

TONY BLAIR INSTITUTE FOR GLOBAL CHANGE

Two Barriers to Normal

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Overview

The UK has done a remarkable job in its vaccine rollout. More than 53.3 million jabs have been administered and 17.8 million people have been fully vaccinated – equivalent to almost 27 per cent of the population. Based on our modelling, we are on track for herd immunity by September 2021, which will mean the lifting of most restrictions. After one of the toughest years in our country's history, the end is in sight.

We must not lose focus in this final stretch, and it is important we do everything we can to get the country back to normal. In a world of new variants and potentially more transmissible strains, we must recognise the self-interest of vaccinating the world as quickly as possible. The UK should play the biggest role it can in this effort, donating surplus vaccines and supporting existing global efforts – including using its presidency of the G7 in 2021 to drive this effort.

Much of the work ahead will be global and draw on the UK's power and influence abroad. But there are two things that are within our power domestically. We call these the two barriers to normal and, as set out in this paper, there is action we can take now to navigate them.

The first barrier is vaccine hesitancy, and the UK has the opportunity to provide the world with complete, clear and comprehensible data showing that the benefits of receiving a Covid-19 vaccine significantly outweigh the risks. Confusion is leading to poor decision-making – from inconsistent restrictions on what vaccines can be taken by whom, to some countries letting vaccine stock expire as there is simply no demand for it. We draw on our previous paper <u>Restoring Confidence in the Workhorse Covid-19 Vaccines</u> and show that this has become a problem in particular for adenovirus vaccines, which – as they are low-cost and can be easily stored – are essentially the workhorse vaccine (adenovirus) and the Pfizer-BioNTech vaccine (mRNA) at scale, is in a unique position to publish data on their comparable performance. This would show that vaccines are working and there is reason to be confident in both.

The second barrier is enabling people to prove their Covid status in the UK and around the world

through a vaccine and testing passport. As it stands, the UK government is poised to repurpose an NHS app that will allow vaccinated individuals to prove their status. This should be applauded, and much progress has been made. However, as we show in this paper, global requirements vary and there is a huge discrepancy between the vaccinated and the unvaccinated. A health passport should go beyond vaccination status by also incorporating testing and giving those with a scientifically acceptable negative result equivalent status with those who have been vaccinated. Moreover, more needs to be done to improve global coordination and to reach consensus on the technical and status standards of health passports. A lot of work has been done on the technical standards, with efforts underway to ensure common standards and global interoperability, but there is further to go on what constitutes greenlight status. The UK can drive this through its G7 leadership.

There is significant crossover between these two areas, and together they speak to a central point: to have an effective rollout programme, you need complete, reliable, secure information on who has had what vaccine and where people are testing negative and positive for the virus. Where available, it is sensible to share this data and use it to inform decision-making and enable reopening as fully and as safely as possible, as soon as possible.

If we act now, we can address these two barriers and be in a position where the virus is contained domestically and increasingly under control globally. This is the state of play we should be aiming for. Anything less and we risk undoing the extraordinary work and effort that has been achieved to date.

Recommendations

- The UK should publish clear data in a way approved as having statistical integrity on every vaccine in use, consisting of absolute numbers for Covid-19 cases, hospitalisations and deaths, broken down by age, vaccine status (not vaccinated, partially vaccinated, fully vaccinated) and vaccine type. This should build on the existing post-vaccination surveillance strategy from Public Health England (PHE) by publishing data more regularly than quarterly, as currently planned, and in as clear a way as possible.
- 2. The UK should make use of its presidency of the G7 in 2021 to draw up a roadmap for delivering interoperability and compliance of a Covid health passport with a set of minimum standards.

Barrier 1: Reducing Vaccine Hesitancy Through Data

There is growing vaccine hesitancy in the UK and around the world, especially relating to the AstraZeneca vaccine. This can largely be attributed to data on blood clots, early trial issues, and suspensions or restrictions of the vaccine across Europe.

In the UK, for example, an announcement by the Medicines & Healthcare products Regulatory Agency (MHRA) on 7 April that there was a possible link between the vaccine and extremely rare blood clots led to an increase in the number of people who believed the claim that the AstraZeneca jab causes blood clots. According to a study by King's College London, 17 per cent of those interviewed prior to the MHRA announcement thought AstraZeneca caused blood clots, compared with 31 per cent interviewed after the announcement. ¹

However, with the right data, announcements like the one made by the MHRA in April can be better contextualised and not perpetuate vaccine hesitancy. Given what we know now about the potential for rare blood clots, the risks associated with Covid-19 still strongly outweigh those associated with vaccination for most age groups, and for all age groups when prevalence is high.

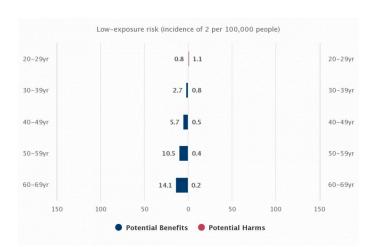
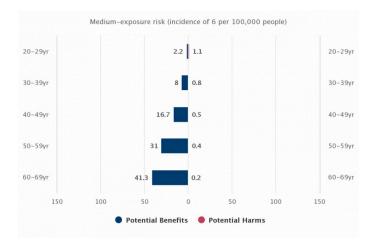


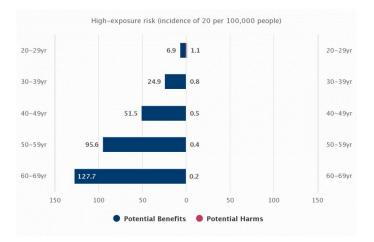
Figure 1 – Potential benefits (ICU admissions prevented) versus harms (blood clots) of the AstraZeneca jab during low-risk period

Source: https://wintoncentre.maths.cam.ac.uk/news/communicating-potential-benefits-and-harms-astrazeneca-covid-19-vaccine/ Figure 2 – Potential benefits (ICU admissions prevented) versus harms (blood clots) of the AstraZeneca jab during medium-risk period



Source: https://wintoncentre.maths.cam.ac.uk/news/communicating-potential-benefits-and-harms-astrazeneca-covid-19-vaccine/

Figure 3 – Potential benefits (ICU admissions prevented) versus harms (blood clots) of the AstraZeneca jab during high-risk period



Source: https://wintoncentre.maths.cam.ac.uk/news/communicating-potential-benefits-and-harms-astrazeneca-covid-19-vaccine/

Currently, the effectiveness of vaccines is presented through percentage risk reductions: these are difficult to understand and lead to false comparisons between different vaccine types. Instead, complete

raw numbers should be collated and shared daily – showing the number of new Covid-19 cases, hospitalisations and deaths, broken down by vaccination type and status.

Hesitancy Is Playing Out Around the World

Vaccine hesitancy is not confined within borders. The decisions made by a government in one country can impact vaccine take-up elsewhere. This is why publishing and presenting data in a clear, understandable way is essential.

We have seen hesitancy rising around the world, especially as regulators in Europe restrict the rollout of the AstraZeneca vaccine for certain age groups based on suspected side effects, fuelling hesitancy elsewhere. In almost every circumstance, the benefits of vaccination continue to outweigh the risks and, as trial data has shown, the approved vaccines are highly effective. Some examples of the real-world impact of such decisions are listed below:

- The Democratic Republic of Congo (DRC) received 1.7 million doses of the AstraZeneca vaccine from the COVAX vaccine-sharing facility on 2 March. However, rollout was delayed after several European countries suspended use of AstraZeneca in response to reports of blood clots. Health authorities in the DRC are now reallocating around 75 per cent of the 1.7 million doses to other African countries that will be able to use them before they expire. ²
- Kenya was given about 1 million doses of AstraZeneca in March through COVAX. As of 25 April, the country had only vaccinated around 152,700 people due to vaccine hesitancy. The government has since had to expand the number of people eligible in hopes of administering as many doses as possible before the vaccines expire. ³
- Nigeria received its first shipment of 3.92 million AstraZeneca doses on 2 March. By 23 April, just over 1.15 million doses had been administered. At the current pace of rollout, it could take until mid-August to use the doses and nearly a decade to vaccinate the adult population. The government has said that the doses are set to expire on 9 July. ⁴
- Denmark became the first European country to suspend the rollout of the AstraZeneca vaccine in March, a decision that became permanent when health authorities there announced they would continue the rollout programme without AstraZeneca.
- When Ireland suspended the use of the AstraZeneca vaccine in March even though the suspension lasted only five days – the country was forced to cancel 30,000 appointments for highrisk individuals. ⁵

Impact on Modelling

There have been <u>two models</u> driving the UK's analysis and response on Covid-19: one from Warwick University and one from Imperial College. In both, assumptions are made on the performance of each vaccine type against infection, hospitalisation and death. As each model estimates when a third wave may arise in the UK and its potential impact on hospitalisations and deaths, they draw on various data sources. The two models make different assumptions that will generate different outcomes, potentially leading to confused reporting. This would be addressed through the macro data set that our paper calls for.

Figure 4 – Assumptions in modelling on AstraZeneca (AZ) vaccine performance (one dose vs two doses)

	Warwick		Imperial	
	AZ (one dose)	AZ (two doses)	AZ (one dose)	AZ (two doses)
Efficacy against severe disease	80%	90%	80%	80%
Efficacy against disease	60%	80%	63%	63%
Efficacy against infection	60%	65%	63%	63%

Impact on Side Effects and Decision-Making

As can be seen from the figures below, which set out reported suspected side effects up to 8 March and then up to 28 April in the UK, there was a significant increase in reporting of blood clots among

recipients of the AstraZeneca vaccine. In the first tranche of data, crucially compiled *before* many European regulators had halted the AstraZeneca rollout, the number of reports between different vaccine types was broadly similar. But there has been an increase in reports of blood clots, especially since the initial decision of EU countries to halt rollout of the AstraZeneca vaccine, which could suggest that publicity on the subsequently reversed decision instigated more reports than actual cases.

Figure 5 – Reported blood clots during UK Covid-19 vaccine rollout to 8 March, versus annual expected cases

Condition	Total reports out of 22 million vaccinated	Total fatalities out of 22 million vaccinated	AstraZeneca: Total reports out of about 11.7 million doses administered	AstraZeneca: Total fatalities out of 11.7 million doses administered	Pfizer: Total reports out of about 10.9 million doses administered	Pfizer: Total fatalities out of about 10.9 doses administered	Expected cases in UK population of 66.6 million per year
Deep vein thrombosis	22	0	14	0	8	0	54,100*
Pulmonary embolism	28	2	13	1	15	1	45,000**
Cerebral venous sinus thrombosis	4	0	3	0	1	0	270***

Source: Covid-19 AstraZeneca vaccine analysis and Pfizer-BioNTech vaccine analysis. Note: *based on the estimated rate of 1 in 1,000 per year for the UK population age 16+; **based on the estimated rate of 1 in 1,200 per year for the UK population age 16+; ***based on the estimated rate of 5 in 1,000,000 per year for the UK population age 16+;

Figure 6 – Reported blood clots during UK Covid-19 vaccine rollout to 28 April, versus annual expected cases

Condition	Total reports out of 28 million vaccinated	Total fatalities out of 28 million vaccinated	AstraZeneca: Total reports out of 28.5 million doses administered	AstraZeneca: Total fatalities out of 28.5 million doses administered	Pfizer: Total reports out of 19.5 million doses administered	Pfizer: Total fatalities out of 19.5 million doses administered	Expected cases in UK population of 66.6 million per year
Deep vein thrombosis	716	4	614	4	102	0	54,100#
Pulmonary embolism	975	84	814	71	161	13	45,000##
Cerebral venous sinus thrombosis	153	16	140	16	13	0	270###

Source: Covid-19 AstraZeneca vaccine analysis and Pfizer-BioNTech vaccine analysis. Note: #based on the estimated rate of 1 in 1,000 per year for the UK population age 16+; ## based on the estimated rate of 1 in 1,200 per year for the UK population age 16+; ###based on the estimated rate of 5 in 1,000,000 per year for the UK population age 16+;

As the figures above show, the number of thrombotic events reported up to 28 April is higher than the number reported up to 8 March. This could be because the publicity surrounding blood clot incidents across Europe instigated more reporting in the UK or it could also be that, during this period, thousands of people across the EU and UK would naturally have suffered from blood clots, regardless of whether they were vaccinated. In addition, thousands more people over the few weeks between the dates in these charts were vaccinated, so statistically speaking we would expect an increase based on the additional people getting vaccinated.

In early April the MHRA and European Medicines Agency (EMA) completed their assessments of the reports of rare blood blots among the 34 million people across the UK and EU that had received the AstraZeneca jab. Neither regulatory agency identified any clear risk factors, such as age or gender, nor a definite cause for the rare instances of blood clots. However, it was concluded that these events had a possible link to the vaccine and requested they be listed as an extremely rare potential side effect, in addition to updates on the labels to reflect these findings. ⁶

As illustrated in Figures 1 to 3, the risk-to-benefit calculation when comparing the risk of blood clots to the risk of getting ill from Covid-19 is highly contextual. Estimates of the likelihood of getting a blood clot vary, but current estimates put the risk of a clot at roughly one in 100,000 for people in their 40s and one in 60,000 for people in their 30s. For this reason, the MHRA made the recommendation to offer individuals under the age of 40 an alternative to the AstraZeneca jab. ^Z Several other European countries have also chosen to restrict the usage of AstraZeneca to older populations.

The UK's Unique Position

Data, and the way we present it, is the most important tool we have to reduce vaccine hesitancy. We need better, clearer data that sets out the health outcomes for those who have the vaccine versus those who don't. The UK is uniquely positioned to lead on this. Thanks to an excellent vaccine rollout programme, we have seen both Pfizer and AstraZeneca jabs – mRNA and adenovirus vaccines, respectively – administered at scale and in similar numbers. This gives rise to data that can show the comparative benefit of taking either vaccine.

There is precedent. The UK's Yellow Card scheme is a tool for self-reporting side effects postvaccination, but it has also been used by some patients (or their doctors) to report contracting Covid-19. These reports are broken down by vaccine manufacturer and published bi-weekly. Incomplete and not accounting for age, the data shows that the AstraZeneca vaccine is far from the poorer cousin of Pfizer.

Figure 7 – Yellow Card data for the AstraZeneca and Pfizer vaccines

	AstraZeneca	Pfizer
First Doses	22,600,000	11,400,000
Second Doses	5,900,000	8,100,000
Total Doses	28,500,000	19,500,000
Yellow Card reports of contracting confirmed Covid-19 after receiving a dose ⁸	386	637
Yellow Card reports of death from Covid-19 after receiving a dose	29	42
Yellow Card reported cases per 100,000 doses	1.35	3.26
Yellow Card reported deaths per 100,000 doses	0.10	0.22

This Yellow Card data was buried on pages 32 and 26 of two large documents released bi-weekly. The government should be more proactive in communicating and sharing this data, while also ensuring access to data sets for academics and other bodies.

<u>A study published in the Lancet</u> in April, using data from more than 1.3 million people vaccinated in Scotland, found that mass rollout of the first doses of the Pfizer vaccine and the AstraZeneca vaccine were both associated with substantial reductions in the risk of hospital admission due to Covid-19. ⁹ Additionally, data recently published by the government shows that the AstraZeneca vaccine lowers the risk of dying from Covid-19 by 80 per cent after just one dose. These studies clearly show that there is no reason to view one vaccine as less effective or less safe than others. ¹⁰

We believe we are at a crisis point for adenovirus-based vaccines – including AstraZeneca – and so the benefits of immediately showing how these vaccines save lives in an easy-to-understand way far outweigh the risks. Our respect for PHE remains. It has done exceptional work throughout the pandemic and continues to do so. But, for reasons set out in this paper and for the sake of the global vaccine effort, these numbers should be published as soon as possible.

There is an example further afield. Israel publishes robust data on confirmed Covid-19 cases that occur after vaccination. Figure 8, below, shows the number of confirmed cases, hospitalisations and deaths post-vaccination, which is published by the Ministry of Health. Data in this table relates to the period of 2 February to 1 May, for those vaccinated up until 31 January. Given the period of data collection begins just a few days after some individuals received their second dose, there are a few days here when the effect of the second vaccine dose had not yet kicked in. As exemplified by the Israeli data below, this type of understandable, absolute data is available and can be made public.

Status	Total	60+	16–59
Vaccinated	1,848,568	1,060,025	788,543
PCR Tests	638,051	290,716	347,335

Figure 8 - Israel's vaccine data, which includes absolute numbers and age breakdown

Positive PCR Results	3,091 (0.17%)	1,626 (.15%)	1,465 (.19%)
Hospitalised	362 (0.020%)	315 (0.030%)	47 (0.006%)
Severe Cases	258 (0.014%)	233 (0.022%)	25 (0.003%)
Deaths	108 (0.0058%)	103 (0.0097%)	5 (0.0006%)

Recommendation

The UK should publish clear data in a way approved as having statistical integrity on every vaccine in use, consisting of absolute numbers for Covid-19 cases, hospitalisations and deaths, broken down by age, vaccine status (not vaccinated, partially vaccinated, fully vaccinated) and vaccine type. This should build on the existing post-vaccination surveillance strategy from Public Health England by publishing data more regularly than quarterly, as currently planned, and in as clear a way as possible.

Barrier 2: Proving Covid Status in the UK and Around the World

Alongside getting the world's population vaccinated, the second barrier to restoring normality is the need for people to access and share their health information – testing, vaccination and natural immunity – securely and privately. Getting this right will be the key to lifting restrictions safely, and to restoring international travel. Now is the moment to put in place mechanisms to avoid the need for blanket lockdowns in the future, in the event that there is a resurgence of Covid-19 infections. Knowing who has received what vaccine and when will also be critical in both identifying and combatting any new, vaccineresistant strains.

The International Situation

At the time of publication, at least five countries – Bahrain, Denmark, Estonia, Israel and the UAE – have introduced a fully functioning health pass. In Estonia, more than 12,000 people used the health pass app to download their vaccination status in the first four days of operation (29 April to 3 May). In Israel, the <u>Green Pass</u> has been in operation since February and has been an instrumental part of the Covid response. The number of active Covid-19 cases dropped below 1,000 at the end of last week.

UK Status

In the UK, the government has announced that the NHS app will be updated to allow it to be used to prove vaccine status from 17 May, when non-essential international travel is allowed to resume. However, it will not be capable of proving test results or natural immunity at that point. It is also not clear yet whether the UK's app will support selective disclosure – that is, the ability to only share the relevant confirmation of health status with the verifier, rather than disclosing detailed or extraneous health information such as the date and type of vaccination received.

Testing

A critical element in creating a viable health pass is ensuring it includes up-to-date testing data. It will be some time until everyone in the UK is fully vaccinated, let alone the whole world. While this remains the case it will be critical for people to display their testing status, to prevent travel and an array of activities being restricted to those who have been vaccinated. In addition, while significant parts of the world remain unvaccinated, the risk of new, more dangerous variants of the virus emerging remains high. In these circumstances it is even more vital that we fully track the spread of the virus (through testing) in the context of the world opening back up. We believe a viable Covid Pass should not just include vaccination status but also have the capability to show testing status. In the UK home testing is now free for the public. The home rapid tests include QR codes, which could be used to safely and securely upload the result onto an app, for instance the NHS app.

International Coordination

Beyond the functionality of the health pass and solutions being put in place at a national level, it is essential that they can be recognised and accepted across borders. Countries and tech providers around the world are working to build systems that enable people to prove their health status. But at the moment, with travel restricted and governments focused on the domestic debate around balancing privacy against managing the public- health risk, there is little incentive to coordinate. This means that there is a risk countries will lock themselves into systems that don't speak to each other.

International coordination is needed to agree governance mechanisms (for instance, how are health-pass solutions accredited as a trusted member of the network?); minimum policy standards (such as how information is protected and shared); and detailed technical standards to ensure interoperability.

Funding

There is also an important set of questions around how to fund the costs of designing, establishing and running the system. For many countries, ability to access and prove health data as part of the management of the pandemic is a public good. At the same time, private companies will inevitably be part of the ecosystem. And detailed technical cooperation is required to make sure that the various national and regional systems meet basic standards and can interoperate.

Of course, the difference in design and operation of different countries' health data management systems will inevitably mean that there is a cost to putting in place an interoperable system. But this is essential to ensure that citizens can prove their health status in a verifiable, frictionless way. Only then can international travel resume with confidence that the risk of transmitting Covid-19 between countries is being managed as effectively as possible.

Entry Requirements

At the moment, national governments are setting their own entry requirements, leading to a great deal of variation. (The below table sets out the respective entry requirements of the countries currently on the green list for England – i.e., countries that residents of England can visit without having to quarantine upon arrival back in the UK – and countries that are currently on the amber list but have stated they will allow vaccinated tourists in.)

In terms of proving these various entry requirements, it is likely that countries within the EU will have harmonised regulations on such a health pass given that the EU Digital Green Certificate could cover 26 countries. Given the varying requirements and the number of countries that will accept proof of vaccination status going forward, a similar harmonisation of regulation on international acceptance health passes is becoming more and more necessary to ensure certification is reliable.

Country	Colour	Entry Requirements
Australia	Green	 Currently closed to most arrivals: exemptions are required unless an AU citizen Negative test 72 hours before arrival 14 days in managed quarantine facilities
Brunei	Green	 Severely restricted: must apply for a permit Negative PCR test 72 hours before arrival

Figure 9 - Entry requirements for country's on England's "green" and "amber" lists

· 2-14 days in managed quarantine facilities

Cyprus	Amber	 Accepts tourists that have had both doses of an EMA approved vaccine, or a negative test
Falkland Islands	Green	 Tourists not permitted to visit including via cruise vessels 14-day self-isolation for any visitors
Faroe Islands	Green	 Vaccinated visitors test on arrival and follow up test four days after Visitors with a positive test more than 10 days old not required to self isolate Non-vaccinated visitors should self-isolate until a negative test on 4th day of arrival
France	Amber	 Foreign tourists will be allowed to enter France on 9 June but will need to show a health pass; details of what this

defined Will not require PCR test Gibraltar Green for British tourists when travel resumes Amber Accepts tourists that can Greece . present a certificate proving they have had either both doses of the vaccine, antibodies or a valid negative test Green Negative test within 72 Iceland hours of departure and testing at airport Vaccinated travellers or those with proof of antibodies will be able to bypass testing 14-day quarantine if travelling from high-risk area **Israel and Jerusalem** Green Vaccinated foreign nationals will be permitted in small numbers from 23 May but will be required to take a PCR test before flying to Israel and

will need to include are not yet

serological test on arrival to prove vaccination status

New Zealand	Green	 Closed to almost all arrivals Negative test within 72 hours of arrival 14-day quarantine
Portugal	Green	 From May, will accept British tourists from who have had the vaccine or tested negative
Singapore	Green	 Short-term visitors not required without prior permission Negative test required within 72 hours of arrival, and three further tests on arrival, after 14 days and 21 days Depending on where visitors have travelled from, must quarantine for 7-14 days
Spain	Amber	 Tourists permitted by June as long as they have been vaccinated; will accept a digital certificate
South Georgia and South Sandwich Islands	Green	 Visitor permit and a health declaration required

St Helena, Ascension and Tristan da Cunha Green

No restrictions on visitors
 provided they meet the
 immigration rules for St Helena;
 entry permit required for
 Ascension Island and Tristan da
 Cunha

Negative test within 72 hours of arrival

 14-day compulsory quarantine for St Helena and Ascension

Fake vaccine and test credentials are already appearing. Without an internationally trusted system to allow people to prove their health status, control mechanisms will be ineffective and citizens could face discrimination depending on how trustworthy their institutions are perceived to be.

International Standards

Ideally, an international body such as the World Health Organisation (WHO) could support member countries in agreeing a common set of requirements for entry, such as those that exist already under the International Health Regulations 2005. But failing this, a digital health pass could at least ensure that all the information and verification travellers may need is accessible via a single system, to minimise the administrative and financial costs of travelling.

A raft of initiatives has been launched to try to coordinate between health-pass providers and national authorities. These differ greatly in their geographic scale, from bilateral agreements to recognise national health passes (for instance between Israel and Bahrain), to regional initiatives such as the EU's Digital Green Pass, to global fora such as the <u>WHO's Smart Vaccination Certificate Working Group</u>. They also vary in the scope of their ambition: they may aim to develop a technical solution, agree technical standards, set governance mechanisms and agree policy principles, or some or all of the above. At present, the landscape remains confused and crowded.

The <u>Good Health Pass Collaborative (GHPC)</u> is a broad consortium of more than 100 corporations and civil society organisations collectively developing a blueprint for interoperable health-pass systems. It has called for health-pass systems to follow four principles: they should be **privacy-protecting, user-**

controlled, interoperable and widely accepted. It will shortly release a detailed blueprint for public comment to guide developers and health authorities in designing health-pass systems in accordance with these principles.

Recommendation

The proliferation of health-pass initiatives is promising, but urgent action is needed to ensure these remain interoperable and globally accepted. GHPC's work in establishing common standards is needed to avoid wasted resources, confusion and tensions. But achieving alignment will require a degree of political coordination by national governments, with global leadership to incentivise coordination and standardisation. The UK should make use of its presidency of the G7 in 2021 to call for global cooperation on health passes and draw up a roadmap for delivering interoperability and compliance with a set of minimum standards.

Footnotes

- 1. ^ https://www.kcl.ac.uk/policy-institute/assets/covid-19-vaccines-confidence-concernsbehaviours.pdf
- 2. ^ https://www.reuters.com/world/africa/congo-lose-13-mln-covid-19-shots-after-delayed-distribution-2021-04-26/
- https://www.reuters.com/world/africa/vaccine-hesitancy-slows-africas-covid-19-inoculationdrive-2021-05-04/
- 4. ^ https://www.reuters.com/world/africa/vaccine-hesitancy-slows-africas-covid-19-inoculationdrive-2021-05-04/
- https://www.dublinlive.ie/news/health/astrazeneca-vaccine-ireland-cancelledappointments-20153449
- 6. ^ https://www.astrazeneca.com/media-centre/articles/2021/update-following-mhra-and-emadecisions-on-astrazenecas-covid-19-vaccine.html
- 7. ^ https://www.bbc.co.uk/news/health-57021738
- 8. ^ Includes all Yellow Card reports of Covid-19 except 'suspected Covid-19' that were not confirmed
- 9. ^ https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00677-2/fulltext
- 10. ^ https://www.telegraph.co.uk/news/2021/05/10/astrazeneca-vaccine-cuts-covid-deathrisk-80-per-cent-one-dose/

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