Managing borders during public health emergencies of international concern:
A proposed typology of cross-border health measures

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ABSTRACT

Background

The near universal adoption of cross-border health measures during the COVID-19 pandemic worldwide has prompted significant debate about their effectiveness and compliance with international law. The number of measures used, and the range of measures applied, have far exceeded previous public health emergencies of international concern. However, efforts to advance research, policy and practice to support their effective use has been hindered by a lack of clear and consistent definition.

Results

Based on a review of existing datasets for cross-border health measures, such as the Oxford Coronavirus Government Response Tracker and World Health Organization Public Health and Social Measures, along with analysis of secondary and grey literature, we propose six categories to define measures more clearly and consistently – type of movement (travel and trade), policy goal, level of jurisdiction, use by public versus private sector, stage of journey, and degree of restrictiveness. These categories are then be brought together into a proposed typology that can support research with generalizable findings and comparative analyses across jurisdictions. The typology facilitates evidence-informed decision-making which takes account of policy complexity including trade-offs and externalities. Finally, the typology can support efforts to strengthen coordinated global responses to outbreaks and inform future efforts to revise the WHO International Health Regulations (2005).

Conclusions
The widespread use of cross-border health measures during the COVID-19 pandemic has prompted significant reflection on available evidence, previous practice and existing legal frameworks. The typology put forth in this paper aims to provide a starting point for strengthening research, policy and practice.

Keywords

COVID-19, cross-border health measures, border management, travel measures, trade measures, International Health Regulations, typology
Introduction

A cross-border health measure can be broadly defined as action taken to control movement of people or trade across two or more jurisdictions with the stated intent of achieving a health goal.

During the COVID-19 (coronavirus disease) pandemic, the number of countries both adopting and impacted by cross-border health measures has been unprecedented. While up to 25% of countries adopted such measures during previous disease outbreaks, virtually all countries have done so during the COVID-19 pandemic [1]. Moreover, countries have adopted a wider range of measures than previously observed and have implemented them in highly varied ways. In turn, studies of cross-border health measures apply diverse, and sometimes inconsistent, terminology to describe these practices. This has reduced the comparability and generalizability of research findings.

Media reporting has likewise applied varied and sometimes misleading terms such as ‘border closures’ and ‘travel bans.’ Importantly, this lack of clear and consistent definition persists at a time of substantial debate about the legality and effectiveness of cross-border health measures in response to the COVID-19 pandemic [2, 3, 4].

This paper argues that more precise and agreed definition is a starting point for understanding how cross-border health measures are used and to what effect. We begin by providing a brief background on the use of these measures during COVID-19, the existing lack of definitional clarity and/or consistency, and the implications for research, policy and practice. To address this gap, we propose six ways to categorize cross-border health measures. We integrate these categories into a proposed typology that can be used, not only to advance research, but to guide decision makers when making choices about the intended purpose, targets and implementation of cross-border health measures. We conclude that clear and consistent definition, alongside an agreed typology, is an important starting point for producing generalizable findings,
comparative analyses, and evidence-informed responses across jurisdictions. This includes future efforts to revise the World Health Organization (WHO) International Health Regulations (IHR) adopted in 2005.

Background

As the legal framework “to prevent, protect against, control and provide a public health response to the international spread of disease”, the WHO IHR (2005) commits States Parties to act in ways that are commensurate with public health risks and which avoid “unnecessary interference with international traffic and trade”[5]. Cross-border health measures, largely covered under IHR Article 43 (Additional health measures), can be applied if they meet these conditions. Such measures are permitted if they are not “more restrictive of international traffic and not more invasive or intrusive to persons than reasonably available alternatives that would achieve the appropriate level of health protection,” are supported by scientific principles and evidence, and promptly reported to WHO [6].

After declaring COVID-19 a Public Health Emergency of International Concern (PHEIC) on 30 January 2020, the IHR Emergency Committee initially recommended against “any travel or trade restriction based on the current information available” [7]. Some States Parties had already adopted travel-related restrictions prior to this declaration. Many more immediately disregarded WHO’s recommendation, prompting international legal scholars to criticize States Parties for alleged non-compliance with the IHR (2005 [2, 8,9]. Individuals and groups adversely affected by the restrictions, such as the tourism sector [10] and frontline humanitarian and medical professionals responding to the pandemic [11], called on governments to ease restrictions. As the pandemic worsened, others criticized governments for not applying cross-border health measures
earlier and/or more strictly [12, 13], or for easing them prematurely [14]. By March 2020, use of 
travel-related measures became near universal. Implementation was highly uncoordinated and 
somewhat chaotic, with cross-border health measures being adopted in highly varying forms, 
duration, and scope across the world [15, 16, 17]. The result has been “a dangerous process of 
trial and error” [18].

Terminology used by government, media and other commentators to describe this near 
universal and varied use of cross-border health measures has also lacked clarity and/or consistency. 
Governments seeking to reassure their domestic populations, that strong action is being taken to 
reduce the risk of coronavirus importation, have often used language suggestive of closed borders 
[19, 20, 21] and prohibited traffic from high risk areas [22, 23]. Given their significant social and 
economic impacts, cross-border health measures have attracted substantial media attention, with 
terms such as “border closure” [24, 25] and “travel ban” [26, 27] frequently used. In practice, few 
if any countries sealed their borders or banned travel during the COVID-19 pandemic. These 
terms are misnomers of actual practice, namely, to restrict selected and manage remaining cross-
border movements. They have also obscured the varied practices that countries have followed to 
achieve this.

Lack of clarity and/or inconsistency in terminology has not helped the increasingly fraught 
debates about the legality and efficacy of cross-border health measures. Amid what Kenwick and 
Simmons describe as growing “border anxiety” during the pandemic [28], the IHR (2005) 
stipulates that “scientific principles” should guide policy decisions. While there is international 
agreement that decisions about the use of cross-border health measures need to be evidence-
formed, systematic reviews conclude that the evidentiary base is limited at best. Most of what 
was previously known about cross-border health measures is based on studies of pandemic and
seasonal influenza, severe acute respiratory syndrome (SARS) and Ebola [29]. In the context of the COVID-19 pandemic, one systematic review to assess the effectiveness of “travel-related control measures” during COVID-19 (25 studies) and outbreaks of SARS and Middle East Respiratory Syndrome (MERS) (11 studies) finds that such measures “may help to limit the spread of disease across national borders” [30]. However, “confidence in these results is limited” given their derivation from assumptions used in modelling studies rather than “real life data”; substantial variation in what studies analysed; and the lack of peer review. Our systematic review of domestic and international “travel measures” implemented during the early stages of the COVID-19 pandemic (29 studies) finds that the adoption of travel measures led to important changes in the dynamics of the early phases of the COVID-19 pandemic. However, most of the identified studies investigated the initial export of cases out of Wuhan, which was found to be highly effective, but few studies investigated the effectiveness of measures implemented in other contexts [31].

Grépin et al. conclude that “[t]here is an urgent need to address important evidence gaps” including the specific cross-border health measures applied, the forms of mobility being controlled, and the context in which they are applied. Most analysis, for example, focus on travel and there has been little study of health-related trade flows during the pandemic. There are also few, if any, comparative analyses of how cross-border health measures have been used in different settings, what factors have influenced their effectiveness at achieving public health goals, and what wider societal effects have been created.
Efforts to improve the evidentiary base on cross-border health measures have been hindered, in turn, by the lack of clear and/or consistent definition. For example, a decision framework by Zlojutro et al., to optimize border controls for global outbreak mitigation, limits the definition of a border control mechanism to “passenger screening upon arrival at airports (entry screening)” [32]. Habibi et al. exclude screening at ports of entry and exit as “travel restrictions” but include “de facto travel restrictions” notably when “airlines stop flying to places” [2]. Iacus et al. focus their analysis on “air traffic suspension” in “analysing the impact of travel bans on the aviation sector” [33]. Russell et al. define travel restrictions as “any measure that completely or almost completely prevents international arrivals from contributing to local transmission, such as entry bans and compulsory 14-day facility-based quarantines” [34]. Finally, the term non-pharmaceutical interventions (NPI) is widely used in public health research, with different researchers including [35] or excluding cross-border measures [36].

Ultimately, agreed terminology and definition is a critical starting point to advancing understanding and scientific principles on the effective and appropriate use of cross-border health measure during a PHEIC.

**METHODOLOGY**

The Pandemics and Borders Project (https://www.pandemics-borders.org/) is analysing the near universal use of cross-border health measures by countries during the COVID-19 pandemic. For this article, we begin with the WHO Public Health and Social Measures (PHSM) Dataset [37] which collates “data from the main trackers, bringing them into a standard structure and coding them to a common taxonomy.” The trackers currently include the ACAPS government measures dataset [38], Johns Hopkins University Coronavirus Research Centre dataset (a subset of the
national and state level dataset) [39], University of Oxford Coronavirus Government Response Tracker [40], and US Centers for Disease Control and Prevention COVID Data Tracker Weekly Review [41]. Using the common taxonomy and glossary of the WHO dataset as a starting point, notably “domestic travel” and “international travel measures” [42], we compared the terminology used in 29 studies of the domestic and international “travel measures” implemented during the early stages of the COVID-19 pandemic [31]. In addition, we reviewed the terminology used in more detailed government guidelines and policies on cross-border measures and COVID-19 available on-line since February 2020, including numerous revisions over time. We focused specifically on Canada, Hong Kong and the USA, for which detailed case studies on decision making concerning cross-border measures are being conducted, along with dozens of other countries and subnational jurisdictions within the WHO dataset.

We then applied a grounded theory approach whereby categories, based on specific properties of groups of measures, emerged from the above data sources. As far as we are aware, this is the most comprehensive effort to develop such categories for cross-border health measures. Using the approach set out by Udo Kelle, on the development of categories in social research [43], once a category was identified, we checked its usefulness for classifying cross-border health measures by coding a sample of the WHO dataset (entries for a random date). Where the category is conceptually not useful for coding, or there is insufficient data to create a clear system of classification, the category was discarded. For example, the category of “potential non-compliance” with the IHR (2005) was abandoned because it was not possible to determine degree of compliance with international law. There remain unresolved legal questions about the meaning of IHR compliance under international law in the context of COVID-19. Where coding confirmed
the usefulness of the category, discussion among the authors led to further refinement of the
defining properties of the category. A total of six categories were identified in this way.

To develop the proposed typology, we carefully considered any relationships, required
sequencing by time or place, or prioritisation among these six categories [43]. This led to the
identification of a hierarchically ordered structure linking the categories together. This typology
does not preclude further refinement using subcategories (e.g. travel, trade). However, the aim of
this initial exercise is to identify major categories to advance research, policy and practice.

An important caveat to note is that, given the existing lack of clarity and consistency in
terminology, the six categories and typology are only intended to be a starting point for increased
standardization. This has not been necessary in the past given the more limited use of cross-border
health measures, in form and duration, during previous PHEICs [44]. At the time of writing, the
COVID-19 pandemic is ongoing and additional measures may yet be applied that are not included
in this analysis. Further refinement of these categories and the typology may be needed
accordingly.

RESULTS: CATEGORIZING CROSS-BORDER HEALTH MEASURES

Measure by type of movement

A broad range of cross-border measures are applied by different regulatory authorities, to control
different forms of movement between one jurisdiction to another for different purposes. These
movements generally fall into two broad categories: travel-related (i.e. human) and trade-related
(e.g. non-human animals, goods and services, information, financial capital). When analysing
cross-border health measures, it is useful to distinguish between these two categories. The IHR
(2005) makes this distinction, defining a “traveller” as limited to “a natural person [human]
undertaking an international voyage.” The term “international traffic” encompasses both travel and trade, defined as “the movement of persons, baggage, cargo, containers, conveyances, goods or postal parcels across an international border, including international trade” [45].

Applying these categories, the category of movement to be controlled will depend on the nature of the risk. If the health risk is a food borne hazard (i.e. biological, chemical or physical), for example, the measure adopted would target relevant trade such as livestock (e.g., bovine spongiform encephalopathy), fresh produce (e.g., salmonella, e-coli) or manufactured product (e.g. lead poisoning) [46, 47]. If the health risk is a communicable pathogen transmitted by direct contact, droplet or airborne, cross-border health measures would target travellers. For vector-borne diseases, travel or trade-related movements may need to be targeted (e.g., spraying, disinfection). These categories also help to identify forms of movement that are not currently, but may need to be, controlled. The flow of health-related mis/disinformation via social media across jurisdictions, for example, has come under growing scrutiny given potentially adverse impacts on the COVID-19 response [48].

Within each of these two categories, a further distinction can be made between, first, measures that determine whether movement (travel or trade) is permitted. These measures encompass government policy regarding travel to or from specific jurisdictions which can be an advisory or alert (recommendation) or mandatory restriction. For travel, the latter may take the form of a ban on movement for a selected jurisdiction or population. For trade, the latter may take the form of an embargo on trade with a selected company or country. Measures that determine movement also include actions that impact the logistics of travel or trade notably whether a point of entry is open or closed, or the availability of transport for travel or trade (e.g. cancellation of flights, cruises). The securing of special documentation (e.g. visa) and payment of fees (entry/exit
fee, import/export tariff) are further measures that determine movement. Finally, movement can be impacted by limits by volume (e.g. ceilings, quotas) or purpose of movement (e.g. essential versus non-essential). For example, during COVID-19, most countries have permitted the continued movement of what is deemed essential travel (e.g. key workers, armed forces, diplomacy, humanitarian reasons) and essential trade (e.g. medical supplies, food). The import and export of essential supplies such as personal protective equipment, ventilators and vaccines were also the subject to control measures by up to 80 countries [49, 50].

Second, there are measures that determine the conditions under which travel and trade movements are permitted to occur. These measures manage health risks associated with traffic moving across different jurisdictions by identifying the presence of the risk (i.e. screening/inspection, testing, vector surveillance), controlling the onward spread of risk (i.e. contact tracing, quarantine/isolation, vector control, certification), and improving public awareness of risk (i.e. information provision). This distinction provides a potentially first step in determining whether a measure is appropriate or proportionate to the nature of the health risk to be addressed. As stated by the IHR (2005), “measures shall not be more restrictive of international traffic and not more invasive or intrusive to persons than reasonably available alternatives that would achieve the appropriate level of health protection” [6]. For some risks, therefore, such as yellow fever, measures to determine whether movement should occur are unnecessary as vaccination certification is sufficient. During the COVID-19 pandemic, however, multiple measures have been needed simultaneously given the nature of the pathogen and mode of transmission. A summary of travel and trade measures, by whether movement permitted and what conditions movement occurs, is summarized in Table 1.
Table 1: Cross-border health measures to control travel- and trade-related movements

<table>
<thead>
<tr>
<th>INTERNATIONAL TRAFFIC</th>
<th>TRAVEL-RELATED MEASURES</th>
<th>TRADE-RELATED MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHETHER MOVEMENT PERMITTED</strong></td>
<td>travel advisory or alert (recommendation) or restriction (requirement)</td>
<td>travel advisory or alert (recommendation) or restriction (requirement)</td>
</tr>
<tr>
<td></td>
<td>point of entry by land, air or sea open/closed</td>
<td>point of entry by land, air or sea open/closed</td>
</tr>
<tr>
<td></td>
<td>transport availability</td>
<td>transport availability</td>
</tr>
<tr>
<td></td>
<td>entry or exit restriction</td>
<td>import/export restriction</td>
</tr>
<tr>
<td></td>
<td>visa requirement</td>
<td>licensing requirement</td>
</tr>
<tr>
<td></td>
<td>essential travel documentation</td>
<td>essential goods or services documentation</td>
</tr>
<tr>
<td></td>
<td>ceilings and quotas</td>
<td>import/export quota</td>
</tr>
<tr>
<td><strong>WHAT CONDITIONS MOVEMENT OCCURS</strong></td>
<td>contact tracing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>entry/exit fees and surcharges</td>
<td>import/export tariff</td>
</tr>
<tr>
<td></td>
<td>screening</td>
<td>inspection</td>
</tr>
<tr>
<td></td>
<td>testing</td>
<td>testing</td>
</tr>
<tr>
<td></td>
<td>quarantine/isolation</td>
<td>quarantine/isolation</td>
</tr>
<tr>
<td></td>
<td>disease free or vaccination certification</td>
<td>disease free or vaccination certification</td>
</tr>
<tr>
<td></td>
<td>information provision</td>
<td>information provision</td>
</tr>
<tr>
<td></td>
<td>vector surveillance and control</td>
<td>vector surveillance and control</td>
</tr>
</tbody>
</table>

**Measure by policy goal**

Cross-border health measures have a stated aim of supporting health policy goals such as the prevention and control of disease spread across jurisdictions, reduction of imported health risks, and promotion of access to health-related goods and services. However, it is important to recognize that cross-border health measures can be shaped by a mixture of health and non-health policy goals. Multiple goals are usually at play simultaneously, representing potential trade-offs among different parts of government. For example, Canadian travel measures announced in January 2021 cancelled flights to Mexico and the Caribbean, to reduce the risk of importing coronavirus variants of concern by targeting popular holiday destinations. The decision not to ban all international flights, despite the global circulation of variants, reflected a desire to minimize...
adverse economic impacts of reducing essential travel and trade [52]. Similarly, the easing of travel restrictions by many European countries during summer 2020, to generate income for the tourism sector, increased virus spread [53]. In some cases, health and non-health goals may come directly into conflict. For example, opposition by some member states of the World Trade Organization, to a temporary waiver of intellectual property rights over COVID-19 vaccines, protects the economic interests of the pharmaceutical industry. In doing so, countries currently with limited access to vaccines are not permitted to manufacture generic versions of vaccines for domestic populations and export to other countries in need [54]. There may also be competing health-related goals at play. A good example is the European Union’s use of export controls to secure vaccine supplies for priority use by member states versus supply to non-EU countries [55]. Finally, governments may claim to apply a cross-border measure for health purposes but be advancing another policy goal. For instance, the indefinite extension of border restrictions by the Trump Administration, on grounds of controlling the coronavirus, was described as an effort “to aggressively use public health laws to reduce immigration” [56].

The co-existence of multiple, sometimes competing, policy goals helps explain choices made about what cross-border health measures have been used during the COVID-19 pandemic, and how they have been applied. When protecting public health is the primary goal, measures may be applied universally and stringently. For example, Australia has limited incoming travellers to a quota of nationals, permanent residents and essential travellers, in addition to adopting mandatory testing and quarantine policies, with few exemptions. By contrast, the UK has adopted targeted restrictions based on assessed risks of virus transmission from source countries over time, a policy intended to balance public health and economic policy goals. Similarly, restrictions on land border crossings between Canada and the US have exempted essential travel and trade for
economic and political reasons. Moreover, the adoption of a measure to achieve a specific public health goal (e.g., prevent importation of infection) might interfere with another public health goal (e.g., cross-border movement of health care workers and carers) in the same jurisdiction. Or a cross-border health measure adopted in one jurisdiction (e.g., restricted export of personal protective equipment, vaccines) can lead to public health harms in another jurisdiction.

It is also important to note the differential impacts of cross-border health measures on diverse populations. Measures adopted to protect the health of one population group from COVID-19, such as domestic populations, can have detrimental consequences for the health and well-being of mobile populations such as migrant workers, refugees and asylum seekers. During the COVID-19 pandemic, the near universal adoption of travel restrictions by governments has led to millions of migrants being stranded worldwide. Many prevented from returning home must live in conditions which put their health at risk [57, 58]. This points to human rights and ethical concerns regarding the potentially inequitable impacts of cross-border health measures on vulnerable populations.

Overall, the use of cross-border health measures occurs within a complex policy environment. Faced with multiple and sometimes competing goals, decision makers must weigh these against the normative frameworks informing their choices. Ideally, scientific evidence will also be considered although this may be imperfect and incomplete amid a public health emergency unfolding in real time. The impacts of policy choices on public health and broader economic, social and political goals may thus be unknown and even unknowable.

Measure by level of jurisdiction applied
Analyses of cross-border health measures to date focus on travel and trade between two or more countries (i.e. international borders) [30]. Insufficient account has been taken of different levels of jurisdiction. Studies of travel-related restrictions, in particular, have focused on national-level measures or have conflated different levels [31]. As a result, it is difficult to separate out the effectiveness of measures applied at a particular level when measures are simultaneously applied at more than one level. Lack of distinction by jurisdiction also undermines the accuracy of comparative analyses.

As the world has become more interconnected from the late twentieth century, traffic volumes have significantly increased. Thus, health measures sit alongside varied national regulation of travel and trade between sovereign states. International agreements set out how States Parties apply these measures in a standardized and coordinated way. For example, the World Trade Organization (WTO) administers international treaties setting out agreed conditions to facilitate the movement of trade and investment. The IHR (2005) sets out commitments by States Parties to coordinate use of cross-border health measures to prevent and control the international spread of disease.

However, clear definition of cross-border health measures should also take account of their use at other levels of jurisdiction both above and below the state (Table 2). There are bilateral and regional arrangements, encompassing selected countries, relevant to health-related cross-border movements (e.g., European Union, Schengen Area). During non-pandemic times, regional agreements regulate the cross-border movement of patients [59], health care workers [60], and financing. During the COVID-19 pandemic, bilateral agreements have been reached to govern travel across land borders between countries (e.g., US-Canada, US-Mexico) [61]. Regional arrangements to establish “air bridges” and “travel corridors” have proliferated [62]. While most
involve two or more sovereign states, some combine a subnational area with sovereign states (e.g. Trans-Tasman Travel Bubble). Amid concerns about limited vaccine supplies, Germany called on potential restriction of exports from the European Union [63].

Table 2: Examples of cross-border health measures by level of jurisdiction for COVID-19

<table>
<thead>
<tr>
<th>Level of Jurisdiction</th>
<th>Travel</th>
<th>Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERNATIONAL</strong> (ALL COUNTRIES)</td>
<td>quarantine measures for travellers under the IHR (WHO)</td>
<td>Codex Alimentarius Commission Standards (WHO/FAO)</td>
</tr>
<tr>
<td><strong>REGIONAL/ BILATERAL</strong></td>
<td>European Council Recommendation on coordinated approach to restriction of free movement [88]</td>
<td>Restrictions by European Union on vaccine exports</td>
</tr>
<tr>
<td></td>
<td>US-Mexico agreement to limit non-essential travel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UK travel corridors to 50 countries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tasman Bubble (Australia/New Zealand)</td>
<td></td>
</tr>
<tr>
<td><strong>SUBNATIONAL</strong> (STATE/PROVINCE)</td>
<td>Atlantic Bubble (Canada) state-level travel restrictions (Australia)</td>
<td>US federal control of PPE supplies to individual US states</td>
</tr>
<tr>
<td><strong>MUNICIPAL</strong></td>
<td>Wuhan lockdown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Big White Ski Resort limits bookings to residents</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kinshasa/Gombe</td>
<td></td>
</tr>
<tr>
<td><strong>MARKET</strong></td>
<td>Airline requirements for passengers (e.g., testing)</td>
<td>Purchase agreements for COVID-19 vaccines</td>
</tr>
</tbody>
</table>

During COVID-19, domestic travel restrictions are increasingly recognized as an important means of controlling spread of the coronavirus [65]. Cross-border health measures have been extensively used to control movements across internal or domestic (subnational jurisdictions)
borders. In the UK, travel advisories sought to limit non-essential travel between the four nations (England, Scotland, Wales and Northern Ireland). Tiering of areas in England (defined by a mix of cities, counties and subregions), based on “five epidemiological indicators” (e.g., coronavirus infection case detection rates, positivity rate), sought to limit travel between higher and lower risk areas between November 2020 and January 2021 [66]. Travel restrictions have been used extensively by Australian states and territories to control domestic spread of the coronavirus [67].

In Canada, the so-called “Atlantic bubble” formed from June-November 2020 allowed unrestricted travel by residents among four Canadian provinces, and restricted travel by non-residents from other provinces [68, 69]. In the US, travel restrictions have localized by state, municipality and even neighbourhoods (e.g., New York City) [70]. There have been fewer efforts to control subnational trade. One example is the US where, amid surging cases of COVID-19, it was reported that the Trump Administration blocked PPE supplies to several states including Michigan and Massachusetts [71]. Shortages in essential supplies (e.g., PPE, ventilators) in the US during the early stages of the pandemic led to reports of diversion of placed orders of selected states by the federal government [72].

Finally, when analysing cross-border health measures, further complexity can arise when arrangements combine multiple jurisdictional levels. For example, during the early stages of the pandemic, different countries adopted a mixture of restrictions on travellers from the city of Wuhan, Hubei Province and China as a whole. Alternatively, travel restrictions may exempt daily commuters between a country and a subregion of a neighbouring country (e.g., Switzerland and bordering regions in France, Singapore and day workers from Malaysia). Travel restrictions seeking to control the spread of new variants of SARS-CoV-2 have simultaneously targeted selected cities, countries, and regions [40]. Jurisdictions with special or disputed legal status also
require specific arrangements. Movements between Hong Kong and mainland China, for example, are treated as somewhere between international and domestic given the former’s status as a special administrative region, with its own immigration policies, while still part of the country. A similar situation exists regarding stricter travel restrictions adopted by New Caledonia, a French Overseas Territory, and the rest of France, which only permits French citizens arriving on a select route (via Japan) and then only after undergoing quarantine. There are also now thousands of special economic zones worldwide to facilitate trade and investment, located within a country’s national borders, but governed separately. For jurisdictions such as these, measures adopted during COVID-19 will reflect the specific political or legal status of these jurisdictions.

Measure by stage of journey

Cross-border health measures can be categorized by the point of application along three main stages of a journey – pre-border, at-the-border and within-the-border. The stage at which a measure is applied can depend on considerations such as administrative convenience, cost, logistics and nature of health risk. In general, measures determining whether movement is permitted are applied at the pre-border stage to minimise denial of entry at a border. Thus, travel and trade are impacted by recommendations or requirements to avoid certain jurisdictions, the opening or closure of points of entry, and availability of transport. Where specific procedures must be followed or documentation needs to be obtained, which can be time-consuming and costly, it is also more appropriate to administer these at the pre-border stage. This includes assembling evidence of eligibility to travel or trade, screening/inspection, health certifications and pre-travel quarantine. In December 2020, for example, the Chinese government introduced the requirement that foreign nationals undergo nucleic acid and IgM antibody tests, and complete a Health
Declaration Certificate two days before boarding [73]. For the safe importation of live animals into the European Union, to avoid the transmission of diseases, health certificates must be obtained beforehand, signed by an official veterinarian of the competent authority of the exporting non-EU country guaranteeing that the conditions for import into the EU have been met [74].

At-the-border measures are applied when a traveller or trade physically reaches a point of entry. These include checking necessary documentation (e.g. visa, proof of essential travel, vaccination or negative test certificates); further testing, screening/inspection and quarantine/isolation; and payment of additional fees, fines or penalties. Vector control through disinfection and disinsection procedures may be applied. Quarantine of non-humans (i.e. pets, wildlife, livestock) is applied at a border by customs officials who check documentation, inspect the animals, and keep them in quarantine for a requisite period depending on the type of animal until their release from customs [75].

Finally, some measures are applied within-the-border to extend the management of health risks after entry into a jurisdiction. Quarantine of humans may be applied at-the-border but, strictly speaking, is administered after a traveller enters a jurisdiction. During the Ebola virus outbreak in 2014, for example, returning travellers to the US were quarantined at some airports, although this technically occurred on American soil [76]. During the COVID-19 pandemic, mandatory quarantine of international and some domestic arrivals after entry has been carried out at designated sites or places of resident. Further screening/inspection and testing of travel and trade after entry may occur. In England (but not the rest of the UK), international travellers must test prior to departure (within 72 hours), and days two and eight after arrival [77]. Other countries require further testing at varying number of days after arrival. A summary of travel and trade measures by stage of journey is provided in Table 3.
The categorising of cross-border health measures using a full journey perspective encourages a more comprehensive and integrated approach to managing health risks associated with cross-border mobility. In some cases, measures may be required at multiple stages of a journey (e.g. screening, testing and quarantine) because of repeated risks of exposures, need for multiple tests to detect a pathogen, and to reduce any residual risk. This approach is illustrated by Australian travel policy during the COVID-19 pandemic which covers measures from pre-travel to the end of the journey. Travellers to Australia must first be deemed eligible, specify whether they will arrive via a red or green zone (i.e. level of risk), self-screen for symptoms, take a PCR test and test negative within 72 hours of departure, and pre-book an available slot (within the quota limit) at a designated quarantine hotel (if required) prior to departure. Upon arrival, the traveller must provide proof of a negative test result, be screened, tested and, if from a red zone, sent to a government designated quarantine facility for a minimum of 14 days. During quarantine, further tests will be administered at 10-12 days. If negative, the traveller will be permitted to enter Australia but must abide by all public health rules including any inter-state travel restrictions. If tested positive at any time, they must remain in isolation [78].

This full journey approach also supports efforts to manage the costly and challenging logistics of implementing cross-border health measures for high volumes of travel and trade. Given finite resources, decision makers may consider how measures applied at one stage, such as vaccination and testing, can potentially reduce the need for the same measures at another stage. For instance, if a traveller provides proof of a yellow fever vaccine received at the pre-border stage, there is no need for vaccination, testing or quarantine at the point of entry. The increased use of pre-border measures can reduce the administrative burden at the point of entry. This reduces the need to implement substantial capacity at-the-border and potential bottlenecks that hinder cross-
border flows. During COVID-19, many governments require travellers to use on-line apps to register required documentation and pre-book reservations in quarantine facilities. If a government is seeking to discourage non-essential travel, pre-border measures can act as a disincentive by shifting the administrative and financial burden onto these travellers. Finally, effective use of pre-border measures can play a valuable preventative role, by screening out or reducing imported health risk. For example, regular inspections at the point of manufacture or processing can enhance the safety before imported products or produce arrive at their destination. Any assessment of the effectiveness of cross-border health measures applied during COVID-19 needs to take account of how they have been used for each of these three stages of a journey.

**Measure by public or private sector use**

Cross-border health measures are, for the most part, officially adopted and applied by public sector authorities operating across different parts (e.g., health, transport, customs and excise, immigration, law enforcement) and levels (international, national, subnational) of government. During the COVID-19 pandemic, as of February 2021, the WHO Public Health and Social Measures dataset suggests most cross-border measures adopted have been applied by governments. The IHR (2005) sets out commitments by States Parties to use cross-border measures only under certain conditions as part of overall actions to prevent the international spread of disease. The IHR is then underpinned by a range of national-level governance arrangements, set out in national and subnational public health legislation, which set out the ways that government can and should act.

However, clearer definition of cross-border health measures should include actions taken by private sector entities that influence travel and trade movements (Table 4) but yet are beyond
the scope of the IHR (2005). This was apparent during the early stages of the COVID-19 pandemic when many airlines and cruise ship companies acted quickly and even earlier than many governments in restricting travel. For instance, KLM Airlines suspended all flight operations to and from Shanghai and Beijing from 29 January 2020, while the Dutch government introduced border restrictions on 18 March 2020. In early February 2020, the US cruise ship company Royal Caribbean restricted passengers holding Chinese passports regardless of travel history [79]. Many companies reduced, rerouted or suspended selected services. While initial cross-border measures by private companies appear to have been motivated by efforts to reduce health risks to passengers, many were subsequently based on business decisions as demand declined and it became insufficiently profitable to continue service. Many measures are motivated by efforts to reduce the health risks of travelling during a pandemic, as a means of resuming business and encouraging consumer uptake. Thus, the private sector has been at the forefront of developing pre-departure and on-board protocols including hygiene practices, wearing of face coverings, and testing. The private sector has also conducted or sponsored research to assess risks associated with travel [80]. Some airlines have created incentives to travellers such as price reductions and free travel insurance. For the most part, these actions were governed by individual company policies and lay outside the authority of the IHR (2005). Table 1 provides examples of cross-border health measures used by the private sector.

Table 4: Cross-border health measures applied by private sector

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>restricted access to mode of transport</td>
<td>flight cancellations, cruise ship cancellations</td>
</tr>
<tr>
<td>health screening</td>
<td>passenger screening</td>
</tr>
<tr>
<td>testing</td>
<td>testing contractor</td>
</tr>
<tr>
<td>certification</td>
<td>vaccine passport scheme</td>
</tr>
<tr>
<td>financial incentives/disincentives</td>
<td>reduced pricing, free health insurance</td>
</tr>
</tbody>
</table>
Alongside recognition of measures taken by both the public and private sector, analysis of the effective use of cross-border health measures should take account of the interconnectedness of these actions. For example, the US government’s restrictions on travel to and from Wuhan, China is believed to have been prompted by airline cancellation of flights [ ] . Conversely, the adoption of pre-border testing requirements by many governments led some airlines and airports to provide convenient and even complimentary testing facilities for travellers. Private contractors may be hired to implement certain measures mandated by government (e.g. testing, quarantine enforcement). Carriers may be punished by governments for failing to comply with measures. In Hong Kong, if an airline violates travel restrictions (e.g. allowing someone to board without the proper testing certificate), or if too many travellers subsequently test positive, the airline is banned from inbound travel for 14 days. At some point, KLM, Emirates, and British Airways were all banned. Air India and Nepal airline have been repeat offenders. Where governments have failed to act swiftly enough, such as testing and vaccination of employees in the US, the private sector has stepped into the breach [81].

Alternatively, a disconnect may exist between public and private measures has been evident in some countries, whereby a government strongly advises against non-essential travel but airlines continue to advertise holiday packages, confusing the public about the stringency of official restrictions. In Canada, it was announced in January 2021 that the federal government and airlines reached an agreement to cancel flights to and from selected holiday destinations. Overall, defining cross-border health measures requires an understanding of the relative roles of the public and private sector, and how the nature of the relationship between them influences cross-border governance.
Measure by restrictiveness

While the terms “travel ban” and “border closure” have come to be commonly used during the COVID-19 pandemic, in practice, cross-border health measures vary widely in degree of restrictiveness. The least restrictive are advisories or warnings by a government seeking to raise awareness of a potential health risk from travel or trade. Certain precautions may also be recommended to manage the risk. For travel, this might be delaying or avoiding travel, vaccination or bringing essential supplies. For trade, this might involve not purchasing or consuming a product (e.g. contaminated food product), issuing a recall or disposal. The most restrictiveness measures are prohibitions on certain travel or trade.

The two most common categories of traveller used are citizenship or residence status, and purpose of travel. Travel restrictions may also be targeted at travellers from selected source countries deemed to be a particular risk to health. Importantly, governments may also adopt measures that exempt or ease travel restrictions based on certain categories of traveller [82] or source country. Travel on humanitarian reasons (e.g., refugee, direct family member) or economic benefit (e.g., students, essential worker), or travel from selected jurisdictions deemed safe from health risks, may be given exemptions and even “fast tracked”. Trade-related restrictions can also range from advisories, such as consumer alerts on potentially harmful products, to bans on certain categories of goods or from a target source country. During the COVID-19 pandemic, many countries eased certain trade policies to facilitate the importation of necessary health supplies and equipment, while others tightened export controls to keep needed health and medical supplies and equipment for national use.
Given the above, efforts have been made to categorize selected cross-border health measures by their degree of restriction during the COVID-19 pandemic. The Oxford Coronavirus Government Response Tracker, for example, collects data on 19 indicators, and records their stringency at given points in time [40]. For international travel controls, stringency ranges from no measures to total border closure (Figure 1). For internal (domestic) movements, stringency of measures are categorized as no measures, recommended movement restriction and restrict movement (Figure 2). However, only a limited number of the travel-related measures listed in Table 1 and 2 are included in this analysis. Similarly, the International Air Transport Association (IATA) COVID-19 Travel Regulations Map categorizes countries as Totally Restrictive, Partially Restrictive or Not Restrictive, with no information provided on what measures are assessed or how [83].

Building on these efforts, we argue that any comparative assessment of the use of cross-border health measures needs clear criteria to assess restrictiveness or stringency by type of movement and measure over time and place. On type of movement, the extent to which a measure impedes the movement of the targeted travel or trade is the overall criteria. In addition, specific measures vary in their restrictiveness, as well as, how specific measures are implemented can vary in restrictiveness (Table 5). For example, screening (e.g. health declaration, temperature check) would be considered less restrictive to travel than quarantine. In addition, specific ways of implementing quarantine (i.e. duration, location, voluntary versus mandatory, liability for cost) influences stringency. Restrictiveness is also cumulative, with the use of multiple cross-border health measures simultaneously capable of creating greater stringency. In all cases, degree of exemptions from the measure directly impacts on restrictiveness. In Canada, there are many exemptions from restrictions on international arrivals by non-nationals and non-permanent
residents including essential workers, direct family members, holders of study visas, military personnel, US citizens travelling to Alaska, and additional individuals exempted by the government [84]. Many of these categories are also exempt from the 14-day quarantine requirements. In Hong Kong, there are few exemptions to entry and quarantine permitted such as business executives of companies listed on the Hong Kong Stock Exchange travelling to and from the Chinese mainland [85].

Importantly, degree of restrictiveness should not be conflated with effectiveness in achieving a stated health goal. Indeed, increased restrictiveness is not the same as greater efficacy. The appropriate degree of stringency will depend on the health risk posed, including the nature of the pathogen, and specific context for implementation of the cross-border health measure. For screening, in particular, a systematic review of evidence on COVID-19 studies to May 2020 found “[o]ne-time screening in apparently healthy people is likely to miss people who are infected” [86]. For example, temperature screening may be stringently enforced for all travellers, but evidence suggests it offers limited public health benefit during previous pandemics [87]. Analyses of the relationship between degree of restrictiveness and effectiveness will need to account of a complex range of factors such as policy change over time, evaluations of policy implementation, outbreak dynamics and health outcomes.

Discussion: A proposed typology of cross-border health measures

Bringing together the six categories, Figure 3 provides a typology of cross-border health measures by type of movement, policy goal, level of jurisdiction, stage of journey, public versus private sector use, and degree of restrictiveness. The typology sets out the many choices to be made when considering border management. This begins with identifying the policy goal(s) to be achieved,
recognising that health and non-health policy goals co-exist and influence the choice of measures, how they are implemented, and whether they are ultimately effective. This acknowledges that there will generally be trade-offs, limitations, and compromises to navigate whenever cross-border health measures are considered.

Figure 3: Proposed typology of cross-border health measures
This typology is useful in several respects. First, current research is characterized by varying terminology and often imprecise definition, thus reducing the generalizability of findings and comparative analyses across jurisdictions. Efforts to determine the effectiveness of cross-border health measures, in controlling the spread of disease, are challenged by differences in practice and ways of describing them. This typology offers a framework for identifying the specific measures used in a standardized way. It encourages researchers to describe measures with greater specificity and in ways that enable comparability across the six categories. The need for comparative analyses is especially important given growing evidence that “international travel was directly associated with the mortality slope and thus potentially the spread of COVID-19. Very early restrictions on international travel should be considered to control COVID-19 outbreaks and prevent related deaths.”

Second, and relatedly, by supporting clear and consistent definition of cross-border health measures, the typology can facilitate research into the varying effects and externalities of such measures. Rather than assuming the possible benefits and harms of cross-border health measures, our approach encourages explicit analysis of not only public health effects, but also social, economic, ethical, and political externalities. For example, the social and economic toll of cross-border health measures may disproportionately harm vulnerable groups, countries, and communities, provide a convenient excuse for governments to take discriminatory trade and immigration measures, or create a false sense of security that may detract from other response measures [89, 90, 91, 92]. These externalities require explicit investigation that is not possible without clear and consistent definitions of cross-border health measures. Public health benefits may still predominate, but these should not be seen in isolation. Enhanced understanding of
externalities can inform harm reduction policies and more accurate assessments of the political implications of a range of cross-border health measures for governments.

Third, the typology aims to support decision-making on the use of cross-border health measures. During the COVID-19 pandemic, policy debates have often focused on whether or travel restrictions work to prevent coronavirus spread. Instead, this typology supports understanding of the complexity of choices faced when thinking about the purpose of such measures, the broad range of measures available, the ways that might be applied singly or in combination, and the importance of timing and context. This shifts decisions, from a binary question of whether or not to use cross-border health measures, to what type of movement may need to be controlled and what conditions need to be introduced to manage an identified health risk. This typology also locates cross-border health measures within the broader context of border management for different, and sometimes competing, policy goals. It is this complexity which explains what Peterson and colleagues call a “dissonance between scientific advice and political realities” [93]. Public communication, when implementing such measures, may also be clarified in ways that enhance compliance.

Fourth, by strengthening research and policy, the typology may encourage more coordinated use of cross-border measures across jurisdictions. Evidence from previous PHEICs shows that effective global responses are facilitated by coordinated action across countries. However, “there is no recognized coordinating body to disseminate timely, consistent, reliable and authoritative information and best practices to all stakeholders” [94]. During the COVID-19 pandemic, there has been limited coordination, with countries using their own mixture of measures applied in different ways. The costs of uncoordinated action are likely to include increased disease transmission risks, prolonged outbreaks and unnecessary economic and social impacts [95, 96].
Finally, the typology can inform future efforts to revise the IHR (2005). The IHR (2005) is the legal framework for the use of “additional health measures” by States Parties based on “scientific principles.” The typology would support more precise definition of additional health measures, research to identify best practices, and thus the development of scientific principles to guide action. Moreover, the typology may inform future efforts to revise the IHR (2005) by revealing cross-border health measures not currently covered under their remit. Many forms of trade are not currently subject to the regulatory authority of IHR despite having implications for the international spread of disease. For example, export controls of PPE and vaccines during the COVID-19 pandemic fall beyond the authority of the IHR (2005). The typology also supports an alternative approach to assessing compliance with the IHR, shifting the focus from legality to broader considerations of effectiveness [97]. With a fuller definition of additional health measures, and the complexity of choices involved, it is unlikely that universally applicable scientific principles will emerge. Instead, compliance could be assessed by the application of a decision instrument, informed by best practice and normative values. Governments might thus demonstrate compliance through due process by working through this decision instrument.

Conclusion

The widespread use of cross-border health measures during the COVID-19 pandemic has prompted significant reflection on available evidence, previous practice and existing legal frameworks. All are found wanting, particularly given insufficiently clear and/or consistent definition about the subject at hand. The typology put forth in this paper aims to provide a starting point for strengthening research, policy and practice. By encouraging a fuller understanding of border management using six categories of measures, the use of cross-border health measures
during future PHEICs can be more evidence-informed, capable of navigating policy complexity
including managing trade-offs and externalities, and ultimately appropriate and effective in
protecting and promoting population health. We argue that these are critical foundations to a more
coordinated approach to the use of cross-border health measures across jurisdictions.
Table 3: Cross-border health measures by stage of journey

<table>
<thead>
<tr>
<th>TRAVEL</th>
<th>PRE-BORDER</th>
<th>AT-THE-BORDER</th>
<th>WITHIN-THE-BORDER</th>
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<tbody>
<tr>
<td>travel advisory or alert (recommendation) or restriction (requirement)</td>
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<tr>
<td>point of entry by land, air or sea open/closed</td>
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<td></td>
<td></td>
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<tr>
<td>transport availability</td>
<td></td>
<td></td>
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<tr>
<td>entry or exit restriction</td>
<td>entry or exit restriction</td>
<td></td>
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<tr>
<td>ceilings and quotas</td>
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<td></td>
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<tr>
<td>visa requirement</td>
<td>visa requirement</td>
<td></td>
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<tr>
<td>essential travel documentation</td>
<td>essential travel documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>disease free or vaccination certification</td>
<td>disease free or vaccination certification</td>
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<tr>
<td>travel insurance coverage for health care</td>
<td>travel insurance coverage for health care</td>
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</tr>
<tr>
<td>screening</td>
<td>screening</td>
<td>screening</td>
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</tr>
<tr>
<td>testing</td>
<td>testing</td>
<td>testing</td>
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<tr>
<td>quarantine/isolation</td>
<td>quarantine/isolation</td>
<td>quarantine/isolation</td>
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<tr>
<td>entry/exit fees and surcharges</td>
<td>entry/exit fees and surcharges</td>
<td></td>
<td></td>
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<tr>
<td>fines and penalties</td>
<td>fines and penalties</td>
<td>contact tracing</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>TRADE</th>
<th>PRE-BORDER</th>
<th>AT-THE-BORDER</th>
<th>WITHIN-THE-BORDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>trade advisory or alert (recommendation) or restriction (requirement)</td>
<td>customs inspection</td>
<td>health inspection</td>
<td></td>
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<tr>
<td>point of entry by land, air or sea open/closed</td>
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<td></td>
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<tr>
<td>transport availability</td>
<td></td>
<td></td>
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<tr>
<td>licensing requirement</td>
<td>seizure, detention and/or destruction</td>
<td>seizure, detention and/or destruction</td>
<td></td>
</tr>
<tr>
<td>technical requirements (e.g. labelling)</td>
<td>fines and penalties</td>
<td>fines and penalties</td>
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<tr>
<td>levy and payment of tariffs</td>
<td>levy and payment of tariffs</td>
<td>levy and payment of tariffs</td>
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<tr>
<td>vector surveillance and control</td>
<td>vector surveillance and control</td>
<td>vector surveillance and control</td>
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</tr>
<tr>
<td>quota (maximum volume of travel or trade)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inspection</td>
<td>inspection</td>
<td>inspection</td>
<td></td>
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<tr>
<td>testing</td>
<td></td>
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</tbody>
</table>
Table 5: Examples of restrictiveness of selected cross-border health measures during COVID-19 pandemic

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>FACTORS AFFECTING RESTRICTIVENESS</th>
<th>EXAMPLES</th>
</tr>
</thead>
</table>
| screening | target population, stage(s) of journey, screening method, frequency, intended data use, exemptions | Low: Germany: Carriers arriving from China, South Korea, Japan, Italy and Iran required to report health status of passengers before entering Germany. Information on Disease prevention distributed to passengers (28 February 2020) [98]  
Medium: Taiwan: All arrivals required to complete health declaration and provide travel and contact history if visited China, Hong Kong or Macao within 14 days before entry (12 February 2020) [99]  
High: Benin: All arrivals coming from countries affected by COVID-19 (including countries with only a single case of COVID-19) must identify themselves using hotline. Such persons must self-isolate for 14 days and may be subject to additional screening and/or relocation to a quarantine facility (10 March 2020). [100] |
| testing | target population, stage(s) of journey, timing, frequency, type of test, liability for cost, exemptions | Low: United Kingdom: No testing requirements for international arrivals until introduced on 18 January 2021 [101].  
Medium: Norway: International arrivals must present proof of negative test for coronavirus taken less than 24 hours prior to entry. Five categories of population are exempted (30 January 2021) [102]  
High: Germany: Two-test strategy which provides for mandatory testing in connection with entry and, voluntary testing for early termination of quarantine at the earliest from the fifth day after entry. People who enter Germany after staying in "high incidence areas" and "virus variant areas" in the last 10 days before entry is obliged to bring proof that they are not infected with |
the SARS-CoV-2 coronavirus upon arrival. The test must be carried out at least 48 hours before entry. If the persons could not obtain evidence, carriers can carry out or have a test carried out before departure. The smear for this test by the carrier may be made no more than 12 hours before departure (2 February 2021) [103]

<table>
<thead>
<tr>
<th>Quarantine</th>
<th>target populations, stage(s) of journey, length, location, voluntary versus mandatory, liability for cost, method of enforcement, exemptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong> USA: CDC recommends international arrivals self-quarantine for 7 days after travel (18 February 2020) [104]</td>
<td></td>
</tr>
<tr>
<td><strong>Medium</strong> Canada: International arrivals by air required to undertake up to 3-day mandatory quarantine in designated hotels at traveller expense. If PCR test upon arrival negative, remaining quarantine completed at home with limited monitoring. International arrivals by land and sea required to undertake 14-day quarantine with limited monitoring (22 February 2021) [52]</td>
<td></td>
</tr>
<tr>
<td><strong>High</strong> Australia: Mandatory enforced 14-day quarantine introduced for all international arrivals (citizens primarily) who must pre-book one of limited slots in designated facility. Travellers pay cost of quarantine. Limited categories of exemption permitted to quarantine at home (29 March 2020) [105]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence of eligibility to travel</th>
<th>target populations, categories of eligibility, cost of entry visa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong> USA: Foreign nationals who travelled to China within past 14 days banned from entry (2 February 2020) [106]</td>
<td></td>
</tr>
<tr>
<td><strong>Medium</strong> Estonia: Foreign workers in agricultural sector allowed to extend short-term work permit. Workers from other sectors excluded (21 April 2020) [107]</td>
<td></td>
</tr>
<tr>
<td><strong>High</strong> Philippines: Non nationals denied entry with exception of crew members, government and international organization officials, and “uniformed personnel for official business” (20 March 2020) [108]</td>
<td></td>
</tr>
</tbody>
</table>
Australia: International arrivals limited to Australian nationals and foreign nationals travelling for essential reasons. Cap of 1475 arrivals per day introduced (4 July 2020) [109]

**Figure 1: International travel controls during the COVID-19 pandemic, Dec 10, 2020**

Source: https://ourworldindata.org/policy-responses-covid

**Figure 2: Restrictions on internal movement during the COVID-19 pandemic, Dec 10, 2020**

Source: https://ourworldindata.org/policy-responses-covid
Ethics approval and consent to participate
Not applicable as no human subjects involved in this research.

Consent for publication
All authors have approved this article for submission and publication.

Availability of data and material
Not applicable

Competing Interests
The authors declare no competing interests.

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Authors’ contributions
All authors contributed to the conception of the paper. KL wrote the initial draft. KG, CW, SM, JP and MS provided two sets of comments, suggested text, edits and selected data. KL revised the paper for submission.

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