BMJ Open

Global access to COVID-19 vaccines: a scoping review of factors that may influence equitable access for low and middle-income countries

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To cite: Peacocke EF, Heupink LF, Frønsdal K, *et al*. Global access to COVID-19 vaccines: a scoping review of factors that may influence equitable access for low and middle-income countries. *BMJ Open* 2021;**11**:e049505. doi:10.1136/bmjopen-2021-049505

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-049505).

Received 26 January 2021
Accepted 03 September 2021

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ABSTRACT

Objective To identify the factors contributing to equitable access to COVID-19 vaccines for low and middle-income countries (LMIC).

Methods We conducted a scoping review following the guidelines for Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews and a five-stage framework for scoping studies. We performed systematic searches for published peer-reviewed literature in five databases: Medline, Embase, Web of Science, Global Index Medicus and COVID-19 Evidence Epistemonikos (August 2020, updated May 2021).

Results Systematic selection according to predefined criteria resulted in the final inclusion of 45 peer-reviewed articles, with no limitations on study design or publication type. We derived four key factors that potentially influence equitable access to COVID-19 vaccines in LMICs: (1) collectively agreed global mechanisms or frameworks; (2) bilateral purchasing, contracting, and vaccine prices; (3) vaccine manufacturing that is supported by sharing know-how; and (4) countries' strength in implementing vaccination programmes.

Conclusions This scoping review highlights the ongoing challenges for the international community in ensuring equitable access to COVID-19 vaccines for LMICs. The literature suggests that vaccine manufacturing can influence the supply of vaccines, as can the role of patent holders who can influence global governance through their role in the distribution of COVID-19 vaccines. Our findings indicate that including the principles of equitable access throughout vaccine research and development, procurement, scale-up and distribution processes can support equitable access for LMICs. Advances made with mRNA vaccines may have additional benefits in relation to expanding the manufacturing of other vaccine. Finally, the exploration and scale-up of such capacities of LMICs are likely to prove to be a valuable investment, even after the pandemic.

Strengths and limitations of this study

- ► To our knowledge, this is the first systematic scoping review of factors influencing equitable access to COVID-19 vaccines.
- ► Included literature was selected exclusively based on relevance to the topic (according to predefined criteria), provided that it was published in peer-reviewed journals with no further quality assessment.
- ► In light of the numerous daily published articles related to the COVID-19 pandemic, there might be additional relevant articles that should have been included. Hence, the list of identified factors might not be exhaustive nor completely cover the full complexity of how various factors interact.

BACKGROUND

The Coronavirus disease (COVID-19) is a global crisis, and collective efforts are essential to curb its most devastating effects. The unprecedented demand for a vaccine has mobilised rapid vaccine development and large-scale investment in manufacturing capacity. The outlay of capital from investors for the scale-up and production of early candidate vaccines has contributed to rapid advances in vaccine science.[1] Despite these investments, the demand for safe, affordable and effective COVID-19 vaccines is expected to outstrip supply for a considerable period of time.[2] To realise the maximum benefit, vaccines should be shared fairly between all nations of the world, otherwise there will continue to be differential morbidity and mortality with increased risk of virus mutations leading to even more death and disease from COVID-19, not to mention the indirect consequences to global development and economy.[3]

In relation to the management of communicable disease outbreaks, the principle of shared benefits is a long-standing commitment of the WHO.[4] The Global Influenza Surveillance and Response System (GISRS) suggests benefit sharing as a potential solution to incentivise global collaborative infectious disease responses and measures, and

in return members have real-time access to pandemic response products, like vaccines.[5 6] Low and middle-income countries (LMIC) face unique challenges in accessing vaccines as they do not have the same resources to purchase vaccines and are less likely to have the know-how and technological capacity to be able to manufacture their own vaccines. They may also face uncertainty in their ability to obtain vaccines due to reduced purchasing power compared with high-income countries (HIC) when negotiating with vaccine manufacturers.[7] Therefore, they are more reliant on multilaterally agreed frameworks or bilateral support to access new technologies.[6] The global community has previously in part managed this with non-binding mechanisms designed to promote equitable access. The 2006 WHO Global Pandemic Influenza Action Plan (GAP), for instance, was designed to support increased vaccine supply and global vaccine manufacturing capacity by promoting technology transfer to middle-income countries (MICs).[8] As established vaccine manufacturing nations, some MICs' expertise can support the scale-up of vaccine production.

Ineffective institutional mechanisms for pandemic vaccine distribution were exposed during the influenza A (H1N1) ('Swine flu') pandemic in 2009,[6] despite embedded principles of reciprocity and equity for the prevention and control of influenza pandemics affirmed by member states at 2003 World Health Assembly. Swine flu and the COVID-19 pandemic are reminders that there is no institutional mechanism to effectively distribute global goods such as COVID-19 vaccines.[4] The Pandemic Influenza Preparedness Framework was developed following the H5N1 outbreak in Indonesia in 2005, triggering increased interest in the GISRS, which in turn led to the WHO intergovernmental process and further scrutiny of its influence on the development of influenza vaccines, and recognition of failures to ensure fairness, transparency and equity in access to vaccines for LMICs.[6 9 10]

Specifically, for COVID-19, the WHO led the Access to COVID-19 Tools Accelerator (ACT-A) global collaboration designed to fast-track development, production and equitable access to COVID-19 tests, treatments and vaccines.[11] COVAX, the vaccines pillar of the ACT-A, is an initiative whose role is proving to be integral in the equitable distribution and access to COVID-19 vaccines, by providing an alternative for LMICs that have been failed by historical bilateral vaccine donation systems.[1 12] COVAX is co-led by the Coalition for Epidemic Preparedness Innovations (CEPI), a vaccine funding initiative, Gavi, the vaccine alliance, and WHO. Member countries of COVAX include those that have self-financing investments, but also others that are being supported through aid. COVAX aims to coordinate the vaccination of high-risk and vulnerable populations, including frontline healthcare workers across the world, through distributing 2 billion vaccine doses by the end of 2021. These vaccines will be shared between the member countries, of which 78 are HICs, and 92 are LMICs.[13] Figure 1 lists the events and a timeline of initiatives introduced before and following relevant pandemics, as identified in our scoping review.

The idea that access and distribution of COVID-19 vaccines should be equitable across countries is widely supported, but what *equity* means in this context is often not specified. From the perspective of LMICs, equitable access to a vaccine is fundamentally linked to a fair and transparent global distribution framework.[14] Hence, for the purpose of this review, equitable access is interpreted as all countries, and their populations, having equal access to COVID-19 vaccines irrespective of the income status of the country. Further, we considered a COVID-19 vaccine as an essential medicine (Essential medicines are those that satisfy the priority healthcare needs of the population). We have used the WHO definition of health equity (Health equity or 'equity in health' implies that ideally everyone should have a fair opportunity to attain their full health potential and that no one should be disadvantaged from achieving this potential).[15 16] In its first phase, COVAX plans to allocate vaccines in proportion to countries' total population so that all countries receive doses to cover 20% of their population.[17 18] Alternative proposals exist, including the Fair Priority Model proposed by a group of ethicists. This model goes beyond proportional allocation by proceeding with allocation of vaccines in three phases, which would in the first instance prioritise the prevention of more urgent harms.[19 20] The ethical rationale behind this model argues that proportional allocation, as suggested by WHO and COVAX, is not the fairest solution, as it implies that some countries with relatively lower risk of death and disease from COVID-19 would receive access to vaccines at the expense of other countries that are facing more exposure.[20]

The objective of this scoping review was to identify and summarise those factors that contribute to the equitable access of COVID-19 vaccines for LMICs. To our knowledge, the literature related to the equitable access of COVID-19 vaccines relevant for LMICs has not yet been systematically investigated. The review is considered highly relevant as it can provide lessons from previous experiences and perspectives on equitable access to pandemic vaccine by identifying key factors that could guide implementation of future initiatives to ensure equitable access.

METHODS

We performed systematic scoping searches following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews as indicated in figure 2, and were guided by the Arksey and O'Malley's five-stage framework for scoping studies through the steps of the review.[21 22] The study protocol was peer reviewed by methodological and subject experts at the Norwegian Institute of Public Health (online supplemental appendix 1).

Based on predefined inclusion criteria (table 1), we systematically searched in the following five databases: Medline (PubMed and Ovid), Embase, Web of Science,

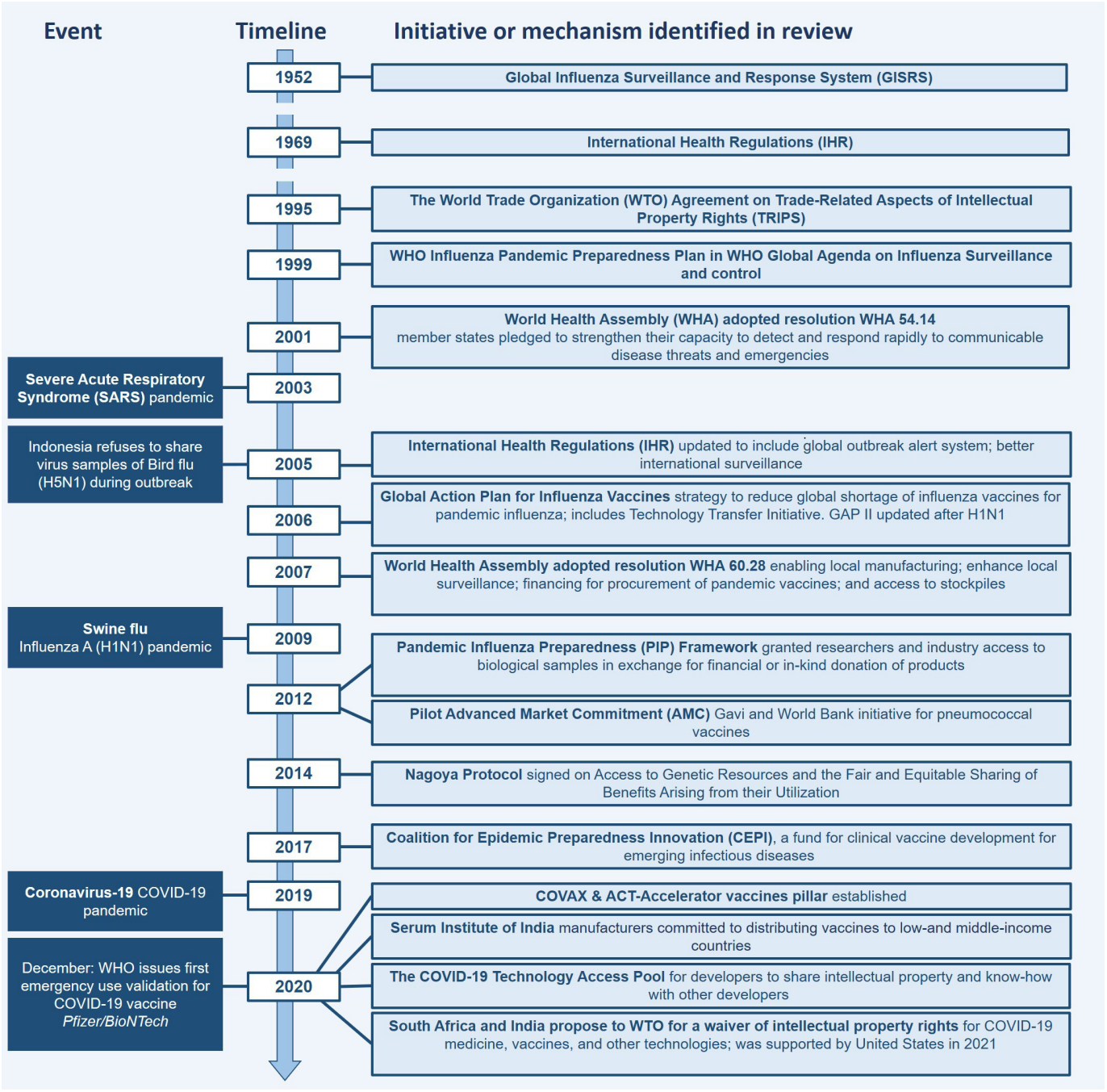

Figure 1 Timeline of events and relevant initiatives. ACT, Access to COVID-19 Tools; GAP, Global Pandemic Influenza Action Plan.

Global Index Medicus (WHO) and COVID-19 Evidence Epistemonikos. The search strategy was based on the following keywords and terms and combinations of these (ie, coronavirus, COVID-19, SARS-CoV, equity, LMIC, pandemic and (influenza) vaccine) (online supplemental appendix 2). An information specialist, in collaboration with coauthors, developed the search strategies for the different databases. The search was performed on 28 August 2020 and updated on 12 May 2021. Only published literature in peer-reviewed journals was eligible for inclusion, with no limitations on study design nor publication type. The articles for extraction were exclusively chosen based on relevance to the topic of identifying and describing potential factors related to equitable access to pandemic or COVID-19 vaccines, with no further quality assessments.

Publications were screened based on title and abstract according to the inclusion criteria (table 1). Two reviewers independently selected articles to be considered for full text screening. Selected articles were then read in full and considered for inclusion or exclusion by two different reviewers. Final decisions on inclusion of relevant articles were determined through consultation between three of the reviewers. Disagreements were resolved through

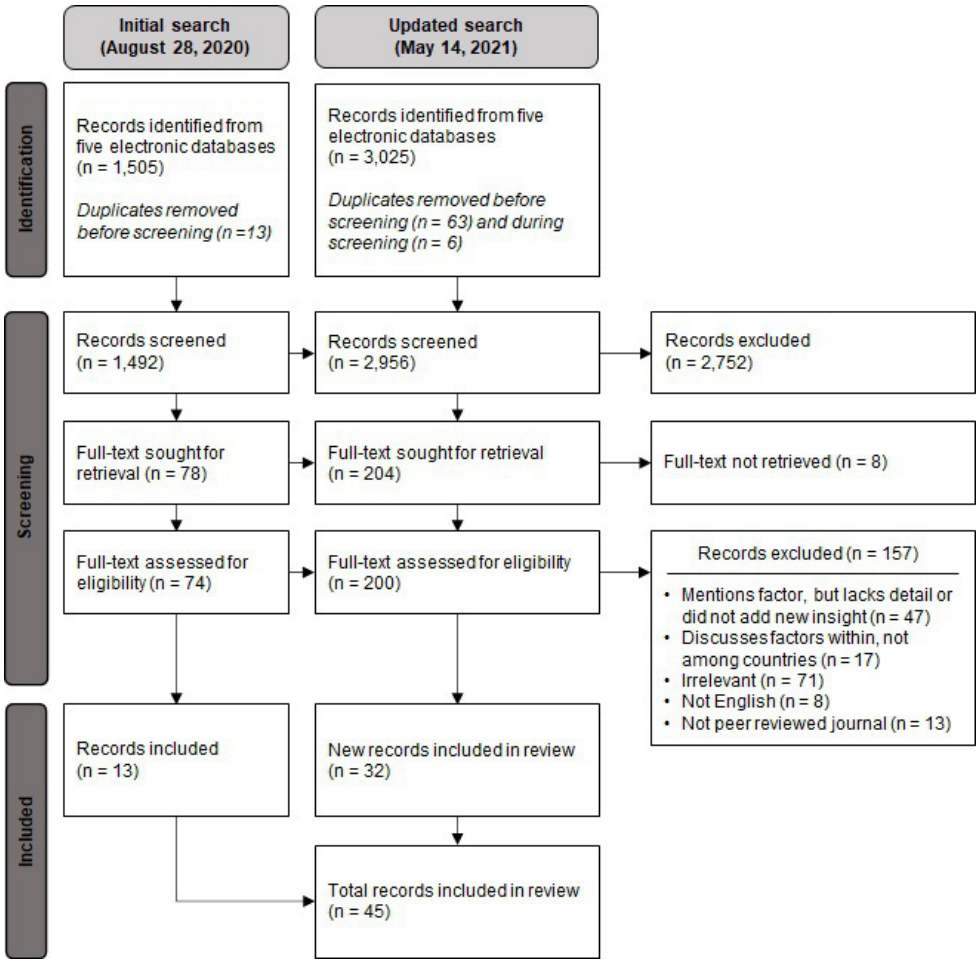

Figure 2 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart for selection of articles.

discussions to reach consensus. See online supplemental appendix 3 for the list of the excluded articles and reasons for exclusion.

Data extraction was performed by one reviewer and verified by a second. We used a data extraction form designed specifically for this scoping review. We extracted information on the setting; discussion on equity, access, allocation or prioritisation of pandemic vaccines; other equity aspects; challenges in implementing equitable access to vaccination between countries; and recommendations for strengthening equitable access to vaccination (online supplemental appendix 4). The analytical process followed the principles of thematic synthesis. The article by Liu *et al* was identified as an index paper as it suggested a framework that closely reflected the focus of our scoping review.[23] The themes identified in this article were used as basis to extract and categorise our findings, and were further refined during analysis, where we identified potential factors influencing equitable access to COVID-19 vaccines in LMICs.

Table 1 Inclusion criteria

Criterion	Inclusion
Time	1 January 2002 to 12 May 2021
Language	English
Type of article	Published in peer-reviewed journals
Article focus	Pandemic vaccines including influenza or COVID-19 vaccine
Outcomes	Factors influencing equitable access to a pandemic vaccine including COVID-19 vaccines

RESULTS

Excluding duplicates, our search identified 3025 unique citations (figure 2). Screenings first based on title and abstract, then on full text resulted in the final inclusion of 45 articles (described in online supplemental appendix 5).

We categorised the identified themes from the included citations into four factors influencing access to COVID-19 vaccines in LMICs: (1) collectively agreed global mechanisms or frameworks can contribute to equitable access to COVID-19 vaccines; (2) bilateral purchasing, contracting and vaccine prices can influence fair access; (3) large-scale vaccine manufacturing that is supported by sharing know-how can facilitate increased supply and access to

Table 2 Summary of identified factors contributing to equitable access to COVID-19 vaccines

Factors	Scoping review findings	Articles contributing to the finding
Collectively agreed global mechanisms or frameworks can contribute to equitable access to COVID-19 vaccines.	Establishing a collective and coordinated COVID-19 donation process will facilitate equitable access to pandemic vaccines.	1 5 13 24–39 52 61
	Global solidarity is facilitated by multilateral organisations and agreed frameworks.	1 5 25 28 30 33 34 40 61
	Previous collective action has been inadequate with examples of deficient vaccine donation and pledging systems related to pandemic vaccines.	1 7 26 27 30–36 40–45
	Vaccine patent holders play a pivotal role in global prices and distribution of vaccines.	6 30 44 46–49
Bilateral purchasing, contracting and vaccine prices influence fair access to vaccines.	Financing mechanisms that facilitate collective purchasing or pooled procurement favour fairer allocation.	5 6 25 27–29 33 34 39 45 46 50 55–58
	Nationalistic approaches, where bilateral rather than collective purchasing is pursued, contribute to hoarding or supply inefficiencies, limiting the global supply of vaccines.	1 7 23–27 29 31–34 36 37 40 42 44 45 48 51–53 55 58 59 61
	Pandemic vaccines will largely be purchased by, and for use in, high-income countries (HICs).	25 27–30 32–36 39 40 43–45 52–55 58 59
	LMICs cannot procure or negotiate the purchase of pandemic vaccines at the same level as HICs, and can therefore be disadvantaged by bilateral deals.	6 25 29 32 33 36
	The price and affordability of vaccines influence equitable access.	7 27–29 33 45 46 56–58
Large-scale vaccine manufacturing that is supported by sharing know-how can facilitate increased supply and access to COVID-19 vaccines.	Substantial investments are required to finance and support global vaccine manufacturing.	5 7 29 32 33 36–38 44 47 52 56
	There is disparity between countries that have the capacity to produce vaccines and those that use vaccines.	5 7 23 24 40 49 59
	Technology transfer of vaccine manufacturing (especially to MICs) supports increased supply, favouring fairer allocation.	1 6 27–30 35 36 44 46–48 55 59 61
	Intellectual property rights influence domestic manufacturing.	6 29 33 36 44 46 49 61
	Capacity building for technology transfer can support vaccine manufacturing and technology transfer in LMICs.	1 6 23 27 29 32 33 46 56 59
	Place of vaccine manufacturing influences exporting of vaccines, such as through a nation's sovereignty over national borders.	1 6 27 29 40 46 49 50 56 59
Countries' strength in implementing vaccination programmes may influence their populations' access to vaccines.	A country's ability to vaccinate could be a consideration in equitable distribution.	1 13 23 24 27 52 62 63
	Management of logistical and administrative components facilitates access to vaccines.	5 13 27 28 36 45 52
	A country's regulatory approval and market authorisation processes for vaccines influence access to vaccines.	30 33 36 49 51 63

LMICs, low and middle-income countries; MICs, middle-income countries.

COVID-19 vaccines; and (4) countries' strength in implementing vaccination programmes may influence their populations' access to vaccines (table 2).

- *Collectively agreed global mechanisms or frameworks can contribute to equitable access to COVID-19 vaccines.*

Most articles indicated collective action as being key to contribute to equitable access.[1 5 6 13 24–50] Global collective agreements should be driven by multilateral agencies that have the global mandate to convene interest groups, advocate for collective response measures, as well as the investment, procurement and distribution of pandemic vaccines.[51] These measures may be addressed by prompt agreement on equitable access.[5 30 38 52]

The reviewed literature suggests that historic vaccine donation and pandemic influenza pledging systems have been insufficient mainly due to the lack of legal obligation to act or the lack of penalty for parties who breach conditions.[1 26 27 30–36 40–43 45] To mitigate this, it is proposed that collective approaches need to be binding.[35] Actually, such a legal framework that has been ratified by 171 countries already exists, the International Covenant on Economic, Social and Cultural Rights (1966); however, it has not achieved its intended purpose for countries to take steps to ensure the right to health and the benefits of scientific research, without discrimination.[34 42] In spite of these so-called failures of collective action, there is wide acceptance of the moral argument that HICs should support LMICs in equitable access to pandemic vaccines, recognising that any collective purchasing will have inherent inequalities related to existing power dynamics between the Global North and the Global South, and recognising that the status quo historically favoured HICs over LMICs.[25 35] Specifically, for vaccine allocation, there are historical examples of manufacturers not reliably committing to reserving production of pandemic vaccines to LMICs.[6 26 40]

Bilateral solutions threaten collective action by enabling some countries to queue jump.[1 29] These approaches will always be pursued during global crises, as has been demonstrated during COVID-19, and as such cannot be avoided.[32] McAdams *et al* therefore suggest that it comes down to how these bilateral arrangements are structured using two deals from different US government agencies, the Biomedical Advanced Research and Development Authority (BARDA) who has a deal with AstraZeneca, and the US Department of Health and Human Services who secured 100 million doses of Pfizer, as examples.[32] The authors suggest that the deal negotiated by BARDA benefits USA, AstraZeneca and the rest of the world by supporting the gaining, and sharing, of knowledge through its funding of advanced clinical studies, vaccine manufacturing technology transfer, process development and scaled-up manufacturing, which in turn supports more vaccines and increased availability. In contrast, the Pfizer deal only supports US and Pfizer interests. The article concludes that BARDA's deal will result in more vaccines for LMICs, regardless of whether HICs vaccinate their own populations first.[32]

COVAX is the supported mechanism and widely promoted in the literature included in this review, yet the facility has faced criticisms related to transparency, limited knowledge sharing and initally struggled with lacking political and financial commitment.[31 53] It has also faced challenges related to managing the role of patent holders who have played a determining role in distribution of their medical countermeasures. This affects global governance, with patent holders maintaining influence over the distribution of patented technologies during a pandemic, a power that rests with few pharmaceutical companies controlling the global supply and distribution of vaccines.[46 48]

The global prices of respective vaccines are not uniform across settings, with the price of a COVID-19 vaccine influenced by its patent, indicating the influence patent holders have in the distribution of vaccines.[29 45 48] To counteract the inequality in global distribution, in October 2020, a proposal was made by India and South Africa to the World Trade Organization (WTO) requesting a temporary waiver of certain provisions of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, based on the need to prevent, contain and treat COVID-19.[44 48] There is no consensus in the literature included in this review on the benefits of the waiving of intellectual property rights (IPR). Those against the waiver arguing that it is not patent protection that is the barrier to introducing generic vaccines,[42 44 47] but rather the lack of knowledge in the public domain and shortages of vaccine supplies.[1] The implications on national manufacturing, including a country's ability to enact compulsory licensure under TRIPS, are discussed later in this article.

- *Bilateral purchasing, contracting and price can influence fair access to vaccines.*

Through their greater advanced purchasing power and their ability to manufacture vaccines, HICs have a track record of dominating the global supply of pandemic vaccines. In 2021, 51% of the initial supply of COVID-19 vaccines had been purchased for 13% of the world's population, mostly residing in HICs,[28 30 40] indicating that fair vaccine allocation is hindered by the inability of LMICs to procure or negotiate access to pandemic vaccines at the same level as HICs.[6 54]

Vaccine development under the COVID-19 pandemic has highlighted the conflicting roles between private capital and access to essential healthcare technologies. Final stage research and development (R&D) of vaccines (and other medical technologies) is largely led by multinational pharmaceutical companies who are incentivised by IPR and return on investment, thus perpetuating structural market-based inequalities of supply and demand. This affects the total quantity of vaccines produced, which, in the case of influenza vaccines, has affected LMICs as it has been perceived that there is 'lower demand' in these markets.[35 50] During this recent pandemic, substantial public funding, which has historically been targeted more towards early- stage development, has also been invested in the late-stage development of multiple COVID-19 vaccines contributing to global market distortions.[32 36 37 55]

Pooled procurement is mentioned in the literature of this review as a means to support equity, with Advance Purchase Agreements (APA) and Advance Market Commitments (AMC) being the most common mechanisms identified in our review to facilitate access for LMICs.[5 6 25 28 29 33 34 39 45 46 50 55–57] APAs are contracts with a specific product developer, whereas an AMC is a global market commitment.[39] The AMC was first introduced in 1999 for the development of a late-stage pneumococcal vaccine, with the intention to shorten the time to introduction of a vaccine to LMICs.[39] Under COVID-19, APAs have been widely used to secure priority access to a scarce resource (when one party has committed to buy a specific number or percentage of doses prior to development), the influential factor for equitable access being whether they promote the interests of one country or several, and if they include LMICs.[5 6 30 34 41 50]

Bilateral deals contribute to supply inefficiencies and threaten collective approaches to the procurement of vaccines, for example, national APAs initiated by countries that are also members of COVAX (not exclusively, but mainly HICs).[32 36 37 53 55 57 58] At the beginning of the COVID-19 pandemic, HICs went ahead to purchase large quantities of COVID-19 vaccines.[31] The necessity for transparency of contractual clauses, especially relating to pricing, licensing and purchase commitments, was identified in the review as potentially negative since global coordination efforts will suffer unless vaccine manufacturers can be trusted to responsibly decide which countries' vaccine orders should be prioritised.[34 36]

Bilateralism is not limited to relationships between countries and vaccine manufacturers. During the COVID-19 pandemic, bilateral deals have also been struck between countries to directly distribute vaccines. For example, both the Russian and Chinese government-owned and

operated vaccine manufacturers have bilateral arrangements with other countries, such as India, Vietnam, Mexico, Brazil and Ethiopia, to guarantee the supply of vaccines.[28 29 55 59]

- *Large-scale vaccine manufacturing that is supported by sharing know-how can facilitate increased supply and access to COVID-19 vaccines.*

Several articles included in this review suggest that substantial additional financial and capacity investment is required to further global vaccine manufacturing.[5 7 29 32 33 36 38 44 47 52 56 60] Vaccine development is multifaceted, and manufacturing during a pandemic faces unprecedented challenges in scale and complexity.[51] A limited number of HICs, and some MICs, have vaccine manufacturing capacity, resulting in a disparity between countries that have the capacity to produce vaccines and those that need access to those vaccines.[5 7 24 40 49 59] Nhamo *et al* reported that development activity for COVID-19 vaccines is almost non-existent in LMICs.[33] The majority of development activity is in Asia, with 12 (52%) COVID-19 vaccine development programmes, followed by Europe (17%) and North America with four programmes each (17%).[33] A few MICs (Brazil, India and Peru) have capitalised on their clinical testing or manufacturing capacity efforts by leveraging these for purchase agreements with vaccine manufacturers.[29] Limited capacity affects the global availability of pandemic vaccines for two reasons. First, the world is unable to manufacture the quantity of vaccines demanded, and second, a manufacturing country has the sovereign authority over goods produced within its borders with most countries in the world having legislation in place that require companies to manufacture and prioritise domestic consumption.[33 49 50] In situations where it is enforced, government intervention may hinder global access through limitations to distribution.

For technology transfers to work, there needs to be a patent holder that is willing to share the intellectual property and a manufacturing facility that can receive it. The findings from this review suggest that MICs with vaccine manufacturing capability can play an important role to support and fill the forecasted gap in international vaccine manufacturing capacity, but this requires technology transfer and capacity building to manufacture vaccines that meet the same efficacy and quality standards as the original vaccine.[1 6 27–30 35 36 44 46–49 55 59 61] Vaccine manufacturing know-how can include vaccine developers by sharing the intellectual property of vaccine manufacturing processes or relaxing patent rights.[6 29 33 36 44 46 61] One article included in this scoping review suggests that for viral vector vaccines (eg, AstraZeneca and Johnson & Johnson), MICs with less advanced manufacturing capacity can contribute with the fill-and-finish stage of the process, rather than producing the active solution of the vaccine.[47]

Under the WTO TRIPS Agreement, countries have a right for the compulsory licensure of products in certain circumstances. In practice, this means that a country can produce a patented product or process without the consent of the patent owner, as demonstrated by Canada, Chile and Ecuador in their pandemic response.[29] The discussion related to the TRIPS waiver is especially important to LMICs, who recall recent historical experiences from South Africa where patents obstructed access to life-saving medicines for the treatment of HIV/AIDS.[42] Advocates for the COVID-19 products TRIPS waiver argue that significant public monies have contributed to the development of these patents thus waiving IPR will support vaccine development and manufacturing, and that some countries are already undermining existing TRIPS flexibilities through restrictive free trade agreements.[42 53 55 61] Proponents against governments' enacting patent waivers claim that they contribute to inefficiencies by diverting raw materials and supplies away from effective manufacturers.[47] Compulsory licences are not considered by these proponents as being a practical tool to rapidly expand access to vaccines, instead they support voluntary licensure, for instance, AstraZeneca's arrangements with Indian and Brazilian manufacturers.[1 44 47] A related issue impacting on manufacturing capacity is the use of limited manufacturing capacity on all vaccine candidates. So and Woo (2019) caution that a weakness of prematurely exhausting capacity for vaccines that show early safety and efficacy promise is that manufacturing capacity will then be locked into first generation vaccines, and may be a bottleneck for manufacturing capacity for second generation more effective vaccines.[55]

Finally, two noteworthy initiatives are identified in the literature reviewed: (1) to increase vaccine supply, GAP (2006-2016), is a strategy to reduce global shortages of influenza and pandemic vaccines that supports technology transfer[30 42]; and (2) the recent COVID-19 Technology Access Pool (C-TAP) (2020) proposed by Costa Rica and adopted by WHO (endorsed by 35 mainly MICs and five HICs). C-TAP calls for the voluntary sharing of knowledge, intellectual property and data, as well as a guarantee of free access and use by WHO member countries for drugs and vaccines that are developed.[29 35 36] Given the world's limited manufacturing capacity, the use of technology transfer and pooling of vaccines could help alleviate a massive shortage of vaccines given the scale of the need.[38]

- *Countries' strength in implementing vaccination programmes may influence their populations' access to vaccines.*

The findings from this scoping review further suggest that the ability of a country to implement a mass vaccination programme is an important factor that may influence equitable access.[23] Vaccination programmes are resource intensive; therefore, to maximise the benefit of COVID-19 vaccines and reduce waste due to improper implementation, it has been suggested that allocation frameworks should consider a country's ability to vaccinate.[1 13 23 24 27 52 62 63] Most LMICs have well-structured immunisation programmes for polio, measles, smallpox, etc, facilitated by organisations such as UNICEF and Gavi, which could support a large-scale pandemic vaccination programme. It has been reported that Gavi, for example,

has sought to expand its Cold Chain Equipment Optimization Program.[27] More than half of the countries in the world lack robust programmes to tackle seasonal influenza, despite most associated death and severe disease from influenza occurring in countries of the Global South.[63] The down prioritisation of seasonal influenza vaccination for older populations in LMICs compared with HICs is a vulnerability for the roll-out of COVID-19 vaccines.[30 33 62 63] Ruscio and Hotez noted that an attempt to fill this gap has been made by the recently published WHO Global Influenza Strategy 2019–2030.[63]

Vaccine roll-out requires stable cold chain and supply processes for the necessary logistical and administrative components to facilitate distribution of vaccines, including financing the in-country delivery of vaccines, from cold chain to administration.[13 27 28 36 45 60] Different vaccines have different temperatures for deployment, which influences supply of vaccine to communities.[13 27 45 47 60] This is a particular challenge in sub-Saharan Africa, where only 28% of healthcare facilities have a reliable energy supply.[13] In this context, vaccines that require only one dose or those that can be stored at room temperature are more likely to facilitate equitable access.[45] There is also an opportunity to explore the use of new containers and packaging that support distribution. For example, preformed plastic vials are being successfully used for oral rotavirus and cholera vaccines.[62] Data solutions should also be considered, as these could support alternative vaccine delivery systems for target groups, as well as being an important tool to capture the populations' vaccination history.[28]

Smooth regulatory and market authorisation processes for vaccines can facilitate the distribution of vaccines.[30 33 36 49 63] One article from this scoping review highlighted the importance of clinical vaccine studies in LMICs and HICs alike, to support the fast-tracking of market authorisation, as local clinical trial data are a recognised grounds for delay to introduce some vaccines into countries' immunisation programmes.[33] Delays for products preventing or treating infectious diseases are cited at being between 4 and 7 years from first approval in an HIC and final approval in a country in sub-Saharan Africa.[36]

DISCUSSION

This study identified four key factors that carry the potential to promote fairer global access to COVID-19 vaccines. Our findings suggest that an international approach is necessary to minimise the spread of a pandemic. A priori of this review, there has been broad international support for the principles of equitable distribution of medical countermeasures, as demonstrated by universal support for WHO resolutions.[4 8 9 14 64–67] COVID-19 is no exception, with relevant commitments passed in months following the declaration of the pandemic.[17 68–71] This has, however, not translated into binding global commitments. The establishment of ACT-A and COVAX was partly a recognition of historic failures, as highlighted in the findings of this review. Co-led by CEPI and Gavi (in partnership with WHO), both were established with a commitment of equitable access to medicines in their ethos. As multicountry-endorsed initiatives, they can be considered good candidates to lead the process for equitable distribution of COVID-19 vaccines.[12 72–74]

The risks that sovereign states pose to equitable access by acting in their national interest, including bilateral agreements with pharmaceutical companies, buying up vaccine stocks during clinical development phases and vaccine hoarding, were anticipated in our findings and have largely been realised.[31]

COVAX's pooled procurement through APAs has faced challenges, initially in accessing the necessary financing, which in turn delayed securing supply against other HIC purchasers.[1 14 27 29] In addition, it has also faced critique on how price has been determined and whether any costs can be recovered if vaccine candidates fail.[34 39 75] While COVAX has attempted to meet foreseen gaps,[14] it has been challenged by national interests, highlighted recently with announcements that Australia is purchasing booster shots,[76] and that several HICs plan to donate parts of their surplus vaccines to LMICs directly,[77] rather than through the COVAX facility, making vaccines a tool of geopolitics.

The pandemic has shown several examples of countries enacting their sovereign authority over goods produced within its borders, one example being the USA's invocation of the Defense Production Act reducing export of active pharmaceutical ingredients,[78] which slowed the production of the AstraZeneca vaccine by its collaborator Serum Institute in India.[79] More recently, in response to a devastating second wave of COVID-19 infections, the Indian government imposed an export ban on vaccines, redirecting these to the domestic market, leading to a further slowdown in doses available to the COVAX facility.[80] Additionally, the use of vaccine manufacturing capacity to scale up production of COVID-19 vaccines will likely impact on the production of other vaccines such as influenza, measles, mumps and rubella with a disproportionate impact on the global poor.[81]

The roll-out of population-wide immunisation programmes has put most governments to the test, with many being critiqued for botched roll-outs. Australia and Japan are two HICs that have faced criticism over the delays related to the logistical issues of setting up such a large vaccination programme.[82 83] In June 2020, it was reported that less than 15% of imported vaccine doses in Japan had been used.[83] In addition, Japan is one example of a country whose vaccine implementation was interrupted by national regulatory requirements for domestic clinical trials, which could not be undertaken due to low numbers of COVID-19 cases. This prevented Japan from registering international clinical trials to meet national requirements related to safety and efficacy.[83] LMICs face similar regulatory delays,[27 33] seemingly a bureaucratic hurdle that could be planned for, especially given

the emergency nature of the pandemic, and that these vaccines have already met stringent regulatory standards (ie, the US Food and Drug Administration or fro the European Medicines Agency).

For LMICs, the well-established child immunisation programmes have targeted parts of the population; however, few LMICs have extensive experience with vaccination of the general adult population. This makes the COVID-19 the 'first' large-scale adult vaccination programme aiming to achieve high coverage rates.[84 85] To facilitate implementation, COVAX has integrated a 'Country Readiness and Delivery (CRD) work stream' to support the introduction of COVID-19 vaccines into national vaccination programmes.[86] However, lack of infrastructure, short shelf-life and vaccine hesitancy challenge the vaccine uptake and distribution of vaccines, which has led to vaccine wastage (eg, South Sudan and Malawi) or redeployment to avoid this outcome (eg, the Democratic Republic of Congo to Ghana and Madagascar).[87] Other countries, such as Bhutan, have impressed with their swift implementation strategies vaccinating 90% of their eligible adult population in 2 weeks.[88]

The potential long-term solution to equitable access highlighted in our scoping review is the need to broaden the basis of manufacturing of vaccines. A success of the COVID-19 response has been the high effectiveness of novel mRNA vaccines that (pre-COVID-19) were yet to enter human clinical trials. However, few manufacturers have the necessary know-how to set up mRNA manufacturing capacity, resulting in centralised production in a few locations in the Global North. The WHO has relaunched C-TAP to support a 'global one-stop shop for developers' following nothing being shared by any pharmaceutical company within the first 12 months of the launch of the C-TAP open platform in mid-2020.[89 90] The TRIPS patent waiver of COVID-19 products received historical support from the incoming US government administration in May 2021, and has since moved into text-based discussions.[91]

It is widely acknowledged in the literature that ramping up production in LMICs while meeting the necessary quality standards takes time and will require extensive knowledge transfer from pharmaceutical companies. Globally, 15 MICs have vaccine production capacity to support the global supply of vaccines, but only 12 have WHO prequalification status which is instrumental for quality-assured generic vaccine candidates.[2 7] The pandemic has further uncovered the need for more vaccine manufacturing capacity across the whole world. The acknowledgement of the incommensurable role of manufacturing capacity is captured in a project led by CEPI to map out manufacturing capacity for use in future pandemics.[92] Further, to counteract this, the African Union and African Centers for Disease Control and Prevention launched a partnership to increase future vaccine production in Africa.[93]

A limitation of this scoping review is that literature was exclusively chosen based on relevance to the topic of identifying and describing potential factors influencing equitable access to COVID-19 vaccines, meaning that we have included commentaries, editorials, essays and viewpoints. We determined that these perspectives were of importance to our research aim, regardless of the type of publication, as the aim was to identify factors and not to assess or evaluate them or compare their relative importance. In light of the nature of the current situation and the topic, restricting the review to only include publications of original research with journal publication time frames did not seem appropriate. To manage this, articles were only included if they were published in a peer-reviewed journal.

CONCLUSION

According to current available published literature, equitable access to vaccines proves to be an ongoing challenge. The uneven global distribution of vaccines is starkly shown in the current divide of vaccine coverage where the wealthiest nations have received more than 87% of the vaccines while LMICs just 0.2%.[94] Altogether, findings identified in this scoping review converge towards vaccine manufacturing being of high importance in the supply of vaccines. Future research could explore the contribution of MICs to facilitate vaccine supply in a pandemic, including some of the challenges of maintaining these facilities outside of a pandemic. Building on COVID-19 success, mRNA technologies will be used for other vaccines in the future, thus the exploration and scale-up of such capacities on the African continent is likely to prove to be a valuable investment, even after the pandemic. Moreover, despite the length of time it takes to build and certify vaccine manufacturing facilities, steps can be taken to share the know-how of the manufacturing of effective vaccines, although the full possibilities of relaxing of patent and IPR are yet to be realised and can contribute to equitable access.

Another issue identified in the literature was the role that patent holders play in global governance through influencing the distribution of COVID-19 vaccines, this needs more transparency. The importance of including equitable access principles to all levels of development also seemed to be relevant, for example, throughout vaccine R&D, procurement, scale-up and distribution.

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Acknowledgements Thank you to the following people who helped develop or offered their feedback on the original concept of this scoping review: Marit Johansen (information specialist), Benedikte Louise Alveberg, Tenu Avafia, Julia Bidonde, Anita Haslie, Unni Gopinathan, Adam Kamradt-Scott, Ida Kristine Lindkvist, Jasper Littman, Trygve Ottersen, Judit Rius Sanjuan, Ingvil Sæterdal, Christine Årdal.

Contributors EP and LC: concept development, drafting the protocol, data extraction, analysis, writing and review. LFH: data extraction, support with analysis, writing and review. KF: methodology, review of extraction, writing and review. EHD: writing and review.

Funding This work was partially supported by the Evaluation Department of the Norwegian Agency for Development Cooperation (Norad) in their role as a member of the OECD COVID-19 Global Evaluation Coalition (grant number 1900737) and Norad Department of Education and Health (grant number QZA-18/0102).

Disclaimer The funders had no role in the study design, data collection and analysis, decision to publish or preparation of the manuscript.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethical clearance was not required as the review used secondary data that are available in the public domain.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

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Appendix 1: Updated protocol

Factors influencing global equitable access to a COVID-19 vaccine for Low- and Middle- Income Countries (LMICs)

Proposal for scoping review

24 September 2020

Elizabeth Peacocke, Lumbwe Chola, Katrine Frønsdal and Marita Fønhus, Norwegian Institute Public Health.

Updated 24 July 2021

Elizabeth Peacocke, Lieke Fleur Heupink, Katrine Frønsdal, Elin Hoffmann Dahl and Lumbwe Chola.

1 Summary

Summary

Vaccines are important medical countermeasures to prevent the spead of infectious diseases. The World Bank forecasts a 5.2% contraction in global GDP in 2020, and long-term negative impacts are expected in terms of lower investment, an erosion of human capital through lost work and schooling, and fragmentation of global trade and supply linkages (1) Without effective vaccines, diagnostics, and therapeutics, COVID-19 will continue to spread and have severe health and socio-economic consequences. The UN's Framework for the Immediate Socio-Economic Response to the COVID 19 Crisis warns "The COVID-19 pandemic is far more than a health crisis: it is affecting societies and econ-omies at their core. While the impact of the pandemic will vary from country to country, it will most likely increase poverty and inequalities at a global scale, making achievement of SDGs even more urgent." (2)

This project includes a scoping review that identifies and characterizes the factors influencing global equitable access to COVID-19 vaccines among countries, and contextualizes these factors with global mechanisms or guidelines that address global equitable access to pandemic vaccines. The documentation of these factors will offer decision makers lessons from previous experiences and information to support the understanding of principles related to equitable access to a COVID-19 vaccine.

This scoping review was conducted during August-November 2020, with a draft report for Norad, who commissioned and partly financed the report. This draft report was then submitted as a manuscript for publication. During the review process, in May 2021, the authors updated the search. This protocol has been updated to reflect the methods used in this Scoping Review.

To our knowledge, such a scoping review has not been systematically investigated.

Title:
Factors influencing global equitable access to a COVID-19 vaccine for Low- and Middle- Income Countries (LMICs)

Proposal for scoping review

Commissioned by:
Commissioned by the Norad Evaluation Department

Start date:
24.07.2020.

End date:
19.07.2021

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Background

New Corona Virus: SARS-CoV-2 (COVID-19) Pandemic

The world is currently facing a global public health emergency with the emergence of the Severe acute respiratory syndrome coronavirus 2 discovered in 2019 (COVID-19), an infectious acute respiratory disease caused by a novel coronavirus. A race to increase access to existing health technologies – including diagnostics - and find new and effective treatments and vaccine is underway, and with this the international community is faced with the challenge of how to ensure equitable access of essential medicines[1] to all populations. In this scoping review, we will systematically review the literature and summarize factors pertaining to the equitable access of a COVID-19 vaccine relevant for low- and middle- income countries (LMICs). For the purpose of this study, we are using the WHO definition of equity,[2] and we take the principle that the COVID-19 vaccine is an essential medicine[3], and that access to essential medicines is part of the right to health which is well founded in international law (4).

The challenge with global equitable availability and access to pandemic vaccines

COVID-19 has seen a large effort and investment in vaccines, and diagnostics, with 22 manufacturers that have applied for and Emergency Use Listing under the WHO Pre-Qualification, 10 of which have been approved (5). Shortly following these rapid advances and regulatory approvals, questions began to be raised about the availability and access of vaccines in LMIC, and as global public goods (6, 7).

The 2005 experience with the sharing of avian influenza A (H5N1) and the 2009 influenza A (H1N1) pandemic made apparent the need for equity considerations and ensuring that global coordination and distribution mechanisms are in place and adhered to, supporting equitable access to scarce vaccines. During H5N1, concerns raised by LMICs about the lack of mechanisms for ensuring global equitable access to vaccines prompted Indonesia to refuse to share H5N1 virus samples with the World Health Organization (WHO) (8). With Asia being the epicenter of the outbreak, fears were raised by the international community that Indonesia's refusal to share virus samples would impede the research and development, surveillance and response efforts, and made the re-

[1]**Essential medicines** are those that satisfy the priority health care needs of the population 3.World Health Organization. Essential medicines and health products. Essential medicines definition 2020 [cited 2020 August 13]. Available from: https://www.who.int/medicines/services/essmedicines_def/en/.
[2] **Equity** is the absence of avoidable, unfair, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically or by other means of stratification. "Health equity" or "equity in health" implies that ideally everyone should have a fair opportunity to attain their full health potential and that no one should be disadvantaged from achieving this potential (World Health Organization. Health Topics: Health Equity. 2020 [cited 2020 August 12]; Available from: https://www.who.int/topics/health_equity/en/).
[3] WHO (2020)

sponse to the global health emergency more difficult. Ensuing negotiations with the WHO and its member states to create a new system of influenza virus sharing and vaccine availability did not immediately yield consensus.

During the 2009 pandemic, high income countries (HIC) bought virtually all vaccine supplies, leaving limited supplies for LMICs. One prominent example for this asymmetry was Mexico. Despite it being one of the first nations affected by H1N1 (concurrently with Canada and the United States), Mexico gained access to vaccines much later than the two other countries (9). The WHO intervened to mediate this potential challenge, engaging in talks with manufacturers and LMIC governments to secure equitable access to the vaccine for LMIC (10). Consequently, donation pledges to LMIC were made by manufacturers and HICs, with the exception of Canada (10, 11). These pledges from manufacturers were made without a fixed delivery date and were perceived to leave HICs with more than enough vaccines for full coverage in their own countries, leaving LMICs with limited access to timely supplies (11).

Lessons from previous collective responses to support global equitable access to vaccines

In response to the H5N1 and H1N1 experiences, WHO and member states developed and adopted the Pandemic Influenza Preparedness (PIP) framework in 2011, a global approach to pandemic influenza preparedness and response (12). The intention of PIP was to improve and strengthen the sharing of influenza viruses with human pandemic potential; and to share the benefit of, which is to increase the access of LMICs to vaccines and other pandemic related supplies. There are, however, several gaps in the framework, not least, that it is not legally binding (13).

There are other relevant frameworks and mechanisms, such as establishing the Advanced Market Commitment for AMC for Pneumonia Vaccine, and the Pan Americal Health Organisation's Revolving Fund for Vaccines. Much can be learnt from these initiatives that is relevant to the current COVID-19 pandemic. Recent events related to COVID-19 have shown some countries and technology holders' tendencies to control the global supply of personal protective equipment, ventilators, diagnostics and therapeutic medicines and reserve supply to HIC, as well as the challenges with limited manufacturing capacity and access to know-how, intellectual property and data; indicating that it is highly likely that similar controls will be placed on a vaccine that meets the necessary safety, efficacy and regulatory standards, to be used for mass vaccination (14).

To manage anticipated issues with the distribution of COVID-19 vaccine, the WHO is convening the Access to COVID-19 Tools (ACT) Accelerator, which brings together governments, scientists, businesses, civil society, and philanthropists and global health organizations (the Bill & Melinda Gates Foundation, CEPI, FIND, Gavi, The Global Fund, Unitaid, Wellcome, the World Bank and Global Financing Facility), in efforts to support the development and equitable distribution of the tests, treatments and vaccines. The ACT-Accelerator is organized into four pillars of work: diagnostics, treatment, vaccines and health system strengthening (15). Gavi and CEPI are leading implementation of the vaccines pillar, "the COVID-19 vaccine global access (COVAX) facility", which is committed to supporting the acute phase of the pandemic through the appropriate allocation of safe and effective doses of a vaccine (16, 17).

The barriers in access to medicines to COVID-19 vaccines relate the demand and the supply of the vaccine, and there continues to be unprecedented demand for a safe and

effective vaccine (18, 19). The supply of this vaccine is hampered by complex vaccine innovation and manufacturing processes. Depending on the candidates that prove to be the most effective, the approach used will determine the necessary manufacturing capacity and length of time for development, (19). In terms of the quantity of the vaccine needed to be produced, this is also influenced by whether one or two does are necessary, in addition other challenges including e.g. with lack or insufficient global vaccine manufacturing capacity & access to know-how and implementation in LMIC countries are also essential for access to vaccines for many. All of these factors will limit the supply of vaccines.

Importance of the project

The access to, and distribution of a scarce vaccine is one of the pegged solutions to enable the world to return some semblance of life pre-COVID 19. With COVID-19 affecting the world, the equitable distribution of this vaccine is important because the virus will cause unnecessary disability and loss of life unless the benefit of a vaccine is distributed fairly among and within countries. To our knowledge, a scoping review of the the factors for the equitable access of a COVID-19 vaccine relevant for LMIC has not been systematically investigated. The project is considered highly relevant to the current situation as it aims at identifying and describing of these factors which can inform decision makers in terms of lessons from previous experiences and supporting the understanding of principles related to equitable access to a COVID-19 vaccine, and further potentially guide implementation of future initiatives to ensure equitable access.

Objective

This objective of this scoping review is to identify and summarize the factors for the equitable access of a COVID-19 vaccine relevant for LMICs. We will address the following question: *What are the factors influencing global equitable access to a COVID-19 vaccine among countries?*

Methods

Scoping searches

We will perform systematic scoping searches for publications according to PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) (20).

Inclusion criteria

We aim to identify and describe factors influencing global equitable access to a COVID-19 vaccine among countries as identified in our search (see the manuscript supplementary material), following the inclusion criteria shown in Table 1.

Table 1. Inclusion criteria

Topic	Pandemic vaccines incl. influenza or COVID-19 vaccine
Outcomes	The factors influencing equitable access to a pandemic vaccine incl. COVID-19 vaccine
Type of publication	Primary studies, systematic reviews
Language	English
Publication date	2002-2021

Restriction to publications from 2002 are made as a pragmatic choice from the date of the 2003-04 SARS pandemic. Furthermore, the limitation to English language journal articles in scientific databases was balancing completeness with the resources available.

Search strategy and Information sources:

An information specialist at NIPH will develop the search strategies together with the project leader, and another information specialist will review the search strategy. The literature search will be conducted in the following databases: Medline (PubMed and Ovid), EMBASE (Ovid), Global Index Medicus, WHO https://www.globalindexmedicus.net/ and Web of Science Core Collection Clarivate Analytics (see supplementary information for updated search strategies and databases).

Additional relevant information will be searched from websites of multilateral agencies and international philanthropic agencies identified in the literature through the database search (e.g. WHO Pandemic Influenza Preparedness Framework) as a means to understand the particular framework or initiative.

Selection of literature

First screening

We will first review articles that are determined to be relevant (according to predefined inclusion criteria described above). Three project team members (EP, LF and LC) will independently go through all identified titles and abstracts and determine if articles should be included for full-text review.

Where there are divergent views, inclusion will be determined through discussion and consensus between the reviewers or by consulting a fourth team member (KF). Records not fulfilling the inclusion criteria will be excluded.

Full text review

Given time constraints, the review group will divide the studies by two and each study will be read in full and assessed for inclusion by one reviewer. This is verified by a second reviewer. Disagreement over exclusion or inclusion will be handled in the same way as for the first screening.

Extraction and presentation of data

Data to be extracted are mainly qualitative data on the predefined outcomes. Standard data extraction templates were designed, and piloted specifically for this scoping review (see the manuscript supplementary material for a copy of the data extraction form).

The predefined outcomes for extracting data include: the setting (LMIC or globally focused or normative guidance that affects LMIC), and argument/ discussion on equity, access, allocation or prioritization of pandemic vaccines, other aspects that article tells us about the knowledge in this topic area, challenges in implementing equitable access to vaccination between countries, and recommendations for strengthening the equitable access to vaccination. In addition, we collected names of relevant global initiatives and mechanisms as identified in our search. Data is to be extracted by one team member and a second reviewer will review the data extraction.

Analysis of data

The analysis of the data collected will provide information on the body of research and evaluations related to the factors influencing global equitable access to a COVID-19 vaccine among countries. Our analysis will include how factors influencing global equitable access to a COVID-19 vaccine among countries pertain to global frameworks and mechanisms identified in our searches.

We will consider using the following framework for analysis, adapted from Liu et al (21), which includes three main areas related to:

- A country's ability to develop or to purchase pandemic vaccines
- Reciprocity
- A country's ability to implement or vaccinate.

Reporting, submission of manuscript and updating of search

A draft report based on the findings from the scoping review was prepared and presented to Norad and two external peer reviewers. A manuscript was then prepared and submitted to BMJ Open in January 2021. Based on feedback from peer review, the search was updated in May 2021.

Risk of bias and limitations

Due to time constraints we are extracting data directly related to our topic of interest. This will mean that some papers are excluded due to their lack of direct relevance to our question, and will not be included in the analysis.

Only one reviewer will complete the full-text review and data extraction, to limit the risk of bias, one reviewer will peer review the full-text categorisation and data extraction.

Peer –review

External and internal peer review is being used to strengthen the methods and improve the rigor of this scoping review.

Internal:
The project plan (this document) has been reviewed by all authors and peer reviewed internally at NIPH. Internal reviewers at NIPH will also review any publication of results presented to Norad.

External:
Two external peer reviewers will be used in addition before publication of results.

Acronyms

CEPI	Coalition for Epidemic Preparedness Innovations
COVAX	the COVID-19 vaccine global access (COVAX) facility
COVID-19	2019 Pandemic corona virus strain
CIS	Critical Interpretive Synthesis
DNA	Deoxyribonucleic acid
Gavi	Gavi, the Vaccine Alliance
FIND	the Foundation for Innovative New Diagnostics
HIC	High income countries
H1N1	2009 influenza A
H5N1	2006 avian influenza A
LMIC	Low- and Middle- income countries

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Appendix 3: Search strategies for each of the five databases ***(Initially searched for the period 01.01.2002 - 28.08.2020, updated to include12.05.2021)***

Databases searched

- MEDLINE ALL 2002 to May 11, 2021
  - Ovid MEDLINE, PubMed (only 28.082020);
  - Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 2002 to August 27, 2020
- Embase 2002 to 2021, Ovid
- Web of Science Core Collection, Clarivate Analytics
- Global Index Medicus, WHO
- COVID-19 Evidence, Epistemonikos Foundation

Updated search 12.05.2021

We searched:

- **PubMed, US National Library of Medicine (NLM):** pubmed.ncbi.nlm.nih.gov/

Only 28.08.2020 as string was not available in 2021.

- **MEDLINE ALL 1946 to May 11, 2021, Ovid (searched 12.05.2021)**

#	Searches	Results
1	COVID-19 Vaccines/	2510
2	Coronavirus/	4692
3	Betacoronavirus/	33218
4	Coronavirus Infections/	44847
5	Coronaviridae Infections/	919
6	Severe Acute Respiratory Syndrome/	5545
7	Pandemics/	56289
8	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).ti,ab,kf.	177584
9	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).ti,ab,kf,hw.	218
10	or/2-9	184722
11	Vaccines/	22577
12	Viral Vaccines/	27055
13	Vaccination/	85401
14	Vaccination Coverage/	1540
15	Mass Vaccination/	3208
16	Immunization/	51563
17	Immunization Programs/	11524
18	(vaccin* or immuni*).ti,ab,kf.	576919
19	or/11-18	610926
20	"Delivery of Health Care"/	95912

21	"Health Services Needs and Demand"/	54005
22	Resource Allocation/	8895
23	Health Care Rationing/	11853
24	Health Services Accessibility/	78488
25	Health Equity/	1805
26	Right to Health/	131
27	Universal Health Care/	149
28	Healthcare Disparities/	18787
29	Socioeconomic Factors/	162607
30	Social Justice/	12551
31	Global Health/	50200
32	Human Rights/	14729
33	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kf.	32465
34	(right to health* or universal health*).ti,ab,kf.	7779
35	((health* or health care) adj (rationing or disparities)).ti,ab,kf.	15193
36	or/20-35	488375
37	10 and 19 and 36	1157
38	1 and 36	280
39	37 or 38	1194
40	(202008* or 202009* or 202010* or 202011* or 202012* or 2021*).dt,dp,ed,ep,yr.	1805737
41	39 and 40	588
42	38 or 41	608

- **Embase 1974 to 2021 Week 18 (searched 12.05.2021)**

#	Searches	Results
1	SARS-CoV-2 vaccine/	2292
2	coronavirus disease 2019/	106145
3	coronavirinae/	3003
4	betacoronavirus/	7651
5	coronavirus infection/	12666
6	coronaviridae infection/	187
7	pandemic/	65235
8	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).mp.	195467

9	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).mp.	355
10	or/3-9	195821
11	vaccine/	63516
12	virus vaccine/	20586
13	severe acute respiratory syndrome vaccine/	453
14	vaccination/	151179
15	vaccination coverage/	2788
16	immunization/	98822
17	mass immunization/	3739
18	(vaccin* or immuni*).ti,ab,kw,ot.	685955
19	or/11-18	736294
20	health care delivery/	184159
21	resource management/	10987
22	resource allocation/	22438
23	health care access/	69640
24	health care quality/	250577
25	health equity/	4605
26	right to health/	214
27	universal health care/	337
28	health care disparity/	17595
29	socioeconomics/	147326
30	social justice/	11121
31	global health/	12881
32	human rights/	26721
33	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kw,ot.	42137
34	(right to health* or universal health*).ti,ab,kw,ot.	9211
35	((health* or health care) adj (rationing or disparities)).ti,ab,kw,ot.	19032
36	or/20-35	714178
37	10 and 19 and 36	1372
38	1 and 36	266
39	2 and 19 and 36	692
40	or/37-39	1423
41	limit 40 to (conference abstracts or embase)	1129
42	limit 37 to (conference abstracts or embase)	1078

43	(202008* or 202009* or 202010* or 202011* or 202012* or 2021*).dd,em,yr.	1850404
44	42 and 43	439
45	limit 38 to (conference abstracts or embase)	259
46	limit 39 to (conference abstracts or embase)	652
47	44 or 45 or 46	751
48	47 use oemez	751

- **Web of Science, Clarivate Analytics** (searched 12.05.2021)

Advanced search - Topic

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics

AND

vaccin* OR immuni*

AND

equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities"

- **Global Index Medicus, WHO:** www.globalindexmedicus.net (searched 14.05.2021)

Advanced search in Title, abstract, subject

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics

AND

vaccine OR vaccines OR vaccination OR immunization OR immunisation

AND

equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities" OR global OR globally

- **COVID-19 Evidence, Epistemonikos Foundation:** app.iloveevidence.com/loves/5e6fdb9669c00e4ac072701d?utm=epdb_en (searched 14.05.2021)

(vaccin* OR immuniz* OR immunis*) AND (equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities" OR global OR globally) AND (access* or allocat* or distribut* or deliver* or provision or supply or supplies)
LIMITED TO Type of publication: Pre-print

Original search of databases: 28.08.2020

- **MEDLINE, PubMed** (searched 28.08.2020)

MeSH: "COVID-19 vaccine" [Supplementary Concept]

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to August 27, 2020 (searched 28.08.2020)

#	Searches	Results
1	Coronavirus/	3244
2	Betacoronavirus/	16530
3	Coronavirus Infections/	24138
4	Coronaviridae Infections/	906
5	Severe Acute Respiratory Syndrome/	4873
6	Pandemics/	24349
7	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).ti,ab,kf.	91205
8	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).ti,ab,kf,hw.	51
9	or/1-8	97109
10	Vaccines/	21690
11	Viral Vaccines/	25884
12	Vaccination/	81687
13	Vaccination Coverage/	1160
14	Mass Vaccination/	3038
15	Immunization/	50752
16	Immunization Programs/	10877
17	(vaccin* or immuni*).ti,ab,kf.	546309
18	or/10-17	579947
19	"Delivery of Health Care"/	91173
20	"Health Services Needs and Demand"/	53044
21	Resource Allocation/	8501
22	Health Care Rationing/	11514
23	Health Services Accessibility/	74764
24	Health Equity/	1291
25	Right to Health/	75
26	Universal Health Care/	80
27	Healthcare Disparities/	17030
28	Socioeconomic Factors/	157123
29	Social Justice/	12160
30	Global Health/	47402
31	Human Rights/	14384

32	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kf.	29976
33	(right to health* or universal health*).ti,ab,kf.	7053
34	((health* or health care) adj (rationing or disparities)).ti,ab,kf.	13345
35	or/19-34	466021
36	9 and 18 and 35	632

- **Embase 1974 to 2020 Week 34, Ovid (searched 28.08.2020)**

#	Searches	Results
1	coronavirinae/	2268
2	betacoronavirus/	4632
3	coronavirus infection/	8485
4	coronaviridae infection/	166
5	pandemic/	30028
6	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).mp.	103695
7	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).mp.	85
8	or/1-7	103962
9	vaccine/	60026
10	virus vaccine/	19609
11	severe acute respiratory syndrome vaccine/	385
12	vaccination/	140276
13	vaccination coverage/	2060
14	immunization/	94131
15	mass immunization/	3511
16	(vaccin* or immuni*).ti,ab,kw,ot.	643022
17	or/9-16	689815
18	health care delivery/	174154
19	resource management/	10271
20	resource allocation/	20867
21	health care access/	62445
22	health care quality/	241073
23	health equity/	3269
24	right to health/	105
25	universal health care/	155
26	health care disparity/	15646
27	socioeconomics/	140163
28	social justice/	10427
29	global health/	9804
30	human rights/	24894
31	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kw,ot.	38602
32	(right to health* or universal health*).ti,ab,kw,ot.	8082
33	((health* or health care) adj (rationing or disparities)).ti,ab,kw,ot.	16415
34	or/18-33	670545
35	8 and 17 and 34	672
36	limit 35 to (conference abstracts or embase)	529

- **Global Index Medicus, WHO** (searched 28.08.2020)

Advanced search in Title, abstract, subject COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics AND vaccine OR vaccines OR vaccination OR immunization OR immunisation AND equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR unfair OR unfairly OR disparity OR disparities OR global OR globally

- **Web of Science, Clarivate Analytics** (searched 28.08.2020)

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics AND vaccin* OR immuni* AND equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR unfair OR unfairly OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities"

Appendix 4: Excluded articles and reason for exclusion

Reason for exclusion key: 1: mentions issue but lacks detail or did not add new insight to factors related to equitable access, 2: discusses within, not amongst countries, 3: irrelevant, 4: not English, 5: full-text unavailable, 6: not in peer reviewed journal.

Nr*	First author, year	Title	Reason excluded
1	Acharya, 2021	Access to and equitable distribution of COVID-19 vaccine in low-income countries	1
2	Anonymous, 2021	Why a pioneering plan to distribute COVID vaccines equitably must succeed	1
3	Anonymous, 2021	It's time to consider a patent reprieve for COVID vaccines	1
4	Aryeetey, 2021	A step backwards in the fight against global vaccine inequities	1
5	Bennett, 2010	Law, ethics and pandemic preparedness: the importance of cross-jurisdictional and cross-cultural perspectives	1
6	Binagwaho, 2021	Equitable and Effective Distribution of the COVID-19 Vaccines - A Scientific and Moral Obligation	1
7	Burki, 2021	Equitable distribution of COVID-19 vaccines	1
8	Burki, 2021	Challenges in the rollout of COVID-19 vaccines worldwide	1
9	Cohen, 2021	As vaccines emerge, a global waiting game begins	1
10	Emanuel, 2020	An ethical framework for global vaccine allocation	1
11	Ferguson, 2020	Love thy neighbour? Allocating vaccines in a world of competing obligations	1
12	Fisher, 2011	Pandemic response lessons from influenza H1N1 2009 in Asia	1
13	Friede, 2011	WHO initiative to increase global and equitable access to influenza vaccine in the event of a pandemic: supporting developing country production capacity through technology transfer	1
14	Garfinkel, 2020	Survival of the Wealthiest?	1
15	Gostin, 2020	Facilitating Access to a COVID-19 Vaccine through Global Health Law	1
16	Haaheim, 2009	Pandemic influenza vaccines - the challenges	1
17	Hay, 2018	The WHO global influenza surveillance and response system (GISRS)-A future perspective	1
18	Herzog, 2021	Covax must go beyond proportional allocation of covid vaccines to ensure fair and equitable access	1
19	Hessel, 2009	Pandemic influenza vaccines: Meeting the supply, distribution and deployment challenges	1
20	Ho, 2020	Global Disparity and Solidarity in a Pandemic	1
21	Hurley, 2021	It's self-interest to share our vaccines globally	1
22	Kamradt-Scott, 2012	Evidence-based medicine and the governance of pandemic influenza	1
23	Kim, 2021	Operation Warp Speed: implications for global vaccine security	1
24	Kimble, 2021	Considerations on the distribution and administration of the new COVID-19 vaccines	1
25	Kupferschmidt, 2020	Despite obstacles, WHO unveils plan to distribute vaccine	1
26	Lie, n.d.	Allocating a COVID-19 Vaccine: Balancing National and International Responsibilities	1
27	Lomazzi, 2020	Equitable access to COVID-19 vaccination: a distant dream?	1
28	Megiddo, 2020	Fairer financing of vaccines in a world living with COVID-19	1
29	Meyer, 2020	After a COVID-19 vaccine: Collaboration or competition?	1
30	Milstien, 2003	Emergency response vaccines: Lessons learned in response to communicable diseases	1
31	Munguia-Lopez, 2021	Fair Allocation of Potential COVID-19 Vaccines Using an Optimization-Based Strategy	1
32	Nannei, 2016	Stakeholders' perceptions of 10years of the Global Action Plan for Influenza Vaccines (GAP) - Results from a survey	1

33	Nazar, 2020	All for vaccine, vaccine for all	1
34	Nkengasong, 2020	COVID-19 vaccines: how to ensure Africa has access	1
35	Ogbogu, 2020	Bioethics and practical justice in the post-COVID-19 era	1
36	Orit Fischman, 2021	A Global Pandemic Remedy to Vaccine Nationalism	1
37	Punjabi, 2021	Vaccine is health and health is wealth	1
38	Rodríguez Mega, 2020	Latin American scientists join the coronavirus vaccine race: 'No one's coming to rescue us'	1
39	Ropero-Alvarez, 2012	Pandemic influenza vaccination: lessons learned from Latin America and the Caribbean	1
40	Sadeghi, 2021	The commitment for fair distribution of COVID-19 vaccine among all countries of the world.	1
41	Schwartz, 2009	Prioritization of pandemic influenza vaccine: Rationale and strategy for decision making	1
42	Schwartz, 2020	Equitable global access to coronavirus disease 2019 vaccines	1
43	Sharun, 2021	COVID-19 vaccine diplomacy and equitable access to vaccines amid ongoing pandemic	1
44	The Lanclet, 2020	Global collaboration for health: rhetoric versus reality	1
45	Usman, 2020	After the Coronavirus Vaccine's Discovery: Concerns Regarding a COVID-19 Vaccination's Distribution	1
46	Yamada, 2009	Poverty, wealth, and access to pandemic influenza vaccines	1
47	Yen, 2015	The development of global vaccine stockpiles	1
48	Zimmerman, 2007	Rationing of influenza vaccine during a pandemic: ethical analyses	1
49	Abramowitz, 2020	Transparent, equitable, safe, and effective use of COVID-19 vaccines: A societal imperative	2
50	Adebambo Anthony, 2020	Intellectual Property Rights, Pharmaceutical Patents and Public Health: Adopting Compulsory and Government Use Licenses in the COVID-19 Emergency in Nigeria	2
51	Ana Santos, 2020	Comments on the Preliminary Framework for Equitable Allocation of COVID-19 Vaccine	2
52	Anonymous, 2020	ASHP principles for COVID-19 vaccine distribution, allocation, and mass immunization	2
53	Ayers, 2021	Disparities in H1N1 Vaccination Rates: a Systematic Review and Evidence Synthesis to Inform COVID-19 Vaccination Efforts	2
54	Bell, 2018	Preparedness for influenza vaccination during a pandemic in the World Health Organization Western Pacific Region	2
55	Cerilles, n.d.	Analysing the interplay between the right to health and pharmaceutical patent rights in the introduction of a COVID-19 vaccine into the Philippines	2
56	Edwards, 2009	Strategies for broad global access to pandemic influenza vaccines	2
57	Hadler, 2005	Public health strategies for distribution of influenza vaccine during an influenza pandemic	2
58	Lee, 2021	Last-Mile Logistics of Covid Vaccination - The Role of Health Care Organizations	2
59	Looi, 2021	Jeremy Farrar: Make vaccine available to other countries as soon as our most vulnerable people have received it	2
60	Martin, 2021	Maintaining a Focus on Health Equity During the COVID-19 Vaccine Rollout	2
61	Medina-Walpole, 2021	What It Will Take to Equitably Distribute a COVID-19 Vaccine	2
62	Muula, 2007	How relevant is Bellagio statement of principles on social justice and influenza to Africa?	2
63	Subbaraman, 2020	Who gets a COVID vaccine first? Access plans are taking shape	2
64	Todd, 2021	Learning from past mistakes? The COVID-19 vaccine and the inverse equity hypothesis	2
65	Varshney, 2021	Vaccine diplomacy: Exploring the benefits of international collaboration	2
66	Adar, 2020	Distribution equality as an optimal epidemic mitigation strategy	3
67	Alaran, 2021	Uneven power dynamics must be levelled in COVID-19 vaccines access and distribution	3

68	AlKhaldi, 2021	Rethinking and strengthening the Global Health Diplomacy through triangulated nexus between policy makers, scientists and the community in light of COVID-19 global crisis	3
69	Al-Oraibi, 2021	Migrant health is public health: a call for equitable access to COVID-19 vaccines	3
70	Anderson, 2020	Intensifying vaccine production	3
71	Anonymous, 2021	COVID-19 Vaccine: Development, Testing, and Distribution	3
72	Bartovic, 2021	Ensuring equitable access to vaccines for refugees and migrants during the COVID-19 pandemic	3
73	Bhatia, 2013	The H1N1 influenza pandemic: need for solutions to ethical problems	3
74	Billington, 2020	Developing Vaccines for SARS-CoV-2 and Future Epidemics and Pandemics: Applying Lessons from Past Outbreaks	3
75	Boulton, 2021	Advancing Global Vaccination Equity	3
76	Boum Ii, 2021	How to ensure a needs-driven and community-centred vaccination strategy for COVID-19 in Africa	3
77	Briand, 2010	Future developments in global influenza surveillance	3
78	Bryan, 2021	WTO Waiver from Intellectual Property Protection for COVID-19 Vaccines and Treatments: A Critical Review	3
79	Cheong, 2020	Unequal Access to Vaccines Will Exacerbate Other Inequalities	3
80	Coleman, 2009	Allocating vaccines and antiviral medications during an influenza pandemic	3
81	Commissioners, 2021	Human rights and fair access to COVID-19 vaccines: the International AIDS Society-Lancet Commission on Health and Human Rights	3
82	Dadari, 2021	Pro-equity immunization and health systems strengthening strategies in select Gavi-supported countries	3
83	Elbe, 2010	Haggling over viruses: the downside risks of securitizing infectious disease	3
84	Eurosurveillance editorial, 2011	Agreement on a pandemic influenza preparedness framework for the sharing of viruses and benefit sharing	3
85	Fedson, 2006	Vaccine development for an imminent pandemic: why we should worry, what we must do	3
86	Gladas, 2021	Supporting efforts for a global COVID-19 vaccine	3
87	Goh, 2021	Covid-19 vaccination: the dangers of "values" imperialism	3
88	Gostin, 2006	Medical countermeasures for pandemic influenza: ethics and the law	3
89	Griffin, 2020	Covid-19: Governments should demand transparency on vaccine deals, says MSF	3
90	Gronvall, 2006	Removing barriers to global pandemic influenza vaccination	3
91	Guerin, 2020	The consequence of COVID-19 on the global supply of medical products: Why Indian generics matter for the world?	3
92	Gurwitz, 2021	Ethical tradeoffs in SARS-CoV-2 vaccine development: Assuring fair availability for low-income countries	3
93	Haaheim, 2007	Vaccines for an influenza pandemic: scientific and political challenges	3
94	Halabi, 2020	No-Fault Compensation for Vaccine Injury - The Other Side of Equitable Access to Covid-19 Vaccines	3
95	Hendriks, 2011	An international technology platform for influenza vaccines	3
96	Henn, 2020	Allocation criteria for an initial shortage of a future SARS-CoV-2 vaccine and necessary measures for global immunity	3
97	Huneycutt, 2020	Finding equipoise: CEPI revises its equitable access policy	3
98	Jecker, 2021	Out of Africa: A Solidarity-Based Approach to Vaccine Allocation	3
99	Jecker, 2021	Vaccine ethics: an ethical framework for global distribution of COVID-19 vaccines	3
100	Kamradt-Scott, 2013	The politics of medicine and the global governance of pandemic influenza	3
101	Karim, 2020	COVID-19 vaccine affordability and accessibility	3
102	Katz, 2021	From Vaccine Nationalism to Vaccine Equity - Finding a Path Forward	3
103	Kelley, 2020	An appeal for practical social justice in the COVID-19 global response in low-income and middle-income countries	3

104	Kelley, 2021	Process and operations strategies to enable global access to antibody therapies	3
105	Khamsi, 2020	If a coronavirus vaccine arrives, can the world make enough?	3
106	Kieny, 2009	WHO supports fair access to influenza A (H1N1) vaccine	3
107	Koff, 2021	A universal coronavirus vaccine	3
108	Kyd, 2010	3rd Global Vaccine Congress	3
109	Lee, 2011	The Benefits To All Of Ensuring Equal And Timely Access To Influenza Vaccines In Poor Communities	3
110	Li, 2010	Healthcare system cost evaluation of antiviral stockpiling for pandemic influenza preparedness	3
111	McLachlan, 2012	A proposed non-consequentialist policy for the ethical distribution of scarce vaccination in the face of an influenza pandemic	3
112	McLachlan, 2015	On the random distribution of scarce doses of vaccine in response to the threat of an influenza pandemic: a response to Wardrope	3
113	Monto, 2011	Response to the 2009 pandemic: effect on influenza control in wealthy and poor countries	3
114	Mukherjee, 2020	Global efforts on vaccines for COVID-19: Since, sooner or later, we all will catch the coronavirus	3
115	Nguyen, 2010	The influenza challenge	3
116	Pagliusi, 2018	Vaccines, inspiring innovation in health	3
117	Palkonyay, 2016	A decade of adaptation: Regulatory contributions of the World Health Organization to the Global Action Plan for Influenza Vaccines (2006-2016)	3
118	Peters, 2021	Ensuring vaccine supply meets global needs	3
119	Rastegar, 2021	An inventory-location optimization model for equitable influenza vaccine distribution in developing countries during the COVID-19 pandemic	3
120	Roope, 2020	How Should a Safe and Effective COVID-19 Vaccine be Allocated? Health Economists Need to be Ready to Take the Baton	3
121	Ruscio, 2020	Shaping meeting to explore the value of a coordinated work plan for epidemic and pandemic influenza vaccine preparedness	3
122	Sabri, 2020	Solidarity in the time of covid-19 pandemic	3
123	Saunders, 2018	EQUALITY IN THE ALLOCATION OF SCARCE VACCINES	3
124	Shretta, 2021	Vaccinating the world against COVID-19: getting the delivery right is the greatest challenge	3
125	Smith, 2021	Top five ethical lessons of COVID-19 that the world must learn	3
126	Snyder, 2020	Designing Pull Funding For A COVID-19 Vaccine	3
127	Stohr, 2006	Influenza pandemic vaccines: How to ensure a low-cost, low-dose option	3
128	Stoto, 2013	Lessons about the state and local public health system response to the 2009 H1N1 pandemic: a workshop summary	3
129	Straetemans, 2007	Prioritization strategies for pandemic influenza vaccine in 27 countries of the European Union and the Global Health Security Action Group: a review	3
130	Tatar, 2021	The Role of Good Governance in the Race for Global Vaccination during the COVID-19 Pandemic	3
131	Wardrope, 2012	Scarce vaccine supplies in an influenza pandemic should not be distributed randomly: reply to McLachlan	3
132	Wong, 2018	Funding vaccines for emerging infectious diseases	3
133	Wynia, 2006	Ethics and public health emergencies: rationing vaccines	3
134	Yau, n.d.	Mapping the inequality of the global distribution of seasonal influenza vaccine	3
135	Zard, n.d.	Leave no one behind: ensuring access to COVID-19 vaccines for refugee and displaced populations	3
136	Aranzazu, 2013	The WHO influenza surveillance network. Modes of circulation of viruses strains, knowledge and technologies, 1947-2007	4

137	Bingzhe, 2020	Expanding the pandemic influenza preparedness framework to the epidemic of COVID-19	4
138	Leineweber, 2021	The influence of the U.S. response to COVID-19 in Global Health	4
139	Collin, 2009	[Influenza vaccine: globalization of public health stakes]	5
140	Donatelli, 2003	[WHO Influenza Global Agenda]	5
141	Iacob, 2020	The Role of the Joint Procurement Agreement during the COVID-19 Pandemic: Assessing Its Usefulness and Discussing Its Potential to Support a European Health Union	5
142	Jorgensen, 2013	Unequal access to vaccines in the WHO European Region during the A(H1N1) influenza pandemic in 2009	5
143	Lopalco, 2016	Pandemic vaccines: Are we prepared for the next pandemic?	5
144	Mark, 2020	The Procurement of a COVID-19 Vaccine in Developing Countries: Lessons from the 2009-H1N1 Pandemic	5
145	Mendes, 2021	Tackling inequitable distribution of the COVID-19 vaccine	5
146	Saransh, 2021	Building Resilient Vaccine Distribution	5
147	Ana Santos, 2020	The COVID-19 Vaccine Race: Intellectual Property, Collaboration(s), Nationalism and Misinformation	6
148	Ana Santos, 2020	The Reemergence of Vaccine Nationalism	6
149	Ana Santos, 2020	The Intellectual Property of COVID-19	6
150	Armin von, 2020	The Role of International Law in Vaccinating Against COVID-19: Appraising the COVAX Initiative	6
151	Benjamin, 2020	COVID-19 Vaccine Research, Development, Regulation and Access	6
152	François, 2020	Spatial Allocation of Scarce Vaccine and Antivirals for COVID-19	6
153	Goldstein, 2021	Failure to achieve global vaccine equity will have dire consequences	6
154	Jorge, 2021	US Support for a WTO Waiver of COVID-19 Intellectual Property – What Does it Mean?	6
155	Mohamed Mustafa, 2021	The Cost of Procuring and Delivering COVID-19 Vaccines in Low- and Middle-Income Countries: A Model of Projected Resource Needs	6
156	National Academies of Sciences Engineering and Medicine, 2020	Framework for Equitable Allocation of COVID-19 Vaccine	6
157	Shlomit, 2021	Intellectual Property Laws in the Digital Era: An International Distributive Justice Perspective	6
158	Simon, 2021	The Covid-19 Vaccine Production Club: Will Value Chains Temper Nationalism?	6
159	Viviana Munoz, 2020	The COVID-19 Pandemic: R&D and Intellectual Property Management for Access to Diagnostics, Medicines and Vaccines	6

Appendix 5: Data extraction form for factors influencing global equitable access to COVID-19 vaccines for Low-and Middle-Income Countries

1. Name of reviewer
2. First author and year of publication (Date) e.g. Li (2011)
3. Title
4. Inclusion criteria (all must be selected):
    - LMIC or globally focussed or normative guidance that affects LMIC
    - Published between 2005-2021
    - Discusses influenza/pandemic/COVID-19 vaccine(s)
    - Contains arguments/discussion on equity, access, allocation or prioritization of influenza/pandemic/COVID-19vaccine(s)
    - Published in English

Findings related to our Scoping Review research objective: What are the factors influencing global equitable access to a COVID-19 vaccine among countries?

5. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
6. Key examples or illustrations from publication (including page numbers)
7. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
8. Key examples or illustrations from publication (including page numbers)
9. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
10. Key examples or illustrations from publication (including page numbers)
11. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
12. Key examples or illustrations from publication (including page numbers)

13. Is there anything else that this study tells us about the knowledge in this topic area?
14. Challenges in implementing equitable access to vaccination
15. List any global initiatives/mechnasims/frameworks identified in our search that address equitable access to pandemic vaccine(s)?
16. Recommendations for strengthening equitable access to vaccination

Appendix 5: Papers underlying this Scoping Review

List of the 44 papers included in the review, including the reference, type of publication and a short summary of the focus of the paper is shown in the table below.

No	Reference (BMJ style)	Study design	Focus of paper
1	Abbott FM, Reichman JH. Facilitating Access to Cross-Border Supplies of Patented Pharmaceuticals: The Case of the COVID-19 Pandemic. *Journal of International Economic Law* 2020;23(3):535-61.	Article	Proposes legal mechanisms for addressing critical issues facing the international community in terms of providing equitable access to vaccines, treatments, diagnostics, and medical equipment.
2	Bollyky TJ, Gostin LO, Hamburg MA. The Equitable Distribution of COVID-19 Therapeutics and Vaccines. *Jama-Journal of the American Medical Association* 2020;323(24):2462-63. doi: 10.1001/jama.2020.6641	Viewpoint	Discusses experiences and suggestions for a future framework to the distribution of COVID-19 vaccines.
3	Choi EM. COVID-19 vaccines for low- and middle-income countries. *Transactions of the Royal Society of Tropical Medicine & Hygiene* 2021;115(5):447-56.	Review	Discusses low- and middle-income countries access COVID-19 vaccines, what is being done to distribute vaccines fairly, as well as the challenges ahead
4	DeFrancesco L. Whither COVID-19 vaccines? *Nature Biotechnology* 2020;38(10):1132-45.	Article	Insights from seven experts on the development of the COVID-19 vaccines.
5	Eccleston-Turner M. The pandemic influenza preparedness framework: A viable procurement option for developing states? *Medical Law International* 2017;17(4):227-48.	Article	Examines the Pandemic Influenza Framework and the content of the Obligations of the Company which have been secured by the World Health Organization.
6	Eccleston-Turner M, Upton H. International Collaboration to Ensure Equitable Access to Vaccines for COVID-19: The ACT-Accelerator and the COVAX Facility. *Milbank Quarterly*	Original Scholarship	Analysis of the COVAX Facility and its aim and ensure equitable availability of the vaccine in low and middle-income countries.
7	Fedson DS. Pandemic influenza and the global vaccine supply. *Clin Infect Dis* 2003;36(12):1552-61.	Article	The article explores several issues related to the global supply of vaccine during influenza pandemics
8	Fedson DS. Preparing for pandemic vaccination: an international policy agenda for vaccine development. *J Public Health Policy* 2005;26(1):4-29.	Commentary	Focuses on the trivalent vaccines currently available that contain inactivated viruses.
9	Fedson DS, Dunnill P. Commentary: From scarcity to abundance: pandemic vaccines and other agents for "have not" countries. *J Public Health Policy* 2007;28(3):322-40.	Commentary	Discusses that access to supplies of pandemic vaccine for most countries is a problem of scarcity and how to ensure the “have not” countries will get access to pandemic vaccines.
10	Felicitas H, Florencia L, Manriquez RT, et al. A matter of priority: equitable access to COVID-19 vaccines. *Swiss Med Wkly* 2021;151	Viewpoint	Highlights inequality in current vaccination rates between some high income countries (HIC) and low income countries (LIC) provides arguments for HIC to support distribution to LIC
11	Fidler DP. Negotiating Equitable Access to Influenza Vaccines: Global Health Diplomacy and the Controversies Surrounding Avian Influenza H5N1 and Pandemic Influenza H1N1. *Plos Medicine* 2010;7(5)	Article	Examines the diplomatic negotiations surrounding influenza virus sharing as an example of the core tensions characterizing multilateralism and emerging forms of global health governance.
12	Fidler DP. Vaccine nationalism's politics. *Science* 2020;369(6505):749.	Editorial	Discusses global politics and the burden of global equitable COVID-19 vaccine access issues, historically and now.
13	Forman R, Anderson M, Jit M, et al. Ensuring access and affordability through COVID-19 vaccine research and development investments: A proposal for the options market for vaccines. *Vaccine* 2020;38(39):6075-77.	Commentary	Discusses existing financing mechanisms and a proposal for vaccine development, referred to as Options Market for Vaccines (OMV).
14	Forman R, Shah S, Jeurissen P, et al. COVID-19 vaccine challenges: What have we learned so far and what remains to be done? *Health Policy* 2021;125(5):553-67.	Review	Offers a framework for understanding remaining and new policy challenges for global vaccine campaigns against COVID-19 and potential solutions.

No	Reference (BMJ style)	Study design	Focus of paper
15	Gray G, van der Heever A, Madhi S, et al. The Scientists' Collective 10-point proposal for equitable and timeous access to COVID-19 vaccine in South Africa. *Samj South African Medical Journal* 2021;111(2):89-94.	(Guest) Editorial	Proposes a ten-point plan for equitable and timely access to COVID-19 vaccine in South Africa.
16	Guzman J, Hafner T, Maiga LA, et al. COVID-19 vaccines pricing policy options for low-income and middle- income countries. *BMJ Global Health* 2021;6(3):03.	Commentary	Discusses four pricing strategies to address high prices and obtain COVID-19 vaccines (and other medical products) at affordable rate.
17	Herlitz A, Lederman Z, Miller J, et al. Just allocation of COVID-19 vaccines. *BMJ Global Health* 2021;6(2):02.	Editorial	Offers three suggestions to strengthen how to achieve the greatest health impact with authorized COVID-19 vaccines.
18	Iacobucci G. Covid-19: How will a waiver on vaccine patents affect global supply? *BMJ* 2021;373:n1182.	News analysis	Presents responses from experts and organizations after Biden administration (US) announced to support a proposal to waive patents on covid-19 vaccines.
19	Kamradt-Scott A, Lee K. The 2011 Pandemic Influenza Preparedness Framework: Global Health Secured or a Missed Opportunity? *Political Studies* 2011;59(4):831-47.	Article	Investigates the diplomatic negotiations surrounding influenza virus sharing, and evaluates the Pandemic Influenza Preparedness (PIP) framework.
20	Kupferschmidt K. Global plan seeks to promote vaccine equity, spread risks. *Science* 2020;369(6503):489-90.	News	Discusses the COVAX facility and its challenges.
21	Liu Y, Salwi S, Drolet BC. Multivalue ethical framework for fair global allocation of a COVID-19 vaccine. *Journal of medical ethics* 2020;46(8):499-501.	Article	Analyses and synthesizes the ethical considerations of four allocation paradigms: ability to develop or purchase; reciprocity; ability to implement; and distributive justice.
22	The Lanclet. Global governance for COVID-19 vaccines. *Lancet (London, England)* 2020;395(10241):1883.	Editorial	Discusses the COVID-19 vaccine bidding war and the necessary global level arrangements to for development, finance, production, and distribution.
23	The Lancet. Access to COVID-19 vaccines: looking beyond COVAX. *Lancet* 2021;397(10278):941.	Editorial	Calls for a strong political leadership to support equitable access to vaccines
24	McAdams D, McDade KK, Ogbuoji O, et al. Incentivising wealthy nations to participate in the COVID-19 Vaccine Global Access Facility (COVAX): a game theory perspective. *BMJ Global Health* 2020;5(11):11.	Commentary	Discusses how maximizing the benefit of bilateral deals to support COVAX, and explores how such deals can improve the global supply of vaccines.
25	McMahon A. Global equitable access to vaccines, medicines and diagnostics for COVID-19: The role of patents as private governance. *Journal of Medical Ethics* 2020;30:30.	Current controversy	Discusses the role of patents and highlights that during the COVID-19 pandemic the power of patent holders should be questioned.
26	Nhamo G, Chikodzi D, Kunene HP, et al. COVID-19 vaccines and treatments nationalism: Challenges for low-income countries and the attainment of the SDGs. *Global Public Health* 2021;16(3):319-39.	Article	Discusses the 2030 Agenda for Sustainable Development and calls stakeholders for their continued support to Gavi and COVAX 'to leave no one behind' and eliminate inequalities.
27	Pagliusi S, Hayman B, Jarrett S. Vaccines for a healthy future: 21st DCVMN Annual General Meeting 2020 report. *Vaccine* 2021;39(18):2479-88.	Meeting Report	Summary of a meeting where public and private sector participants presented challenges and opportunities related to vaccine R&D, supply chain, global policies, financing, health objectives, and supporting access for LMIC.
28	Phelan AL, Eccleston-Turner M, Rourke M, et al. Legal agreements: barriers and enablers to global equitable COVID-19 vaccine access. *Lancet* 2020;396(10254):800-02.	Commentary	Discusses role of law on equitable access to COVID-19 vaccines, highlighting challenges of bilateral agreements, advanced purchasing, and COVAX.
29	Rourke MF. Access by Design, Benefits if Convenient: A Closer Look at the Pandemic Influenza Preparedness Framework's Standard Material Transfer Agreements. *Milbank Q* 2019;97(1):91-112.	Article	Analyses the PIP Framework, its Standard Material Transfer Agreements (SMTAs), and secondary sources to determine whether the PIP Framework will effectively function as an access and benefit-sharing (ABS) instrument during an influenza pandemic.

No	Reference (BMJ style)	Study design	Focus of paper
30	Ruscio BA, Hotez P. Expanding global and national influenza vaccine systems to match the COVID-19 pandemic response. *Vaccine* 2020;38(50):7880-82.	Commentary	Discusses the double burden synergies of Influenza and COVID 19 in the Global South, and proposes how a way to address both issues.
31	Saksena N. Global justice and the COVID-19 vaccine: Limitations of the public goods framework. *Global Public Health* 2021	Article	Focuses on global access, discussing the limitations of the global public good framework in addressing the problem of distribution COVID-19 vaccines.
32	Sawal I, Ahmad S, Tariq W, et al. Unequal distribution of COVID-19 vaccine: A looming crisis. *Journal of Medical Virology* 2021;03:03.	Letter to Editor	Argues for the promotion of equitable access to COVID-19 vaccines to benefit the whole world.
33	Sharma S, Kawa N, Gomber A. WHO's allocation framework for COVAX: is it fair? *Journal of Medical Ethics* 2021;09:09.	Article	Explores comparing COVAX allocation mechanisms to a targeted allocation system, based on need. Arguing that this could maximize well-being and align with principles of equity.
34	Sehovic AB, Govender K. Addressing COVID-19 vulnerabilities: How do we achieve global health security in an inequitable world. *Global Public Health* 2021	Commentary	Discusses the particular challenges of COVID-19 for LMICs, and the inequities being perpetuated in the COVID-19 Pandemic and the suggestions in how to address these challenges.
35	So AD, Woo J. Reserving coronavirus disease 2019 vaccines for global access: cross sectional analysis. *Bmj-British Medical Journal* 2020;371	Special paper	Analyzes premarket purchase commitments for COVID-19 vaccines from leading manufacturers to recipient countries.
36	So AD, Woo J. Achieving path-dependent equity for global COVID-19 vaccine allocation. *Medicina Intensiva* 2021;2(4):373-77.	Commentary	Discusses the interdependence of equitable allocation based on three policy levers: Development and Production, Procurement, and Healthcare Delivery.
37	Torres I, Artaza O, Profeta B, et al. COVID-19 vaccination: returning to WHO's Health For All. *The Lancet Global Health* 2020;8(11):e1355-e56.	Commentary	Promotes the perspective of World Health Organization, calling for inclusion of all member states, and transparency.
38	Towse A, Chalkidou K, Firth I, et al. How Should the World Pay for a Coronavirus Disease (COVID-19) Vaccine? *Value in Health* 2021;24(5):625-31.	Article	Proposes the Benefit-Based Advance Market Commitment as a collaborative, market-based financing mechanism for the world to incentivize and pay for the development and provide equitable access to second and third generation COVID-19 vaccines.
39	Turner M. Vaccine procurement during an influenza pandemic and the role of Advance Purchase Agreements: Lessons from 2009-H1N1. *Glob Public Health* 2016;11(3):322-35.	Article	A case study on the procurement of pandemic influenza vaccines during 2009-H1N1, and the likely manner in which procurement will occur during future pandemics.
40	Usher AD. COVID-19 vaccines for all? *Lancet (London, England)* 2020;395(10240):1822-23.	World report	Provides an assessment of the initiatives being planned to ensure equitable access to COVID-19 vaccines, and shortcomings.
41	Usher AD. CEPI criticised for lack of transparency. *Lancet* 2021;397(10271):265-66.	World Report	Provides insights and perspectives on CEPI contracts for COVID-19 vaccines.
42	Usher AD. South Africa and India push for COVID-19 patents ban. *Lancet* 2020;396(10265):1790-91.	World Report	Report on the proposal by India and South Africa to waiver Intellectual Property Rights to COVID-19 products (incl. vaccines).
43	Wouters OJ, Shadlen KC, Salcher-Konrad M, et al. Challenges in ensuring global access to COVID-19 vaccines: production, affordability, allocation, and deployment. *Lancet* 2021;397(10278):1023-34.	Article	Reviews potential challenges and policy implications for the production, afforable pricing, and global allocation of Covid-19 vaccines.
44	Yamey G, Schäferhoff M, Hatchett R, et al. Ensuring global access to COVID-19 vaccines. *Lancet (London, England)* 2020;395(10234):1405-06.	Commentary	Discusses how COVID-19 vaccines can be used globally to end the COVID-19 pandemic, arguing for three imperatives: speed, manufacture and deployment at scale, and global access.

Appendix 1: Updated protocol

Factors influencing global equitable access to a COVID-19 vaccine for Low- and Middle- Income Countries (LMICs)

Proposal for scoping review

24 September 2020

Elizabeth Peacocke, Lumbwe Chola, Katrine Frønsdal and Marita Fønhus, Norwegian Institute Public Health.

Updated 24 July 2021

Elizabeth Peacocke, Lieke Fleur Heupink, Katrine Frønsdal, Elin Hoffmann Dahl and Lumbwe Chola.

1 Summary

Summary

Vaccines are important medical countermeasures to prevent the spead of infectious diseases. The World Bank forecasts a 5.2% contraction in global GDP in 2020, and long-term negative impacts are expected in terms of lower investment, an erosion of human capital through lost work and schooling, and fragmentation of global trade and supply linkages (1) Without effective vaccines, diagnostics, and therapeutics, COVID-19 will continue to spread and have severe health and socio-economic consequences. The UN's Framework for the Immediate Socio-Economic Response to the COVID 19 Crisis warns "The COVID-19 pandemic is far more than a health crisis: it is affecting societies and econ-omies at their core. While the impact of the pandemic will vary from country to country, it will most likely increase poverty and inequalities at a global scale, making achievement of SDGs even more urgent." (2)

This project includes a scoping review that identifies and characterizes the factors influencing global equitable access to COVID-19 vaccines among countries, and contextualizes these factors with global mechanisms or guidelines that address global equitable access to pandemic vaccines. The documentation of these factors will offer decision makers lessons from previous experiences and information to support the understanding of principles related to equitable access to a COVID-19 vaccine.

This scoping review was conducted during August-November 2020, with a draft report for Norad, who commissioned and partly financed the report. This draft report was then submitted as a manuscript for publication. During the review process, in May 2021, the authors updated the search. This protocol has been updated to reflect the methods used in this Scoping Review.

To our knowledge, such a scoping review has not been systematically investigated.

Title:
Factors influencing global equitable access to a COVID-19 vaccine for Low- and Middle- Income Countries (LMICs)

Proposal for scoping review

Commissioned by:
Commissioned by the Norad Evaluation Department

Start date:
24.07.2020.

End date:
19.07.2021

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Background

New Corona Virus: SARS-CoV-2 (COVID-19) Pandemic

The world is currently facing a global public health emergency with the emergence of the Severe acute respiratory syndrome coronavirus 2 discovered in 2019 (COVID-19), an infectious acute respiratory disease caused by a novel coronavirus. A race to increase access to existing health technologies – including diagnostics - and find new and effective treatments and vaccine is underway, and with this the international community is faced with the challenge of how to ensure equitable access of essential medicines[1] to all populations. In this scoping review, we will systematically review the literature and summarize factors pertaining to the equitable access of a COVID-19 vaccine relevant for low- and middle- income countries (LMICs). For the purpose of this study, we are using the WHO definition of equity,[2] and we take the principle that the COVID-19 vaccine is an essential medicine[3], and that access to essential medicines is part of the right to health which is well founded in international law (4).

The challenge with global equitable availability and access to pandemic vaccines

COVID-19 has seen a large effort and investment in vaccines, and diagnostics, with 22 manufacturers that have applied for and Emergency Use Listing under the WHO Pre-Qualification, 10 of which have been approved (5). Shortly following these rapid advances and regulatory approvals, questions began to be raised about the availability and access of vaccines in LMIC, and as global public goods (6, 7).

The 2005 experience with the sharing of avian influenza A (H5N1) and the 2009 influenza A (H1N1) pandemic made apparent the need for equity considerations and ensuring that global coordination and distribution mechanisms are in place and adhered to, supporting equitable access to scarce vaccines. During H5N1, concerns raised by LMICs about the lack of mechanisms for ensuring global equitable access to vaccines prompted Indonesia to refuse to share H5N1 virus samples with the World Health Organization (WHO) (8). With Asia being the epicenter of the outbreak, fears were raised by the international community that Indonesia's refusal to share virus samples would impede the research and development, surveillance and response efforts, and made the re-

[1]**Essential medicines** are those that satisfy the priority health care needs of the population 3.World Health Organization. Essential medicines and health products. Essential medicines definition 2020 [cited 2020 August 13]. Available from: https://www.who.int/medicines/services/essmedicines_def/en/.
[2] **Equity** is the absence of avoidable, unfair, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically or by other means of stratification. "Health equity" or "equity in health" implies that ideally everyone should have a fair opportunity to attain their full health potential and that no one should be disadvantaged from achieving this potential (World Health Organization. Health Topics: Health Equity. 2020 [cited 2020 August 12]; Available from: https://www.who.int/topics/health_equity/en/).
[3] WHO (2020)

sponse to the global health emergency more difficult. Ensuing negotiations with the WHO and its member states to create a new system of influenza virus sharing and vaccine availability did not immediately yield consensus.

During the 2009 pandemic, high income countries (HIC) bought virtually all vaccine supplies, leaving limited supplies for LMICs. One prominent example for this asymmetry was Mexico. Despite it being one of the first nations affected by H1N1 (concurrently with Canada and the United States), Mexico gained access to vaccines much later than the two other countries (9). The WHO intervened to mediate this potential challenge, engaging in talks with manufacturers and LMIC governments to secure equitable access to the vaccine for LMIC (10). Consequently, donation pledges to LMIC were made by manufacturers and HICs, with the exception of Canada (10, 11). These pledges from manufacturers were made without a fixed delivery date and were perceived to leave HICs with more than enough vaccines for full coverage in their own countries, leaving LMICs with limited access to timely supplies (11).

Lessons from previous collective responses to support global equitable access to vaccines

In response to the H5N1 and H1N1 experiences, WHO and member states developed and adopted the Pandemic Influenza Preparedness (PIP) framework in 2011, a global approach to pandemic influenza preparedness and response (12). The intention of PIP was to improve and strengthen the sharing of influenza viruses with human pandemic potential; and to share the benefit of, which is to increase the access of LMICs to vaccines and other pandemic related supplies. There are, however, several gaps in the framework, not least, that it is not legally binding (13).

There are other relevant frameworks and mechanisms, such as establishing the Advanced Market Commitment for AMC for Pneumonia Vaccine, and the Pan Americal Health Organisation's Revolving Fund for Vaccines. Much can be learnt from these initiatives that is relevant to the current COVID-19 pandemic. Recent events related to COVID-19 have shown some countries and technology holders' tendencies to control the global supply of personal protective equipment, ventilators, diagnostics and therapeutic medicines and reserve supply to HIC, as well as the challenges with limited manufacturing capacity and access to know-how, intellectual property and data; indicating that it is highly likely that similar controls will be placed on a vaccine that meets the necessary safety, efficacy and regulatory standards, to be used for mass vaccination (14).

To manage anticipated issues with the distribution of COVID-19 vaccine, the WHO is convening the Access to COVID-19 Tools (ACT) Accelerator, which brings together governments, scientists, businesses, civil society, and philanthropists and global health organizations (the Bill & Melinda Gates Foundation, CEPI, FIND, Gavi, The Global Fund, Unitaid, Wellcome, the World Bank and Global Financing Facility), in efforts to support the development and equitable distribution of the tests, treatments and vaccines. The ACT-Accelerator is organized into four pillars of work: diagnostics, treatment, vaccines and health system strengthening (15). Gavi and CEPI are leading implementation of the vaccines pillar, "the COVID-19 vaccine global access (COVAX) facility", which is committed to supporting the acute phase of the pandemic through the appropriate allocation of safe and effective doses of a vaccine (16, 17).

The barriers in access to medicines to COVID-19 vaccines relate the demand and the supply of the vaccine, and there continues to be unprecedented demand for a safe and

effective vaccine (18, 19). The supply of this vaccine is hampered by complex vaccine innovation and manufacturing processes. Depending on the candidates that prove to be the most effective, the approach used will determine the necessary manufacturing capacity and length of time for development, (19). In terms of the quantity of the vaccine needed to be produced, this is also influenced by whether one or two does are necessary, in addition other challenges including e.g. with lack or insufficient global vaccine manufacturing capacity & access to know-how and implementation in LMIC countries are also essential for access to vaccines for many. All of these factors will limit the supply of vaccines.

Importance of the project

The access to, and distribution of a scarce vaccine is one of the pegged solutions to enable the world to return some semblance of life pre-COVID 19. With COVID-19 affecting the world, the equitable distribution of this vaccine is important because the virus will cause unnecessary disability and loss of life unless the benefit of a vaccine is distributed fairly among and within countries. To our knowledge, a scoping review of the the factors for the equitable access of a COVID-19 vaccine relevant for LMIC has not been systematically investigated. The project is considered highly relevant to the current situation as it aims at identifying and describing of these factors which can inform decision makers in terms of lessons from previous experiences and supporting the understanding of principles related to equitable access to a COVID-19 vaccine, and further potentially guide implementation of future initiatives to ensure equitable access.

Objective

This objective of this scoping review is to identify and summarize the factors for the equitable access of a COVID-19 vaccine relevant for LMICs. We will address the following question: *What are the factors influencing global equitable access to a COVID-19 vaccine among countries?*

Methods

Scoping searches

We will perform systematic scoping searches for publications according to PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) (20).

Inclusion criteria

We aim to identify and describe factors influencing global equitable access to a COVID-19 vaccine among countries as identified in our search (see the manuscript supplementary material), following the inclusion criteria shown in Table 1.

Table 1. Inclusion criteria

Topic	Pandemic vaccines incl. influenza or COVID-19 vaccine
Outcomes	The factors influencing equitable access to a pandemic vaccine incl. COVID-19 vaccine
Type of publication	Primary studies, systematic reviews
Language	English
Publication date	2002-2021

Restriction to publications from 2002 are made as a pragmatic choice from the date of the 2003-04 SARS pandemic. Furthermore, the limitation to English language journal articles in scientific databases was balancing completeness with the resources available.

Search strategy and Information sources:

An information specialist at NIPH will develop the search strategies together with the project leader, and another information specialist will review the search strategy. The literature search will be conducted in the following databases: Medline (PubMed and Ovid), EMBASE (Ovid), Global Index Medicus, WHO https://www.globalindexmedicus.net/ and Web of Science Core Collection Clarivate Analytics (see supplementary information for updated search strategies and databases).

Additional relevant information will be searched from websites of multilateral agencies and international philanthropic agencies identified in the literature through the database search (e.g. WHO Pandemic Influenza Preparedness Framework) as a means to understand the particular framework or initiative.

Selection of literature

First screening

We will first review articles that are determined to be relevant (according to predefined inclusion criteria described above). Three project team members (EP, LF and LC) will independently go through all identified titles and abstracts and determine if articles should be included for full-text review.

Where there are divergent views, inclusion will be determined through discussion and consensus between the reviewers or by consulting a fourth team member (KF). Records not fulfilling the inclusion criteria will be excluded.

Full text review

Given time constraints, the review group will divide the studies by two and each study will be read in full and assessed for inclusion by one reviewer. This is verified by a second reviewer. Disagreement over exclusion or inclusion will be handled in the same way as for the first screening.

Extraction and presentation of data

Data to be extracted are mainly qualitative data on the predefined outcomes. Standard data extraction templates were designed, and piloted specifically for this scoping review (see the manuscript supplementary material for a copy of the data extraction form).

The predefined outcomes for extracting data include: the setting (LMIC or globally focused or normative guidance that affects LMIC), and argument/ discussion on equity, access, allocation or prioritization of pandemic vaccines, other aspects that article tells us about the knowledge in this topic area, challenges in implementing equitable access to vaccination between countries, and recommendations for strengthening the equitable access to vaccination. In addition, we collected names of relevant global initiatives and mechanisms as identified in our search. Data is to be extracted by one team member and a second reviewer will review the data extraction.

Analysis of data

The analysis of the data collected will provide information on the body of research and evaluations related to the factors influencing global equitable access to a COVID-19 vaccine among countries. Our analysis will include how factors influencing global equitable access to a COVID-19 vaccine among countries pertain to global frameworks and mechanisms identified in our searches.

We will consider using the following framework for analysis, adapted from Liu et al (21), which includes three main areas related to:

- A country's ability to develop or to purchase pandemic vaccines
- Reciprocity
- A country's ability to implement or vaccinate.

Reporting, submission of manuscript and updating of search

A draft report based on the findings from the scoping review was prepared and presented to Norad and two external peer reviewers. A manuscript was then prepared and submitted to BMJ Open in January 2021. Based on feedback from peer review, the search was updated in May 2021.

Risk of bias and limitations

Due to time constraints we are extracting data directly related to our topic of interest. This will mean that some papers are excluded due to their lack of direct relevance to our question, and will not be included in the analysis.

Only one reviewer will complete the full-text review and data extraction, to limit the risk of bias, one reviewer will peer review the full-text categorisation and data extraction.

Peer –review

External and internal peer review is being used to strengthen the methods and improve the rigor of this scoping review.

Internal:
The project plan (this document) has been reviewed by all authors and peer reviewed internally at NIPH. Internal reviewers at NIPH will also review any publication of results presented to Norad.

External:
Two external peer reviewers will be used in addition before publication of results.

Acronyms

CEPI	Coalition for Epidemic Preparedness Innovations
COVAX	the COVID-19 vaccine global access (COVAX) facility
COVID-19	2019 Pandemic corona virus strain
CIS	Critical Interpretive Synthesis
DNA	Deoxyribonucleic acid
Gavi	Gavi, the Vaccine Alliance
FIND	the Foundation for Innovative New Diagnostics
HIC	High income countries
H1N1	2009 influenza A
H5N1	2006 avian influenza A
LMIC	Low- and Middle- income countries

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Appendix 2: Search strategies for each of the five databases ***(Initially searched for the period 01.01.2002 - 28.08.2020, updated to include12.05.2021)***

Databases searched

- MEDLINE ALL 2002 to May 11, 2021
  - Ovid MEDLINE, PubMed (only 28.082020);
  - Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 2002 to August 27, 2020
- Embase 2002 to 2021, Ovid
- Web of Science Core Collection, Clarivate Analytics
- Global Index Medicus, WHO
- COVID-19 Evidence, Epistemonikos Foundation

Updated search 12.05.2021

We searched:

- **PubMed, US National Library of Medicine (NLM):** pubmed.ncbi.nlm.nih.gov/

Only 28.08.2020 as string was not available in 2021.

- **MEDLINE ALL 1946 to May 11, 2021, Ovid (searched 12.05.2021)**

#	Searches	Results
1	COVID-19 Vaccines/	2510
2	Coronavirus/	4692
3	Betacoronavirus/	33218
4	Coronavirus Infections/	44847
5	Coronaviridae Infections/	919
6	Severe Acute Respiratory Syndrome/	5545
7	Pandemics/	56289
8	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).ti,ab,kf.	177584
9	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).ti,ab,kf,hw.	218
10	or/2-9	184722
11	Vaccines/	22577
12	Viral Vaccines/	27055
13	Vaccination/	85401
14	Vaccination Coverage/	1540
15	Mass Vaccination/	3208
16	Immunization/	51563
17	Immunization Programs/	11524
18	(vaccin* or immuni*).ti,ab,kf.	576919
19	or/11-18	610926
20	"Delivery of Health Care"/	95912

21	"Health Services Needs and Demand"/	54005
22	Resource Allocation/	8895
23	Health Care Rationing/	11853
24	Health Services Accessibility/	78488
25	Health Equity/	1805
26	Right to Health/	131
27	Universal Health Care/	149
28	Healthcare Disparities/	18787
29	Socioeconomic Factors/	162607
30	Social Justice/	12551
31	Global Health/	50200
32	Human Rights/	14729
33	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kf.	32465
34	(right to health* or universal health*).ti,ab,kf.	7779
35	((health* or health care) adj (rationing or disparities)).ti,ab,kf.	15193
36	or/20-35	488375
37	10 and 19 and 36	1157
38	1 and 36	280
39	37 or 38	1194
40	(202008* or 202009* or 202010* or 202011* or 202012* or 2021*).dt,dp,ed,ep,yr.	1805737
41	39 and 40	588
42	38 or 41	608

- **Embase 1974 to 2021 Week 18 (searched 12.05.2021)**

#	Searches	Results
1	SARS-CoV-2 vaccine/	2292
2	coronavirus disease 2019/	106145
3	coronavirinae/	3003
4	betacoronavirus/	7651
5	coronavirus infection/	12666
6	coronaviridae infection/	187
7	pandemic/	65235
8	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).mp.	195467

9	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).mp.	355
10	or/3-9	195821
11	vaccine/	63516
12	virus vaccine/	20586
13	severe acute respiratory syndrome vaccine/	453
14	vaccination/	151179
15	vaccination coverage/	2788
16	immunization/	98822
17	mass immunization/	3739
18	(vaccin* or immuni*).ti,ab,kw,ot.	685955
19	or/11-18	736294
20	health care delivery/	184159
21	resource management/	10987
22	resource allocation/	22438
23	health care access/	69640
24	health care quality/	250577
25	health equity/	4605
26	right to health/	214
27	universal health care/	337
28	health care disparity/	17595
29	socioeconomics/	147326
30	social justice/	11121
31	global health/	12881
32	human rights/	26721
33	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kw,ot.	42137
34	(right to health* or universal health*).ti,ab,kw,ot.	9211
35	((health* or health care) adj (rationing or disparities)).ti,ab,kw,ot.	19032
36	or/20-35	714178
37	10 and 19 and 36	1372
38	1 and 36	266
39	2 and 19 and 36	692
40	or/37-39	1423
41	limit 40 to (conference abstracts or embase)	1129
42	limit 37 to (conference abstracts or embase)	1078

43	(202008* or 202009* or 202010* or 202011* or 202012* or 2021*).dd,em,yr.	1850404
44	42 and 43	439
45	limit 38 to (conference abstracts or embase)	259
46	limit 39 to (conference abstracts or embase)	652
47	44 or 45 or 46	751
48	47 use oemez	751

- **Web of Science, Clarivate Analytics** (searched 12.05.2021)

Advanced search - Topic

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics

AND

vaccin* OR immuni*

AND

equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities"

- **Global Index Medicus, WHO:** www.globalindexmedicus.net (searched 14.05.2021)

Advanced search in Title, abstract, subject

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics

AND

vaccine OR vaccines OR vaccination OR immunization OR immunisation

AND

equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities" OR global OR globally

- **COVID-19 Evidence, Epistemonikos Foundation:** app.iloveevidence.com/loves/5e6fdb9669c00e4ac072701d?utm=epdb_en (searched 14.05.2021)

(vaccin* OR immuniz* OR immunis*) AND (equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR fair* OR unfair* OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities" OR global OR globally) AND (access* or allocat* or distribut* or deliver* or provision or supply or supplies)
LIMITED TO Type of publication: Pre-print

Original search of databases: 28.08.2020

- **MEDLINE, PubMed** (searched 28.08.2020)

MeSH: "COVID-19 vaccine" [Supplementary Concept]

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to August 27, 2020 (searched 28.08.2020)

#	Searches	Results
1	Coronavirus/	3244
2	Betacoronavirus/	16530
3	Coronavirus Infections/	24138
4	Coronaviridae Infections/	906
5	Severe Acute Respiratory Syndrome/	4873
6	Pandemics/	24349
7	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).ti,ab,kf.	91205
8	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).ti,ab,kf,hw.	51
9	or/1-8	97109
10	Vaccines/	21690
11	Viral Vaccines/	25884
12	Vaccination/	81687
13	Vaccination Coverage/	1160
14	Mass Vaccination/	3038
15	Immunization/	50752
16	Immunization Programs/	10877
17	(vaccin* or immuni*).ti,ab,kf.	546309
18	or/10-17	579947
19	"Delivery of Health Care"/	91173
20	"Health Services Needs and Demand"/	53044
21	Resource Allocation/	8501
22	Health Care Rationing/	11514
23	Health Services Accessibility/	74764
24	Health Equity/	1291
25	Right to Health/	75
26	Universal Health Care/	80
27	Healthcare Disparities/	17030
28	Socioeconomic Factors/	157123
29	Social Justice/	12160
30	Global Health/	47402
31	Human Rights/	14384

32	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kf.	29976
33	(right to health* or universal health*).ti,ab,kf.	7053
34	((health* or health care) adj (rationing or disparities)).ti,ab,kf.	13345
35	or/19-34	466021
36	9 and 18 and 35	632

- **Embase 1974 to 2020 Week 34, Ovid (searched 28.08.2020)**

#	Searches	Results
1	coronavirinae/	2268
2	betacoronavirus/	4632
3	coronavirus infection/	8485
4	coronaviridae infection/	166
5	pandemic/	30028
6	(COVID-19 or COVID 19 or COVID19 or 2019-nCoV or SARS2 or SARS-CoV or SARS-CoV-2 or SARS-Cov-19 or coronavirus* or corona or pandemic?).mp.	103695
7	(BNT162 or BNT-162 or mRNA-1273 or mRNA1273 or INO-4800 or INO4800 or ChAdOx1 or Ad5-nCoV).mp.	85
8	or/1-7	103962
9	vaccine/	60026
10	virus vaccine/	19609
11	severe acute respiratory syndrome vaccine/	385
12	vaccination/	140276
13	vaccination coverage/	2060
14	immunization/	94131
15	mass immunization/	3511
16	(vaccin* or immuni*).ti,ab,kw,ot.	643022
17	or/9-16	689815
18	health care delivery/	174154
19	resource management/	10271
20	resource allocation/	20867
21	health care access/	62445
22	health care quality/	241073
23	health equity/	3269
24	right to health/	105
25	universal health care/	155
26	health care disparity/	15646
27	socioeconomics/	140163
28	social justice/	10427
29	global health/	9804
30	human rights/	24894
31	((equit* or equal* or fair* or inequit* or unequal or unfair* or global*) adj3 (access* or allocat* or distribut* or deliver* or provision or supply or supplies)).ti,ab,kw,ot.	38602
32	(right to health* or universal health*).ti,ab,kw,ot.	8082
33	((health* or health care) adj (rationing or disparities)).ti,ab,kw,ot.	16415
34	or/18-33	670545
35	8 and 17 and 34	672
36	limit 35 to (conference abstracts or embase)	529

- **Global Index Medicus, WHO** (searched 28.08.2020)

Advanced search in Title, abstract, subject COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics AND vaccine OR vaccines OR vaccination OR immunization OR immunisation AND equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR unfair OR unfairly OR disparity OR disparities OR global OR globally

- **Web of Science, Clarivate Analytics** (searched 28.08.2020)

COVID-19 OR "COVID 19" OR COVID19 OR 2019-nCoV OR "2019 nCoV" OR SARS2 OR SARS-CoV OR "SARS CoV" OR SARS-CoV-2 OR "SARS CoV 2" OR SARS-Cov-19 OR "SARS Cov 19" OR coronavirus OR corona OR pandemic OR pandemics AND vaccin* OR immuni* AND equity OR equitable OR equal OR equally OR inequity OR inequitable OR unequal OR unequally OR unfair OR unfairly OR "right to health" OR "right to healthcare" OR "universal health" OR "universal healthcare" OR "healthcare rationing" OR "health care rationing" OR "healthcare disparity" OR "healthcare disparity" OR "healthcare disparities" OR "healthcare disparities"

Appendix 3: Excluded articles and reason for exclusion

Reason for exclusion key: 1: mentions issue but lacks detail or did not add new insight to factors related to equitable access, 2: discusses within, not amongst countries, 3: irrelevant, 4: not English, 5: full-text unavailable, 6: not in peer reviewed journal.

Nr*	First author, year	Title	Reason excluded
1	Acharya, 2021	Access to and equitable distribution of COVID-19 vaccine in low-income countries	1
2	Anonymous, 2021	Why a pioneering plan to distribute COVID vaccines equitably must succeed	1
3	Anonymous, 2021	It's time to consider a patent reprieve for COVID vaccines	1
4	Aryeetey, 2021	A step backwards in the fight against global vaccine inequities	1
5	Bennett, 2010	Law, ethics and pandemic preparedness: the importance of cross-jurisdictional and cross-cultural perspectives	1
6	Binagwaho, 2021	Equitable and Effective Distribution of the COVID-19 Vaccines - A Scientific and Moral Obligation	1
7	Burki, 2021	Equitable distribution of COVID-19 vaccines	1
8	Burki, 2021	Challenges in the rollout of COVID-19 vaccines worldwide	1
9	Cohen, 2021	As vaccines emerge, a global waiting game begins	1
10	Emanuel, 2020	An ethical framework for global vaccine allocation	1
11	Ferguson, 2020	Love thy neighbour? Allocating vaccines in a world of competing obligations	1
12	Fisher, 2011	Pandemic response lessons from influenza H1N1 2009 in Asia	1
13	Friede, 2011	WHO initiative to increase global and equitable access to influenza vaccine in the event of a pandemic: supporting developing country production capacity through technology transfer	1
14	Garfinkel, 2020	Survival of the Wealthiest?	1
15	Gostin, 2020	Facilitating Access to a COVID-19 Vaccine through Global Health Law	1
16	Haaheim, 2009	Pandemic influenza vaccines - the challenges	1
17	Hay, 2018	The WHO global influenza surveillance and response system (GISRS)-A future perspective	1
18	Herzog, 2021	Covax must go beyond proportional allocation of covid vaccines to ensure fair and equitable access	1
19	Hessel, 2009	Pandemic influenza vaccines: Meeting the supply, distribution and deployment challenges	1
20	Ho, 2020	Global Disparity and Solidarity in a Pandemic	1
21	Hurley, 2021	It's self-interest to share our vaccines globally	1
22	Kamradt-Scott, 2012	Evidence-based medicine and the governance of pandemic influenza	1
23	Kim, 2021	Operation Warp Speed: implications for global vaccine security	1
24	Kimble, 2021	Considerations on the distribution and administration of the new COVID-19 vaccines	1
25	Kupferschmidt, 2020	Despite obstacles, WHO unveils plan to distribute vaccine	1
26	Lie, n.d.	Allocating a COVID-19 Vaccine: Balancing National and International Responsibilities	1
27	Lomazzi, 2020	Equitable access to COVID-19 vaccination: a distant dream?	1
28	Megiddo, 2020	Fairer financing of vaccines in a world living with COVID-19	1
29	Meyer, 2020	After a COVID-19 vaccine: Collaboration or competition?	1
30	Milstien, 2003	Emergency response vaccines: Lessons learned in response to communicable diseases	1
31	Munguia-Lopez, 2021	Fair Allocation of Potential COVID-19 Vaccines Using an Optimization-Based Strategy	1
32	Nannei, 2016	Stakeholders' perceptions of 10years of the Global Action Plan for Influenza Vaccines (GAP) - Results from a survey	1

33	Nazar, 2020	All for vaccine, vaccine for all	1
34	Nkengasong, 2020	COVID-19 vaccines: how to ensure Africa has access	1
35	Ogbogu, 2020	Bioethics and practical justice in the post-COVID-19 era	1
36	Orit Fischman, 2021	A Global Pandemic Remedy to Vaccine Nationalism	1
37	Punjabi, 2021	Vaccine is health and health is wealth	1
38	Rodríguez Mega, 2020	Latin American scientists join the coronavirus vaccine race: 'No one's coming to rescue us'	1
39	Ropero-Alvarez, 2012	Pandemic influenza vaccination: lessons learned from Latin America and the Caribbean	1
40	Sadeghi, 2021	The commitment for fair distribution of COVID-19 vaccine among all countries of the world.	1
41	Schwartz, 2009	Prioritization of pandemic influenza vaccine: Rationale and strategy for decision making	1
42	Schwartz, 2020	Equitable global access to coronavirus disease 2019 vaccines	1
43	Sharun, 2021	COVID-19 vaccine diplomacy and equitable access to vaccines amid ongoing pandemic	1
44	The Lanclet, 2020	Global collaboration for health: rhetoric versus reality	1
45	Usman, 2020	After the Coronavirus Vaccine's Discovery: Concerns Regarding a COVID-19 Vaccination's Distribution	1
46	Yamada, 2009	Poverty, wealth, and access to pandemic influenza vaccines	1
47	Yen, 2015	The development of global vaccine stockpiles	1
48	Zimmerman, 2007	Rationing of influenza vaccine during a pandemic: ethical analyses	1
49	Abramowitz, 2020	Transparent, equitable, safe, and effective use of COVID-19 vaccines: A societal imperative	2
50	Adebambo Anthony, 2020	Intellectual Property Rights, Pharmaceutical Patents and Public Health: Adopting Compulsory and Government Use Licenses in the COVID-19 Emergency in Nigeria	2
51	Ana Santos, 2020	Comments on the Preliminary Framework for Equitable Allocation of COVID-19 Vaccine	2
52	Anonymous, 2020	ASHP principles for COVID-19 vaccine distribution, allocation, and mass immunization	2
53	Ayers, 2021	Disparities in H1N1 Vaccination Rates: a Systematic Review and Evidence Synthesis to Inform COVID-19 Vaccination Efforts	2
54	Bell, 2018	Preparedness for influenza vaccination during a pandemic in the World Health Organization Western Pacific Region	2
55	Cerilles, n.d.	Analysing the interplay between the right to health and pharmaceutical patent rights in the introduction of a COVID-19 vaccine into the Philippines	2
56	Edwards, 2009	Strategies for broad global access to pandemic influenza vaccines	2
57	Hadler, 2005	Public health strategies for distribution of influenza vaccine during an influenza pandemic	2
58	Lee, 2021	Last-Mile Logistics of Covid Vaccination - The Role of Health Care Organizations	2
59	Looi, 2021	Jeremy Farrar: Make vaccine available to other countries as soon as our most vulnerable people have received it	2
60	Martin, 2021	Maintaining a Focus on Health Equity During the COVID-19 Vaccine Rollout	2
61	Medina-Walpole, 2021	What It Will Take to Equitably Distribute a COVID-19 Vaccine	2
62	Muula, 2007	How relevant is Bellagio statement of principles on social justice and influenza to Africa?	2
63	Subbaraman, 2020	Who gets a COVID vaccine first? Access plans are taking shape	2
64	Todd, 2021	Learning from past mistakes? The COVID-19 vaccine and the inverse equity hypothesis	2
65	Varshney, 2021	Vaccine diplomacy: Exploring the benefits of international collaboration	2
66	Adar, 2020	Distribution equality as an optimal epidemic mitigation strategy	3
67	Alaran, 2021	Uneven power dynamics must be levelled in COVID-19 vaccines access and distribution	3

68	AlKhaldi, 2021	Rethinking and strengthening the Global Health Diplomacy through triangulated nexus between policy makers, scientists and the community in light of COVID-19 global crisis	3
69	Al-Oraibi, 2021	Migrant health is public health: a call for equitable access to COVID-19 vaccines	3
70	Anderson, 2020	Intensifying vaccine production	3
71	Anonymous, 2021	COVID-19 Vaccine: Development, Testing, and Distribution	3
72	Bartovic, 2021	Ensuring equitable access to vaccines for refugees and migrants during the COVID-19 pandemic	3
73	Bhatia, 2013	The H1N1 influenza pandemic: need for solutions to ethical problems	3
74	Billington, 2020	Developing Vaccines for SARS-CoV-2 and Future Epidemics and Pandemics: Applying Lessons from Past Outbreaks	3
75	Boulton, 2021	Advancing Global Vaccination Equity	3
76	Boum Ii, 2021	How to ensure a needs-driven and community-centred vaccination strategy for COVID-19 in Africa	3
77	Briand, 2010	Future developments in global influenza surveillance	3
78	Bryan, 2021	WTO Waiver from Intellectual Property Protection for COVID-19 Vaccines and Treatments: A Critical Review	3
79	Cheong, 2020	Unequal Access to Vaccines Will Exacerbate Other Inequalities	3
80	Coleman, 2009	Allocating vaccines and antiviral medications during an influenza pandemic	3
81	Commissioners, 2021	Human rights and fair access to COVID-19 vaccines: the International AIDS Society-Lancet Commission on Health and Human Rights	3
82	Dadari, 2021	Pro-equity immunization and health systems strengthening strategies in select Gavi-supported countries	3
83	Elbe, 2010	Haggling over viruses: the downside risks of securitizing infectious disease	3
84	Eurosurveillance editorial, 2011	Agreement on a pandemic influenza preparedness framework for the sharing of viruses and benefit sharing	3
85	Fedson, 2006	Vaccine development for an imminent pandemic: why we should worry, what we must do	3
86	Gladas, 2021	Supporting efforts for a global COVID-19 vaccine	3
87	Goh, 2021	Covid-19 vaccination: the dangers of "values" imperialism	3
88	Gostin, 2006	Medical countermeasures for pandemic influenza: ethics and the law	3
89	Griffin, 2020	Covid-19: Governments should demand transparency on vaccine deals, says MSF	3
90	Gronvall, 2006	Removing barriers to global pandemic influenza vaccination	3
91	Guerin, 2020	The consequence of COVID-19 on the global supply of medical products: Why Indian generics matter for the world?	3
92	Gurwitz, 2021	Ethical tradeoffs in SARS-CoV-2 vaccine development: Assuring fair availability for low-income countries	3
93	Haaheim, 2007	Vaccines for an influenza pandemic: scientific and political challenges	3
94	Halabi, 2020	No-Fault Compensation for Vaccine Injury - The Other Side of Equitable Access to Covid-19 Vaccines	3
95	Hendriks, 2011	An international technology platform for influenza vaccines	3
96	Henn, 2020	Allocation criteria for an initial shortage of a future SARS-CoV-2 vaccine and necessary measures for global immunity	3
97	Huneycutt, 2020	Finding equipoise: CEPI revises its equitable access policy	3
98	Jecker, 2021	Out of Africa: A Solidarity-Based Approach to Vaccine Allocation	3
99	Jecker, 2021	Vaccine ethics: an ethical framework for global distribution of COVID-19 vaccines	3
100	Kamradt-Scott, 2013	The politics of medicine and the global governance of pandemic influenza	3
101	Karim, 2020	COVID-19 vaccine affordability and accessibility	3
102	Katz, 2021	From Vaccine Nationalism to Vaccine Equity - Finding a Path Forward	3
103	Kelley, 2020	An appeal for practical social justice in the COVID-19 global response in low-income and middle-income countries	3

104	Kelley, 2021	Process and operations strategies to enable global access to antibody therapies	3
105	Khamsi, 2020	If a coronavirus vaccine arrives, can the world make enough?	3
106	Kieny, 2009	WHO supports fair access to influenza A (H1N1) vaccine	3
107	Koff, 2021	A universal coronavirus vaccine	3
108	Kyd, 2010	3rd Global Vaccine Congress	3
109	Lee, 2011	The Benefits To All Of Ensuring Equal And Timely Access To Influenza Vaccines In Poor Communities	3
110	Li, 2010	Healthcare system cost evaluation of antiviral stockpiling for pandemic influenza preparedness	3
111	McLachlan, 2012	A proposed non-consequentialist policy for the ethical distribution of scarce vaccination in the face of an influenza pandemic	3
112	McLachlan, 2015	On the random distribution of scarce doses of vaccine in response to the threat of an influenza pandemic: a response to Wardrope	3
113	Monto, 2011	Response to the 2009 pandemic: effect on influenza control in wealthy and poor countries	3
114	Mukherjee, 2020	Global efforts on vaccines for COVID-19: Since, sooner or later, we all will catch the coronavirus	3
115	Nguyen, 2010	The influenza challenge	3
116	Pagliusi, 2018	Vaccines, inspiring innovation in health	3
117	Palkonyay, 2016	A decade of adaptation: Regulatory contributions of the World Health Organization to the Global Action Plan for Influenza Vaccines (2006-2016)	3
118	Peters, 2021	Ensuring vaccine supply meets global needs	3
119	Rastegar, 2021	An inventory-location optimization model for equitable influenza vaccine distribution in developing countries during the COVID-19 pandemic	3
120	Roope, 2020	How Should a Safe and Effective COVID-19 Vaccine be Allocated? Health Economists Need to be Ready to Take the Baton	3
121	Ruscio, 2020	Shaping meeting to explore the value of a coordinated work plan for epidemic and pandemic influenza vaccine preparedness	3
122	Sabri, 2020	Solidarity in the time of covid-19 pandemic	3
123	Saunders, 2018	EQUALITY IN THE ALLOCATION OF SCARCE VACCINES	3
124	Shretta, 2021	Vaccinating the world against COVID-19: getting the delivery right is the greatest challenge	3
125	Smith, 2021	Top five ethical lessons of COVID-19 that the world must learn	3
126	Snyder, 2020	Designing Pull Funding For A COVID-19 Vaccine	3
127	Stohr, 2006	Influenza pandemic vaccines: How to ensure a low-cost, low-dose option	3
128	Stoto, 2013	Lessons about the state and local public health system response to the 2009 H1N1 pandemic: a workshop summary	3
129	Straetemans, 2007	Prioritization strategies for pandemic influenza vaccine in 27 countries of the European Union and the Global Health Security Action Group: a review	3
130	Tatar, 2021	The Role of Good Governance in the Race for Global Vaccination during the COVID-19 Pandemic	3
131	Wardrope, 2012	Scarce vaccine supplies in an influenza pandemic should not be distributed randomly: reply to McLachlan	3
132	Wong, 2018	Funding vaccines for emerging infectious diseases	3
133	Wynia, 2006	Ethics and public health emergencies: rationing vaccines	3
134	Yau, n.d.	Mapping the inequality of the global distribution of seasonal influenza vaccine	3
135	Zard, n.d.	Leave no one behind: ensuring access to COVID-19 vaccines for refugee and displaced populations	3
136	Aranzazu, 2013	The WHO influenza surveillance network. Modes of circulation of viruses strains, knowledge and technologies, 1947-2007	4

137	Bingzhe, 2020	Expanding the pandemic influenza preparedness framework to the epidemic of COVID-19	4
138	Leineweber, 2021	The influence of the U.S. response to COVID-19 in Global Health	4
139	Collin, 2009	[Influenza vaccine: globalization of public health stakes]	5
140	Donatelli, 2003	[WHO Influenza Global Agenda]	5
141	Iacob, 2020	The Role of the Joint Procurement Agreement during the COVID-19 Pandemic: Assessing Its Usefulness and Discussing Its Potential to Support a European Health Union	5
142	Jorgensen, 2013	Unequal access to vaccines in the WHO European Region during the A(H1N1) influenza pandemic in 2009	5
143	Lopalco, 2016	Pandemic vaccines: Are we prepared for the next pandemic?	5
144	Mark, 2020	The Procurement of a COVID-19 Vaccine in Developing Countries: Lessons from the 2009-H1N1 Pandemic	5
145	Mendes, 2021	Tackling inequitable distribution of the COVID-19 vaccine	5
146	Saransh, 2021	Building Resilient Vaccine Distribution	5
147	Ana Santos, 2020	The COVID-19 Vaccine Race: Intellectual Property, Collaboration(s), Nationalism and Misinformation	6
148	Ana Santos, 2020	The Reemergence of Vaccine Nationalism	6
149	Ana Santos, 2020	The Intellectual Property of COVID-19	6
150	Armin von, 2020	The Role of International Law in Vaccinating Against COVID-19: Appraising the COVAX Initiative	6
151	Benjamin, 2020	COVID-19 Vaccine Research, Development, Regulation and Access	6
152	François, 2020	Spatial Allocation of Scarce Vaccine and Antivirals for COVID-19	6
153	Goldstein, 2021	Failure to achieve global vaccine equity will have dire consequences	6
154	Jorge, 2021	US Support for a WTO Waiver of COVID-19 Intellectual Property – What Does it Mean?	6
155	Mohamed Mustafa, 2021	The Cost of Procuring and Delivering COVID-19 Vaccines in Low- and Middle-Income Countries: A Model of Projected Resource Needs	6
156	National Academies of Sciences Engineering and Medicine, 2020	Framework for Equitable Allocation of COVID-19 Vaccine	6
157	Shlomit, 2021	Intellectual Property Laws in the Digital Era: An International Distributive Justice Perspective	6
158	Simon, 2021	The Covid-19 Vaccine Production Club: Will Value Chains Temper Nationalism?	6
159	Viviana Munoz, 2020	The COVID-19 Pandemic: R&D and Intellectual Property Management for Access to Diagnostics, Medicines and Vaccines	6

Appendix 4: Data extraction form for factors influencing global equitable access to COVID-19 vaccines for Low-and Middle-Income Countries

1. Name of reviewer
2. First author and year of publication (Date) e.g. Li (2011)
3. Title
4. Inclusion criteria (all must be selected):
    - LMIC or globally focussed or normative guidance that affects LMIC
    - Published between 2005-2021
    - Discusses influenza/pandemic/COVID-19 vaccine(s)
    - Contains arguments/discussion on equity, access, allocation or prioritization of influenza/pandemic/COVID-19vaccine(s)
    - Published in English

Findings related to our Scoping Review research objective: What are the factors influencing global equitable access to a COVID-19 vaccine among countries?

5. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
6. Key examples or illustrations from publication (including page numbers)
7. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
8. Key examples or illustrations from publication (including page numbers)
9. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
10. Key examples or illustrations from publication (including page numbers)
11. Summarise: What does this article tell us about the knowledge related to allocation and pandemic vaccine(s)?
12. Key examples or illustrations from publication (including page numbers)

13. Is there anything else that this study tells us about the knowledge in this topic area?
14. Challenges in implementing equitable access to vaccination
15. List any global initiatives/mechnasims/frameworks identified in our search that address equitable access to pandemic vaccine(s)?
16. Recommendations for strengthening equitable access to vaccination

Appendix 5: Papers underlying this Scoping Review

List of the 44 papers included in the review, including the reference, type of publication and a short summary of the focus of the paper is shown in the table below.

No	Reference (BMJ style)	Study design	Focus of paper
1	Abbott FM, Reichman JH. Facilitating Access to Cross-Border Supplies of Patented Pharmaceuticals: The Case of the COVID-19 Pandemic. *Journal of International Economic Law* 2020;23(3):535-61.	Article	Proposes legal mechanisms for addressing critical issues facing the international community in terms of providing equitable access to vaccines, treatments, diagnostics, and medical equipment.
2	Bollyky TJ, Gostin LO, Hamburg MA. The Equitable Distribution of COVID-19 Therapeutics and Vaccines. *Jama-Journal of the American Medical Association* 2020;323(24):2462-63. doi: 10.1001/jama.2020.6641	Viewpoint	Discusses experiences and suggestions for a future framework to the distribution of COVID-19 vaccines.
3	Choi EM. COVID-19 vaccines for low- and middle-income countries. *Transactions of the Royal Society of Tropical Medicine & Hygiene* 2021;115(5):447-56.	Review	Discusses low- and middle-income countries access COVID-19 vaccines, what is being done to distribute vaccines fairly, as well as the challenges ahead
4	DeFrancesco L. Whither COVID-19 vaccines? *Nature Biotechnology* 2020;38(10):1132-45.	Article	Insights from seven experts on the development of the COVID-19 vaccines.
5	Eccleston-Turner M. The pandemic influenza preparedness framework: A viable procurement option for developing states? *Medical Law International* 2017;17(4):227-48.	Article	Examines the Pandemic Influenza Framework and the content of the Obligations of the Company which have been secured by the World Health Organization.
6	Eccleston-Turner M, Upton H. International Collaboration to Ensure Equitable Access to Vaccines for COVID-19: The ACT-Accelerator and the COVAX Facility. *Milbank Quarterly*	Original Scholarship	Analysis of the COVAX Facility and its aim and ensure equitable availability of the vaccine in low and middle-income countries.
7	Fedson DS. Pandemic influenza and the global vaccine supply. *Clin Infect Dis* 2003;36(12):1552-61.	Article	The article explores several issues related to the global supply of vaccine during influenza pandemics
8	Fedson DS. Preparing for pandemic vaccination: an international policy agenda for vaccine development. *J Public Health Policy* 2005;26(1):4-29.	Commentary	Focuses on the trivalent vaccines currently available that contain inactivated viruses.
9	Fedson DS, Dunnill P. Commentary: From scarcity to abundance: pandemic vaccines and other agents for "have not" countries. *J Public Health Policy* 2007;28(3):322-40.	Commentary	Discusses that access to supplies of pandemic vaccine for most countries is a problem of scarcity and how to ensure the “have not” countries will get access to pandemic vaccines.
10	Felicitas H, Florencia L, Manriquez RT, et al. A matter of priority: equitable access to COVID-19 vaccines. *Swiss Med Wkly* 2021;151	Viewpoint	Highlights inequality in current vaccination rates between some high income countries (HIC) and low income countries (LIC) provides arguments for HIC to support distribution to LIC
11	Fidler DP. Negotiating Equitable Access to Influenza Vaccines: Global Health Diplomacy and the Controversies Surrounding Avian Influenza H5N1 and Pandemic Influenza H1N1. *Plos Medicine* 2010;7(5)	Article	Examines the diplomatic negotiations surrounding influenza virus sharing as an example of the core tensions characterizing multilateralism and emerging forms of global health governance.
12	Fidler DP. Vaccine nationalism's politics. *Science* 2020;369(6505):749.	Editorial	Discusses global politics and the burden of global equitable COVID-19 vaccine access issues, historically and now.
13	Forman R, Anderson M, Jit M, et al. Ensuring access and affordability through COVID-19 vaccine research and development investments: A proposal for the options market for vaccines. *Vaccine* 2020;38(39):6075-77.	Commentary	Discusses existing financing mechanisms and a proposal for vaccine development, referred to as Options Market for Vaccines (OMV).
14	Forman R, Shah S, Jeurissen P, et al. COVID-19 vaccine challenges: What have we learned so far and what remains to be done? *Health Policy* 2021;125(5):553-67.	Review	Offers a framework for understanding remaining and new policy challenges for global vaccine campaigns against COVID-19 and potential solutions.

No	Reference (BMJ style)	Study design	Focus of paper
15	Gray G, van der Heever A, Madhi S, et al. The Scientists' Collective 10-point proposal for equitable and timeous access to COVID-19 vaccine in South Africa. *Samj South African Medical Journal* 2021;111(2):89-94.	(Guest) Editorial	Proposes a ten-point plan for equitable and timely access to COVID-19 vaccine in South Africa.
16	Guzman J, Hafner T, Maiga LA, et al. COVID-19 vaccines pricing policy options for low-income and middle- income countries. *BMJ Global Health* 2021;6(3):03.	Commentary	Discusses four pricing strategies to address high prices and obtain COVID-19 vaccines (and other medical products) at affordable rate.
17	Herlitz A, Lederman Z, Miller J, et al. Just allocation of COVID-19 vaccines. *BMJ Global Health* 2021;6(2):02.	Editorial	Offers three suggestions to strengthen how to achieve the greatest health impact with authorized COVID-19 vaccines.
18	Iacobucci G. Covid-19: How will a waiver on vaccine patents affect global supply? *BMJ* 2021;373:n1182.	News analysis	Presents responses from experts and organizations after Biden administration (US) announced to support a proposal to waive patents on covid-19 vaccines.
19	Kamradt-Scott A, Lee K. The 2011 Pandemic Influenza Preparedness Framework: Global Health Secured or a Missed Opportunity? *Political Studies* 2011;59(4):831-47.	Article	Investigates the diplomatic negotiations surrounding influenza virus sharing, and evaluates the Pandemic Influenza Preparedness (PIP) framework.
20	Kupferschmidt K. Global plan seeks to promote vaccine equity, spread risks. *Science* 2020;369(6503):489-90.	News	Discusses the COVAX facility and its challenges.
21	Liu Y, Salwi S, Drolet BC. Multivalue ethical framework for fair global allocation of a COVID-19 vaccine. *Journal of medical ethics* 2020;46(8):499-501.	Article	Analyses and synthesizes the ethical considerations of four allocation paradigms: ability to develop or purchase; reciprocity; ability to implement; and distributive justice.
22	The Lanclet. Global governance for COVID-19 vaccines. *Lancet (London, England)* 2020;395(10241):1883.	Editorial	Discusses the COVID-19 vaccine bidding war and the necessary global level arrangements to for development, finance, production, and distribution.
23	The Lancet. Access to COVID-19 vaccines: looking beyond COVAX. *Lancet* 2021;397(10278):941.	Editorial	Calls for a strong political leadership to support equitable access to vaccines
24	McAdams D, McDade KK, Ogbuoji O, et al. Incentivising wealthy nations to participate in the COVID-19 Vaccine Global Access Facility (COVAX): a game theory perspective. *BMJ Global Health* 2020;5(11):11.	Commentary	Discusses how maximizing the benefit of bilateral deals to support COVAX, and explores how such deals can improve the global supply of vaccines.
25	McMahon A. Global equitable access to vaccines, medicines and diagnostics for COVID-19: The role of patents as private governance. *Journal of Medical Ethics* 2020;30:30.	Current controversy	Discusses the role of patents and highlights that during the COVID-19 pandemic the power of patent holders should be questioned.
26	Nhamo G, Chikodzi D, Kunene HP, et al. COVID-19 vaccines and treatments nationalism: Challenges for low-income countries and the attainment of the SDGs. *Global Public Health* 2021;16(3):319-39.	Article	Discusses the 2030 Agenda for Sustainable Development and calls stakeholders for their continued support to Gavi and COVAX 'to leave no one behind' and eliminate inequalities.
27	Pagliusi S, Hayman B, Jarrett S. Vaccines for a healthy future: 21st DCVMN Annual General Meeting 2020 report. *Vaccine* 2021;39(18):2479-88.	Meeting Report	Summary of a meeting where public and private sector participants presented challenges and opportunities related to vaccine R&D, supply chain, global policies, financing, health objectives, and supporting access for LMIC.
28	Phelan AL, Eccleston-Turner M, Rourke M, et al. Legal agreements: barriers and enablers to global equitable COVID-19 vaccine access. *Lancet* 2020;396(10254):800-02.	Commentary	Discusses role of law on equitable access to COVID-19 vaccines, highlighting challenges of bilateral agreements, advanced purchasing, and COVAX.
29	Rourke MF. Access by Design, Benefits if Convenient: A Closer Look at the Pandemic Influenza Preparedness Framework's Standard Material Transfer Agreements. *Milbank Q* 2019;97(1):91-112.	Article	Analyses the PIP Framework, its Standard Material Transfer Agreements (SMTAs), and secondary sources to determine whether the PIP Framework will effectively function as an access and benefit-sharing (ABS) instrument during an influenza pandemic.

No	Reference (BMJ style)	Study design	Focus of paper
30	Ruscio BA, Hotez P. Expanding global and national influenza vaccine systems to match the COVID-19 pandemic response. *Vaccine* 2020;38(50):7880-82.	Commentary	Discusses the double burden synergies of Influenza and COVID 19 in the Global South, and proposes how a way to address both issues.
31	Saksena N. Global justice and the COVID-19 vaccine: Limitations of the public goods framework. *Global Public Health* 2021	Article	Focuses on global access, discussing the limitations of the global public good framework in addressing the problem of distribution COVID-19 vaccines.
32	Sawal I, Ahmad S, Tariq W, et al. Unequal distribution of COVID-19 vaccine: A looming crisis. *Journal of Medical Virology* 2021;03:03.	Letter to Editor	Argues for the promotion of equitable access to COVID-19 vaccines to benefit the whole world.
33	Sharma S, Kawa N, Gomber A. WHO's allocation framework for COVAX: is it fair? *Journal of Medical Ethics* 2021;09:09.	Article	Explores comparing COVAX allocation mechanisms to a targeted allocation system, based on need. Arguing that this could maximize well-being and align with principles of equity.
34	Sehovic AB, Govender K. Addressing COVID-19 vulnerabilities: How do we achieve global health security in an inequitable world. *Global Public Health* 2021	Commentary	Discusses the particular challenges of COVID-19 for LMICs, and the inequities being perpetuated in the COVID-19 Pandemic and the suggestions in how to address these challenges.
35	So AD, Woo J. Reserving coronavirus disease 2019 vaccines for global access: cross sectional analysis. *Bmj-British Medical Journal* 2020;371	Special paper	Analyzes premarket purchase commitments for COVID-19 vaccines from leading manufacturers to recipient countries.
36	So AD, Woo J. Achieving path-dependent equity for global COVID-19 vaccine allocation. *Medicina Intensiva* 2021;2(4):373-77.	Commentary	Discusses the interdependence of equitable allocation based on three policy levers: Development and Production, Procurement, and Healthcare Delivery.
37	Torres I, Artaza O, Profeta B, et al. COVID-19 vaccination: returning to WHO's Health For All. *The Lancet Global Health* 2020;8(11):e1355-e56.	Commentary	Promotes the perspective of World Health Organization, calling for inclusion of all member states, and transparency.
38	Towse A, Chalkidou K, Firth I, et al. How Should the World Pay for a Coronavirus Disease (COVID-19) Vaccine? *Value in Health* 2021;24(5):625-31.	Article	Proposes the Benefit-Based Advance Market Commitment as a collaborative, market-based financing mechanism for the world to incentivize and pay for the development and provide equitable access to second and third generation COVID-19 vaccines.
39	Turner M. Vaccine procurement during an influenza pandemic and the role of Advance Purchase Agreements: Lessons from 2009-H1N1. *Glob Public Health* 2016;11(3):322-35.	Article	A case study on the procurement of pandemic influenza vaccines during 2009-H1N1, and the likely manner in which procurement will occur during future pandemics.
40	Usher AD. COVID-19 vaccines for all? *Lancet (London, England)* 2020;395(10240):1822-23.	World report	Provides an assessment of the initiatives being planned to ensure equitable access to COVID-19 vaccines, and shortcomings.
41	Usher AD. CEPI criticised for lack of transparency. *Lancet* 2021;397(10271):265-66.	World Report	Provides insights and perspectives on CEPI contracts for COVID-19 vaccines.
42	Usher AD. South Africa and India push for COVID-19 patents ban. *Lancet* 2020;396(10265):1790-91.	World Report	Report on the proposal by India and South Africa to waiver Intellectual Property Rights to COVID-19 products (incl. vaccines).
43	Wouters OJ, Shadlen KC, Salcher-Konrad M, et al. Challenges in ensuring global access to COVID-19 vaccines: production, affordability, allocation, and deployment. *Lancet* 2021;397(10278):1023-34.	Article	Reviews potential challenges and policy implications for the production, afforable pricing, and global allocation of Covid-19 vaccines.
44	Yamey G, Schäferhoff M, Hatchett R, et al. Ensuring global access to COVID-19 vaccines. *Lancet (London, England)* 2020;395(10234):1405-06.	Commentary	Discusses how COVID-19 vaccines can be used globally to end the COVID-19 pandemic, arguing for three imperatives: speed, manufacture and deployment at scale, and global access.