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Letter to the Editor

Fixed Wing Patient Air Transport during the Covid-19 Pandemic



The World Health Organisation has recently declared that the Covid-19 outbreak is now a pandemic, and it's impossible to ignore the rising numbers of those diagnosed with carrying the virus, and the steadily growing number of patients who are fatally affected. The silent nature of the infection in the pre-symptomatic yet highly contagious phase has created an enormous challenge for us all and, inevitably, there are particular concerns with regards to the transport of the victims of infection who are unaware that they are carrying (and, indeed, spreading) the virus. Serious dilemmas lay ahead and neither air ambulance services nor commercial aircraft medical escorts are exempt from facing these challenges.

Being unprepared is not an option and thoughtful detailed planning is key. For some, the problem with planning is finding the place to start. This article makes no attempt to be a comprehensive tome but the musings that follow may help focus on key areas of concern. The content is mostly directed towards air ambulance operations since airline medical escorts will be constrained by individual airline availability, internal regulations and international restrictions and limitations.

There are hundreds of small dedicated air ambulances operating around the world, and none is the perfect vehicle for moving patients, let alone highly contagious ones. The different models of aircraft used have different size cabins, different cabin conditioning systems, variable ease or difficulty of loading and unloading stretcher (litter) patients and a wide range of other variables that have an influence on the quality of medical care that can be given in the air. In this context, the unknown affect of cabin airflow and conditioning systems is a major concern. It has not yet been disproven that exhaled droplets may be aerosolised by the conditioned cabin air flow, and some air ambulances may not recycle enough air to effectively dilute aerosol pathogens, or they don't pass recycled air through a HEPA filter.

At the time of submission of this paper, up to 18% of newly diagnosed Covid-19 patients are healthcare professionals and 1 in 4 front

line staff have been diagnosed or are in self-isolation. What can we do to ensure that flight medical teams and aircrew reduce their personal risks to an acceptable level?

Perhaps the easiest decision for air ambulance organisations is the one with the greatest possible contention. At some stage the decision must be made – should our service transport a patient who is symptomatic and has tested positive for Covid-19? Indeed, why would anybody want to move such a highly contagious patient?

Each service must be able to justify why they would want to risk the health and lives of others to transport a symptomatic patient infected by a potentially lethal pathogen, and then prove that the service has the highly skilled personnel and the appropriate equipment to be considered competent and safe for such high risk work.

Indications for transfer are therefore not quite so clear-cut as for non-infected patients. Potential indications, although controversial, may include:

- A patient transfer to a more appropriate facility where expertise and a higher echelon of medical care can be provided. Consider 'if/when a bed is available' and 'if/when the higher level of care is appropriate' (i.e. when the patient has a reasonable chance of survival).
- Diplomatic or other non-medical pressures to repatriate or transport (e.g. governmental decision to repatriate their citizens, inadequate facilities overseas, lack of high dependency or isolation beds in local hospitals, and so on).
- Repatriation for end-of life care when there is nothing that can be done to save the patient. This is highly unlikely but may be requested for religious reasons by some families.

Even if an indication is justified, clearly everything depends on the capabilities of the service. In essence, the transport of symptomatic highly contagious patients has been well documented elsewhere, following events over the past two decades, and they don't need to be elaborated here. However, the management of undeclared but potentially highly contagious patients is the real challenge and a decision tree might help with justifying the choices made. This starts with five key questions that should flag up important issues:

The Five Key Questions and Related Issues

1. **Is the aircraft suitable for specialist transport of highly contagious patients?**
 - Is the cabin big enough to allow easy loading of a patient isolator and is there room for the medical team to work safely around the isolator?
 - Can the isolator be securely fitted to the aircraft (is an STC necessary)?
 - Is there a flight deck door to isolate the aircrew from the patient compartment?
 - Does the cabin conditioning system work efficiently, and does it include HEPA filtration of recycled air?

- How is the integrity of the isolator ‘skin’ maintained during loading and unloading?
 - Will the centre of gravity of the aircraft be dangerously affected by the position or weight of the equipment, consumables and team required to conduct the mission?
 - Will the power requirement of the medical equipment be within the limits of the aircraft’s power inverter? If not, have battery replacement calculations been made?
 - Is the light inside the cabin adequate for good visualisation of the patient inside the isolator?
 - Does the service have bariatric capability for patients over the specified weight limit for the ‘routine’ equipment?
2. **Does the service offer critical care capability in flight?**
- Experienced and current intensive care flight physician and flight nurse(s).
 - Equipment to manage planned or unexpected sedation, intubation, ventilation and cardiovascular support.
 - Procedures and equipment to manage problem airways and peri-arrest scenarios.
 - Comprehensive intensive care patient monitoring, including ‘bedside laboratory’ capability.
3. **Does the service offer patient isolation capability and management of highly contagious patients?**
- Specific training in the transport of highly contagious patients for the flight medical crew, including use of full PPE (personal protective equipment), safe lifting, loading and securing patients with or without a patient isolator. Frequent and fastidious practical training is essential prior to a mission.
 - Specific training for the air ambulance aircrew or cabin crew/loadmasters of non-air ambulance aircraft, as well as for anyone who will also work in the patient compartment on the aircraft during or after the transport.
 - An air-portable patient isolator with secure airlocks, HEPA filters and protected access to the patient.
 - A comprehensive policy and practical experience of decontamination, fumigation and deep cleaning after the flight.
4. **Does the service understand the importance of comprehensive communication?**
- Established contacts with public health expertise, port health authorities and infectious disease centres.
 - Understanding of International Health Regulations and the need for notifications and regulations of the destinations countries/airports with regards to border procedures and notifiable diseases.
 - Knowledge is key. Ensure full and up to date medical reports, discuss with referring and receiving medical teams and appropriate infectious diseases teams.
 - Impeccable attention to detail and fastidious planning of each stage of the transport is essential and must be communicated effectively to all parties concerned with the transfer. Briefings should include all conceivable ‘what if’ scenarios.
 - Awareness of ‘go’ and ‘no-go’ tech stops. For instance, if a flight has a planned fuel stop in Italy, will the aircraft then be allowed to land at its final destination. This is an issue even for positioning flights when there is no patient on board.
5. **Are the employees of the service willing to undertake these missions?**
- Have detailed and bespoke risk assessments been undertaken prior to each mission?
 - Are pilots, engineers, aircraft handlers, equipment and aircraft cleaners as well as the flight physicians and nurses fully informed about the risks and do they freely give their consent to take part in the transport?
 - Has evidence been provided that due consideration has been taken in regard to medical team flight duty limitations and the

effects of working in full PPE over long periods in the constraints of the aircraft cabin? If so, have mitigations for fatigue, exhaustion, and hyperthermia been factored in to the mission planning?

- Are they all properly trained, practiced and equipped to fulfil their roles under the constraints imposed by the appropriate and necessary infection control procedures?
- Do they have adequate personal health cover insurance? Does the service provide all-risks cover?
- Who has the information on the medical histories of the personnel involved? Are they being screened to exclude those who are at higher risk of serious complications if they become infected?
- Have the personnel concerned discussed the issue with their family and loved ones?
- Has the possibility of arranging tarmac transfers at both airports of origin and destination been considered, so that exposure of the medical team to extra risk be avoided?
- Is there any useful prophylactic treatment or has vaccination been developed yet?

If the answer to any single one of these issues causes doubt or concern, then the decision is simple – the mission cannot be safely undertaken. This is, in fact, the simplest scenario. The more difficult decisions come from what at first appear to be much more benign situations – asymptomatic patients or those with only minor and vague symptoms and who have not been tested for Covid-19. The difficulties don’t end there. Does your service have a policy for the management of all patients being transported from a Covid-19 hotspot (currently China, South Korea, Iran, Italy, Spain and USA, at the time of writing). Likewise, would it be ethical to transport any patient to such a hotspot?

As if that doesn’t give us enough to think about, how can we be sure that any of our patients, being transported for any reason at all, is not already infected with Covid-19, even though they may not have respiratory symptoms. For instance, the elderly lady with a fractured hip may pick up the virus during her short hospital stay overseas, or perhaps it was the cause of her fall in the first place. If this has not been taken into consideration, she would be the ideal vehicle for the carriage of Covid-19 (as well as all the multi-drug resistant bacteria that are always a concern). It’s not just the elderly and those with chronic health issues that are at high risk, it is any patient who has a compromised immune system or any reduced ability to shake off pathogenic invasion. This is particularly true of intensive care patients. Don’t forget to check on the health of the travelling companion(s) too!

Some experts have determined that possibly as little as only 10% of Covid-19 infected patients have been diagnosed (and that is, of course, only in the countries that have introduced mass testing of ‘likely’ virus carriers). When our eyes are opened to these issues, we are compelled to consider how we manage *all* patient transfers during the pandemic.

The suggested decision tree in [Figure 4](#) (Ref: *CCAT Aeromedical Training, 2020*) is a simple algorithm to help with transport choices, but the key part is the actual detail of the best and most appropriate measures to be taken for each of the four main categories of patients. It is relatively easy to plan appropriately for known Covid-19 patients who have symptoms, and Covid-19 positive patients without symptoms are also a ‘known’ entity. It is the rest of the patient transport population that cause concern, so the following suggested guidelines make perfect sense, even if some may feel that the response is overly complicated.

In a pandemic in which death is a real risk, then being risk averse is by far better than being laissez-faire. With that in mind,

- Experienced and appropriately equipped service provider
- Trained and practiced flight medical team and aircrew
- Appropriate aircraft
- Appropriate and experienced ground ambulance links
- Full PPE available
- Consideration regarding the transport personnel's occupational health hazards and risks
- These procedures are well documented elsewhere

Figure 1. Moving the Symptomatic Highly Contagious Covid-19 Positive Patient

- Flight medical team to wear 'routine' PPE (gloves, apron, fluid-resistant (Type IIR) surgical mask or N95 mask¹ and face shield or goggles) when assessing the patient pre-flight.
- Initially, measure the patient's temperature whilst taking recent medical history and chronic health/other risk factors history. Ask specifically for respiratory tract and flu-like symptoms.
- Also ask specifically about sore throat but do not ask the patient to open the mouth or attempt to look at the oropharynx.
- Examine the chest. Check for dehydration and measure BP and oxygen saturation (stating FiO₂).
- Review chest Xrays if available.
- Review recent blood results (especially for markers of infection/inflammation).
- Complete the remaining usual pre-flight assessment indicated for each individual patient.
- Review recent observations/MEWS/NEWS (etc) chart.
- Test for Covid-19 if available and time allows.
- Flight medical team to wear routine PPE for entire flight if the patient has no significant findings or history of Covid-19 infection.
- If the patient raises a high index of suspicion, he/she should be treated as a highly contagious patient.
- All patients to have routine clinical observations recorded once onboard the aircraft and at least hourly thereafter.
- Any deterioration or new illness occurring enroute should be documented and treated symptomatically. If indicated, ask the patient to wear an N95 mask.

Figure 2. Suggested Minimum Procedure for All Covid-19 Negative and Unknown Covid-19 Status Patients for Transfer During the Pandemic

Figures 1 to 3 take a risk averse view to 'minimum' procedures for the transport of patients during this high-risk period of uncertainty.

Controversies

The World Health Organisation (WHO) states in its interim guidance document dated 19 March 2020 (Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19)) 'coveralls (sometimes called Ebola PPE) are not required when managing COVID-19 patients'. However, with the alarming rise in the number of healthcare workers who have contracted Covid-19, a more risk averse approach would be welcomed by those of us that

will be sat for potentially several hours with these patients in the confined cabin of a small air ambulance aircraft. This is a scenario that is not covered in the WHO guidelines. In addition, full body suits are currently used by front line health care professionals caring for Covid-19 patients all around the world.

The same may be said regarding the use of an N95 mask (a Class 3 filtering face piece or FFP3) in comparison with a fluid-resistant (Type IIR) surgical mask (FRSM). The US Center for Disease Control and the Food and Drug Administration have produced undated guidance on both types of masks (N95 Respirators and Surgical Masks) but, again, no mention is made of our scenario of highly contagious

- Due to unknown risks of aerosol transmission between patient and other aircraft occupants, the risk averse solution for the patient is to wear an N95 mask throughout flight.
- Aircrew should also wear an N95 mask and the flight deck door should remain closed except for emergencies. Hence, intercom communication with the flight deck is essential.
- Extra vigilance is needed for management of biological fluids and waste.

Figure 3. Additional Minimum Procedures for Asymptomatic Patient Transfers from Hot Zones

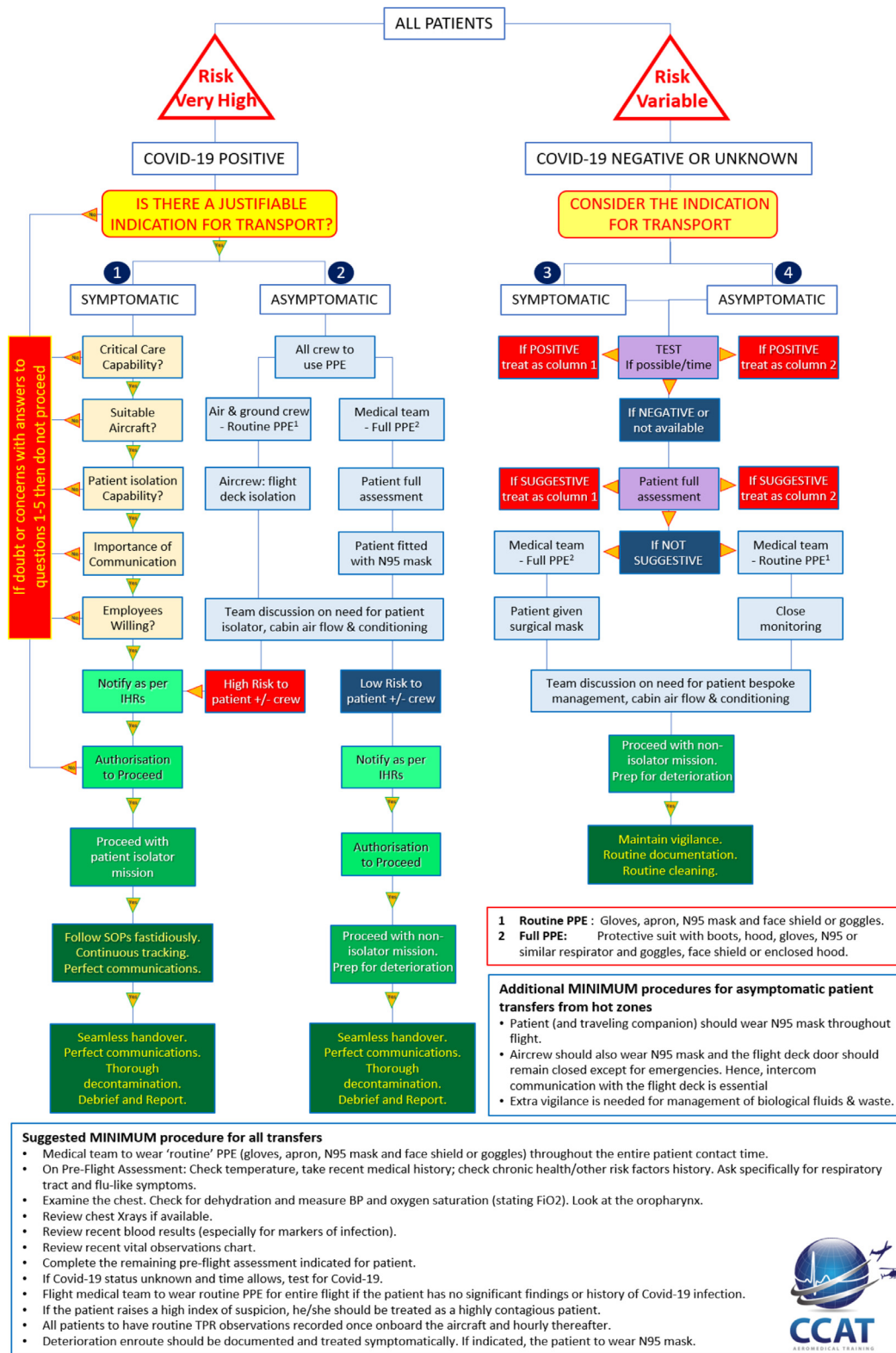


Figure 4. Suggested decision tree for transport triage of all patients during COVID-19 pandemic.

patients in the small and confined space of an aircraft cabin. The UK Government prevention and control guidance document (COVID-19: Guidance for infection Prevention and Control in Healthcare Settings version 1.0) favours the use of FRSM masks during intra-hospital patient transport, but makes no comment on the long haul patient

transport missions in small dedicated air ambulances. However, given the distinct possibility of the need for aerosol generating procedures (AGPs), the document does suggest that a FFP3 respirator should be worn as part of the PPE. If further convincing is necessary, the same document states that FFP3 respirators should be worn 'at all

times in intensive care units (ICU), intensive therapy units (ITU), and high dependency units (HDU). This definition includes a substantial proportion of patients being transported by dedicated fixed wing air ambulances around the world.

It is therefore the author's belief that, although WHO and similar guidelines do exist for the terrestrial management of Covid-19 positive patients, there is very little detail with regards to the long haul transport of these patients, and no guidance on how to safely manage patients of unknown Covid-19 status. These explanatory notes and Figure 4 take a risk averse stance given that the flight cabin environment is much more constrained, limited and challenging than a terrestrial bed space.

In addition to the WHO and national public health organisations, aeromedical authorities, such as AMPA in the USA, have produced guidelines, advice and expert opinion that can be found online and through official postings from these august bodies and legal entities. The author therefore invites comments and other useful information from the readership. This global problem not only deserves, but requires, international co-operation and sharing. Furthermore, it remains essential in these days when news and guidance can change daily, that the latest intelligence and advice is checked at the start of every day and before every patient transport flight. Frequent updates should cover such issues as:

- WHO statistics of international spread.
- WHO and local advice on management of the pandemic and of individual patients.
- Changes to IHRs.
- Declaration of new 'hotspots'.
- Travel restrictions imposed by governments, airlines and other provider agencies.
- Progress in the development of vaccination and other therapeutic agents.
- Progress with antigen and antibody test kits and procedures.

Beyond these words of advice, fly safe, fly within your capabilities and don't take unnecessary risks.

Conflict of Interest and Personal Opinion Statement

Dr Martin is a Consultant in Intensive Care Medicine and Anaesthesia with a first degree in immunology and significant experience in aeromedical transport and management of air ambulance services. He has widespread knowledge and experience managing contagious patients, but he does not purport to be an expert in virology or in matters of public health outside of the flight environment. This article therefore reflects his personal observations and opinions based on a thorough understanding of the limitations to the practice of patient care in the air. The state of knowledge about Covid-19 and its pandemic changes on a daily basis and interested readers must, of course, keep themselves updated through the local, national and international expert advice provided by Public Health authorities.

Much of the information contained in this article may become out of date as knowledge of this novel virus and the dynamics of the pandemic increases. The author can therefore not accept responsibility for changes in official advice offered after the submission date of this article (14 March 2020).

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