Restarting aviation following COVID-19

Medical evidence for various strategies being discussed as at 07 July 2020 IATA Medical Advisory Group

Introduction

Many international groups are exploring possible pathways to facilitate a "restart" of international airline aviation. The resumption of international flights will require a number of hurdles to be crossed in order for Governments to allow travel, and further hurdles in terms of the passenger journey, which includes the airports of departure and arrival, the flights themselves, and other elements. Discussion by all of the groups involved includes a number of key elements which depend on sound medical evidence. The aim of this note is to review the current state of medical evidence regarding those elements.

The state of knowledge is changing rapidly; hundreds of research articles have been published since the start of the outbreak, and an enormous amount of work is in progress with both researchers and industry. Therefore, this document must be read with the latest review date in mind.

There are many logistical, financial, and political aspects to the restart plans well beyond the scope of this discussion, which will be confined to the medical aspects. There are also reports specific to airports and immigration processes which are also out of scope here. The report has been prepared by IATA's Medical Advisor along with the Medical Advisory Group of 10 airline medical directors, on the basis of extensive review of available literature, advice and expertise during the pandemic thus far.

Re-start requires two key components: first, Governments must be prepared to allow passengers to travel, between countries and regions. Secondly, passengers must have sufficient confidence that they can travel safely, and achieve what they wish to do on their journey. For the passenger journey, an acceptable risk of in-flight transmission is a key factor, but this is along with other considerations such as risk of illness while away, risk of being quarantined, availability of safe and suitable accommodation, availability of travel insurance, etc. For Governments, in-flight transmission is secondary to the greater risk of importation of people who are incubating the illness and can become sources of infection. This is a more challenging problem to solve, but will employ many of the same layers of protection which are discussed here.

In-flight Transmission

Little is available in the way of published research on in-flight transmission of COVID-19. One paper from Canada reports careful follow up of a long-haul flight on which someone later confirmed to have been unwell at the time, but no secondary cases resulted. A recent public report shows that a flight on 31 March from USA to China Taipei with 12 people subsequently confirmed to be symptomatic at the time of flight, generated no secondary confirmed cases from the 328 other passengers and crew members, who all tested negative.

A public health investigation into a flight from UK to Vietnam on 2 March 2020 suggests transmission by one passenger to up to fourteen other passengers (twelve of whom were seated nearby the presumed index case) and a cabin crew member. Initial information has been obtained from this investigation but a formal study is expected in due course. This is the only event known to IATA of suspected on-board transmission to multiple people.

By contrast, an informal survey of 18 major airlines in correspondence with IATA has identified, during Jan-Mar 2020, just four episodes of suspected in-flight transmission, all from passenger to crew, and a further four episodes of apparent transmission from pilot to pilot, which could have been in-flight or before/after (including layover); there were no instances of suspected passenger-to-passenger transmission reported by the group of airlines. The group of airlines represents 14% of global traffic for that period. A request to a much larger group of 70 airlines (representing half of global passenger traffic) also failed to identify any cases of suspected passenger-to-passenger transmission. And finally, closer analysis with IATA was able to be carried out by four airlines which had close contact with local public health authorities during the outbreak. The four airlines (with a combined annual traffic of 329 billion RPK) together followed up around 1100 passengers who were identified as confirmed cases having recently flown. The flights in question represent about 125000 passengers. There was one possible secondary passenger case identified in the total, along with just two crew cases, thought to be the result of possible in-flight transmission. By comparison, a recent article from Shenzhen China on transmission quotes an overall transmission rate of 6.6% across modes of contacts (household, travel, or meals), which would equate to a predicted 72 cases from those 1100 passengers, compared with the three that we have observed.

The reasons for the apparently low rate of in-flight transmission are not known but could encompass a combination of the lack of face-to-face contact, and the physical barriers provided by seat backs, along with the characteristics of cabin air flow. Further study is under way.

Multi-layered approach:

In the absence of a single measure which can achieve high-levels of risk reduction, the alternative is to use a combination of approaches to mitigate the risk as far as practical. This is essentially the approach being applied at present for those services that continue to operate for cargo and repatriation flights. The combination of intrusive and burdensome measures creates a travel experience far removed from 'normal' operations and one which is unlikely to be commercially sustainable for any significant period. However this provides a potential pathway towards recovery and reconnection. It is likely that there will be a stratified approach which employs more measures to routes, or passenger groups, which entail higher risk at the time. Summary: A multi-layered approach will almost certainly be required in the initial stages.

Temperature screening

Fever (elevated core body temperature) is an early sign of COVID-19 in some people, but by no means all. Surface temperature measurement is less reliable than core temperature, but is easier, which is why temperature screening usually involves a measurement of surface temperature. The various methods include handheld measuring devices which may be contact (eg aural) or contactless, remote thermal scanning, and newly developed devices with cameras which are apparently able to measure temperate, pulse and respiration rate from a distance. All these methods have deficiencies.

Temperature screening has been employed at both departure and arrival. It will miss many of those with early illness, asymptomatic illness, those whose symptoms do not include fever, and in some cases, those who have taken antipyretic medication (such as acetaminophen/paracetamol) to lower their temperature. It has been documented however, that in the early stages of the COVID-19 pandemic, several new cases were detected in passengers who underwent routine temperature checks after arriving at their destination.

Survey research during the COVID-19 outbreak has indicated that airline passengers are reassured by temperature screening undertaken in airports. It could also have an effect of deterring passengers who might otherwise travel when feeling unwell.

Temperature screening needs to be done with validated equipment, and if done manually, by staff who have appropriate training and personal protective equipment (PPE). IATA maintains that it should not be the role of airline staff to carry out such screening.

Even under these conditions there will be false positive and false negative results. Temperature (and other) screening is more likely to be useful in populations where COVID-19 prevalence is higher (such as returned travelers) than in low-prevalence groups such as the general travel population.

Summary: Temperature screening has deficiencies and should be undertaken with appropriate precautions. It may be of some benefit, applied selectively along with other measures.

Symptom screening

Many countries have been using a questionnaire to ask travelers about symptoms (usually fever, cough, breathing difficulties) as an added screen to detect people possibly currently suffering from COVID-19, usually upon arrival; a declaration of symptoms could also be added to a nation's electronic visa process as another layer of protection prior to travel. Obviously it depends on the honesty of the answers, but being required to make a declaration of being symptom-free could provide a deterrent to travelling while unwell. Various groups are developing electronic applications which can assist with screening for symptoms, often in conjunction with applications to facilitate contact tracing. It is noted that many countries already had symptom screening in place when the virus was imported; many studies have now documented the level of asymptomatic spread, which contributes to transmission and limits the usefulness of symptom screening. Summary: Symptom screening is a useful adjunct to other measures but has significant limitations.

Use of masks and PPE

The primary method of spread of COVID-19 is exhaled droplets, with a secondary method of spread from those droplets via surfaces and hands. There is ongoing debate as to the level to which smaller aerosol particles, which can remain suspended for longer times or distances, contribute to spread. IATA's earlier guidance has reflected WHO advice that the use of surgical masks should be reserved for those who are unwell or those who are caring for those who are unwell. As a protection for individuals in public places, without close contact with others, it is of very limited benefit; however, increasingly, authorities have been promoting or requiring the use of non-medical face coverings for those who are in public, especially in situations where physical distancing is not possible. This "source control" strategy is intended to protect the public from the wearer, rather than to protect the individual – by creating a physical barrier to the exhalation of droplets. Studies increasingly suggest that such use of face coverings is effective at reducing droplet spread, and this is of potential benefit where physical distancing cannot be achieved; WHO has recently incorporated this strategy in its advice, and provided information on how to create suitable masks from material, to avoid depleting supplies of medical grade disposable masks which are required for use by health care workers.

As the pandemic has progressed, more aviation authorities have encouraged or required passengers to wear face coverings. Similarly for crew members, it is expected that the use of surgical masks and gloves, with appropriate instruction and training, and disposal methods, and associated with meticulous hygiene, will provide protection, as well reassurance for both them and their passengers. It is reasonable to require mask use for those airline workers in situations where physical distancing cannot be ensured (not just crew but also gate staff, ground staff who board the aircraft, etc), until risk is judged to be sufficiently reduced. Many countries have gone further and required full PPE for cabin crew.

This is not an infallible protection but forms one element of an overall set of measures.

Summary: Face coverings for passengers along with suitable PPE for crew and other airline staff are a useful element of a multi-layered protection strategy.

Physical distancing

The mainstay of interrupting the spread of COVID-19 is preventing people from having close contact with each other, since the most efficient method of spread is by inhalation of exhaled droplets from an infected person. This is presumed to be most efficient when coughing, sneezing or talking, face to face. All of the measures employed currently around the world to slow the spread make use of maintaining distance between individuals as much as possible, and guidance around the ideal distance ranges from 1-2 metres (3-6 feet). It is possible to modify airport check-in, immigration, security, departure lounge, and boarding processes in such a way as to ensure such physical distancing, and the Airports Council International (ACI) has published guidance on this.

On board the aircraft, it is difficult to achieve such a high degree of distancing, unless the aircraft loadings are so light as to be uneconomical. However, other protections are in place including the fact that people all face the same direction rather than face-to-face, they generally remain in their seat after boarding, except to visit bathrooms. Additional possible protection is derived from the physical barrier of the seat backs, and the direction of cabin air flow which is generally from ceiling to floor, at a much higher rate than in public buildings, with little lateral flow. Contamination of the supplied air is reliably avoided by the presence of HEPA filters, which are installed in those modern jet airliners which use recirculation. The greatest challenges for distancing may relate to when passengers are moving, particularly boarding, disembarking, and using bathrooms. Physical distancing measures currently in use by airlines include: management of the boarding process to minimize passengers passing each other; limiting carry-on baggage; sequenced boarding rear first, window first; allocation of bathrooms for each area; allowing only one passenger at a time visiting the bathroom. Interactions of crew and passengers face-to-face are avoided by pre-placing service items (food, water, and trash containers) on seats before boarding. Finally, these measures may be supplemented by the wearing of face covers or masks by passengers and crew alike.

Some airlines are currently, while load factors are low, also achieving a degree of distancing by leaving every second seat empty, or similar. In a restart scenario this would be economically unviable. Given the data presented above regarding in-flight transmission from passenger to passenger, its justification would be questionable. There may however be benefit in leaving empty seats in the region where crew are seated (in their jump seats) face to face with passengers. Where possible, leaving empty seats may further reduce risk although further study is required regarding the nature and risk of droplet spread in the cabin air environment. Study is currently under way employing review of previous research, new computational modelling, and planning for simulation studies.

Summary: Physical distancing on board can be achieved to a large degree especially during the airport processes and boarding, but leaving large numbers of empty seats on a routine basis is probably unsustainable.

Cleaning and Disinfection

While the primary route of transmission is direct respiratory droplet spread (exhaled and then inhaled), fomite transfer via surfaces and hands is also important, and in addition to the primary preventive tool of hand hygiene, cleaning and disinfection of frequently/recently touched surfaces is advised by WHO and other health agencies. Concern has been heightened by research indicating potential virus survival on a range of surfaces for a few days. Cleaning with normal agents such as alcohol 60% is very effective at destroying the virus on such surfaces, and other agents such as quarternary ammonium compounds, commonly used in aviation, are also effective; manufacturers have updated advice on compounds to be used.

On the aircraft, there is potential for transmission in this manner particularly on short-haul flying where rapid turnarounds have previously prevented extensive cleaning between sectors. Many airlines have increased the frequency and extent of their routine cleaning. Some regulators (including China CAAC and EASA) have recommended particular cleaning procedures as a routine. It is likely that improved routine cleaning provides reassurance to passengers, whether or not it reduces risk of transmission. Another possibility which has been adopted for rapid turnaround flights is for passengers to be given material (alcohol wipes etc) to use on the surfaces in their seat area, so that they know it has been done and have some agency in the process; this has been shown to be reassuring for passengers. There are other potential methods of disinfection such as UV light and gaseous ozone which have not been evaluated in the airline setting.

Summary: Cleaning and disinfection procedures, in excess of the previous norms, are part of the range of measures required in a restart process.

COVID-19 Testing

Background: The mainstay of testing for current infection (presence of virus) in the community is a polymerase chain reaction (PCR) test which involves taking a swab of the upper throat and amplifying the genetic material in a laboratory until it can be detected and confirmed. An increasing number of regions (examples include South Korea, Hong Kong SAR, Macao SAR, Austria, Luxembourg, Iceland and China in conjunction with Singapore) have introduced testing into their State requirements for travelers, either before departure (perhaps incorporated into an electronic visa process), or after arrival.

All medical testing has limitations; even PCR can miss some people with the infection, early in the illness, particularly if the person has recently been infected and is still incubating; this opens a window during which the person may become infected (and turn positive), AFTER testing. Pre-departure testing means this window occurs in the departure location. Post-arrival testing means that the delay occurs in the arrival country and the person could infect others while the result is awaited, unless isolated. For our specific purposes of ensuring safe travel, the ideal time to test is immediately prior to travel, and for convenience and simplicity, this would be best done at the airport of departure.

Another limitation, even of PCR, is the converse problem: late in the illness it appears that people can test positive without actually being infectious, so this represents a false positive which is problematic for travelers, whether it occurs in their own country or a foreign country for them.

Testing with throat swabs is also somewhat invasive and uncomfortable, and requires the sample to be taken by a trained person (usually a health care worker) who is also equipped and competent with PPE. A technology which could be performed with saliva would therefore provide a significant advantage, being able to be performed more easily and more acceptably.

Next, there is the question of speed: this is improving, but with PCR tests there is a delay waiting for the result – which is at best a few hours currently.

New testing: Many alternative technologies are now either in development or available, which can either rapidly amplify the genetic material, or can use other components of the virus (antigens) such as surface proteins. In order to be able to be used as part of the airport process (either departure or arrival) they would need to be able to perform at speed (results well inside an hour) but also at sufficient scale (hundreds of tests per hour) for this to be practical. Ideal would once again be the use of saliva.

Finally and crucially, in order to be usable, the tests would be required to have demonstrated extremely high reliability when compared with standard PCR technology: firstly, they would require a very low false negative rate (ideally less than 1%), but for the aviation setting probably even more important is a very low false positive rate, because any significant percentage of false positives will result in large numbers of passengers having to cancel their travel when already at the airport. This reliability needs to be certified by reputable national or international authorities, whether scientific, therapeutic, or public health .

Summary: Rapid point-of-care testing is an important potential extra layer of protection. Technology for rapid on-site PCR tests, molecular tests and alternative antigen tests, is advancing rapidly, and if validated by a reputable scientific organization could be an additional layer of protection. Suggested requirements are that this testing be:

- validated by a reputable National scientific, therapeutic, or public health agency, to achieve less than 1% false negatives and the lowest possible false positive rate compared with PCR;

- deployable in an airport setting, preferably using saliva and able to be sampled without use of PPE;

- capable of scaling to achieve hundreds of tests per hour, with results well inside one hour.

Antibody Testing

Many groups are developing serological (antibody) tests for COVID-19. These typically use a blood sample which can be obtained from a finger-prick. Detection of antibodies early on can confirm current or recent infection and later on, can confirm immunity. The detection of antibodies could, once validated, be used to indicate that someone is able to travel without risk of either contracting or transmitting infection (see below). Antibodies are not detected early in the infection and are therefore not useful for diagnosis.

There are many epidemiological estimates that the number of mild recovered cases could greatly exceed the number of confirmed cases, and with suitable widespread serology (antibody) testing, there may be a large enough population of recovered and immune individuals. Indeed, many serology studies of closed communities (small towns, ships, etc) have shown a high proportion of individuals to have been infected – however, in larger population studies the highest proportions have been around 17% which is insufficient to provide a significant population of immune individuals.

It remains unclear for how long immunity is maintained or its extent; some coronaviruses generate relatively short-lived immunity and therefore this is not yet a reliable protection. If antibody testing were adopted for use in connection with an “immunity passport” (below), the testing would initially need to have a short “validity” since the duration of immunity would not be known. Furthermore, WHO advice has consistently been that there are no validated and reliable antibody tests available for use on an individual level, and that such tests should be used only for studying populations to understand the nature of the pandemic and its transmission.

Summary: This is not yet a reliable tool other than for epidemiological study. It has potential when validated and supported by major health bodies such as WHO, and with further experience.

Immunity Passports

This concept arises from the fact that once someone has recovered from a viral infection they normally retain immunity; there is some evidence from animal and human studies to suggest that immunity to COVID-19 will be retained at least for some months. The concept of immunity passports is that if someone can be documented as having recovered from COVID-19 they are presumed to be immune, therefore many of the normal protections would not be required; this would mean that by showing their documentation (or incorporating it into a prior electronic visa process), they could achieve the airport, boarding and on-board processes bypassing many of the protective steps such as face cover, temperature checks etc. Those airport staff and aircrew who were immune could similarly omit many of the requirements, including for PPE and physical distancing.

The main difficulty is that even now, the proportion of the population who are recovered cases is very small – serological surveys have typically shown less than 10% of the population with evidence of immunity, although more recently London UK has shown around 17.5%. These levels would not be enough to allow a significant restart, but they are increasing over time. Furthermore, a proportion of those cases have been diagnosed clinically rather than with laboratory confirmation, and Governments are likely to require laboratory documentation before granting such a passport, which would make the population even smaller. However, as the pandemic progresses, it is possible that the population of immune people may eventually become big enough to make this a viable proposition.

There are also important potential unintended consequences of such a measure. For example, granting of privileges to those who have recovered could incentivize people to contract the disease. This "perverse incentive" could tempt people to deliberately expose themselves, and thereby undermine public health measures and propagate the pandemic.

Summary: Limited potential unless global spread continues to a large proportion of the population. Some risks as ongoing immunity is not assured; unwise at the current time.

Quarantine

One of the key measures which is being imposed by governments is a period of quarantine for incoming travelers – almost universally 14 days, to exceed the 12 days which is considered the maximum incubation period. There are considerable logistical difficulties involved in this process to ensure that while all needs of transport, accommodation, food, exercise, and communication are met, there is no cross-contamination between those in quarantine. In many cases, the quarantine is accompanied by COVID-19 testing so that the measure is not solely dependent on people recognizing and reporting symptoms.

While this can be an effective means of ensuring any imported cases do not spread, it is a major disincentive to travel, particularly if required after both (outbound and return) legs of an international journey. In situations where travel is between two countries with similar levels of community transmission in the community, any travelers who had been COVID-19 tested negative upon departure, would be of lower risk than the non-tested members of the surrounding community, so the argument could be advanced that they should be subject to no more restrictions than the others in the community. This may well even be the case when travel is from a community with higher transmission risk than the destination; testing procedures could therefore be one of the considerations against which to balance a decision about quarantine. This goes alongside the other measures in place such as: discouraging symptomatic passengers from travelling; health declarations including symptom screening; the measures adopted during travel as outlined in the ICAO "Take-off" recommendations; and contact tracing measures after arrival.

By contrast, if traveling from an area of low risk to one of high risk, then it is difficult to support an argument for quarantine on arrival. These are all questions for the government of the destination country to resolve.

Summary: Quarantine is a major inhibitor of travel and on a careful analysis of the risks, governments may determine that it is not justified in many scenarios.

Measures to assist contact tracing

Although the prime objective will be to prevent anyone travelling while unwell, an important back-up to this is the ability to rapidly identify and trace the contacts of anyone who, after travelling, is discovered to have been infected at the time of travel. Measures to assist and facilitate such tracing have been employed as part of arrival procedures in some countries. They could be as simple as providing contact details for follow-up if required. In many cases these have made use of technology such as phone applications which, with the user's consent, allow their movements and even their close contacts to be traced and tracked. The use of such technologies could be a condition applied by governments to allowing international (or indeed domestic) travel in a restart. A further element to this would be ensuring early reporting of any instances where passengers are unwell in flight, with symptoms consistent with COVID-19. Ground-based medical services could have a role here in ensuring public health processes are triggered.

Summary: Procedures, and technologies, for contact tracing are likely to be part of the suite of required measures.

Measures related to crew members

In the current operations, aircrew (pilots and flight attendants) are almost the only people travelling between countries. On long-haul sectors, it is necessary for them to layover at destination. Health authorities are allowing this to occur contingent on strict procedures to prevent them becoming infected while on layover. These have included social distancing (such as being confined to a hotel room during layover, with meals delivered), use of masks, special arrangements for transport, and temperature checks. In a restart scenario, some crew protective procedures are also likely to be one of the conditions for governments allowing airline travel to increase. Indeed it is strongly recommended that governments work with airlines in determining what protections are appropriate. There are also a range of in-flight procedures related specifically to crew aimed at preventing transmission between passengers, or between crew and passengers, and a separate IATA document details these.

Summary: procedures for crew in flight and during layover are likely to be a significant part of the required measures to allow restart.

Treatment

If a medical treatment became available which drastically and reliably reduced the mortality and severity of disease, then the concerns of both Governments and travelers would be massively reduced, potentially allowing a resumption of travel. No such measures are currently available. Summary: Potentially a major help but not yet available.

Vaccination

The eventual arrival of a reliable vaccine, with production scaled up to allow widespread availability, would achieve immunity for those vaccinated. However, best-case estimates of the time course for reaching this situation are mostly not before the 2021 calendar year. It is not a certainty that a successful vaccine will be produced, but there are large numbers under development and even human testing. This would be the world's first vaccine against a coronavirus. If successfully produced and widely distributed, a certificate of immunity such as mentioned above would become a viable tool to facilitate travel. Summary: The best solution, being vigorously pursued, but not yet in sight.

This multi-layered approach, incorporating many of the above possible protective measures, is proposed as a pathway for aviation recovery.

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