledge, there is no prior existing mapping of the funding activities in response to the COVID-19 pandemic in the Asia-Pacific region. In this study, we present the findings from this collaborative work undertaken by the GloPID-R Secretariat and KRIBB.

Study aim

1. To map all sources of funding for COVID-19 research in the Asia-Pacific region during the COVID-19 pandemic.
2. To assess the funding landscape of COVID-19 research projects in the Asia-Pacific region and their alignment to the WHO research priorities.

METHODS

Mapping of funders in the Asia-Pacific region

An online search of the WHO COVID-19 resources webpage was undertaken on 22 September 2022 to identify

research funding tracking databases. Five databases were identified and included in the analysis: Universities Allied for Essential Medicines COVID Mapping,²⁰ OECD Global Science Forum,²¹ Policy Cures R&D Tracker,²² UKCDR & GloPID-R COVID-19 Research Projects Tracker²³ and the COVID-NMA initiative.²⁴ Online supplemental file 1 summarises these datasets and their characteristics.

Data were downloaded, cleaned and analysed using Microsoft Excel 2021. Some maps were developed using map chart. Research projects taking place in at least one of the countries in the WHO Western Pacific Region or the WHO South-East Asia Region were included in the analysis.²⁵ Sources of funding for research involving these countries were identified and the resulting list of funding sources was screened for duplicates, which were removed. The funders and funding sources identified were categorised by country of location. Funding sources/funders based in the Asia-Pacific region were further classified by type of funding source or funding organisation. Owing to the variable quality and scope of the datasets included in the analyses and potential duplication of projects, comparison of funding amounts, number of projects and areas funded was not undertaken.

Scope of COVID-19 research response in the Asia-Pacific region

Only data captured in the UKCDR and GloPID-R COVID-19 Research Project Tracker as of 15 April 2022 were included in this analysis on the scope of the COVID-19 research response. This was the only database selected from the five databases initially analysed for ‘mapping of funders in the Asia-Pacific region’ as it maps funded research projects to the WHO research priorities.

Further, this approach was taken to avoid inaccuracies involving duplicate studies (the databases assessed were of variable design and scope with variable project information captured in each case, resulting in challenges for screening and deduplication of merged records). Research projects involving Asia-Pacific countries as previously defined were identified from the UKCDR and GloPID-R COVID-19 Research Project Tracker. A review of funders involved in research was undertaken and both funders based in the Asia-Pacific region and those external to the region were identified. The total number of projects funded and the total funding amount invested by each of the funders and funding sources (where known) was calculated. Due to incomplete funding data in the database, analyses emphasised number of projects funded rather than amounts invested in research. We undertook further descriptive analyses of the identified projects mapped to the WHO & GloPID-R COVID-19 Research Roadmap priorities.

Patient and public involvement

Patients and the public were not involved in the design, conduct or dissemination plans of this research.

RESULTS

Mapping of funders in the Asia-Pacific region

Four hundred and fifty-three funders and funding sources supporting COVID-19 research based in the Asia-Pacific region were identified across the five databases. These were based in 15 of the 38 Asia-Pacific countries as seen in figure 1. The majority of funders and funding

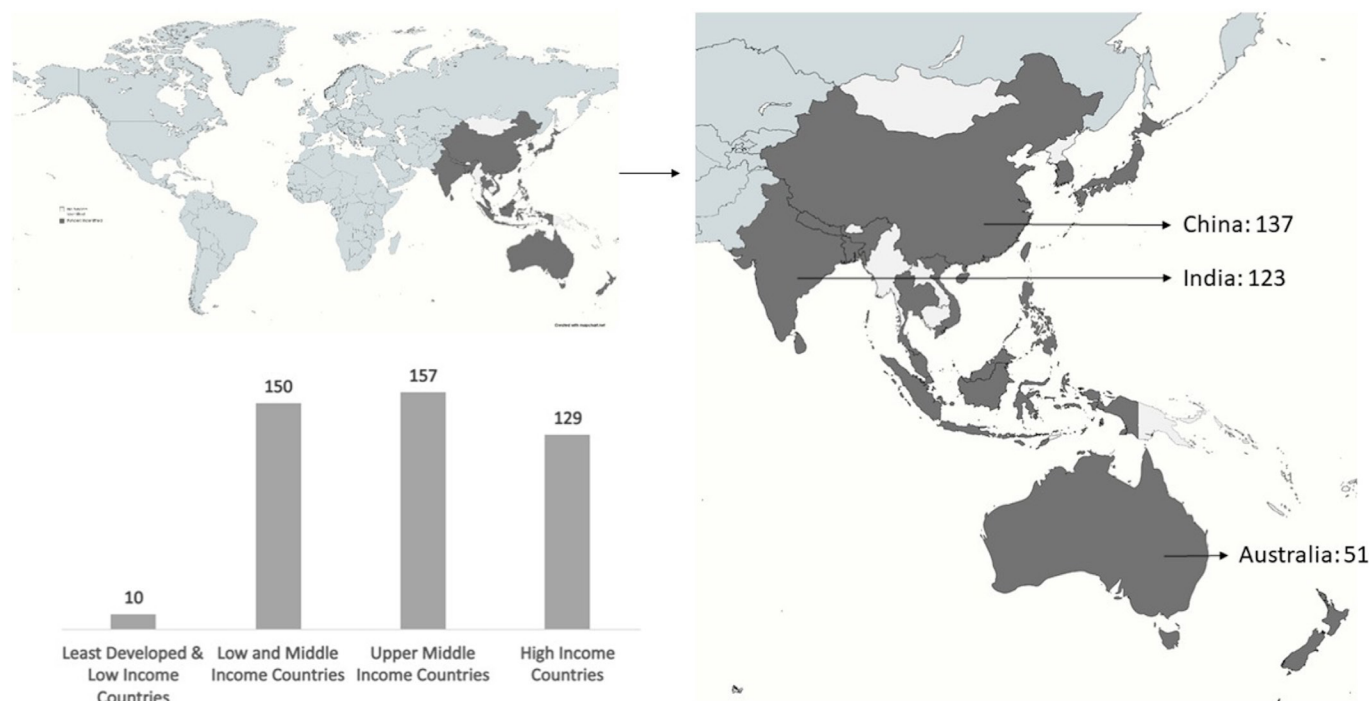


Figure 1 Locations of COVID-19 research funders and funding sources identified based in the Asia-Pacific region.

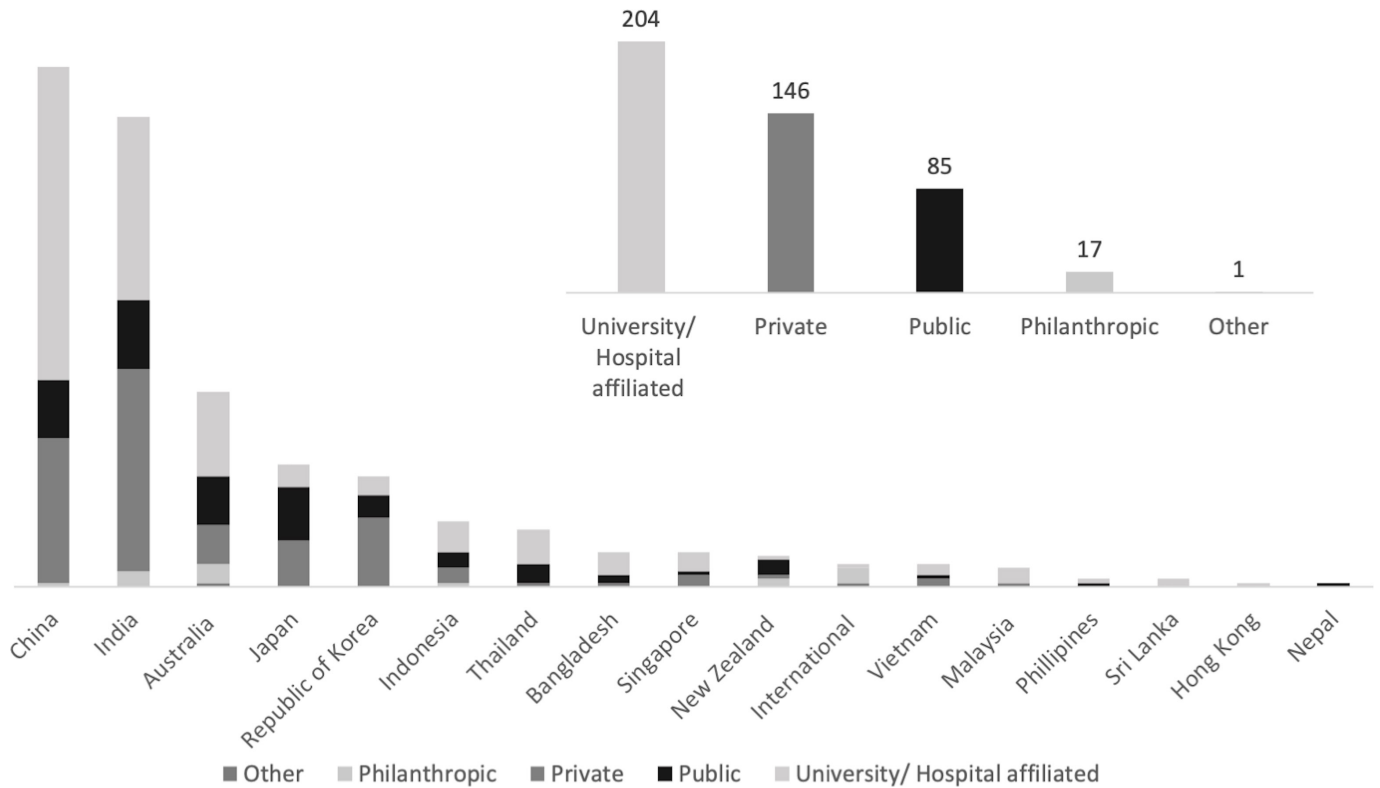


Figure 2 Categories of COVID-19 research funders and funding sources identified in countries in the Asia-Pacific region. Private entities - Funding organisations and funding sources with a profit-making objective. Public entities - Governmental funding organisations and sources of funding; Universities/ hospital-affiliated entities - Funding organisations and sources of funding which are universities or affiliated to universities/hospitals; Philanthropies - Charitable funding organisations and funding sources with a non-profit motive; Funding source in the 'other' category received funding from both private and public sources.

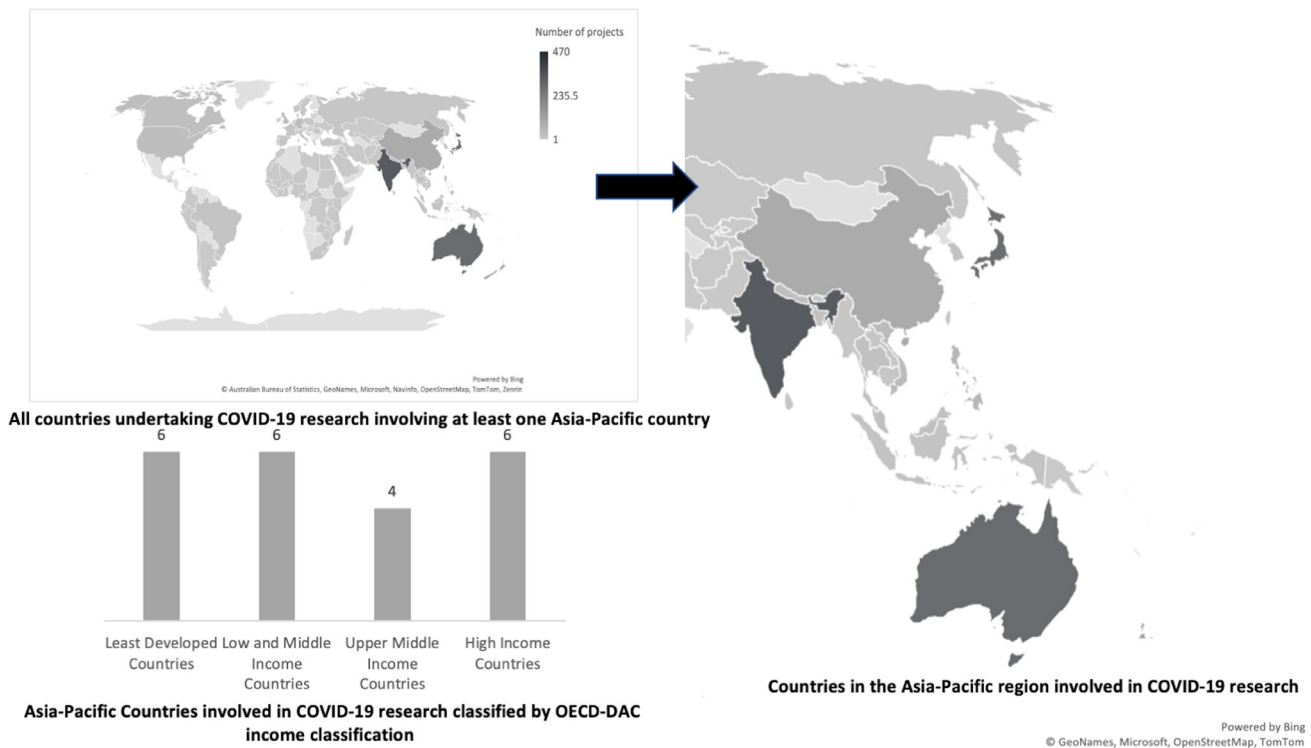


Figure 3 Locations of COVID-19 research projects involving at least one Asia-Pacific country identified from an analysis of the UKCDR & GloPID-R COVID-19 research project Tracker. Individual research projects may take place in multiple countries; GloPID-R, Global Research Collaboration for Infectious Disease Preparedness; UKCDR, UK Collaborative on Development Research; OECD-DAC, Organisation for Economic Co-operation and Development Development Assistance Committee.

sources identified are based in China (30%), India (27%) and Australia (11%). The entities classified as ‘international’ included regional organisations such as Southeast Asia Engineering Education Development Network and BRICS (collaboration among the governments of Brazil, Russia, India, China & South Africa).

Funders and funding sources were identified across all the country income groupings (as defined by the 2022–2023 OECD-DAC classification of aid recipients). Fewer of these were identified in the least developed countries than countries in the other income groups in the Asia-Pacific region. The majority of funders and sources of funding identified were hospital or university-affiliated most of which are based in China as seen in figure 2. The next two largest groups were private funders and public funders, respectively.

Scope of COVID-19 response in the Asia-Pacific region and alignment to WHO research priorities

Of the 16 353 projects captured in the UKCDR & GloPID-R Tracker (as of 15 April 2022), 1752 projects involved at least one country in the Asia-Pacific Region. These research projects involved 22 of the 38 countries in the region (see figure 3). Most projects involved Singapore (470 projects), India (329 projects) and Australia (282 projects). One

hundred and seventeen funders invested at least US\$604m (USD) in COVID-19 research in the Asia-Pacific region whereas US\$6.2bn of the known amounts was invested globally in the same period. National Medical Research Council (Singapore), Grants-in-Aid for Scientific Research (KAKENHI, Japan) and Japan Agency for Medical Research and Development funded the most research projects (figure 4). However, the majority of funders identified are based in North America and Europe.

Mapping of funded research projects to the WHO COVID-19 research priorities showed most projects mapped to the ‘social sciences in the outbreak response’ priority area (see figure 5). Projects on ‘virus: natural history, transmission and diagnostics’, ‘clinical characterisation and management’ and ‘candidate therapeutics R&D’ were the next priority areas with the most projects. Research on ‘ethics considerations for research’ and ‘animal and environmental research was the focus of the least number of projects’.

Many projects on ‘social sciences in the outbreak response’ focused on adherence to public health interventions and effective communication on various aspects of the pandemic. The majority of the projects could not be classified under any of the existing sub-priorities in this category and were tagged ‘N/A’.

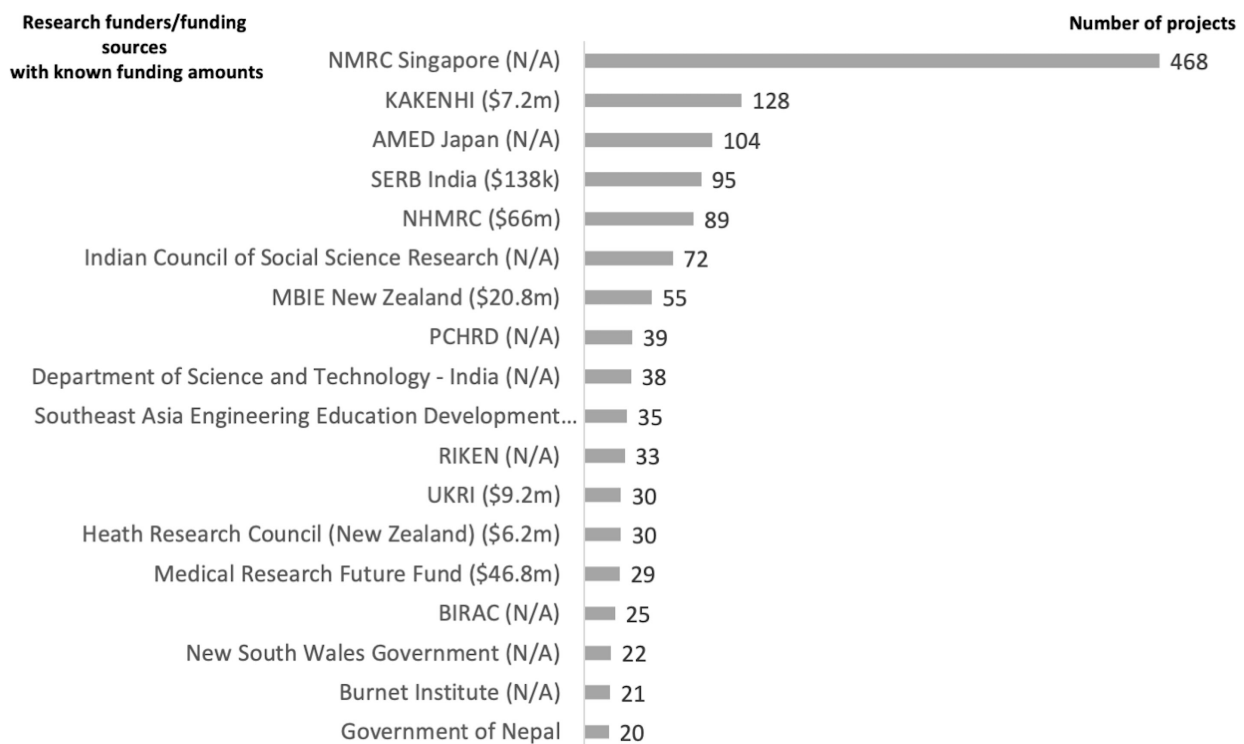


Figure 4 Funders of COVID-19 Research in the Asia-Pacific Region identified from an analysis of the UKCDR & GloPID-R COVID-19 Research Project Tracker. Known funding amounts in brackets, funders of 20 or more projects shown. Forty percent of projects in the Asia-Pacific region include details on funding amounts hence ranking of funders based on number of projects rather than funding amounts. N/A is indicated where no information on funding amounts identified. GloPID-R, Global Research Collaboration for Infectious Disease Preparedness; N/A, not available; UKCDR, UK Collaborative on Development Research; NMRC, National Medical Research Council; AMED, Agency for Medical Research and Development; SERB, Science and Education Research Board; NHMRC, National Health and Medical Research Council; KAKENHI, Grants in Aid for Scientific Research; MBIE, Ministry of Business, Innovation and Employment; PCHRD, Philippine Council for Health Research and Development; UKRI, UK Research and Innovation; BIRAC, Biotechnology Industry Research Assistance Council.

Funders of less than 20 projects: APPRISE (US\$497k, 19 Projects), (SGC) (N/A, 19 Projects), OUCRU (N/A, 17 Projects), CIHR (US\$5.5m, 15 Projects), Social Sciences Research Council (N/A, 13 Projects), UKRI/National Institute for Health Research (US\$6.9m, 12 Projects), University of New South Wales (N/A, 12 Projects), International Growth Centre (N/A, 11 Projects), Paul Ramsay Foundation (via APPRISE) (N/A, 11 Projects), BRICS (N/A, 10 Projects), e-Asia JRP (N/A, 10 Projects), IDRC (US\$5.9m, 10 Projects), Therapeutic Innovation Australia (N/A, 10 Projects), Callaghan Innovation (US\$1m, 9 Projects), RBWH Foundation (N/A, 9 Projects), Shastri Institute (US\$7.5k, 8 Projects), Victoria State Government (Australia) (N/A, 8 Projects), APPRISE/CREID (N/A, 7 Projects), Australian National University (N/A, 7 Projects), British Academy (45k, 7 Projects), NSF (USA) (US\$800k, 7 Projects), University of Auckland (N/A, 7 Projects), Doherty Institute (N/A, 6 Projects), G2LMILIC (N/A, 6 Projects), ANRS (US\$893k, 5 Projects), Brain Research New Zealand (N/A, 5 Projects), Institut Pasteur (N/A, 5 Projects), NCSEHE (N/A, 5 Projects), Other Funders (Canada) (N/A, 5 Projects), RAENG (US\$130k, 5 Projects), Volkswagen Stiftung (N/A, 5 Projects), Auckland Medical Research Foundation (US\$185k, 4 Projects), Azim Premji University (N/A, 4 Projects), Coalition for Epidemic Preparedness Innovations - CEPI (US\$338m, 4 Projects), CREID (N/A, 4 Projects), (NIH) (US\$1.6m, 4 Projects), Novo Nordisk Foundation (N/A, 4 Projects), RCN Norway (US\$2.9m, 4 Projects), Snow Medical (via CREID/APPRISE) (N/A, 4 Projects), SSHRC (US\$1.7m, 4 Projects), University College London - UCL (US\$2k, 4 Projects), Agence nationale de

la recherche (ANR) (N/A, 3 Projects), Duke University (N/A, 3 Projects), Emergent Ventures Fast Grants (N/A, 3 Projects), European Commission (US\$8m, 3 Projects), ICMR/NIH (US\$628k, 3 Projects), National Institute for Health Research (US\$7.4m), NSFC/NRF (Korea) (N/A, 3 Projects), PEDL (N/A, 3 Projects), RSTMH/National Institute for Health Research (N/A, 3 Projects), Vingroup (US\$839k, 3 Projects), AXA (N/A, 2 Projects), CIHR/Alberta Innovates (US\$869k, 2 Projects), COVID-19 Therapeutics Accelerator (Wellcome/Bill & Melinda Gates Foundation) (US\$9m, 2 Projects), DBT India (N/A, 2 Projects, 2 Projects), European Commission (IMI) (US\$42.3m, 2 Projects), FCDO (formerly DFID)/National Institute for Health Research/Wellcome (Elrha funding call) (N/A, 2 Projects), Innovations for Poverty Action (N/A, 2 Projects), International Science Council (N/A, 2 Projects), IZA—Institute of Labor Economics (N/A, 2 Projects), NSFC/BNSF (N/A, 2 Projects), NWO Netherlands (N/A, 2 Projects), University of Michigan (N/A, 2 Projects), Wellcome/FCDO (formerly DFID) (US\$2.2m, 2 Projects), French Development Agency - AFD (US\$2.1m, 1 Project), ANRS/Expertise France (US\$132k, 1 Project), Agence Universitaire de la francophonie - AUF (N/A, 1 Project), BSAC (US\$99k, 1 Project), CIHR/SSHRC (US\$502k, 1 Project), Danish Independent Research Foundation (US\$460k, 1 Project), DFG (N/A, 1 Project), DPI—Universidade de Brasilia (Brazil) (US\$66k, 1 Project), Estonian Research Council (US\$132k, 1 Project), European Commission (Horizon) (US\$3.5m, 1 Project), FORMAS (N/A, 1 Project), FWO Belgium (N/A, 1 Project), HRB Ireland/Irish Research Council (US\$14k, 1 Project), ICGEB (N/A, 1 Project),

WHO RESEARCH PRIORITY NAME (Broad priority areas)	Sub-priority areas							Funding Amount (USD)
	a	b	c	d	e	f	N/A	
1.Virus: natural history, transmission and diagnostics	167	61	32	85	16	4	2	\$ 47,608,675.04
2.Animal and environmental research on the virus origin, and management measures at the human-animal interface	11	4	0				0	\$ 1,122,639.08
3.Epidemiological studies	88	25	4	34			18	\$ 14,378,235.78
4.Clinical characterization and management	36	120	2	119	2		22	\$ 19,374,568.10
5.Infection prevention and control, including health care workers' protection	23	32	40	28			28	\$ 11,147,530.52
6.Candidate therapeutics R&D	168	11	0	51	10		18	\$ 106,508,736.70
7.Candidate vaccines R&D	56	5	0	0	2		27	\$ 372,142,940.00
8.Ethics considerations for research	7	1	4	20	0		2	\$ 326,208.05
9.Social sciences in the outbreak response	75	60	72	19	3	4	326	\$ 45,023,807.18
N/A	142							\$ 11,820,604.66

Figure 5 Heatmap showing COVID-19 research projects in the Asia-Pacific region mapped against the WHO & GloPID-R Research Roadmap priorities and subpriorities (list of subpriorities names in online supplemental file 2). GloPID-R, Global Research Collaboration for Infectious Disease Preparedness; R&D, Research and Development.

ICMR/CDC (US\$527k, 1 Project), ICMR/DRDO India/DDR&D Israel (N/A, 1 Project), ICMR/National Institute for Health Research (US\$82.9k, 1 Project), ICMR/National Institute for Health Research UKRI (US\$240k, 1 Project), ICMR/Novavax/360biolabs (US\$996k, 1 Project), ICMR/University of Edinburgh (US\$7.5k, 1 Project), ICMR/University of Oxford (US\$100k, 1 Project), ICMR/WHO (US\$90k, 1 Project), ICMR/WHO-SEARO (US\$66.5k, 1 Project), Johns Hopkins University (N/A, 1 Project), Leibniz Association (N/A, 1 Project), NASA (N/A, 1 Project), National Science Center Poland (US\$80.4, 1 Project), Nuffield Foundation (US\$309k, 1 Project), Other Funders (USA) (N/A, 1 Project), Paul Ramsay Foundation (N/A, 1 Project), Peter Wall Institute (N/A, 1 Project), REACTing/INSERM (N/A, 1 Project), Robert Wood Johnson Foundation (US\$419k, 1 Project), RSTMH (US\$6.7k, 1 Project), Swiss National Science Foundation - SNF (US\$308.8k, 1 Project), SVRI (N/A, 1 Project), UNITAID/ANRS (N/A, 1 Project), University of Colorado (N/A, 1 Project).

DISCUSSION

The findings presented in this study show the distribution and characteristics of funding sources and funders who responded to the COVID-19 pandemic in the Asia-Pacific region. Over two-thirds of the identified funders and sources of funding were in three countries: China, India and Australia. Japan and the Republic of Korea (South Korea) are the next two countries with the most funders/funding sources among the remaining third of the funders identified. The analysis of five databases across multiple disciplines was intended to allow for an assessment of a breadth of research funding activities in the Asia-Pacific region. However, while the apparent dominance of some countries shown in the results may be a true reflection of their strong research environments, it might also suggest limited data capture for funders/funding sources in the other Asia-Pacific countries across the databases analysed. The findings might also suggest limited data available from lower income countries in the Asia-Pacific region.

The classification of funders and funding sources in the Asia-Pacific region showed university/hospital affiliated entities supported the most COVID-19 research. Most of these were located in China and this is likely explained by the numerous research activities undertaken in China, particularly early in the pandemic.^{26 27} It is challenging to ascertain whether the institutions identified supported COVID-19 research directly or received funding from other sources, as is typically the case for universities. The high representation of private funding entities can be attributed to the large number of industry players who invested in COVID-19 products during the pandemic.²⁸ Many of these were captured in the COVID NMA database, which specifically captures research on vaccines, diagnostics and therapeutics.

The findings could also be attributed to a variable definition of 'research funders' applied across the databases analysed. This could have resulted in variable capturing of research funders to include: sponsors of research (typically sites hosting clinical trials); entities directly providing funding for research and intermediaries disbursing funds received from various sources. The capture of sponsors as research funders could explain the high number of university/hospital-affiliated funders identified. This mixed picture of funders and funding sources particularly, downstream intermediary funding sources poses a challenge to discerning which funders primarily supported research, owing to the lack of data in this regard. More broadly, our findings highlight the persistent limited transparency in health research funding, contributing to the challenges for the effective tracking of research investments for infectious diseases research.

The analysis of the UKCDR and GloPID-R COVID-19 Research Project Tracker showed almost 10% of the total projects captured in the database involved at least one country in the Asia-Pacific region. The analysis also identified key funders based outside the Asia-Pacific region which supported COVID-19 research in the region. Some of the funders identified supported research taking place in Cambodia, Laos, Myanmar, Bhutan, Maldives, Papua New Guinea and Brunei. Research projects involving these countries were all funded by funders based outside the Asia-Pacific Region and hence were not identified by the combined analyses of the five databases. Of the funders located outside the Asia-Pacific region, UK Research and Innovation, Canadian Institutes of Health Research and Social Sciences and Humanities Research Council (Canada) funded the most research projects.

In presenting findings from analysing the UKCDR and GloPID-R COVID-19 Research Project Tracker, we have emphasised the number of research projects funded rather than the funding amounts as this data is incomplete. Only 40% of the projects taking place in the Asia-Pacific region included details on amounts invested. This speaks to the need for greater transparency of funders in providing details on their research funding investments.

Analysis of funding amounts must be interpreted with caution given that the financial investments required for research vary across research disciplines. An example of this is shown in our analysis where we found CEPI invested at least US\$338m in four clinical research projects (based on the known research funding amounts). An emphasis on the size of investments in research may also diminish the value of investments made by low-income and middle-income country-based funders where research costs are likely to be lower (particularly when pegged to the USD) than in higher-income settings.

In assessing the alignment of funded projects to the WHO research priorities, we found many projects falling within the social sciences (the focus of most of the projects) did not fall under any of the WHO subpriority areas outlined. Many of these projects focused on longer-term

priorities including secondary economic impacts of the pandemic and impacts on mental health and health systems. The WHO Roadmap was developed in the early phases of the pandemic and focused on more immediate research priority areas and, hence, could explain why these projects could not be categorised beyond their broad area of focus in the social sciences. The UN Research Roadmap, published in November 2020, complements the WHO Roadmap, providing longer-term priorities relevant for the recovery from COVID-19.²⁹ Mapping of the globally funded COVID-19 projects to this roadmap has shown some research projects funded were focused on effective recovery in the postpandemic period.¹³

Of the projects which mapped to the subpriority areas outlined in the WHO Roadmap, most focused on assessing effective measures to promote adherence to public health interventions, development of effective COVID-19 diagnostics and investigating pathogenesis and clinical management procedures for COVID-19. The few projects focusing on 'ethics considerations for research' and 'animal and environmental research' found in this analysis aligns with limited the global trend in funded research under these topics and are recognised gaps in funded COVID-19 research.¹³

The alignment of most projects identified to at least one WHO research priority area supports the view that the WHO priorities were widely used by funders and other stakeholders in their practice during the pandemic.³⁰ However, activities to identify research priorities in Africa highlighted the need for regional priority setting to address regional research needs.^{31–33} In September 2022, almost 2 years after the WHO Roadmap was developed, the WHO South-East Asia Regional Office published the results of a priority setting survey.³⁴ Their paper outlined region-specific public health research priorities on COVID-19. We have not, however, identified any published research prioritisation exercises for the Pacific region.

One of the aims of this work was to identify key funders active in infectious diseases research in the Asia-Pacific region. Taken together, the findings from the combined database analysis and the analysis of the UKCDR and GloPID-R Research Project Tracker could suggest limited publicly available data on funding and research activities during the COVID-19 pandemic in the Asia-Pacific region. The COVID-19 pandemic resulted in a massive global research response with many funding organisations supporting research in diverse fields. Hence, an assessment of these funders is likely to capture many of the usual research funding organisations active in the infectious diseases field.

Accountability is a commonly cited benefit of tracking research funding investments in global health.³⁵ Mugabushaka *et al* suggest additional considerations with regard to the COVID-19 pandemic, in their 2022 review of bibliometric data on COVID-19 research.³⁶ These include enhanced transparency on potential

conflicts of interests among research actors and learning from various funding modalities for research.³⁶ These elements of 'improved' funding practice among funders are at the core of GloPID-R's mandate. The newly initiated pilot hub in the Asia-Pacific region has the potential to facilitate local stakeholder engagement to gain insights into regional and national research priorities and functioning of the research system in the region. The mapping results shown here are an early step to identifying the key actors in this regard, which can now be supplemented by networking activities. The planned activities in the regional hub including research capacity strengthening, strengthening regional research networks and coordination of research funders will be crucial for promoting preparedness for outbreaks of infectious diseases of epidemic and pandemic potential.

Limitations

Data for the analyses of funded COVID-19 research activities were sourced from publicly available databases. Hence, this analysis is limited to those projects with information in the public domain. The inherent limitations of these datasets must also be noted in the interpretation of results. In particular, the variable level of completeness of funding data captured across the databases and varying data fields captured must be considered. In the assessment of funding sources and funders for research, we used data as listed in the databases assessed with due acknowledgement of the likely variation in definition of research funders applied across these databases. Furthermore, as there is no standard definition for the classification of funders, classification in this work (see figure 2) was done by reviewing available information on websites of each of the identified funding sources. For the analysis of the UKCDR and GloPID-R Research Project Tracker, we have emphasised number of projects funded rather than funding amounts invested, given that data on award amounts captured in the database is incomplete.

CONCLUSIONS

We undertook an analysis of the funded COVID-19 research activities in the Asia-Pacific region to support GloPID-R's regional hub pilot in the region. Our analyses show the diversity of funding sources and funders investing in research in the Asia-Pacific region. It is envisaged that the GloPID-R Asia-Pacific regional hub, through enhanced engagement with the diverse actors involved in research, will strengthen regional ownership of research and promote coordinated approaches to preparing for and responding to infectious diseases outbreaks regionally and globally.

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Summary of key information on datasets included in study to map research funders and funding sources in the Asia-Pacific region during the COVID-19 pandemic

Database	COVID-19 Research Area of focus	Version	Total Number of Projects
UKCDR & GloPID-R Research Project Tracker	All COVID-19 research & projects aligned to the WHO Coordinated Global Research Roadmap for COVID-19 priorities	15th April 2022	16,353
Policy Cures R&D Tracker	Vaccines, Therapeutics & Diagnostics	1st October 2021	561
OECD Global Science Forum	No specific area reported	21st September 2020	Could not be determined
Universities Allied for Essential Medicines COVID Mapping	Vaccines, Therapeutics & Diagnostics Tracking Public Investment in International COVID-19 Research and Development	14th April 2021	1,798
The COVID-NMA initiative	Vaccines, Therapeutics & Other (post-acute care) interventions	20 th September, 2022	4,492

WHO Research Priorities

World Health Organisation: A Coordinated Global Research Roadmap: 2019 Novel Coronavirus, March 2020

https://www.who.int/blueprint/priority-diseases/key-action/Coronavirus_Roadmap_V9.pdf?ua=1

- | | |
|----------|---|
| 1 | Virus: natural history, transmission and diagnostics |
| 1.a | Support development of diagnostic products to improve clinical processes. |
| 1.b | Understand virus compartments, shedding and natural history of disease. |
| 1.c | Develop tools and conduct studies to monitor phenotypic change and potential adaptation. |
| 1.d | Characterize immunity (naturally acquired, population and vaccine-induced, including mucosal immunity). |
| 1.e | Develop disease models (animal models and 3Rs approaches) |
| 1.f | Virus stability in the environment |
| 2 | Animal and environmental research on the virus origin, and management measures at the human-animal interface |
| 2.a | Investigation of animal source and route of transmission |
| 2.b | Socioeconomic and behavioural risk factors for spill-over |
| 2.c | Risk reduction strategies at the human-animal environment interface |
| 3 | Epidemiological studies |
| 3.a | Transmission dynamics- Clarify the relative importance of pre-symptomatic/asymptomatic transmission (including distinction between virus shedding and infectious transmission) |
| 3.b | Disease severity - Identify groups at high risk of severe infection; Determine the role of different age groups in transmission |
| 3.c | Susceptibility - Determine if children are infected, and if so, are they infectious? |
| 3.d | Control and mitigation measures - Predict the most effective measures to reduce the peak burden on healthcare providers and other societal functions; Estimate the effects of social distancing measures and other non-pharmaceutical interventions on transmissibility |
| 4 | Clinical characterization and management |
| 4.a | Prognostic factors for severe disease (Different populations - pregnancy, young children, risk groups - immunosuppressed) |
| 4.b | Understand pathophysiology of COVID-19 infection, including understanding mild disease and the role of co-infections / infection, transmissibility, viral shedding |
| 4.c | Optimal endpoints for clinical trials |
| 4.d | Improve processes of care, including early diagnosis, discharge criteria; Determine interventions that improve the clinical outcome of infected patients (Steroids, High flow oxygen therapy) |
| 4.e | Optimal adjuvant therapies for patients (and contacts) |
| 4.f* | Develop core clinical outcomes to maximize usability of data across range of trials |
| 5 | Infection prevention and control, including health care workers' protection |

- 5.a Effectiveness of restriction of movement of healthy exposed and infected persons to prevent secondary transmission (home, congregate setting, geographical restriction vs nothing)
- 5.b Effectiveness of specific PPE to reduce the risk of COVID-19 transmission among HCWs, patients and individuals in the community
- 5.c Effectiveness of activities to minimize the role of the environment in COVID-19 transmission
- 5.d Factors and methods influencing compliance with evidence-based IPC interventions during outbreak response

6 Candidate therapeutics R&D

- 6.a Develop in vitro and in vivo testing to identify candidates
- 6.b Evaluate efficacy and safety in prophylactic use
- 6.c Promote adequate supply of therapeutics showing efficacy
- 6.d Evaluate efficacy and safety of therapeutics through randomised clinical trials
- 6.e Investigate combination therapies

7 Candidate vaccines R&D

- 7.a* Identification of candidates for clinical evaluation in addition to the ones already prioritized.
- 7.b To develop and standardize animal models to evaluate the potential for vaccine effectiveness and to understand the potential for enhanced disease after vaccination. Results from animal models are expected to be important prior to large-scale efficacy studies and prior to studies in which enhanced disease is considered a significant possibility.
- 7.c To develop and standardize assays to support vaccine development, particularly to support the evaluation of immune responses and to support clinical case definition. Basic reagents should be shared to accelerate the development of international standards and reference panels that will help support the development of ELISAs, pseudovirion neutralization and PCR assays.
- 7.d To develop a multi-country Master Protocol for Phase 2b/Phase 3 vaccine evaluation to determine whether candidate vaccines are safe and effective before widespread distribution, using methodologically sound and ethically acceptable vaccine trial design. Vaccine efficacy trials should be done if such are feasible to implement.
- 7.e To develop potency assays and manufacturing processes to rapidly enable the production of high quality large quantities of clinical grade and GMP materials.

8 Ethics considerations for research

- 8.a Articulate and translate existing ethical standards to salient issues in COVID-19
- 8.b Sustained education, access, and capacity building
- 8.c The impact of restrictive public health measures (e.g., quarantine, isolation, cordon sanitaire)
- 8.d Public health communications and the 'infodemic'; ensuring accurate and responsible communications
- 8.e Ethical governance of global epidemic research

9 Social sciences in the outbreak response

- 9.a Public Health - What are relevant, feasible, effective approaches to promote acceptance, uptake, and adherence to public health measures for COVID-19 prevention and control; and how can secondary impacts be rapidly identified and mitigated?

- 9.b** (Clinical) care and health Systems - What are the relevant, acceptable and feasible approaches for supporting the physical health and psychosocial needs of those providing care for COVID-19 patients?
- 9.c** Media and communication - How are individuals and communities communicating and making sense of COVID-19? What are the most effective ways to address the underlying drivers of fear, anxieties, rumours, stigma regarding COVID-19, and improve public knowledge, awareness, and trust during the response?
- 9.d** Engagement - What are the relevant, acceptable and feasible approaches for rapid engagement and good participatory practice that includes communities in the public health response.?
- 9.e** Sexual and reproductive health - What are the relevant, acceptable and feasible approaches to communicating uncertainty regarding mother to child transmission of COVID-19, and possible sexual transmission?
- 9.f** International cooperation - What international coordination mechanisms can optimize the international response to COVID-19?

* These sub-priorities were added from "key milestones" or "other research priorities" listed in the document to help classify the data