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Article

Receptiveness of and implementation considerations for COVID-19 vaccination certificates in Asia: A survey across 9 countries

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Abstract: COVID-19 vaccination certificates (CVCs) have played a key role in safe reopening of borders for international travel and trade, so understanding key stakeholder perceptions of enablers and barriers for their effective use is critical. The COVID-19 Vaccination Policy Research and Decision-Support Initiative in Asia (CORESIA) was established to address policy questions related to CVCs. We conducted two online surveys, i.e., one for the public and one for health and non-health sector experts, from June to October 2021 in nine Asian countries. Descriptive analysis identified participants, enablers, and barriers. Most participants (78% public, 89% experts) accepted the use of CVCs, primarily to resume international travel (76%). Most respondents in both surveys wanted the minimum vaccination coverage to be 60% before CVCs were implemented nationwide. Most of the public (82%) agreed to maintain existing non-pharmaceutical interventions, while most experts wanted risk-based testing and quarantine policy for incoming travellers (51%) and both digital and paper format CVCs (64%). Support for CVCs for international travel remains high in Asia. Recognising key enablers and barriers for effective use of CVCs from COVID-19 pandemic may help policymakers draft effective border policies for future epidemics.

Keywords: COVID-19; Cross-border travel; Immunity certificate; Regional collaboration; Vaccination certificate; Vaccination passport; Asia

1. Introduction

Vaccines against the COVD-19 virus have had profound implications on the trajectory of the global pandemic. Even though they have been unsuccessful at limiting transmission as initially expected, they have successfully lowered hospitalisation and severe disease among those infected [1, 2]. Holders of COVID-19 vaccination certificates (CVCs), or

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verifiable proofs of vaccination, have therefore been able to signal their comparatively lower risk for developing acute illness from COVID-19 infection as compared to those unvaccinated to relevant authorities. By doing so, they have also been able to communicate that they are less likely to require critical care resources and hospital treatments, both of which continue to cause steep health system burdens in countries, especially pronounced in under resourced contexts [3]. Based on our experience thus far in the pandemic, CVCs can be understood as having been central to enabling a relatively safe resumption in global socioeconomic activity.

However, there remain significant gaps in how these vaccine verification systems globally are organised and operated. Countries are using these certificates for multiple requirements, including cross-border travel, entry into community events and gatherings, and resuming in-person employment. Existing studies have highlighted that certain requirements are much more acceptable among the public; for example, using CVCs for foreign travel rather than for resuming in-person education or employment [4, 5]. Such differences have made the uniform operationalisation of these instruments challenging. On a global scale, siloed country efforts have resulted in the creation of numerous versions of vaccine and immunity verification (such as immunity certificates which are proofs of natural immunity from prior infection) and systems within which they operate [6] As a result, country-level CVCs are not easily recognisable and verifiable by others, fragmenting their global utility even under high-acceptance scenarios such as international travel. Only some countries, such as India, Indonesia and Thailand are now allowing an 'international version' outlining some basic information such as passport numbers to be listed [7]. This lack of interoperability has been cited as one of the biggest hurdles to the regional adoption of CVCs [6, 8]. Furthermore, concerns of data privacy are significant in using digital vaccine systems, especially in regions that are yet to have a common framework on data use, storage and encryption [6, 9]. In cases where a paper-based version is used (non-digital), fraudulent, unverifiable documents can have deep consequences. Therefore, encouraging an effective and equitable uptake of CVCs requires an understanding of the enablers and barriers to the same in the region, from the perspectives of both the public citizenry and implementing or supporting institutions. Such studies, although important to aid the development of a regional policy on CVCs are currently lacking in Asia.

In 2021, the Thai government commissioned a regional study on CVCs, conducted as part of a larger research program called the COVID-19 Vaccination Policy Research and Decision Support Initiative in Asia (CORESIA). CORESIA has representation from government and research institutions from nine countries across Asia including India, Indonesia, Japan, Laos, Malaysia, the Philippines, Singapore, South Korea, and Thailand. Public and institutional surveys were conducted as advised by a group of global inter-disciplinary experts, decision-makers, and the World Health Organization (WHO) representatives from the region. This paper utilises the findings from these surveys and by extension, this initiative to highlight key enablers and barriers to an effective CVCs policy for the Asian region.

2. Materials and Methods

Study design

We conducted a cross-sectional study using self-administered online survey, Survey Sparrow, from June to October 2021 in India, Indonesia, Japan, Laos, Malaysia, the Philippines, Singapore, South Korea, and Thailand.

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Survey tool development and piloting

Survey questionnaires were initially developed in English, drawing on insights from a literature review of vaccine and immunity verification processes and consultations with CORESIA members. The final version of the questionnaires was translated into Bahasa Indonesia, Japanese, Korean, Lao, Malay, and Thai, primary languages for six participating countries. No translation was done for the Philippines and Singapore as English are widely spoken in the countries. For India, the questionnaires were administered telephonically where interviewers translated the questions into the regional language, after which responses were back-translated into English. To improve sampling and allow questions to be aligned to priorities and requirements of target participants, the survey was divided into separate versions for the public and for CORESIA member institutions. Most questions were multiple choice, while a few used Likert scales. Both surveys were piloted among select Thai institutions (e.g., National Research Council Thailand, Thai Hotels Association, and The Airlines Association of Thailand) and CORESIA members to further refine and shape questionnaires before regional circulation.

Public survey questionnaires in seven languages used lay language and focused on acceptability and perceptions of CVCs. In total, 39 questions were divided into five sections: (i) participant sociodemographic information and vaccination status; (ii) opinions about preferred CVCs use (e.g., international travel, resuming education, employment); (iii) public preferences for COVID-19 testing and quarantine policies (e.g., frequency of testing versus duration of quarantine) and whether non-pharmaceutical interventions should continue with CVCs uptake; (iv) preferences on the format of CVCs (e.g., electronic, paper, both), acceptable vaccination coverage prior to adopting CVCs (% of national population fully vaccinated), and concerns regarding CVC implementation (e.g. public health challenges, ethics, social justice and data privacy concerns, implementation infrastructure requirements, governance structures); and (v) concluding (final) opinion about CVCs acceptance (i.e., 'yes, no, or unsure' about implementing CVCs after considering relevant issues). **Supplementary 1** provides the English version of this questionnaire.

Institutional surveys in English, which were also translated in the same way as the public survey, focused on policy-specific issues around CVCs implementation and decision-making. Both versions included demographic and instrument utility questions. Adapted from the public survey, this version included the same five sections along with questions on policy and practical implications of introducing CVCs nationally (e.g., suitability of immunity-based certificates (alongside vaccination) and types of information and data these documents might contain. Select questions in section (iii) also differed, as institutional respondents were asked to select appropriate policy measures for entering their country and identify the three business sectors most financially affected by COVID-19 and the 3 sectors most likely to financially benefit from CVC uptake. The question on data trust in government and private sector was eliminated to reduce biased responses and questions on personal information were made optional to encourage transparent responses. English version of this questionnaire can be found in **Supplementary 2.**

Participants recruitment and data collection

Public recruitment included person aged 18 years and above and from one of the nine participating countries. The survey was voluntary and opened with an information section giving an overview of the study and measures taken to ensure anonymity and confidentiality. All respondents confirmed their consent in order to participate. Approaches to increase survey samples in each country included using the CORESIA website (www.vaxcert.info), direct email to partner networks, CORESIA member dissemination channels,

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and social media (e.g., Twitter, Facebook, LinkedIn). Private survey agencies were hired in Japan, India, and South Korea. In Laos, the survey was primarily disseminated via WhatsApp, with face-to-face interviews conducted in Vientiane. Sample size calculations were not attempted, as different recruitment approaches were used in the nine countries.

Institutional recruitment in six participating countries (i.e., Indonesia, India, Laos, Philippines, Singapore, Thailand) was done by official invitation. However, conducting institutional surveys in the remain three countries was not feasible. Eligible institutions were selected from the literature review and CORESIA's expert consultations. For instance, in Thailand, the survey was disseminated through official channels, by traditional post and email, to approximately 130 domestic organisations. Examples include the Board of Investment (BOI), National Research Council Thailand (NRCT), Laws association, Thai hotel association, Tourism Authority of Thailand, Customs Offices, press/media companies, philanthropy agencies, Governor Offices, tourist police offices, Ministry of Transportation, Ministry of Foreign Affairs (MFA), among others.

Data analysis

Responses from all countries were consolidated in a Microsoft Excel file. Non-English responses were translated into English by SKC, DF, AA, and CR. Data were transferred to Stata version 16.0 (StataCorp, College Station, TX, USA), cleaned to remove missing data, and analysed descriptively by SKC, DF, AA, and CR. Categorical variables were reported as absolute (numbers) and relative (percentages) frequencies. Notably, responses to the question on the concluding position on CVCs (i.e., yes, no, not sure) were recategorised as binary (i.e., more receptive for 'yes' and less receptive for 'no' and 'not sure'). We cross-tabulated data to conduct sub-group analyses examining potential relationships between factors related to CVCs acceptance.

3. Results

Demographic characteristics

A total of 12,547 public survey responses were received from across the nine countries. We omitted 343 for missing responses, yielding 12,204 observations for analysis. Table 1 shows most respondents were from the Philippines (28%), India (20%) and Japan (17%), generally were between age 25-40 (44%), and female (51%), holding an undergraduate degree (54%) and currently working in industry, trade, and services (26%). Eighty-three percent reported having been vaccinated (either one or full course of vaccination), with AstraZeneca the most common vaccine (29%). Most participants had no travel history prior to the pandemic in 2019, (54%) and reported having no travel plans for 2021 at the time of the survey (75%).

Table 2 shows a total of 795 institutional responses were received, most from the Philippines (79%), followed by Thailand (11%), India (4%), Laos (3%), Singapore (2%) and Indonesia (1%).

Acceptance of CVCs

Most respondents, both public (78%) and institutional (89%), were receptive to the adoption of CVCs. A smaller fraction of 22% public and 11% of institutional respondents were less receptive to CVCs, reporting that they either did not support their use, or remained unsure. Figure 1 provides additional details about the respondents who are most receptive CVCs implementation.

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Table 1. Participants' characteristics of the public survey as tabulated by their response to the adoption of CVCs

Variables	CVCs adoption, N (%)		
	Regional total, 12,204 (100)	More receptive, 9,547 (78)	Less receptive, 2,657 (22)
Country			
India	2,490 (20)	1,980 (80)	510 (20)
Indonesia	596 (5)	494 (83)	102 (17)
Japan	2,098 (17)	1,298 (62)	800 (38)
Laos	231 (2)	213 (92)	18 (8)
Malaysia	291 (2)	255 (88)	36 (12)
Other	344 (3)	245 (71)	99 (29)
Philippines	3,410 (28)	2,727 (80)	683 (20)
Singapore	263 (2)	190 (71)	73 (28)
South Korea	813 (7)	665 (82)	148 (18)
Thailand	1,668 (14)	1,480 (89)	188 (11)
Age group			
18-24 years	1,837 (15)	1,324 (72)	513 (28)
25-40 years	5,337 (44)	4,208 (79)	1,129 (21)
41-65 years	4,687 (38)	3,747 (80)	940 (20)
>65 years	301 (2)	245 (81)	56 (19)
Prefer not to say	42 (0)	23 (55)	19 (45)
Gender			
Female	6,202 (51)	4,879 (79)	1,323 (21)
Male	5,874 (48)	4,590 (78)	1,284 (22)
Other†	128 (1)	78 (61)	50 (39)
Vaccination status 1*			
Unvaccinated	2,070 (17)	1,029 (50)	1,041 (50)
Vaccinated	10,134 (83)	8,518 (84)	1,616 (16)
Vaccination status 2**			
Vaccinated	10,134 (83)	8,518 (84)	1,616 (16)
Awaiting my first dose	730 (6)	518 (71)	212 (29)
Considering	403 (3)	152 (38)	251 (62)
No intention	454 (4)	48 (11)	406 (89)
Not available in my country	52 (0)	37 (71)	15 (29)
Not in priority group	253 (2)	169 (67)	84 (33)
Want a different brand	178 (1)	105 (59)	73 (41)
Travel plans in 2019			

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Variables	CVCs adoption, N (%)		
	Regional total, 12,204 (100)	More receptive, 9,547 (78)	Less receptive, 2,657 (22)
Yes	3,017 (25)	2,530 (84)	487 (16)
No	9,284 (75)	7,015 (76)	2,169 (24)
No response	3 (0)	2 (67)	1 (33)
Purpose of travel			
Business	518 (4)	425 (82)	93 (18)
Leisure	2,021 (17)	1,684 (83)	337 (17)
Personal/other	455 (4)	362 (80)	93 (20)
No response‡	9,210 (75)	7,076 (77)	2,134 (22)
Use of CVCs for international travel			
Agree	9,216 (76)	8,031 (87)	1,185 (13)
Neutral	1,617 (13)	999 (62)	618 (38)
Disagree	1,371 (13)	517 (38)	854 (62)
Are there any financial benefits of implementing CVCs for your occupational sector?			
Yes	4,920 (40)	4,563 (93)	357 (7)
No	3,068 (25)	1,908 (62)	1,160 (38)
Not sure†	3,561 (29)	2,532 (71)	1,029 (29)
Unemployed	655 (5)	544 (83)	111 (17)
Should the use of NPIs continue?			
Yes	9,999 (82)	8,365 (84)	1,634 (16)
No	1,353 (11)	721 (53)	632 (47)
Not sure†	852 (7)	461 (54)	391 (46)
What is the preference for testing vs quarantine?			
More quarantine	2,205 (18)	1,746 (79)	459 (21)
More testing	6,727 (54)	5,840 (87)	887 (13)
Not sure†	3,272 (27)	1,961 (60)	1,311 (40)
Which format of CVCs do you prefer?			
Electronic and paper	4,593 (38)	3,784 (82)	809 (18)
Electronic only	6,058 (50)	5,126 (85)	932 (15)
Paper only	825 (7)	471 (57)	354 (43)

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Variables	CVCs adoption, N (%)		
	Regional total, 12,204 (100)	**More receptive, 9,547 (78)**	**Less receptive, 2,657 (22)**
Not sure†	728 (6)	166 (23)	562 (77)
What do you believe is the ONE most concerning challenge in the implementation of CVCs?			
Data privacy	2,093 (17)	1,538 (73)	555 (27)
Ethics and social justice	3,203 (26)	2,447 (76)	755 (24)
Governance	963 (8)	779 (81)	184 (19)
Implementation infrastructure	1,059 (9)	870 (82)	189 (18)
Public health	4,655 (38)	3,832 (82)	823 (18)
Other†	232 (2)	81 (35)	151 (65)
Do you feel comfortable sharing your personal information (e.g., vaccine history, pre-existing health condition)?			
Yes	8,561 (70)	7,391 (86)	1,170 (14)
No	3,372 (28)	1,934 (57)	1,438 (43)
Not sure†	271 (2)	222 (86)	49 (18)
To what extent do you trust your own government to protect data privacy?			
High trust	3,801 (31)	3,437 (90)	364 (10)
Moderate trust	2,952 (24)	2,505 (85)	447 (15)
Low trust	2,343 (19)	1,913 (82)	430 (18)
No response	3,108 (25)	1,692 (54)	1,416 (46)

† We combined no response, not sure and/or prefer not to say with other, as appropriate.

‡ Data were obtained from those who answered "no travel plan" and no response.

** Vaccination status 1: people who had either received 1st, 2nd or full dose of vaccination*

*** Vaccination status 2: includes unvaccinated participants and their reported reasons for the same.*

***Note:** Column 2 provides a breakdown of total responses for all variables and their sub-categories, (%), additive across each column. Columns 3, 4, & 5 provide responses to the questions on whether respondents would adopt (CVCs more receptive (yes), and less receptive (no and not sure)) broken down by individual variable, (%) additive across each row.)*

Table 2. Participants characteristics of the institutional survey as tabulated by responses to the adoption of CVCs

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Variables	Regional total, N (%) 795 (100)	CVCs adoption, N (%)	
		More receptive 704 (89)	Less receptive 91 (11)
Country			
India	28 (4)	25 (89)	3 (11)
Indonesia	7 (1)	6 (86)	1 (14)
Laos	27 (3)	23 (85)	4 (15)
Philippines	631 (79)	554 (88)	77 (12)
Singapore	15 (2)	15 (100)	0 (0)
Thailand	87 (11)	81 (93)	6 (7)
Do you agree CVCs to be used for international travel?			
Agree	663 (83)	634 (96)	29 (4)
Neutral	52 (7)	35 (67)	17 (33)
Disagree	80 (10)	35 (44)	45 (56)
Do you prefer more testing or more quarantine?			
More quarantine	123 (15)	112 (91)	11 (9)
More testing	577 (73)	528 (92)	49 (8)
Not sure	95 (12)	64 (67)	31 (33)
What is the appropriate policy measure for entering your country?			
Not sure	53 (7)	26 (49)	27 (51)
Risk-based policy (depending on country of origin)	407 (51)	380 (93)	27 (7)
Same testing and quarantine policy	335 (42)	298 (89)	37 (11)
Do you agree NPIs should not be continued?			
Yes	47 (6)	29 (62)	18 (38)
No	748 (94)	675 (90)	73 (10)
Which format for CVCs do you prefer?			
Electronic and paper	508 (64)	469 (92)	39 (8)
Electronic only	212 (27)	190 (90)	22 (10)
Paper only	39 (5)	33 (85)	6 (15)
Not sure	36 (5)	12 (33)	24 (67)

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Variables	Regional total, N (%) 795 (100)	CVCs adoption, N (%)	
		More receptive 704 (89)	Less receptive 91 (11)
What is the most concerning challenge in implementing paper-based CVCs?			
Forgery	323 (41)	287 (89)	36 (11)
Language restrictions	24 (3)0	21 (88)	3 (13)
Lost or stolen	64 (8)	58 (91)	6 (9)
Updating new info	59 (7)	49 (83)	10 (17)
Verification	309 (39)	285 (92)	24 (8)
None	16 (2)	4 (25)	12 (75)
What is the most concerning challenge in implementing electronic-based CVCs?			
Data privacy	161 (20)	133 (83)	28 (17)
Digital infrastructure	132 (17)	121 (92)	11 (8)
Equity	256 (32)	226 (88)	30 (12)
Interoperability	240 (30)	223 (93)	17 (7)
None	6 (1)	1 (17)	5 (83)
What is the most concerning challenge in adopting CVCs?			
Data privacy	120 (15)	105 (88)	15 (13)
Ethics and social justice	224 (28)	190 (85)	34 (15)
Governance	99 (12)	90 (91)	9 (9)
Implementation infrastructure	107 (13)	101 (94)	6 (6)
None	3 (0)	1 (33)	2 (67)
Public health	242 (30)	217 (90)	25 (10)

Note: *Column 2 provides a breakdown of total responses for all variables and their sub-categories, (%), additive across each column. Columns 3 & 4 provide response to the questions on whether respondents would adopt CVCs (More receptive (yes), and less receptive (no and not sure), broken down by individual variable, (%), additive across each row.)*

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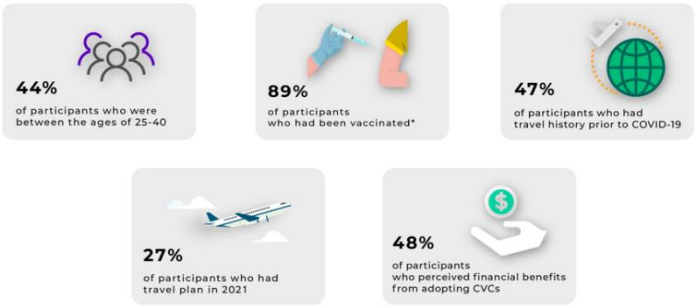
Figure 1. Groups who are more receptive to the adoption of CVCs



Note:

**Includes both first and second or full dose of vaccination*

Data were derived from the public survey, including only those who more receptive or agreed with implementation of CVCs (N = 9,547).

Conditions under which CVCs are acceptable

From the public survey, while most respondents (78%) accepted the adoption of CVCs, a more nuanced examination suggests that their adoption is influenced by other related factors. For instance, one of the primary questions concerns the purposes under which their adoption or use is most acceptable i.e., ease of domestic and international travel, resumption of the hospitality sector, public events, education and employment. Among these scenarios, most respondents agreed on the use of CVCs to resume international travel (76%), followed by its use for easing domestic travel, entry into community events (67%), reviving the hospitality sector (69%), and resuming education (63%). The lowest acceptance was for the adoption of CVCs for employment (55%).

Similarly, respondents of both the public and institutional surveys indicated that CVCs should be adopted only upon ensuring that a high proportion (60-100%) of the population has received a full course of vaccination, therefore ensuring that people can continue to be protected as restrictions are eased (Figure 2).

Regardless of CVCs, majority of the public survey respondents (82%) agreed to maintain the current NPIs measures. At the regional level, the three most preferred NPIs were testing on arrival or during quarantine (21%), social distancing (20%), and monitoring inbound travellers (17%). Other NPIs such as mask-wearing (16%) were most preferred in Japan and South Korea, followed by the home quarantine for 7 to 14 days (13%), and institutional quarantine for 7 to 14 days (12%). The majority of the respondents (51%) from the institutional survey preferred risk-based testing and quarantine for incoming travellers using CVCs; risk-based policies distinguish countries based on their national infection rates,

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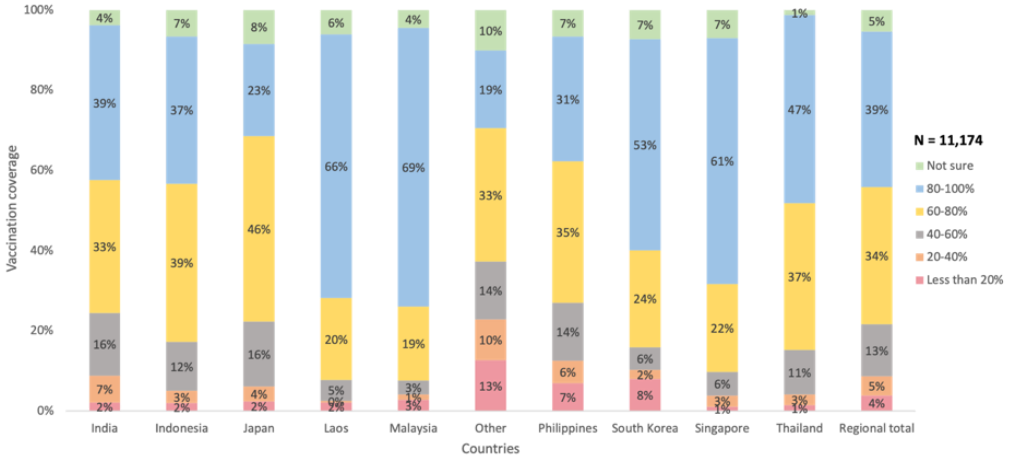
vaccination coverage, types of COVID-19 vaccines in use and their reported efficacies, and COVID-19 variants in circulation. However, 42% of the institutional respondents were acceptable to avoiding this distinction between countries and instituting a blanket testing and quarantine policy for all travellers regardless of their country-specific risk of infection (42%).

Figure 2. Minimum population-level vaccination coverage before implementing COVID-19 vaccine certificate



Note: *Data were derived from public survey and "no response" was excluded (N total 12,527, N no response: 1,353)*

Implementation considerations

The institutional survey results found that in eight of the nine participating countries, except for Laos, preferred an increased frequency of testing as compared to lengthier quarantine periods (54%). At regional level, longer quarantine with less testing was chosen by only 18% of the sample in the public survey.

Respondents of both the public and institutional surveys were asked to provide their preference for a suitable format for CVCs, instituting them exclusively either as electronic or digital records or paper-based ones, or a combination of both. While the public respondents appeared less consistent in their decision, the institutional stakeholders were in favour of adopting both digital and paper formats (64%). In furthering the reasons for their choices, respondents suggested that relying exclusively on digital instruments would be inequitable (32%), inevitably produce technical challenges in ensuring their interoperability (30%) across the region as well as raise concerns about ensuring data privacy (20%). Separately, they also said that enabling supportive digital infrastructure (17%) to assist the design, access and rollout these documents would be complicated across the region. Responding to similar concerns when relying on a paper-based format alone, these stakeholders indicated that forgery (41%) and verification issues (39%) constituted some of the biggest challenges. A minority of respondents also

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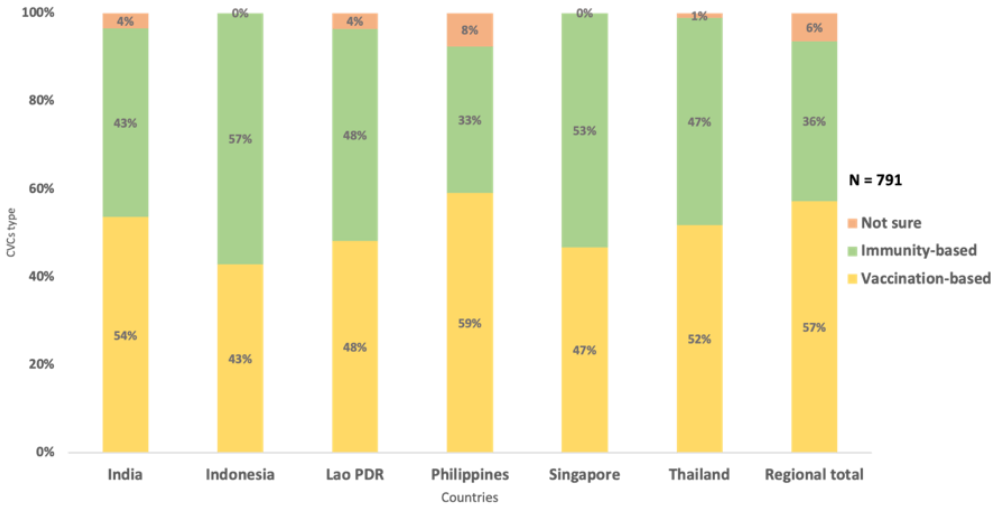
acknowledged that there is possibility for loss and theft of CVCs (8%), and practical challenges in updating new information on paper documents (7%), as well as with ensuring a common language across regions (3%).

Figure 3. Preferred CVCs type: vaccination versus immunity-based



Note: *Data were derived from the institutional survey*

The details of participants' characteristics of public and institutional surveys are summarised in **Supplementary Table S1 and Supplementary Table S2**, respectively.

4. Discussion

Data show that a significant majority of public and institutional respondents in nine countries across Asia were receptive to the adoption of COVID-19 vaccine certificates. This is a reassuring indication for South and Southeast Asia, where many countries rely on the free movement of people, goods and services, including for tourism. Economic recovery, a critical part of such vaccine verification systems is also highlighted in the survey data with 93% of respondents concurring that CVCs are useful in partially alleviating the financial impacts of the COVID-19 pandemic on their occupational sectors. A similar sentiment is also echoed among the institutional stakeholders who suggest that these tools have the potential to revitalise diverse sectors of the economy, including entertainment, real estate and media. However, the uptake of CVCs is enabled by some important considerations as indicated in the survey results. In addition to these enablers, there are specific barriers that have so far challenged the use of these tools across the world, primary of which is the absence of uniform, global infrastructure for CVCs to realise their potential as functional tools towards easing some of the challenges from the pandemic.

Enablers

Acceptance of CVCs

Proof of vaccination, often referred to as vaccine or immunity passports, has been in routine use for several years to lower infectious disease risk in different settings [1-8]. These

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instruments have been critical not just as public health measures, but as a means to sustain economies and communities. For instance, their use has ensured safer schools and occupational settings and aided global economic activity [3]. With growing evidence on the protections offered by COVID-19 vaccines against severe disease and death, CVCs are an inevitable tool for a return to basic, necessary economic and social requirements. Across the sample, mirroring global literature, there has been an overwhelming acceptance that CVCs are likely unavoidable for pandemic recovery despite the paucity of clear scientific evidence in support of its safe use in terms of public health impact [2, 4]. Following global trends, data from both surveys also showed that these instruments were most preferred for international travel, followed by the hospitality sector and far less so for education and employment resumption.

There is increasing global evidence to suggest that the utility of CVCs will depend on their widespread public acceptance. While the concept of vaccination certificates is not necessarily novel, the current COVID-19 crisis has been distinct in its display of fragmentation and politicisation of vaccines and related instruments. Our public sample demonstrates this conflict, with data showing that those more inclined to receive COVID-19 vaccines are much more likely to accept the adoption of CVCs [5]. A similar understanding was inferred in a study from the United States on public understanding for vaccine passports [9]. Furthering on the links between vaccination intention and the use of CVCs and similar instruments, few studies [8, 10, 11] suggested that scientific information or knowledge are important factors in improved vaccination and could therefore also be assumed as important influences in the acceptance of vaccine verification systems such as CVCs. This trend is also observed in our public survey data, with acceptance levels growing as education increases (beyond high school).

Conditions under which CVCs are most acceptable

Growing literature on vaccine verification, through passports or certificates, has now focused on highlighting the value of public perception in encouraging pandemic-safe behaviours [12]. Our survey, in building on this understanding, has explored the conditions under which these tools are preferred by the public as well as institutions. Key insights suggest that high national vaccination coverage levels and continued use of NPIs are fundamental ahead of enrolling CVCs-based relaxations. This may also reflect the positive scientific understanding from survey respondents that CVCs are less likely to be an infection prevention measure by curbing transmission but rather one that can protect people from acute illness. Both these measures allow protections for populations to be strengthened, in light of continued clinical developments on the efficacy and effectiveness of existing vaccines, development of newer ones, evolution of new variants as well as other uncertainties. Across the region, data shows that both the public and institutional respondents express their preference for population vaccine coverage to be between 60-100% before the rollout of CVCs. In maintaining these population protections against the virus, both categories of survey respondents strongly support the continued use of NPIs that have so far been in practice since the onset of the pandemic, with only 6% of respondents in the region indicating that a relaxation is preferable. The public respondents, although less strong in their call for continued NPIs, suggest that they should remain in place. This finding is a critical one since the use of NPIs post-vaccination have had mixed policy responses as they been closely associated with socio-cultural freedoms and geographic context [13]. For Asia, some evidence indicates that NPIs such as mask mandates might continue to be practicable, even preferred, despite the relaxations with CVCs, unlike in Western countries where mandates have been dropped, only to be reinstated occasionally as new variants emerge [14-17]. With models indicating an inevitable steep rise in cases without the continued use of NPIs [12], estimating the appetite for their continuation and identifying nudges to support their use is an area of further investigation [7, 8, 18]. At the moment, mask mandates have almost entirely been removed in countries

across the world, including on international air travel, and a resurgence in hospitalisation is slowly being observed with the newer Omicron variant, BA.5 [19]. By making NPIs such as masking and social distancing voluntary, the onus of continuing these behaviours rely squarely on individual choice, with significant consequences for vulnerable populations.

Challenges/ Barriers

Implementation considerations

Despite collaborative engagement advancing scientific merit throughout this crisis, global decisions have been slow and inward-looking, exacerbating deep divisions between high and low-income countries [20]. As we write this paper, CVCs continue to be implemented in a fragmented manner with national governments left in charge of policy decision-making on the issue, and more recently with the private sector taking charge on whether or not to require it for their work spaces and events [21, 22]. In some instances, there have been variations within countries, with decision-making left to individual states. This lack of coordination has resulted in sub-optimal global responses to pandemic recovery, further complicated by rapidly changing scientific discovery. In this study, one of the most pressing challenges was concerning the inclusion of proofs of natural immunity from previous infection alongside vaccination to ensure that both populations are recognised for their lower risk of infection and hospitalisation. However, given the continued clinical uncertainties about natural immunity as well as the duration of such immunity upon recovery, there is variation across stakeholder preferences in their acceptance [23]. The increase in reinfections that has been observed recently also raises an important question regarding the protections conferred by an immune status. However, with the unresolved issue of inequitable global vaccine access continuing to plague us, the recognition of immunity from infection for recovered persons is an inexorable policy option to ensure the non-exclusion of people, especially in developing countries[24-26]. Similarly, differences in digital infrastructure have led to concerns surrounding the format of these certificates-paper or electronic. Several countries have developed or adapted necessary digital systems, while some continue to rely on paper formats. In the Asian region, institutional stakeholders showcase a clear preference to have both versions to ensure an equitable solution, while the public responders marginally prefer an exclusively digital version. Given that the sample (except for Laos) answered the survey online, the majority preference for digital certificates maybe linked to the level of digital literacy and access required in the sample group. Globally, the response has been mixed even in countries that have so far developed CVCs, and calls for a digital solution are gaining ground in light of security, data privacy and interoperability [27]. With booster doses and newer vaccines expected to be the primary tools against COVID-19, digital CVCs offer a more practical and cost-efficient method to record and verify these time-sensitive updates, as compared to paper-based systems. Data from the public survey suggests that respondents have high levels of trust in sharing their vaccination data with both the government and private sector. This is a positive indication that both sectors could come together in designing a uniform CVCs, taking on board WHO guidance on the Smart Vaccine Certificate. If a global solution of this kind is unfeasible, the next best solution would be a regional effort to allow seamless cross-border movement, which has received support in all nine surveyed countries. The well-noted challenges of ethics and social justice in implementing these instruments have been raised as a central concern by both public and institutions responding to the surveys. As ASEAN slowly reopens the region, these results offer key suggestions and insights into the preferences and considerations needed in designing and implementing a regional CVCs policy. Governance and infrastructure for implementation has also been cited as a foundation, in a manner that maintains data privacy and ensures public health and wellbeing [28].

With a focus on expanded COVID-19 vaccine programs for neonates and young children previously excluded as well as on developing newer vaccines to tackle the Omicron

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subvariants [29, 30], it is unlikely that CVCs will stop being a requirement for many scenarios, including those outlined in this research. From our survey data and the literature, it is clear that coordination around CVCs will require multidisciplinary efforts and multilateral partners, led by a policy champion that can balance public health, equity and ethics, technology and the global economy [31]. Without championship of this kind, CVCs will not disappear but continue to be implemented in a less equitable and ineffective manner, worsening the impacts on the poor and on vulnerable countries. Emerging evidence that CVCs may also be able to improve vaccination rates among hesitant groups reaffirm their role as a powerful policy instrument [32]. Streamlining their use is possible through collaborative solutions at the regional level, despite the diversity of health systems, income levels and other characteristics as in the ASEAN [33]. There is yet hope in achieving a common policy, if it is a championed cause.

Limitations

Although this study is one of the first of its kind in Asia, the data included in this study cannot be considered nationally representative for each participating country due to the heterogeneity in the methods of sampling and surveying amongst them all. The sample in each country has been limited to those with access to online mediums of participation and a knowledge and access to supporting digital infrastructure. In Japan, India and Korea, professional surveying companies were employed to collect the data, while in the others, CORESIA country members disseminated the survey through their partner institutions and networks as well as the official CORESIA website and social media channels. This set up has resulted in different sample sizes and compositions across the nine countries, where those with larger sample sizes such as the Philippines and India have held a greater influence on the results. Given the dynamic nature of the virus and evolving evidence, we also acknowledge that survey questions focused on issues of CVCs that were most relevant at the time. These findings are therefore useful to capture the sentiments surrounding CVCs in the region when they were first discussed and offer important insights for in-depth review for future decisions and planning. Moreover, the analyses completed were descriptive in nature, and future research could build on to explore more in-depth associations using explanatory analyses. With vaccines being our only concrete solution to a prolonging pandemic and other emerging concerns such as monkeypox and resurgence of polio, we believe that this research offers important insights for countries and regions in planning and operationalising vaccine verification infrastructure, especially for blocs like the ASEAN that work on regional policy for present and future health crises [24].

5. Conclusions

Support for CVCs in Asia and worldwide remains high. However, certain conditions such as high vaccination coverage, continuation of NPIs, and digital system that is interoperable across settings and privacy protecting remain pre-requisites for this acceptance. As we enter the 'post-COVID-19' era, experience and lessons from the use of CVCs and immunity certificates should help us draft better border policies during future outbreaks. Given the cross-border and cross-sectoral implications of outbreaks, we recommend collaboration between national and global leaders from all sectors to draft uniform border policy, which was lacking the COVID-19 pandemic.

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