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**D4.5 – Protection of People and infrastructure**

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Summary

A literature review revealed no documented transmission events in transport hubs for travel by air, land or sea for influenza, coronaviruses, Ebola Virus Disease (EVD) or pneumonic plague, nor of deliberate release in hubs for plague or anthrax. However the lack of published data on such events may be in part due to the rapid dispersal of disembarking travellers and consequent difficulty in identifying clustered cases. Therefore it is important that precautions are taken to protect passengers and staff within transport hubs because these are crowded environments with extensive patterns of mixing involving transient occupants from different parts of the world who may have different susceptibilities, and who may also import infection from their places of origin.

A review of existing infection prevention and control guidance relevant to points of entry (PoE) was undertaken to identify both best practice, and to identify any gaps in current guidance.

Customised guidance was generated, built around five common control principles (ventilation, exclusion of symptomatic persons, separation of international and domestic travellers, interpersonal distancing, and measures to reduce indirect contact transmission) taking into consideration pathogen specific transmission routes, virulence of the pathogen, the types of control that are practical and available, and high risk areas where control is most important. Principle based infection prevention and control guidance is provided for routine circumstances, together with guidance for specific types of public health communicable disease threats, for different staff groups within transport hubs.

Preparedness guidance for public health events in transport hubs is provided in the format of best practice checklists, developed following a review of existing PoE preparedness guidance in the context of responding to communicable disease events.

The expert advice from local, national and international public health bodies takes precedence over advice offered in this guidance, however it is hoped this guidance supplements guidance from such bodies and can, depending on local organisation needs, be adapted for use.
# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACDP</td>
<td>Advisory Committee on Dangerous Pathogens (UK)</td>
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<td>ACI</td>
<td>Airports Council International</td>
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<tr>
<td>ACRP</td>
<td>Airport Cooperative Research Programme</td>
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<td>AGP</td>
<td>Aerosol Generating Procedure</td>
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<tr>
<td>ATOC</td>
<td>Association of Train operating Companies</td>
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<tr>
<td>CAPSCA</td>
<td>Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation</td>
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<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>DH</td>
<td>Department of Health (UK)</td>
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<td>EC</td>
<td>European Commission</td>
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<td>ECAC</td>
<td>European Civil Aviation Authority</td>
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<td>ECDC</td>
<td>European Centre for Disease Prevention and Control</td>
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<td>EVD</td>
<td>Ebola Virus Disease</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>FFP</td>
<td>Filtering Face Piece</td>
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<tr>
<td>HICPAC</td>
<td>Healthcare Infection Control Practices Advisory Committee</td>
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<td>HPS</td>
<td>Health Protection Scotland</td>
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<td>IATA</td>
<td>International Air Transport Association</td>
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<td>ICAO</td>
<td>International Civil Aviation Organization</td>
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<td>IHR</td>
<td>International Health Regulations</td>
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<td>Acronym</td>
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<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
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<tr>
<td>MERS-CoV</td>
<td>Middle East Respiratory Syndrome Coronavirus</td>
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<tr>
<td>PANDHUB</td>
<td>Prevention and Management of High Threat Pathogen Incidents in Transport Hubs</td>
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<tr>
<td>PCR</td>
<td>Polymerase Chain Reaction</td>
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<td>PHE</td>
<td>Public Health England</td>
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<td>PHEIC</td>
<td>Public Health Event of International Concern</td>
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<td>PoE</td>
<td>Point of Entry</td>
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<td>PPE</td>
<td>Personal Protective Equipment</td>
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<td>RAGIDA</td>
<td>Risk Assessment Guidance for Infectious Diseases transmitted on Aircraft</td>
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<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
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<td>SLG</td>
<td>Stakeholder Liaison Group</td>
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<tr>
<td>VHF</td>
<td>Viral Haemorrhagic Fever</td>
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<td>WHO</td>
<td>World Health Organization</td>
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1. Introduction

1.1 Background

Points of Entry (PoEs) can play a role in the international spread of diseases. A number of epidemic threats since 2000, such as Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome Coronavirus (MERS-CoV), pandemic H1N1, and Ebola Virus Disease (EVD) have illustrated how international travel poses health risks, including the importation and spread of infectious agents. (Browne, Ahmad et al. 2016) (Olsen, Chang et al. 2003, Brouqui and Ippolito 2014)

The protection of people involves prevention as well as an effective rapid response to events. Whilst most modes of transport carry some risks with regards to transmission of infection, this is likely to be minimised if procedures are in place to rapidly and effectively respond to a public health emergency and measures are in place to reduce secondary spread, including at transport hubs.

The efficiency of any public health response will be improved if disease introductions are identified as quickly as possible. There may be opportunities, in some transport sectors at least, for illness to be noticed in the hub and travel prevented. It is likely that the highest risks for the introduction of novel or re-emerging pathogens are associated with air transport due to passenger volumes and the frequency and speed of transit, and it is in airports that detection is most likely because of the extent of interaction between passengers and hub or airline staff.

The all-hazards approach in the revised IHR regulations means that PoE must also have the capacity to detect and respond to non-communicable disease threats, i.e. chemical or radiological incidents. However the focus here is communicable diseases, as events concerning other biological, chemical or radiological events would likely require a complex urgent emergency response at a national level which will override and therefore potentially restrict the input from hub operators in terms of response.
2. Purpose, scope and approach

2.1 Purpose

The primary purpose of this ‘Protection of people’ guidance document is to assist hub operators with the management of communicable disease public health events by providing pragmatic advice on infection prevention and control and providing benchmarks to optimise preparedness. An additional aim is to provide advice and evidence in a consolidated format that may potentially be a useful resource to public health authorities as well as to hub operators.

For infection prevention and control the objective is to provide hub operators with simple, practical, operational advice regarding appropriate precautions and actions, proportional to risk, which will help minimise the risk and incidence of communicable disease transmission events in transport hubs, and thus reduce the risk of spreading diseases nationally and internationally. The advice is for the protection of staff and passengers and is intended to help prevent transmission of common communicable diseases as well as communicable diseases of greater public health significance such as Ebola and pandemic influenza.

The aim of the preparedness checklist element of this document is to provide a means for hub managers responsible for emergency preparedness and response to assess the status of their current preparedness in the context of communicable disease events.

The main target audiences for this document are hub operators, especially those with responsibility for preparedness and response, and public health authorities. It is also largely relevant to other hub employees (it includes some personnel group specific guidance), as well as transport operators and employees e.g. airline/train operators and employees. The secondary target audience is passengers (the travelling public).

2.2 Scope and approach

2.2.1 Scope

The guidance provided is limited to actions that are within the operational remit and authority of transport hub operators, and where these are dual responsibilities with transport
operators, these are included. However, to provide context, a number of responsibilities that lie elsewhere are also outlined e.g. responsibilities of health ministries and competent authorities such as public health authorities, which, in the event of serious threat, will advise operators.

The guidance is about protection, therefore it embraces preparedness and response, and prevention and control. It includes location specific (hotspots) guidance and guidance specific to particular types of disease threat. Some guidance will be more relevant to international transport hubs than to domestic hubs. For the purposes of this document hubs include airports, sea ports, railway stations, metro stations, underground stations and bus stations.

The following are out of scope (because either they primarily concern events on board transport, or are largely the remit of the public health authority and/or transport operator, rather than the hub operator):

- Infection prevention and control for events on board aircraft, vessels and other transports vehicles
- Disinfection and disinsection of aircraft, vessels and other transports vehicles
- Medical transfers, evacuation and evacuees, single patient isolation units
- Contact tracing
- Quarantine (of exposed people) and isolation (of sick people)
- Measures required for sick animals
- Preparedness and response for radiological or chemical events
- Response and decontamination after a bioterror attack
- Measures for food outlets and other commercial venues

2.2.1.1 Scope of infection prevention and control guidance

The guidance is intended to fill gaps and vulnerabilities identified during the review of existing infection prevention and control guidance (see section 7) and to address the needs of hub operators identified through other PANDHUB deliverables, particularly D4.3 *Multi-country investigations and cross border threats*. It also aims to enhance some of the advice available at an international or European Union (EU) level. For example, for personal protective equipment (PPE) use, Airports Council International (ACI) only go so far as to state that ‘PPE
appropriate to the suspected communicable disease, the mode of transmission and the nature of duties being performed by aviation personnel, should be worn. For many communicable diseases, disposable gloves and good hand hygiene (at times in combination with facemasks) are sufficient. The national public health authority may provide detailed recommendations' (Airport preparedness guidelines for outbreaks of communicable disease, ACI 2009). PANDHUB guidance attempts to expand on this level of advice to include both more detailed routine infection prevention and control advice and advice specific to particular types of threats.

2.2.1.2 Scope of preparedness guidance

Checklists are provided as a means for managers responsible for emergency preparedness and response (in the context of communicable disease) to assess the status of current preparedness. The focus is on prevention and mitigation of risks and immediate response, rather than recovery or business continuity. The elements of preparedness dictated by international and national legislative frameworks are assumed to already be in place. Operational frameworks will also be in place and the checklists are designed to enable an assessment of these, and identify any gaps.

The impact of a public health event on business continuity is out of scope, as is the recovery after a deliberate release event.

2.2.2 Approach

The guidance is not designed or intended to override advice that a public health authority might give during the process of managing a specific outbreak or incident; such advice must take priority. It is not prescriptive but captures the key infection prevention and control principles to enable a rational, proportionate approach, based on evidence where this exists. A principle-based approach also confers adaptability and transferability between different types of transport hub. For Ebola (and other viral haemorrhagic fevers (VHFs)) and pneumonic plague (and other high risk respiratory infections), the assumption is that the country of arrival has no current outbreak so the focus is on the response on arrival at a hub rather than on the exit from an affected area.
The infection prevention and control outputs and preparedness outputs have been built on the framework of, and other outputs from, the PANDHUB project, in particular D4.3, *Multi-country investigations and cross border threats*; D2.2 *Report of Hotspots*; D4.4 *Disinfection and Decontamination* and the D2.4 *Guidelines for threat assessment*. It is underpinned by a review of existing guidance (section 7), a review of transmission evidence (annex 1), a review of the evidence for the principles of infection prevention and control (annex 2), and input from members of the PANDHUB Stakeholder Liaison Group (SLG).

Note that as the intended key output, the customised guidance itself has been presented in the first half of the document, and the reviews on which it is based follow later. The reviews of existing guidance form part of the main document, as these primarily inform the customised guidance. It was also appropriate to review the evidence for transmission modes and guiding principles. These reviews have been included as annexes as they are supplementary to the main reviews of infection prevention and control guidance and preparedness guidance.

### 3. Disease transmission

Disease transmission is the transfer of micro-organisms from an infected person directly or indirectly to another individual. Infectious disease transmission is traditionally categorised into three principal modes: airborne transmission, direct and indirect contact transmission, and droplet transmission (note, droplet transmission is traditionally and technically considered a form of direct contact transmission). The transmission modes and disease characteristics (such as infectivity period and transmission range by pathogen (for PANDHUB pathogens and others)) underpin the guidance. See annex 1.

#### 3.1 Pathogens

The PANDHUB consortium reviewed pathogens at the outset of the project. Taking into consideration outbreak potential and pathogenicity, and the need to provide a sufficiently broad range to include pathogens with pandemic potential as well as high threat pathogens, a focus on four pathogens was agreed: (pandemic) influenza, Ebola, inhalation anthrax and pneumatic plague (although there are other forms of plague, it is pneumatic plague that can be transmitted person to person). Although high threat pathogens for potential bioterrorist
deliberate release scenarios are included, they are a greater focus elsewhere in PANDHUB; the prevention and control aspects of response to such a release (of anthrax spores or aerosol of plague) are beyond the remit of this guidance.

The PANDHUB guidance is principle driven, therefore guidance may be relevant to more than one pathogen, including pathogens in addition to the selected PANDHUB ones. For example guidance for pandemic influenza is relevant to other respiratory viruses such as the coronaviruses, MERS-CoV and SARS. Other pathogen-specific guidance and other pathogen-specific travel orientated guidance is available elsewhere. For example ECDC, as part of the RAGiDA (Risk Assessment Guidance for Infectious Diseases transmitted on Aircraft) project, issued operational risk assessment guidelines for tuberculosis (Risk assessment for infectious diseases transmitted on aircraft (Tuberculosis), ECDC 2014), updating WHO guidelines from 2008 (Tuberculosis and air travel-guidelines for prevention and control, WHO 2008), and influenza (Risk assessment for infectious diseases transmitted on aircraft (influenza), ECDC 2014). Additional guidance covered meningococcal disease, VHF, SARS, measles and rubella. (Risk assessment for infectious diseases transmitted on aircraft, ECDC 2010) (Leitmeyer 2011)

3.2 Transmission routes

See annex 1 for review of evidence for transmission routes.

3.3 Disease transmission in a transport hub environment

It is important that precautions are taken to protect the safety of passengers and staff within transport hubs because these are crowded environments with extensive patterns of mixing involving transient occupants from different parts of the world who may have different susceptibilities, and who may also import infection from their places of origin. In terms of evidence there is a paucity of published data on disease transmission occurring in transport hubs - a literature search (as part of PANDHUB deliverable D2.3 Disease spread in transport environments) revealed no documented reports of definite transmission events in transport hubs for travel by air, land or sea for influenza, coronaviruses, EVD or pneumonic plague, nor of deliberate release in hubs with regards to plague or anthrax. This may be in part due
to the rapid dispersal of travellers from such locations, making it difficult to identify the hub as the place where the transmission event occurred. There is however evidence in the literature for transmission of measles in an airport. (Nic Lochlainn, Mandal et al. 2016)

Infectious diseases may be detected at hubs if people travel with noticeable symptoms, however this is most likely only to be picked up if symptoms are very serious, or where there is a reasonable level of interaction between passengers and passenger service agents e.g. in airports.

For deliberate release, the bio-agents of interest (anthrax and plague) have incubation periods of 1 to 7 days for anthrax, and 1 to 6 days for pneumonic plague, therefore detection and alerts to a release in a transport hub are unlikely to be immediate, unless there is a prompt claim by those responsible for the release. Whilst international guidance exists (Public Health response to deliberate release of biological and chemical agents, WHO 2004) and such an occurrence would be a major public health event for the hub concerned, incident management would primarily fall to national security authorities, public health authorities, and national ministries of health. For example, in the UK the Department of Health (DH) have a number of documents addressing the response to deliberate release of biological or chemical agents.¹ The involvement of different authorities makes the investigation and management of deliberate incidents complex. For this reason guidance on hub response to intentional release events is considered beyond the scope of this document.

3.3.1 Hot spots on the passenger journey

Hot spots are points or sites within a traffic hub environment where the risk for disease transmission is at least transiently increased due to favourable conditions for transmission or by human behaviour, or both. Such hot spots occur along the passenger journey as hubs contain a number of different micro-environments with varying and fluctuating occupancy levels. Details on hot spots are provided in PANDHUB deliverable D2.2 Report on hot spots. Infection prevention and control advice for hotspots on the passenger path constitutes the guidance for routine circumstances (see 4.3.2).

For infections transmitted by droplets or droplet nuclei/short-range aerosol transmission (see Transmission routes in annex 1) hot spots are hub areas with a potentially high volume and density of passengers, including:

- ticket offices, arrival halls, corridors, and waiting areas
- baggage claim halls
- border control points
- security control points
- custom inspection points
- boarding bridges
- passenger buses from planes to terminal
- station platforms or airport gates
- crowded areas in underground stations

For infections transmitted by indirect contact, hotspots are surfaces (particularly non-porous, ones) frequently touched by passengers, including:

- self-service touch screens
- security control boxes for carry-on luggage
- hand-rails
- surfaces in waiting halls
- washroom facilities
- key pads in shops, cash machines (though out of scope as operators do not control commercial premises)
- children’s playrooms and toys
4. Introduction to infection prevention and control

4.1 Levels of control

Guidance is developed by considering together i) principles for control of infection, ii) transmission routes of different infections, iii) pathogenicity and virulence of the pathogen iv) high risk areas where control is most important, and v) the levels of control that can be applied. A common concept or model used for dealing with infectious agents, adopted from an industry 'Hierarchy of Controls' involves controls at three levels. Historically these were presented as a hierarchy, with control at source as the most effective, and PPE as the least effective as it depends strongly on human behaviour. In fact the controls are likely to offer the best protection when combined, and the hierarchy itself is not of particular importance.

The three levels of control are:

1. ENVIRONMENTAL AND ENGINEERING CONTROLS

Some of these controls are built into design to remove or reduce the concentration of the hazard at source to help prevent spread of infection. For example good ventilation is an engineering control measure against the hazard of infectious respiratory aerosols. Another example would be the use of partition screens in a passenger assessment area.

Cleaning and disinfection are effective environmental controls for infectious agents spread by indirect contact, and also those spread by droplet transmission, as droplets can settle on surfaces.

2. ADMINISTRATIVE CONTROLS

These are management measures, implemented at an organisational level, to reduce risk of transmission or exposure, for example through screening (when advised by public health), risk assessment, training, exercises, policies (including, for example, occupational health

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2 PANDHUB deliverable D2.4 Guideline for threat assessment may be useful here to identify high risk areas
policies re exclusion from work, preventative vaccination policies, and policies on isolating and assessing suspected passengers) and procedures (e.g. procedures for disembarkation of ill passengers), planning, working practices, and promotion of good practices, (for example use of posters to promote good hand and respiratory hygiene). These measures require consistent implementation to be effective.

3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

The use of PPE is often the most visible element of infection control but its effectiveness relies on compliance and correct usage by individuals, more so than with the administrative or environmental/engineering levels of control. PPE includes, but is not limited to, the use of gloves and facemasks to reduce exposure to pathogens. Selection of PPE depends on the nature of the hazard, its potential impact, and the risks of exposure; in some instances enhanced PPE may be required. *(Use of PPE for safe first assessment of persons under investigation of Ebola Virus Disease in the EU/EEA, ECDC 2014)*

4.2 Guiding principles for infection prevention and control

The guidance provided is built around five principles of infection prevention and control which were developed elsewhere in the PANDHUB project (D2.3 Disease transmission in transport hubs). A brief rationale for the principles is outlined below. The evidence supporting the principles is detailed in annex 2.

The principles are:

1. Ventilation (heating, ventilation and air conditioning (HVAC)) (environmental control)
2. Exclusion of symptomatic persons (administrative control)
3. Separation of international and domestic travellers (administrative control)
4. Interpersonal distancing (administrative and environmental control)
5. Measures to reduce indirect contact transmission (administrative, environmental and PPE control)
4.2.1 Rationale for guiding principles

4.2.1.1 Heating, ventilation and air conditioning (HVAC)

Under-ventilation is a potential risk factor for transmission of airborne pathogens on aircraft, buses and in cars. This control principle can equally well be applied to wider transportation hubs and systems. Conditions in which interpersonal distances are compromised are likely to be made more transmission-prone by combining with hypo ventilation and extended duration of contact, for example an overcrowded aircraft transfer shuttle bus that is held for several minutes with the doors shut between the terminal and the aircraft. Ventilation controls can also be used to mitigate spread in the event of deliberate release of high threat pathogens.

4.2.1.2 Exclusion of symptomatic persons

Transmission in transport hubs can occur when an infectious person gains entry to a transport system and spreads disease to others. Usually these individuals are passengers, but infected airport workers are also potentially capable of infecting multiple passengers if they work whilst infectious, so they should be excluded from work. The focus is on preventing ill passengers from commencing their travel journey or turning them back at the earliest possible moment and equally the exclusion of symptomatic staff. This principle needs to be applied in ways which are practical and also proportional to the threat. For example, it could be argued that it is critically important to prevent someone with symptomatic EVD from entering a transport hub; whereas the same may be less true for the late stages of an influenza pandemic when the virus has already spread globally and is already transmitting in the wider community at the beginning and end points of the journey.

For some infections, (including Ebola and SARS, and possibly pneumonic plague though data are lacking) infectivity is none or minimal before symptoms start. For others, such as influenza, people are infectious before symptoms appear but less so than when symptoms are heavy. Excluding symptomatic people will reduce the risk of transmission; so although it is not possible to identify asymptomatic people or those incubating an infection, it is possible to spot those with obvious symptoms, who will be the most infectious. Therefore staff across the board should be trained in recognising the signs of illness, and opportunities for such recognition highlighted so that efforts can be made to prevent travel where appropriate.
4.2.1.3 Interpersonal distancing

Transport related transmission generally occurs at short range (within approx. 2 metres), perhaps in some cases by a combination of different routes. The practical application of the principle of interpersonal distancing requires attention to passenger flows and densities by area and by time, the aim being to create safe distancing arrangements that are proportional to the threat level. Overcrowding situations such as passport queues, security check queues, pre-boarding areas, airport shuttle buses, and peak travel periods are examples of when interpersonal distances are most likely to be compromised.

The principle of distancing can also be applied to working practices, for example, during a pandemic, alternatives to face-to-face meetings could be used in some instances.

4.2.1.4 Separation of international and domestic passengers

Modelling studies indicate that transport hubs with direct international connectivity are at greater risk of disease importation (and therefore of onward transmission) assuming infected and infectious cases evade travel restrictions. (Gomes, Pastore et al. 2014) It can therefore be deduced that hubs which serve both domestic and international routes will perform better in terms of transmission prevention if domestic and international passenger flows are separated as early as possible during the passenger journey, and that mixing between international and domestic passengers is limited to those crossing between the two systems.

In addition, the separation of international and domestic passengers is, in part, about having confidence that those travelling from countries experiencing a particular outbreak can be separated from those from other countries where there is no such outbreak. This separation is a critical part of border control, which, for example, played a major role during the 2014 Ebola outbreak.

4.2.1.5 Measures to reduce indirect contact

It is recognised in various settings that indirect contact transmission is possible. For example, hand hygiene practiced in primary school settings reduces the incidence of acute respiratory infection (see annex 2, evidence for guiding principles). Inasmuch that there are many frequently touched surfaces in transport hubs and evidence that respiratory viruses can be
recovered from such surfaces (detailed in PANDHUB deliverables D2.2 *Report on hotspots* and D4.4 *Decontamination and disinfection*) it is prudent to include the reduction of indirect contact transmission as a guiding principle. This can be achieved through a combination of cleaning of frequently touched surfaces, hand sanitation (via washing with soap and water, or using alcohol based sanitiser), the adoption of ‘no-touch-face’ behaviours, and the use of PPE in some circumstances. Respiratory hygiene will also reduce the risk of indirect transmission.

4.3 PANDHUB Infection prevention and control guidance

4.3.1 Format of the guidance

The guidance comprises of three elements:

1. Guidance to address ‘routine’ infection risks at points in the passenger journey, i.e. at hotspots for transmission of infection. The risks at each point on the passenger journey are summarised in table format with recommendations and additional points for consideration provided. This advice by journey point will be most useful those concerned with operational management. Tables have been provided for a passenger journey in a typical airport (Tables 1-5) and in a typical sea port (Tables 6-9). The same principles can be applied to the simpler journey through a land transport hub, and the tables adapted to suit the local context.

2. Guidance in the format of ACTION CARDS specific to three key types of communicable disease that pose a serious public health risk: respiratory infections, particularly those with the potential to cause a pandemic; Ebola as an example of viral haemorrhagic fever; and guidance for pneumonic plague (or other high risk respiratory infections). The latter was a late addition in the light of the increase in cases in Madagascar in the second half of 2017. The ACTION CARDS are targeted at key groups (hub operators, passenger service agents, cleaning personnel, baggage handlers, customs personnel, and first responders) for the infection types outlined.

3. Principle based infection prevention and control guidance for hub design and renovation.
For routine risks the advice is offered at three levels:

- **Recommendations**
  This advice constitutes best practice and is evidence based where possible. Best practice should be implemented at all times i.e. not just during outbreaks.

- **Points for consideration**
  Advice at this level is likely to enhance protection but may be dependent on cost, practicality etc.

- **Enhanced infection prevention and control advice for heightened situations**
  Specific and enhanced advice is offered for heightened situations such as during a pandemic or an outbreak.

The ACTION CARDS are aimed at key groups. In the main the groups mirror those selected by IATA in their guidance. This approach was adopted because it is evident that the IATA guidance has been well received and referenced by other groups e.g. PHE when events have occurred. First responders were added to the IATA groups as an important group that requires protection from communicable disease threats as these are often the personnel that have to make rapid risk assessments and decisions armed with little information. It has not been assumed that first responders are health professionals as practices differ state to state.
4.3.2 Routine infection risk on passenger journey

Recommendations and points for consideration for infection prevention and control along the passenger path are detailed in tables 1 to 9. These are provided for an airport passenger journey and a sea port passenger journey. As land transport hubs are generally much simpler, no table has been provided but the same principles apply so the tables can be adapted to context.

For airports only the source of the advice has been indicated where a specific one was available.
### Table 1  Infection prevention and control for airport check-in area

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
<th>Existing source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of desks open is flexible and optimised during busy periods</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
<td>WHO Management of Public Health events in air transport includes social distancing</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Encourage passenger use of on-line check-in</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>Medium</td>
<td>Distancing</td>
<td>Administrative</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Passenger service agents are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
<td>IATA Passive passenger screening; IATA Suspected communicable disease (Guidelines for passenger agents); ICAO Template for National aviation public health emergency preparedness plan; ECEC/29-2 prevention of spread of communicable diseases by means of air travel</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Minimise number of staff in contact with a very sick passenger</td>
<td>Minimise staff exposed to risk</td>
<td>None</td>
<td>Exclusion and distancing</td>
<td>Administrative</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Action</td>
<td>Reason</td>
<td>Indirect contact</td>
<td>Environmental</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
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<td></td>
</tr>
<tr>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids potentially infectious; environment must be decontaminated effectively</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft recommends biohazard kits available to employees</td>
<td></td>
</tr>
<tr>
<td>Cleaning schedules include frequently touched surfaces e.g. counter tops and self-service screens</td>
<td>Frequently touched surfaces may be easily re-contaminated</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
<td>WHO Management of Public Health events in air transport/ACRP Infectious disease mitigation in airports and on aircraft</td>
<td></td>
</tr>
<tr>
<td>Hand sanitisers at check-in desks with signage encouraging their use</td>
<td>To reduce risk of indirect contact transmission</td>
<td>High</td>
<td>Indirect contact</td>
<td>PPE</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft suggests had sanitiser stations at strategic locations, including at check-in counters</td>
<td></td>
</tr>
<tr>
<td>Cleaning audits are conducted regularly</td>
<td>To ensure cleaning reaches required standards</td>
<td>None</td>
<td>Indirect contact</td>
<td>Administrative</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
<td></td>
</tr>
<tr>
<td>Check-in area meets any agreed ventilation requirements</td>
<td>Passenger density can be high; ventilation dilutes infective aerosols</td>
<td>None</td>
<td>HVAC</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
<td></td>
</tr>
<tr>
<td>Hand sanitisers at self-service kiosks with signage encouraging their use before and after using terminal</td>
<td>To reduce risk of indirect contact transmission from terminals that are frequently touched by multiple users</td>
<td>High</td>
<td>Indirect contact</td>
<td>PPE</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft suggests had sanitiser stations at strategic locations, including at check-in counters</td>
<td></td>
</tr>
<tr>
<td>Recommendation / points for consideration</td>
<td>Advice</td>
<td>Rationale</td>
<td>Level of passenger compliance</td>
<td>Principle(s)</td>
<td>Type of control</td>
<td>Existing source</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Periodically conduct cleaning inspections using microbiological testing techniques</td>
<td>To assess quality of cleaning as visual assessment may not be a good indicator of contamination</td>
<td>None</td>
<td>Indirect contact</td>
<td>Administrative</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
<td>Recommendation in outbreak/pandemic</td>
<td>Supply of PPE (inc gloves and facemasks) accessible locally</td>
<td>Protect staff and other passengers (if respiratory infection suspected ask passenger to wear facemask)</td>
<td>High if passenger asked to wear facemask</td>
<td>Indirect contact</td>
<td>PPE</td>
<td>IATA Guidelines for passenger agents</td>
</tr>
<tr>
<td>Recommendation in outbreak/pandemic</td>
<td>Increase cleaning frequency of surfaces touched by multiple people</td>
<td>Frequently touched surfaces may be easily re-contaminated</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
</tbody>
</table>
Table 2 Infection prevention and control for airport security

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
<th>Existing source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of security channels open is flexible and optimised during busy periods</td>
<td>To decrease passenger queuing time i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
<td>WHO Management of Public Health events in air transport includes social distancing</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Security staff are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
<td>IATA Passive passenger screening; IATA Suspected communicable disease (Guidelines for passenger agents); ICAO Template for National aviation public health emergency preparedness plan; ECEC/29-2 prevention of the spread of communicable diseases by means of air travel</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Security staff wear gloves</td>
<td>To reduce risk to staff from contaminated passenger clothing</td>
<td>None</td>
<td>Indirect contact</td>
<td>PPE</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of</td>
<td>All body fluids are potentially infectious; environment must</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft recommends biohazard kits available to employees</td>
</tr>
<tr>
<td><strong>Recommendation</strong></td>
<td><strong>Check-in area meets any agreed ventilation requirements</strong></td>
<td><strong>Passenger density can be high. Ventilation dilutes infective aerosols</strong></td>
<td><strong>None</strong></td>
<td><strong>HVAC</strong></td>
<td><strong>Environmental</strong></td>
<td><strong>ACRP Infectious disease mitigation in airports and on aircraft</strong></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------------------</td>
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<td>---------------------------------------------------------------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Point for consideration</strong></th>
<th><strong>Hand sanitisers are placed at end of queues and at the end of the security section, with signage encouraging their use before and after passing through security</strong></th>
<th><strong>To reduce risk of indirect contact transmission from luggage trays which are repeatedly handled</strong></th>
<th><strong>High</strong></th>
<th><strong>Indirect</strong></th>
<th><strong>PPE</strong></th>
<th><strong>ACRP Infectious disease mitigation in airports and on aircraft - recommends sanitiser station after security line</strong></th>
</tr>
</thead>
</table>
Table 3 Infection prevention and control for airport border control

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
<th>Existing source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of desks open is flexible and optimised during busy periods</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
<td>WHO Management of Public Health events in air transport includes social distancing</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Adoption of Automated Border Control facilities</td>
<td>To help mitigate long queues, to decrease passenger time spent in queues, i.e. decrease duration of close contact</td>
<td>Minimal</td>
<td>Distancing</td>
<td>Administrative</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Border control staff are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
<td>IATA Passive passenger screening; IATA Suspected communicable disease (Guidelines for passenger agents); ICAO Template for National aviation public health emergency preparedness plan; ECEC/29-2 prevention of the spread of communicable Diseases by means of Air Travel</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</th>
<th>All body fluids are potentially infectious; environment needs to be decontaminated effectively</th>
<th>None</th>
<th>Indirect</th>
<th>Environmental</th>
<th>ACRP Infectious disease mitigation in airports and on aircraft recommends biohazard kits available to employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point for consideration</td>
<td>Hand sanitisers are placed at end of queues, just prior to border control desks, with signage encouraging their use</td>
<td>To minimise risk of indirect contact transmission between passengers and border control staff</td>
<td>High</td>
<td>Indirect</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Glass panel screens are used at desks (with gap for exchange of documents)</td>
<td>To reduce risk of transmission from respiratory droplets</td>
<td>None</td>
<td>Distancing</td>
<td>Environmental</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4 Infection prevention and control for airport departure lounges

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
<th>Existing source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Passenger agents are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None, unless acted on then high</td>
<td>Exclusion</td>
<td>Administrative</td>
<td>IATA Passive passenger screening; IATA Suspected communicable disease (Guidelines for passenger agents); ICAO Template for National aviation public health emergency preparedness plan; ECEC/29-2 Prevention of the spread of communicable diseases by means of air travel</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious;</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft recommends biohazard kits available to employees</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Upholstery is impermeable and wipeable or, if fabric, covers removable for machine washing if necessary</td>
<td>Furnishings robust enough to clean effectively</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Hand sanitisers are made available at entrance to lounges with signage encouraging their use</td>
<td>To encourage hand hygiene to decrease risk of indirect contact transmission</td>
<td>High</td>
<td>Indirect</td>
<td>PPE</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
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<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Point for consideration (outbreak/pandemic)</td>
<td>Limit availability of shared items such as magazines and newspapers</td>
<td>To reduce risk of indirect contact transmission from contaminated articles</td>
<td>None</td>
<td>Indirect</td>
<td>Administrative</td>
<td></td>
</tr>
<tr>
<td>Point for consideration (outbreak/pandemic)</td>
<td>Supply boxes of tissues and ensure easy access to bins</td>
<td>To encourage respiratory hygiene to reduce risk of direct and indirect contact transmission</td>
<td>Medium</td>
<td>Indirect</td>
<td>Administrative</td>
<td></td>
</tr>
<tr>
<td>Point for consideration (outbreak/pandemic)</td>
<td>Display notices regarding respiratory hygiene</td>
<td>To encourage respiratory hygiene to reduce risk of direct transmission from coughs and sneezes and indirect contact transmission from used tissues</td>
<td>Medium</td>
<td>Exclusion and indirect</td>
<td>Administrative</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
<td>Point for consideration (outbreak/pandemic)</td>
<td>Display notices regarding hand hygiene</td>
<td>To encourage hand hygiene to decrease risk of indirect contact transmission</td>
<td>Medium</td>
<td>Indirect</td>
<td>Administrative</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
</tbody>
</table>
Table 5 Infection prevention and control for airport departure gates

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
<th>Existing source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Passenger agents are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
<td>IATA Guidelines for passenger agents and IATA Passive passenger screening guidance</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious; environment needs to be decontaminated effectively</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td>ACRP Infectious disease mitigation in airports and on aircraft</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Seating is easy to clean i.e. non-porous with smooth surfaces</td>
<td>For easy removal of contamination</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Holding rails on transfer buses are included in cleaning schedule</td>
<td>These are frequently touched by multiple people; cleaning reduces risk of indirect transmission</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Hand rails of escalators are included in cleaning schedule</td>
<td>These are frequently touched by multiple people so risk of recontamination; cleaning reduces risk of indirect transmission</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
<td>ACRP Infectious Disease mitigation at airports and on aircraft</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------------</td>
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<td>---------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Recommendation</strong></td>
<td><strong>Outbreak/pandemic</strong></td>
<td>Hand sanitisers are made available at exit with signage encouraging their use</td>
<td>To encourage hand hygiene to decrease risk of indirect contact transmission</td>
<td>High</td>
<td>Indirect</td>
<td>PPE</td>
</tr>
</tbody>
</table>
Table 6 Infection prevention and control for port check-in/ticketing

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of desks open is flexible and optimised during busy periods</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Passenger agents are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Minimise number of staff in contact with a very sick passenger</td>
<td>Minimise staff put at risk</td>
<td>None</td>
<td>Exclusion and distancing</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious; environment must be decontaminated effectively</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Cleaning schedules include frequently touched surfaces e.g. counter tops and self-service screens</td>
<td>Frequently touched surfaces may be easily re-contaminated</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Hand sanitisers at check-in/ticketing desks with signage encouraging use</td>
<td>To reduce risk of indirect contact transmission</td>
<td>High</td>
<td>Indirect contact</td>
<td>PPE</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Cleaning audits are conducted regularly</th>
<th>To ensure cleaning reaches required standards</th>
<th>None</th>
<th>Indirect contact</th>
<th>Administrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Increase cleaning frequency of frequently touched surfaces</td>
<td>Frequently touched surfaces may be easily re-contaminated</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
</tr>
<tr>
<td>Outbreak/pandemic</td>
<td>Hand sanitisers at self-service kiosks with signage encouraging their use before and after using terminal</td>
<td>To reduce risk of indirect contact transmission from self-service terminal which are frequently touched by multiple users</td>
<td>High</td>
<td>Indirect contact</td>
<td>PPE</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Periodically conduct cleaning inspections using microbiological testing techniques</td>
<td>To assess quality of cleaning as visual assessment may not be a good indicator of contamination</td>
<td>None</td>
<td>Indirect contact</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>PPE (inc gloves and facemasks) accessible locally</td>
<td>Protect staff and other passengers (if respiratory infection suspected passenger can be asked to wear a facemask)</td>
<td>High</td>
<td>Indirect contact</td>
<td>PPE</td>
</tr>
<tr>
<td>Outbreak/pandemic</td>
<td>Increase cleaning frequency of frequently touched surfaces</td>
<td>Frequently touched surfaces may be easily re-contaminated</td>
<td>None</td>
<td>Indirect contact</td>
<td>Environmental</td>
</tr>
</tbody>
</table>
### Table 7: Infection control for port security

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of security channels open is flexible and optimised during busy periods</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Security staff are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Security staff wear gloves</td>
<td>To reduce risk to staff from passenger contaminated clothing</td>
<td>None</td>
<td>Indirect</td>
<td>PPE</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious; environment needs to be decontaminated effectively</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Hand sanitisers are placed at end of queues and at the end of the security section, with signage encouraging their use before and after passing through security</td>
<td>To reduce risk of indirect contact transmission from luggage trays which are repeatedly handled</td>
<td>High</td>
<td>Indirect</td>
<td>PPE</td>
</tr>
</tbody>
</table>
Table 8: Infection prevention and control for port border control

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>The number of desks open is flexible and optimised during busy periods</td>
<td>To decrease passenger time spent in queues, i.e. decrease close contact</td>
<td>None</td>
<td>Distancing</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Adoption of Automated Border Control facilities</td>
<td>To help mitigate long queues, decreasing passenger time spent in queues, i.e. decrease close contact</td>
<td>Minimal</td>
<td>Distancing</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Border control staff are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious; environment needs to be decontaminated effectively</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Hand sanitisers are placed at end of queues, just prior to border control desks, with signage encouraging their use</td>
<td>To minimise risk of indirect contact transmission between passengers and border control staff</td>
<td>High</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Point for consideration</td>
<td>Glass panel screens are used at desks (with gap for exchange of documents)</td>
<td>To reduce risk of transmission from respiratory droplets</td>
<td>None</td>
<td>Distancing</td>
<td>Environmental</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
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<td>---------------</td>
</tr>
</tbody>
</table>

### Table 9 Infection prevention and control for port departure area/gates

<table>
<thead>
<tr>
<th>Recommendation / points for consideration</th>
<th>Advice</th>
<th>Rationale</th>
<th>Level of passenger compliance</th>
<th>Principle(s)</th>
<th>Type of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Passenger agents are made aware of signs of communicable disease</td>
<td>To increase chance of detection and decrease risk of infectious person travelling</td>
<td>None unless acted on, then high</td>
<td>Exclusion</td>
<td>Administrative</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Spill kits are easily accessible for use by trained staff in the event of a spillage of body fluids</td>
<td>All body fluids are potentially infectious; environment needs to be decontaminated effectively</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Seating is easy to clean i.e. non-porous with smooth surfaces</td>
<td>For easy removal of contamination</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Hand rails of escalators are included in cleaning schedule</td>
<td>These are frequently touched by multiple people so risk of recontamination; cleaning reduces risk of indirect transmission</td>
<td>None</td>
<td>Indirect</td>
<td>Environmental</td>
</tr>
<tr>
<td>Recommendation Outbreak/pandemic</td>
<td>Hand sanitisers are made available at exit with signage encouraging their use</td>
<td>To encourage hand hygiene to decrease risk of indirect contact transmission</td>
<td>High</td>
<td>Indirect</td>
<td>PPE</td>
</tr>
</tbody>
</table>
4.3.3 Action cards for pandemic influenza

ACTION CARDS FOR PANDEMIC INFLUENZA

Note that these action cards come with a ‘What you need to know about …’ as key information regarding particular pathogens. If the cards are used as a stand-alone resource, this information could usefully be placed on the reverse of each card. To avoid unnecessary duplication, that key information is set out once only in this document for each set of action cards.
WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA

- Pandemic influenza differs from seasonal influenza because it is due to a strain of virus (novel or re-emerging) to which most people do not have immunity, and one for which no immediate vaccine is available.

- The symptoms of pandemic influenza are likely to be the same as the most common symptoms of seasonal influenza and include fever, cough, headache, body aches, sore throat and runny nose. A person with influenza can be infectious before symptoms show but will be more infectious when they do have symptoms. The illness generally lasts 1-2 weeks.

- Influenza is spread easily through coughing and sneezing, therefore the main prevention measures are interpersonal distancing, good hand hygiene and good respiratory hygiene, i.e. using tissues or coughing into your sleeve.

- A passenger identified as likely to be infected should be asked to wear a facemask, if it can be tolerated, to reduce the expulsion of droplets into the surrounding environment. If a mask cannot be tolerated, tissues should be offered, along with a bag to dispose of the tissues.

- Influenza virus can survive on surfaces for a number of hours, particularly on hard surfaces, so cleaning is important to reduce transmission through touch. The virus is killed by cleaning with standard cleaning agents. Additional PPE beyond standard for cleaning is not required.
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not come to work
- Staff developing influenza symptoms whilst at work should report illness promptly and should be instructed to go home until well and symptom free, and advised to seek medical advice if symptoms become unmanageable or if the person has a medical condition

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover mouth and nose when coughing, sneezing or blowing nose
- Dispose of used tissues promptly in a nearby waste bin (preferably lined); if tissues are not available, cough into your sleeve
- Avoid touching own eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds, (or use a skin-friendly detergent wipe if water not available), then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds
- Consider supplying personal alcohol hand-rub or communal alcohol hand-rub at main access points to administrative areas and check-in/ticketing areas

Hand Hygiene

Hands should be cleaned before:

- eating or drinking, taking a break/ going home, and before putting on PPE

Hands should be washed using soap and water (or detergent wipe) after:

- Using the toilet, blowing nose or covering a cough or sneeze and when hands are visibly soiled
- Cleaning equipment or environment, or handling waste, and removing PPE

Cleaning

- During a pandemic, consider increasing frequency of routine cleaning, particularly of frequently touched surfaces/objects e.g. door handles
- Equipment such as desks, keyboard and telephones, if shared, should be cleaned before commencing work at a station and at the end of a shift

SEE REVERSE FOR WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not come to work
- Staff developing influenza symptoms whilst at work should report illness promptly and go home until well and symptom free

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover your mouth and nose when coughing, sneezing or blowing your nose
- Dispose of used tissues promptly in a nearby waste bin (preferably lined); if tissues are not available, cough into your sleeve
- Avoid touching eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds, (or use skin-friendly detergent wipe if water not available), then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. Staff may be given personal alcohol hand-rub or communal alcohol hand-rub may be situated behind check-in/ ticketing desk for use at intervals and before leaving area

Hand Hygiene

Hands should be cleaned before:

- eating or drinking, taking a break/ going home, and before putting on PPE

Hands should be cleaned after:

- Using the toilet, blowing nose or covering a cough or sneeze or if hands are visibly soiled (using soap and water or detergent wipe)
- Cleaning equipment, environment or handling waste, or removing PPE

Cleaning equipment

- If shared, equipment such as desks, keyboards and telephones should be cleaned before commencing work at a station and at the end of a shift

Interaction with passengers

- If passenger displays signs of significant respiratory illness, report to supervisor for action.
  - If passenger requires help and is coughing, ask them to wear a facemask. If not available, or it is not tolerated, provide tissues to cover nose and mouth, and a bag for tissue disposal.
  - If the passenger cannot tolerate a mask, the passenger service agent should wear a mask, if trained to put it on and remove it correctly.
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not come to work
- Staff developing influenza symptoms whilst at work should report illness promptly and go home until well and symptom free

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover your mouth and nose when coughing, sneezing or blowing your nose
- Dispose of used tissues promptly in a nearby waste bin (preferably lined); if tissues are not available, cough into your sleeve
- Avoid touching own eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Always cover broken skin with a waterproof plaster
- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a detergent wipe if water not available), then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds

Hands should be cleaned before:
- taking a break or going home, and eating or drinking, putting on PPE

Hands should be cleaned after:
- Using the toilet, blowing nose, sneezing etc, hands become visibly soiled (using soap and water, or detergent wipe if water not available)
- Cleaning environment and handling waste, or removing gloves and any other PPE

ACTIONS TO BE TAKEN BY THOSE RESPONSIBLE FOR CLEANING

- Treat all blood and body fluids as infectious at all times
- Use standard PPE: disposable gloves and a waterproof apron should be worn for cleaning activities
- Use approved cleaning agents
- Where possible clean from clean to dirty areas
- Clean mops and cloths according to standard procedures and dispose of waste according to standard procedures
- Wash hands after removing and disposing of gloves
- Be aware that cleaning frequency may be increased during a pandemic

SEE ‘WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA’
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not come to work
- Staff developing influenza symptoms whilst at work should report illness promptly and be advised to go home until well and symptom free

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover mouth and nose when coughing, sneezing or blowing nose
- Dispose of used tissues promptly in a nearby waste bin (preferably lined); if tissues are not to hand, cough into your sleeve
- Avoid touching own eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds (or using a skin friendly detergent wipe if water not available) then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds
- Staff may be given personal alcohol hand-rub or communal alcohol hand-rub may be available at the entrance/exit to work areas for use at intervals and before leaving the area.

Hand Hygiene

Hands should be cleaned before:

- Taking a break or going home, and eating or drinking

Hands should be cleaned (using soap and water, or skin-friendly detergent wipe) after:

- Using the toilet, blowing nose or covering a cough or sneeze
- Handling waste or hands become visibly soiled

BAGGAGE

- Unless informed otherwise from public health authorities, no special handling of baggage is required unless visibly dirty with blood or body fluids

SEE ‘WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA’
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not come to work
- Staff developing influenza symptoms whilst at work should report illness promptly and be advised to go home until well and symptom free

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover your mouth and nose when coughing, sneezing etc
- Dispose of used tissues in a nearby waste bin (preferably lined); if tissues are not available, cough into your sleeve
- Avoid touching own eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available), then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds.
- Staff may be given personal alcohol hand-rub or communal alcohol hand-rub may be available at the entrance/exit to work areas for use at intervals and before leaving the area.

Hand Hygiene

Hands should be cleaned before:
- A shift that may involve handling or opening passenger luggage and taking a break or going home, and eating or drinking

Hands should be cleaned after:
- Using the toilet, blowing nose or covering a cough or sneeze, handling waste or hands become visibly soiled (using soap and water or skin-friendly detergent wipe) cleaning equipment or environment, removing gloves and any other PPE

Interaction with passengers

- If passengers display signs of severe respiratory illness, refer to supervisor as local policy dictates
  - If the passenger requires assistance and is coughing, ask them to wear a facemask. If none is available, or it is not tolerated, provide tissues to cover the nose and mouth, with a bag for tissue disposal
If the passenger cannot tolerate a mask, it may be prudent for staff to wear a mask, if trained to put in and remove it correctly.

- Unless informed otherwise by public health authorities, no special handling of baggage is required unless it is visibly dirty with blood or body fluids. If a package is visibly contaminated with body fluids or is leaking, waterproof gloves and a plastic apron should be worn.

SEE ‘WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA’
ATTENDING WORK

- To protect others, staff with symptoms of influenza must not work

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover your mouth and nose when coughing, sneezing or blowing nose
- Dispose of used tissues promptly in a nearby waste bin (preferably lined); if tissues are not available, cough into your sleeve
- Avoid touching own eyes, nose and mouth, particularly with gloved or not recently cleaned hands

Hand Hygiene

Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available, then dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds

Hands should be cleaned before:

- taking a break or going home, and eating or drinking

Hands should be cleaned after:

- Using the toilet, blowing nose or covering a cough or sneeze or if hands are visibly soiled (using soap and water or detergent wipe)
- Cleaning equipment or environment, handling waste
- Interacting with ill persons and removing PPE

INTERACTION WITH PASSENGERS

- Disposable gloves should be worn
- Ask the passenger to wear a facemask. If none is available, or it cannot be tolerated, provide tissues to cover the nose and mouth, and a bag for tissue disposal
- The responder should wear a facemask whilst dealing with the passenger, and during transport
- Clean hands after interactions with ill passengers, and after removing facemask or other PPE
- Use disposable linen if available, and treat other linen as infected

SEE ‘WHAT YOU NEED TO KNOW ABOUT PANDEMIC INFLUENZA’
4.3.4 Key sources for pandemic influenza guidance


4.3.5 Action cards for EVD or other VHF

ACTION CARDS FOR EBOLA VIRUS DISEASE OR OTHER VIRAL HAEMORRHAGIC FEVER

Note that these action cards come with a ‘What you need to know about …’ as key information regarding particular pathogens. If the cards are used as a stand-alone resource, this information could usefully be placed on the reverse of each card. To avoid unnecessary duplication, that key information is set out once only in this document for each set of action cards.
WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE

- The chance of passengers with Ebola travelling by public transport is extremely low; anyone infected is likely to be too ill to attempt to travel. It is very hard to catch Ebola unless the person is very ill with symptoms.

- People with Ebola will not spread the infection until they have symptoms. The symptoms of Ebola include fever (noticeable signs include shivering, sweating, pallid complexion), weakness, muscle pains and headache, confusion, vomiting, diarrhoea, and later, unexplained bleeding (such as bloodshot eyes, bleeding gums, nosebleeds).

- Some of the earlier symptoms (fever, headache, muscle aches) match those of a number of other infectious diseases, for example, influenza. If a passenger has not arrived from or been to an affected country in the previous 21 days, such symptoms will not be caused by Ebola.

- Ebola is not spread through the air, and it is not spread by normal social contact with someone who has no symptoms. It is transmitted by direct physical contact with symptomatic people, i.e. contact with blood or other body fluids of an infected person or animal (dead or alive). It can also be present on contaminated clothing, or contaminated surfaces. At room temperature, the virus can survive and remain infective for two weeks or possibly longer on fabrics. The infection can be caught from dead or living animals, including infected bush meat from affected countries.

- The virus is killed by detergent and a broad range of disinfectants (including bleach). Although killed by detergent given the severity of EVD, a disinfectant should be used after cleaning with detergent, once surface is dry. However staff should not attempt to clean up any body fluids, e.g vomit or blood of a person who has a high possibility of having Ebola. Expertise is required for such cleaning and decontamination; public health authorities may be able to advise regarding such arrangements, but the responsibility is that of the hub.
ATTENDING WORK

- Staff should attend work as normal, and report any illness developing at work promptly, using standard procedures

HAND HYGIENE (AT ALL TIMES)

- Always cover broken skin with a waterproof plaster

- Clean hands frequently, by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. In particular, hands should be cleaned
  - before taking a break or going home, and eating or drinking
  - after using the toilet, blowing nose, etc, hands become visibly soiled (using soap and water or skin-friendly detergent wipe), handling waste, cleaning equipment etc

OPERATIONS

- Communicate to all staff who interact with passengers the process for medical referral of passengers suspected of having a high threat serious communicable disease

- Identify a space in advance for (entry) screening in case this is advised by a competent authority

- Make staff aware of disembarkation procedures for sick passengers (generally ill passenger(s) first)

- Identify a space in advance for potentially infected passengers to be taken to post disembarkation

In the event of a passenger with symptoms of Ebola being identified in the hub, after disembarkation, immediate actions are:

- Restrict number of staff in contact with the passenger

- Work with Public Health to assemble list of staff and passengers with potential exposure

- Keeping a safe distance, and avoiding touch, accompany passenger to place of safety where they can be isolated in order to be assessed by emergency services

- Wear PPE for any close interaction with the passenger (gloves at a minimum, but preferably other PPE including facemask to protect nose and mouth from splashes)

- Isolate area where passenger was located (indoors and outdoors)

SEE ‘WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE’
ATTENDING WORK

- Staff should attend work as normal, and report any illness developing at work promptly, using standard procedures.

HAND HYGIENE (AT ALL TIMES)

- Always cover broken skin with a waterproof plaster.
- Avoid touching own eyes, nose or mouth.
- Clean hands frequently by washing with soap and water for at least 20 seconds (or skin-friendly detergent wipe if water not available) and dry well, or use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. Staff may be given personal alcohol hand-rub or communal alcohol hand-rub may be available at check-in/ticketing desks to be used at intervals and before leaving the area.
  - Hands should be cleaned before taking a break or going home, and eating or drinking.
  - Hands should be cleaned after using the toilet, blowing nose, sneezing etc, hands become visibly soiled (using soap and water/detergent wipe), handling waste, cleaning equipment or environment, removing gloves and any other PPE.

INTERACTION WITH PASSENGERS

- If disembarking passengers display signs of severe illness (see over), emergency services will need to be called. Follow standard procedures for this.
- For severely ill passengers, keep a safe distance, and avoiding touch, accompany passenger to place of safety where they can be isolated in order to be assessed by emergency services.
- Wear PPE for any close interactions with suspected passengers (gloves at a minimum, but preferably also PPE to protect nose and mouth from splashes).
- Wash hands with soap and water after any interaction.

SEE ‘WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE’
ATTENDING WORK

- Staff should attend work as normal and report any illness developing at work promptly, using standard procedures

HAND HYGIENE (AT ALL TIMES)

- Always cover broken skin with a waterproof plaster
- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds
- Avoid touching face, particularly with gloved or unwashed hands
- Hands should be cleaned before taking a break or going home, and eating or drinking

Hands should be washed using soap and water/detergent wipe, after:

- Using the toilet, blowing nose, sneezing etc, cleaning environment, handling waste or if hands are visibly soiled, and removing and disposing of gloves and any other PPE

ACTIONS FOR THOSE RESPONSIBLE FOR CLEANING, IN THE EVENT OF POTENTIAL CONTAMINATION

- If an area appears to be contaminated with body fluids such as vomit, blood, faeces, or urine, do not enter area or attempt any cleaning, and do not remove any belongings from the area
- Secure and restrict access to such areas and seek advice from a public health specialist
- If a suspected case is subsequently confirmed (this can take around 24 hours), keep the area secure as a specialist contractor may be required for cleaning. Seek Public Health authority advice regarding the need for this.
- If the passenger has not vomited or had diarrhoea, or had bleeding, it may be possible for cleaning staff to clean a public area that the passenger has passed through; this must be confirmed with Public Health. Additional PPE beyond standard, and cleaning agents beyond standard are not required.

ACTIONS IF A SUSPECTED CASE TESTS NEGATIVE

If a suspected case is confirmed as not infected, normal cleaning of an area can resume:

- Wear waterproof gloves for all cleaning activities
- Treat all blood and body fluids as infectious
- Dispose of waste and disposable PPE according to standard procedures

SEE ‘WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE’
ATTENDING WORK

- Staff should attend work as normal, and report any illness developing at work promptly, using standard procedures

HAND HYGIENE (AT ALL TIMES)

- Always cover broken skin with a waterproof plaster
- Clean hands frequently by washing with soap and water for at least 20 seconds (or a skin friendly detergent wipe if water is not available) and dry well, or use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds

Hands should be cleaned before:

- a shift that may involve handling or opening passenger luggage
- taking a break or going home, and eating or drinking

Hands should be cleaned after:

- using the toilet, blowing nose, sneezing etc, hands become visibly soiled (using soap and water/detergent wipe), handling waste, cleaning equipment or environment
- a shift that involves handling or opening passenger luggage, and removing gloves/ other PPE

ACTIONS TO BE TAKEN BY THOSE DEALING WITH BAGGAGE BELONGING TO A PERSON WITH SUSPECTED EBOLA, OR OTHER SUSPICIOUS BAGGAGE OR CARGO

Baggage will not pose a risk for Ebola unless visibly soiled with blood, fluids or other tissue.

- Wear PPE to handle any package that is leaking; use waterproof gloves and a waterproof layer, such as a plastic apron
- Move any package that is leaking to a place of safety and isolated before closer investigation (wearing PPE as above). If the contents appear suspicious, do not investigate further. Keep the package isolated and contact public health to discuss specialist contractors for disposal.
- Dispose of disposable PPE as biological waste and non-disposable PPE should be disinfected, and bagged up until test results are known

SEE ‘WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE’
ATTENDING WORK

- Staff should attend work as normal, and report any illness developing at work promptly, using standard procedures

HAND HYGIENE (AT ALL TIMES)

- Always cover broken skin with a waterproof plaster
- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds
  - Hands should always be cleaned before taking a break or going home, and eating or drinking
  - Hands should always be cleaned after using the toilet, blowing nose, sneezing etc, hands become visibly soiled (using soap and water or detergent wipe), handling waste, cleaning equipment or environment, removing gloves and any other PPE, patient interaction

INTERACTION WITH PASSENGERS

- If passengers have a travel history that makes them a suspected case, but have only a fever, they are low risk and can be managed with standard precautions in a normal emergency vehicle.

- If EVD is suspected, first responders need to:
  - Put on PPE before approaching passenger (gloves, FFP3 respirator/ fluid resistant mask, (depending on local public health advice) protective clothing e.g. Tyvek suit, eye protection). More protection is required if excretions are copious.
  - Call for specialised transport for transport to an Ebola receiving unit
  - Limit physical interactions to those that are absolutely critical
  - Avoid all aerosolising procedures

- If the passenger requires assistance ask the passenger to wear a facemask. If none is available, or it cannot be tolerated, provide tissues and a biohazard bag for tissue disposal.

SEE ‘WHAT YOU NEED TO KNOW ABOUT EBOLA VIRUS DISEASE’
4.3.6 Key sources for EVD guidance


4.3.7 Action cards for pneumonic plague or other high risk respiratory infections

ACTION CARDS FOR PNEUMONIC PLAGUE OR OTHER HIGH RISK RESPIRATORY INFECTIONS

Note that these action cards come with a ‘What you need to know about …’ as key information regarding particular pathogens. If the cards are used as a stand-alone resource, this information could usefully be placed on the reverse of each card. To avoid unnecessary duplication, that key information is set out once only in this document for each set of action cards.
WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE

- People who have acquired pneumonic plague can develop symptoms rapidly. It is possible that someone who has contracted pneumonic plague could develop symptoms during a journey. Procedures will be in place to respond to such an event on board. This ACTION CARD relates to the hub response after disembarkation.

- Pneumonic plague is transmitted by coughing (of respiratory droplets) so those having close contact (within 6 feet/2 metres) with a person with pneumonic plague may be at risk. Anyone likely to have been in close contact with a person with pneumonic plague should seek medical advice. Public Health conduct contact tracing and deal with prophylaxis, when appropriate.

- A person with pneumonic plague is not likely to spread the infection until they have symptoms. The symptoms include fever (noticeable signs are shivering, sweating, pale complexion), coughing (possibly bloody) aches, chest pain, difficulty breathing, abdominal pain, possibly with vomiting or diarrhoea, so an infected passenger will appear to be quite ill. Some symptoms (fever, headache, muscle aches) match those of some other infectious diseases, for example, influenza. If a passenger has not been in close contact with a person with pneumonic plague in the previous seven days, such symptoms will not be caused by pneumonic plague.

- A passenger identified as likely to be infected should be asked to wear a facemask (at any point on their journey) to reduce the expulsion of respiratory droplets into the environment. If they cannot tolerate a mask, they should be given tissues to cover the nose and mouth, and a plastic bag for used tissues.

- Staff helping the affected passenger, or other passengers positioned very close to the suspected passenger, should also wear a facemask.

- The bacteria (*Yersinia pestis*) can survive for prolonged periods on surfaces contaminated by respiratory secretions so cleaning is important. The bacteria are susceptible to a broad range of disinfectants, including bleach.
ATTENDING WORK

- Staff developing symptoms of severe respiratory infection or flu-like illness at work should seek prompt medical attention, particularly if they have had close contact with a person with a severe respiratory illness in the previous 7 days.

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a paper tissue to cover mouth and nose when coughing, sneezing or blowing nose, and dispose of used tissues promptly in a nearby waste bin (preferably lined).
- Avoid touching your eyes, nose and mouth, particularly with gloved or not recently cleaned hands.
- Clean hands frequently by washing with soap and water for at least 20 seconds, (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. Consider supplying personal hand-rub, or communal hand-rub at access points to administrative areas/check-in/ticketing points.

OPERATIONS

- Communicate to all staff who interact with passengers the process for medical referral of passengers suspected of having a serious communicable disease.
- Identify a space in advance for entry screening in case this is advised by a competent authority.
- Make staff aware of disembarkation procedures for passengers suspected of having a communicable disease (generally ill passenger(s) first).
- Identify space in advance for potentially infected passengers to go to post disembarkation.
- Ensure procedures in place for transfer to medical facility.
- Make facemasks available at strategic points in the hub. Train staff in the use of facemasks for their own use, and in how to instruct a member of the public to put on a mask (a suspected passenger should be requested to wear a mask if it can be tolerated).
- Work with Public Health authorities to ensure measures are in place for the distribution of prophylactic antibiotics to staff/passengers who have had close contact with a suspected case, and for providing passengers with information about their health and what to look for, post disembarkation.

Cleaning

- Cleaning activities should be conducted as normal. However in the event of a person suspected of having a severe respiratory infection being in the hub for a prolonged period, enhanced cleaning using a bleach-based disinfectant should be undertaken, paying attention to hard surfaces.
ATTENDING WORK

- Staff developing symptoms of flu-like illness or severe respiratory infection whilst at work should seek prompt medical attention, particularly if they have had close contact with a person with a severe respiratory illness in the previous 7 days

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a tissue to cover your mouth and nose when coughing, sneezing or blowing your nose and dispose of used tissues promptly in a nearby waste bin (preferably lined)
- Avoid touching your eyes, nose and mouth particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds (use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. Staff may be given personal hand-rub or communal hand-rub may be at check-in/ticketing desks for use at intervals and before leaving the area.

Cleaning equipment

- Equipment such as desks, keyboards and telephones, if shared, should be cleaned before commencing work at a station and at the end of a shift

INTERACTION WITH PASSENGERS

- If disembarking passengers display signs of severe respiratory illness (see over), report to supervisor so that appropriate action can be taken; this may result in a referral to medical staff
- If the passenger requires assistance and is coughing, ask the passenger to wear a facemask. If none is available, or it cannot be tolerated, provide tissues to cover the mouth, and provide a plastic bag for tissue disposal. If assisting a passenger, wear gloves if possible, to prevent contact with respiratory secretions.
- If the passenger cannot tolerate a mask, it may be prudent for the passenger service agent to wear a mask, if trained to put it on and remove it correctly
- Passenger service agents should be aware of the procedure for ensuring that belongings of an affected passenger remain with the passenger

SEE ‘WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE’
ATTENDING WORK

- Staff developing symptoms of flu-like illness or severe respiratory infection whilst at work should seek prompt medical attention, particularly if they have had close contact with a person with a severe respiratory illness in the previous 7 days.

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a tissue to cover your mouth and nose when coughing, sneezing or blowing your nose and dispose of used tissues promptly in a nearby waste bin (preferably lined).
- Avoid touching your eyes, nose and mouth, particularly with gloved or not recently cleaned hands.
- Always cover broken skin with a waterproof plaster.
- Clean hands frequently by washing with soap and water for at least 20 seconds, (use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds. Staff may be given personal alcohol hand-rub.

Hands should be cleaned before:
- eating or drinking, taking a break/going home, and putting on PPE

Hands should be cleaned after:
- Using the toilet, blowing nose, sneezing etc, or hands become visibly soiled (using soap and water/detergent wipe).
- Cleaning environment and handling waste.
- Removing gloves and any other PPE.

MEASURES FOR THOSE RESPONSIBLE FOR CLEANING, IN THE EVENT OF POTENTIAL CONTAMINATION

- A communal area that the passenger has passed through can be cleaned as normal. Additional PPE beyond standard is not is required. Standard cleaning agents should be used.
- Wear disposable gloves, and a waterproof apron for all cleaning activities.
- Treat all blood and body fluids as infectious.
- Dispose of waste according to standard procedures.

SEE ‘WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE’
ATTENDING WORK

- Staff developing symptoms of severe respiratory infection or flu-like illness whilst at work should seek prompt medical attention particularly if they have had close contact with a person with a severe respiratory illness in the previous 7 days.

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a tissue to cover mouth and nose when coughing, sneezing or blowing the nose and dispose of used tissues promptly in a nearby waste bin (preferably lined).

- Avoid touching your eyes, nose and mouth, particularly with gloved or not recently cleaned hands.

- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds.

- Staff may be given personal hand-rub or communal hand-rub may be situated at the entrance/exit to work areas to be used at intervals and before leaving the area.

Hands should be cleaned before:

- Taking a break or going home, and eating or drinking, or putting on PPE.

Hands should be cleaned after:

- Using the toilet, blowing nose or covering a cough or sneeze, handling waste or when hands become visibly soiled (using soap and water or skin-friendly detergent wipes).

- Removing PPE.

BAGGAGE

- Unless informed otherwise from public health authorities, no special handling of baggage is required unless visibly dirty with blood or body fluids.

SEE ‘WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE’
ATTENDING WORK

- Staff developing symptoms of flu-like illness or severe respiratory infection whilst at work should seek prompt medical attention, particularly if they have had close contact with a person with a severe respiratory illness in the previous 7 days.

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a tissue to cover mouth and nose when coughing, sneezing or blowing nose and dispose of used tissues promptly in a nearby waste bin (preferably lined).
- Avoid touching your eyes, nose and mouth, particularly with gloved or not recently cleaned hands.
- Clean hands frequently by washing with soap and water for at least 20 seconds, (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds.
  - Hands should be cleaned before a shift that may involve handling/ opening passenger luggage and before taking a break or going home, eating or drinking, or putting on PPE.
  - Hands should be cleaned after using the toilet, blowing nose, sneezing etc, hands become visibly soiled (using soap and water/detergent wipe), handling waste, cleaning equipment or environment, removing gloves and any other PPE.

INTERACTION WITH PASSENGERS

- If passengers display signs of severe respiratory illness, report to supervisor for further action.
- If the passenger requires assistance and is coughing, ask the passenger to wear a facemask. If none is available, or it cannot be tolerated, provide tissues to cover the nose and mouth, and a bag for tissue disposal. If assisting a passenger, wear gloves if possible, to prevent contact with respiratory secretions.
- If the passenger cannot tolerate a mask, the customs official may wear a mask, if trained to put it on and remove it correctly.
- Wear waterproof gloves to handle any package that is visibly contaminated with body fluids and also a plastic apron if a package is leaking.

SEE ‘WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE’
ATTENDING WORK

- Staff should attend work as normal, and report any illness developing at work promptly, using standard procedures

RESPIRATORY AND HAND HYGIENE ADVICE (AT ALL TIMES)

- Use a tissue to cover mouth and nose when coughing, sneezing or blowing nose and dispose of used tissues promptly in a nearby waste bin (preferably lined)
- Avoid touching your eyes, nose and mouth, particularly with gloved or not recently cleaned hands
- Clean hands frequently by washing with soap and water for at least 20 seconds (or use a skin-friendly detergent wipe if water not available) and dry well. Alternatively use alcohol hand-rub (at least 60% alcohol) for 15-20 seconds
  - Clean hands before taking a break or going home, and eating or drinking, putting on PPE
  - Clean hands after using the toilet, blowing nose, etc, or if hands become visibly soiled (using soap and water/detergent wipe), and after handling waste, cleaning equipment or environment, removing PPE and after any interaction with ill passengers

- Always cover broken skin with a waterproof plaster

INTERACTION WITH PASSENGERS

- Standard precautions should be used for all patients (disposable gloves). Precautions against infectious respiratory transmission should also be taken i.e. respiratory protection (not just a surgical facemask), plus eye protection, gloves, and gown if available
- Ask ill passenger to wear a facemask. If it cannot be tolerated, provide tissues and a bag for tissue disposal. Other staff or passengers very close to the ill passenger should wear a facemask
- Follow local procedures for transfer of high risk patients
- If passenger displays signs of severe respiratory illness (see over), first responders need to:
  - Limit physical interactions to those that are critical
  - Avoid all aerosolising procedures

SEE ‘WHAT YOU NEED TO KNOW ABOUT PNEUMONIC PLAGUE’
4.3.8 Key sources for pneumonic plague guidance


4.3.9 Key sources for general infection prevention and control guidance


5. Introduction to preparedness planning for communicable disease threats

5.1 Regulatory frameworks

5.1.1 International Health Regulations (IHR) 2005

The purpose of IHR 2005 is to ‘prevent, protect against, control and provide a public health response to the international spread of diseases’. The revised regulations (implemented by WHO in 2007) set out a legally binding framework for detecting, reporting, managing and responding to outbreaks of infectious disease or other hazards. Member countries are obliged under IHR to report particular public health events to WHO. WHO verifies the event and collaborates with others to assess the potential for international spread. IHR National Focal Points provide the communication network for the notification of a potential public health emergency of international concern (PHEIC) and other public health events, both nationally and upwards to WHO. A PHEIC is an extraordinary public health event that constitutes a risk to other states through the international spread of disease, and may require a coordinated international response. The definition implies that the event is serious, unusual or unexpected. If appropriate, WHO can offer technical guidance, co-ordinate information exchange and offer other assistance as appropriate.

In 2016, following the Ebola outbreak, WHO reviewed and reported on the ‘Role of the IHR (2005) in the Ebola outbreak and response’. The resulting 87 page report included lessons learned; 12 recommendations were made, primarily with regard to implementation and improved delivery of IHR. Relevant to hubs, the recommendations included establishing a task force with ICAO, IATA, the International Maritime Organization (IMO), (a specialised agency of the UN) and other stakeholders to facilitate rapid information sharing. Such a task force was set up for Ebola in 2014.

5.1.1.1 Hub (PoE) responsibilities under IHR

IHR Annex 1 (B) details capacities specific to PoE. These vary between routine ones required at all times, and additional ones required during a PHEIC. At all times there must be
provision of medical services, equipment and premises; access to transport for sick passengers; a safe environment; and access to equipment and personnel for transport to a medical facility. During a PHEIC, the additional measures most relevant to preparedness and infection prevention and control for the hub are the requirement for a contingency plan; designated space for interviewing travellers suspected of having a communicable disease; the application of border controls (screening), and access to specialist equipment and PPE (with training).

5.1.1.2 Competent authority responsibilities under IHR

IHR define a competent authority as 'the authority responsible for the implementation of health measures under IHR'. This is commonly a port health authority but there may not be consistency between different State parties. The responsibilities under IHR are numerous and include, for example, implementing agreements and arrangements for the management of passengers displaying symptoms of a disease of concern, and working with ports to establish an area where such people can be assessed.

Whilst there is delineation between hub responsibilities and competent authority responsibilities, cooperative working is an important principle of preparedness.

5.1.2 Serious cross-border threats to health

EU Legislation (Decision 1082/2013/EU) was introduced in 2013 to improve preparedness and strengthen the capacity to respond to health emergencies, thus improving health security in the region, including protection from communicable diseases. A serious cross-border threat to health is defined as 'a life-threatening or otherwise serious hazard to health of biological, chemical, or environmental or unknown origin which spreads or entails a significant risk for spreading across the national borders of member states, and which may necessitate coordination at Union level in order to ensure a high level of human health protection.' The benefits of the Decision on serious cross-border threats were to strengthen preparedness planning, improve risk assessment, establish arrangements for a joint EU procurement of medical countermeasures, and enhance the response at EU level by the existence of a legal mandate.
5.1.3 Regulatory frameworks for airports

The international regulatory framework for the aviation sector is robust. A legally binding framework is set out in the Convention on International Civil Aviation (the Chicago Convention) which stipulates that, with regards to public health, **aerodrome/airport emergency plans must include plans for public health emergencies**. In addition, national public health plans are required to contain an element of aviation. The Convention ensures these reciprocal elements are present and put into practice. There is also a regulatory framework at the EU level. At a national level there are regulatory bodies, for example the Civil Aviation Authority, which is the statutory body that oversees civil aviation for the UK.

5.1.4 Regulatory frameworks for seaports

Under IHR seaports must maintain public health contingency plans for PoE to prevent the spread of diseases internationally. The United Nations Convention on the Law of the Sea (UNCLOS) dictates that national laws apply while a ship is at a port or within 24 nautical miles of land. In addition the IMO provides a regulatory framework for the shipping industry, overseeing and implementing ‘conventions’ for international shipping. In this role they share information regarding particular communicable disease threats.

The international regulatory and legal frameworks are detailed in WHO’s *Handbook for management of public health events on board ships*, WHO 2016)

Whilst the SHIPSAN project was established to coordinate action for the EU, the responsibilities are not regulatory. IHR applies, as do regulations from each nation.

At a national level the countries own Administrations will be involved in regulation. For example, in the UK, in addition to Public Health Regulations, the Maritime Coastguard Agency has statutory responsibilities for the safety of shipping in the UK and has the power to detain ships, and UK Border Force enforces the law regarding the UK border.

5.1.5 Regulatory frameworks for land transport hubs

Regulatory frameworks for land transport are primarily at a national level. For example, in the UK the Transport Act delivers legislation and the Government Department of Transport offers the strategic framework and provides policy. These bodies also oversee the aviation and maritime sectors.
5.2 Strategic frameworks

5.2.1 Role of WHO

WHO describe their strategic role for preparedness in their *Strategic framework for emergency preparedness*, (WHO 2017). A key strategic outcome discussed in the document is that of operational readiness, which facilitates a timely and effective response to an emergency. Some of the essential requirements for operational readiness include planning, coordination, role clarification, capacity, risk assessment and knowledge. WHO encourage and support intersectoral and international collaboration and provide and disseminate technical support and guidance for prevention, early detection and control of public health risks at PoE. They support preparedness capacity, for example they host a Strategic Partnership Portal ⁴ and provide an *Assessment tool for core capacity requirements at designated airports, ports and ground crossings*. (WHO 2009) They also provide certification for airports and ports. WHO disseminate other IHR related communication such as information bulletins for public health and other stakeholders, IHR training materials for example an e-learning Health security training platform ⁵ They established PAGNet,⁶ a web-based network that brings together port health officials and other key partners.

5.2.1 Other strategic frameworks

The European Commission (EC) published a document: *Strategy for generic preparedness planning: technical guidance on generic preparedness planning for public health emergencies* (EC 2011) which includes a section on bridging the gap between disciplines or sectors. Also at the EU level is the European Civil Aviation Conference (ECAC), a strategic intergovernmental organisation that seeks to harmonise policies and practices among Member States.

For the maritime sector a project aim within SHIPSAN was to develop and establish and EU integrated strategy for safeguarding the health of passengers and crew.

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⁴ [https://extranet.who.int/donorportal/](https://extranet.who.int/donorportal/)
⁵ [https://extranet.who.int/hslp/training/](https://extranet.who.int/hslp/training/)
⁶ [Ports, Airports and Ground Crossings Network](http://www.who.int/ihr/ports_airports/pagnet/en/)
An example of a strategic framework at a national level is the Association of Port Heath Authorities in the UK which liaises with international bodies such as WHO as well as relevant bodies at EU and national level. The association is concerned with both seaports and airports, developing strategy and policy nationally, and contributes to international policy development.

In the aviation sector there are a number of specialised organisations which work together strategically for a coordinated approach.

**International Civil Aviation Organization (ICAO)**

ICAO is a specialized UN agency which was established in 1944 and works with Member States and global aviation organisations to develop international standards, underpinned by the Chicago Convention, which are then adopted by each nation. It works closely with WHO in the development of Standards and Recommended Practices (SARPS), technical guidance and operational procedures. Their ultimate goal is for globally harmonised preparedness plans to mitigate the health risks from the spread of communicable diseases; ICAO play a coordinating role in developing communication links to work towards this. ICAO have collected together their health-related guidance in one document *(Health related SARPS and guidelines, ICAO 2014)*.

**Airport Council International (ACI)**

ACI is a global organisation which focuses on airports, which aims to achieve cooperation for all sections of the aviation industry and their stakeholders, as well as with governments and international organisations. In 2009 they published *Airport preparedness for outbreaks of communicable disease*, (ACI 2009).

**International Air transport Association (IATA)**

IATA supports the aviation industry, acting as a trade association for airlines across the world. It provides global standards, including one for health. Although their focus is airlines, they have published guidance regarding the management of communicable diseases for various personnel groups, relevant to airport staff, which has been well accepted and widely adopted.
Collaborative Arrangement for the Prevention and Management of public health events in Civil Aviation (CAPSCA)

This ICAO global programme, established in 2006, aims to improve preparedness planning and response to public health events that affect the aviation sector. Its aim is to coordinate the international aviation response to public health events, ensuring compliance with IHR and it helps implement ICAO, WHO, ACI and IATA guidelines, fostering harmonisation. As part of this CAPSCA undertake assistance visits to airports which include detailed reviews of preparedness plans.

5.3 Operational frameworks

In the context of this report operational frameworks are those that support and implement strategic goals. These occur most commonly at a business level, i.e. they are operators’ own policies. For example Heathrow airport has a protocol for the notification of infectious disease at the airport, designed to prevent importation of disease or disease vectors into the UK, relevant to departing and arriving passengers (and staff) (Protocol for the notification of communicable disease or any death on board an aircraft at Heathrow airport, BAA Heathrow 2012). The safety instruction is based on IHR and Public Health legislation. Similarly Finland has a joint airport preparedness plan for imported cases of serious infectious diseases.

As an example of operational frameworks for land transport, in the UK, there is the Association of Train Operating Companies (ATOC). In 2008 ATOC and National Rail issued guidance on contingency planning for pandemic influenza to support government objectives with regard to continuity of services and return to normality. Topics included preparedness and infection prevention and control such as such as communication of advice on personal hygiene; not working when ill, interpersonal distancing etc. The guidance content was based on information provided by the UK Government Department of Health and the UK Government Cabinet Office. (UK Influenza pandemic preparedness strategy, Department of Health 2011)
5.4 PANDHUB preparedness checklists for infection prevention and control

5.4.1 Format of preparedness guidance

The format of the preparedness guidance is that of checklists to facilitate hub operators in ensuring that their preparedness plans are comprehensive and include all the recommended elements. The checklists are structured around: policy, communication, coordination, staff protection, passenger protection, case management and risk management. The lists indicate a source for the advice, where this exists. Checklists are provided for airports only, however the type of issues addressed are transferable to other types of transport hub.
## 5.4.2 Checklists and gap analysis for airport preparedness

### AREA: NATIONAL POLICY AND DOCUMENTATION

#### GOALS
- To facilitate a response to threats that is consistent with legal requirements and national policy
- To promote a unified approach to the management of public health threats at airports

<table>
<thead>
<tr>
<th>Question</th>
<th>Response (Y/In progress/No)</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status</th>
<th>If ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a system for informing competent authority of a public health event?</td>
<td>No = GAP</td>
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<td>ICAO Annex 14, 9.1.1-9.1.3)</td>
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<tr>
<td>Is there an (AIRPORT specific) preparedness plan for Public Health events and PHEICs?</td>
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<td>ICAO Annex 14, 9.1.1-9.1.3</td>
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<tr>
<td>Is there an airport Emergency Response Plan (ERP)/ Aerodrome Emergency Plan (AEP)?</td>
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<td>ICAO Annex 14, 9.1.1-9.1.3</td>
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<tr>
<td>Is the airport aviation preparedness plan for public health events part of the Aerodrome Emergency Plan?</td>
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<td>ICAO Annex 14, 9.1.1-9.1.3</td>
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<tr>
<td>Is there a distribution list for the ERP/AEP?</td>
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<td>Is communicable disease specified in ERP/AEP?</td>
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<td>Is the ERP distributed to all airlines?</td>
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<td>Has the ERP been tested in exercises?</td>
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<td>Template for a National Aviation PH Emergency Preparedness Plan; ICAO Guidelines for States - general preparedness; ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<td>Is there a contingency plan for communicable disease?</td>
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<td>ICAO Annex 11, Attachment C</td>
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<tr>
<td>Question</td>
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<td>If yes, detail where it is addressed</td>
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<tr>
<td>Is a Contact Point identified for policy formulation and operational organization for preparedness?</td>
<td>No = GAP</td>
<td></td>
<td></td>
<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Is it clear whose role it is to implement the preparedness plan?</td>
<td></td>
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<td></td>
<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the airport preparedness plan address airport response to screening that WHO may advise for defined periods?</td>
<td></td>
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<td></td>
<td>WHO IHR (2005); ICAO Annex 9</td>
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<tr>
<td>Does the airport preparedness plan include transport of ill passengers to health facilities?</td>
<td></td>
<td></td>
<td></td>
<td>ACI Airport preparedness guidelines for outbreaks of communicable disease; IHR(2005), Annex 1B</td>
<td></td>
</tr>
</tbody>
</table>
## AREA: COMMUNICATION

### GOALS:
- To establish an infrastructure for communication required during public health events, in line with international guidance, to facilitate a swift response to the events
- To ensure a system is in place for the communication of information regarding mitigation measures to be taken in the event of a public health event to relevant parties and to ensure that the communication is timely and consistent between parties
- To inform staff, passengers and other people in the hub about what measures they can personally take to lower the risk of infection
- To ensure there is a system to keep passengers informed about public health events that may affect them, and to minimise public concern

<table>
<thead>
<tr>
<th>Question</th>
<th>Response (Y/In progress/No)</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status if ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
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<tbody>
<tr>
<td>Is the ERP distributed to all hub personnel?</td>
<td>No = GAP</td>
<td></td>
<td></td>
<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
</tr>
<tr>
<td>Does the plan (airport preparedness plan) include communication links with airlines?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with handling agents?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with air traffic management?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<td>Does the plan include communication links with local hospitals?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with emergency medical services?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with police?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with customs?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Question</td>
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<tr>
<td>Does the plan include communication links with immigration?</td>
<td>No = GAP</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<td>Does the plan include communication links with security?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with airport retailers?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<td>Does the plan include communication links with airport customer services?</td>
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<tr>
<td>Does the plan include communication links with public health authority?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
</tr>
<tr>
<td>Does the plan include communication links between public health authority and affected aircraft?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<td>Does the plan include communication links with travellers in the terminal?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include communication links with other airports in country?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the plan include a strategy for communication links with local/national media?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
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<tr>
<td>Does the airport preparedness plan include communication links with organisations concerned with migration?</td>
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<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
</tr>
<tr>
<td>Question</td>
<td>Response (Y/In progress/No)</td>
<td>If yes, detail where it is addressed</td>
<td>If ‘in progress’ indicate status</td>
<td>GAP</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Is there a system to inform passengers about screening, should this be instigated? e.g. plans for screen display/posters, with/without audible announcements using public address system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there a system to safeguard against accidental release of emergency announcements?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are command and control systems in place for management of public health event?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there a process for dissemination of safety related documentation?</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
## AREA: COORDINATION

### GOALS:
- To ensure that mechanisms are in place so that the response to a public health event is swift and effective
- To ensure a coordinated response among responders

<table>
<thead>
<tr>
<th>Response (Y/In progress/No)</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status if ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are command and control systems in place for management of public health event?</td>
<td>No = GAP</td>
<td></td>
<td>ICAO Annex 14 paras. 9.17 – 18 ICAO web-based Guidelines for States</td>
</tr>
<tr>
<td>Is there a process for recording suspected communicable disease events?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the procedure clear for initiating the plan, and for standing down again?</td>
<td></td>
<td></td>
<td>Capsca</td>
</tr>
<tr>
<td>Is there a system to implement screening measures for passengers?</td>
<td></td>
<td></td>
<td>WHO Pandemic influenza preparedness and Response, 2009</td>
</tr>
<tr>
<td>Is there an area (pre-airside) designated for dealing with anyone who on screening is suspected of having a communicable disease?</td>
<td></td>
<td></td>
<td>ICAO web-based Guidelines for States</td>
</tr>
</tbody>
</table>
### AREA: STAFF PROTECTION

#### GOALS
- To reduce risk of exposure of staff to communicable disease from interaction with passengers

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status</th>
<th>If ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are staff trained in recognising signs of communicable disease?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IATA guidelines (passenger agents, border control)</td>
</tr>
<tr>
<td>Is PPE available for staff when dealing with passengers suspected of having a communicable disease?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is PPE available for staff when dealing with passengers suspected of having a communicable disease on screening?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are all staff likely to use PPE, trained in its use?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are written and pictorial instructions available for using PPE?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are staff informed of need for minimal staff in contact with a very sick passenger?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are spill kits accessible to staff at points throughout hub?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are staff trained to use spill kits?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are procedures in place for the removing bio-hazard waste?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do local pandemic contingency plans include alternatives to face to face meetings?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is a system in place to notify aircraft cleaners if special cleaning is required?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### PASSENGER PROTECTION

**GOALS**
To encourage good hand and respiratory hygiene for passengers

<table>
<thead>
<tr>
<th></th>
<th>Response</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status</th>
<th>If ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there posters for hand hygiene in washrooms at all times?</td>
<td>No = GAP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there posters for respiratory hygiene at points throughout hub? (PANDEMIC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there contingency for increasing cleaning frequency in event of public health event?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there capacity for increase in supplies of hand hygiene agents such as hand sanitiser and tissues, if required?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### AREA: MANAGEMENT OF CASES

#### GOALS
- To minimise risks to fellow passengers, and to hub-based staff
- To minimise inconvenience to passengers through lost luggage etc.
- To ensure rapid handover of passengers who require medical assessment and care

<table>
<thead>
<tr>
<th>Question</th>
<th>Response (Y/In progress/No) No = GAP</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status If ‘GAP’, indicate action</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a designated area able to be used as a temporary holding area for passengers suspected of having a communicable disease, after disembarkation?</td>
<td></td>
<td></td>
<td></td>
<td>WHO IHR (2005)</td>
</tr>
<tr>
<td>Are there systems in place for handling baggage, security screening, customs clearance and border control for passengers identified as suspect cases?</td>
<td></td>
<td></td>
<td></td>
<td>ICAO, IATA and ACI web-based Guidelines for airport operators</td>
</tr>
<tr>
<td>Are partition screens or equivalent available in a temporary area for separating passengers who require medical assessment from each other?</td>
<td></td>
<td></td>
<td></td>
<td>Same principle as outlined in ‘Handbook for the management of public health events on board ships’ (WHO 2016) P64</td>
</tr>
<tr>
<td>Is an appropriate*7 parking place established for an aircraft arriving with one or more suspected or confirmed cases of communicable disease?</td>
<td></td>
<td></td>
<td></td>
<td>ACI Airport preparedness guidelines for outbreaks of communicable disease</td>
</tr>
<tr>
<td>Is there a designated ambulance loading point?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*7 Must have easy access for public health and ambulance services. Must be able to have continuous ventilation on aircraft and other services eg waste disposal, electricity, water supply.
### RISK MANAGEMENT

**GOALS:**
To reduce risks by implementing administrative controls

<table>
<thead>
<tr>
<th>Question</th>
<th>Response (Y/In progress/No)</th>
<th>If yes, detail where it is addressed</th>
<th>If ‘in progress’ indicate status</th>
<th>Source (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do international passenger flows mix with domestic passenger flows on arrival?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are policies in place for maximising check-in desk opening at busy periods to avoid crowding?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are policies in place for maximising security point opening at busy periods to avoid crowding?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are criteria for denial of boarding clear, and communicated to all relevant staff?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are cleaning audits conducted regularly?</td>
<td></td>
<td></td>
<td></td>
<td>ACRP Disease Mitigation in Airports and on Aircraft</td>
</tr>
<tr>
<td>Are cleaning inspections scheduled at frequent intervals?</td>
<td></td>
<td></td>
<td></td>
<td>ACRP Disease Mitigation in Airports and on Aircraft</td>
</tr>
<tr>
<td>Does the organisation have system to capture data relevant to risk management?</td>
<td></td>
<td></td>
<td></td>
<td>ICAO annex 6 (from SMS model Gap analysis),</td>
</tr>
<tr>
<td>Is there emergency response training for all personnel?</td>
<td></td>
<td></td>
<td></td>
<td>from SMS model Gap analysis</td>
</tr>
</tbody>
</table>
6. Methods

In order to gain an overview of current policy, a literature review (not systematic) was undertaken to identify documents relevant to infection prevention and control and documents relevant to preparedness. The approach was designed to identify key publicly available documents from major organisations involved in transport and transport hubs, including those with an interest in limiting cross border communicable disease transmission such as WHO and ECDC, as well as other key documents relating to infection prevention and control for PANDHUB pathogens. The search included both PubMed and Google to increase the likelihood of finding relevant policy papers rather than just academic papers. The reference lists of the policy papers were reviewed for further relevant documents. Search results from the systematic review for the PANHUB deliverable on transmission of infection on transport hubs were also re-visited for relevant scientific papers and reports.

In addition, relevant websites were searched for documents and information. These included:

- ICAO
- IATA
- ACI
- CDC
- ECDC
- WHO
- Port Health Authorities
- UK Department of Heath

7. Review results

Through Google searches of the organisations listed above, 127 potentially relevant documents were identified, the majority of which were not journal papers. From these searches, and the references used in those documents, 87 were documents were identified as directly relevant to preparedness and infection prevention and control in the context of transport hubs. Table 12 details those documents used to inform guidance or referred to otherwise in this report. The table indicates their key features and provides a link to them.
Note that these documents are identified by use of an *italic font* in this document and that they are listed by name and detailed; they are not in the standard list of References. Other documents that have relevance but are not specific to the transport hub context and not directly referenced in this document are included in the bibliography.

Whilst contributing to the knowledge underpinning principle driven infection prevention and control guidance, and being drawn on for the action cards on occasion, guidance specifically for healthcare environments has not been reviewed. For example hand hygiene advice is adopted from that issued by WHO, e.g. *WHO Guidelines on hand hygiene in health care: a summary* (WHO 2009) which is extensively evidence-based. Similarly Department of Health guidance for pandemic influenza for healthcare settings, and for ambulance services informed some action points but is not reviewed here as a document in its own right. (*Influenza: summary of guidance for infection control in healthcare settings*, Department of Health 2010 and *Influenza: summary infection control guidance for ambulance services during an influenza pandemic*, Department of Health 2010)

As infection prevention and control is part of the response to a public health event, not unexpectedly, infection prevention and control guidance was often found within preparedness guidance, rather than being distinct documentation. In the following reviews of infection prevention and control guidance and preparedness guidance, (sections 7.1 and 7.2) a degree of cross-referencing has been required to ensure that relevant documents are referenced in both sections where appropriate.

### 7.1 Review of existing infection prevention and control guidance

The search identified infection prevention and control guidance from a variety of sources, and included sector-specific guidance as well as disease-specific guidance. Some of the guidance identified is intended for use globally, some regionally (e.g. EU) and some intended for use nationally. Much of the existing transport sector guidance is specific to on board events rather than transport hubs.

Detailed advice related to travel has tended to emerge in response to major public health events in which travel, particularly air travel, is a particular concern, such as SARS in 2003, the 2009 influenza pandemic and the 2014 Ebola outbreak. Advice for ships and aircraft regarding pneumonic plague was published (by ECDC) in response to the Madagascar outbreak in 2017. (*Outbreak of plague in Madagascar, 2017*, ECDC 2017)
7.1.1 Existing non-sector-specific PoE guidance

In 2012 WHO published a guide for *Public health contingency planning at points of entry*, (WHO 2012), targeted at national PoE Health Authorities to guide local health officers and emergency planners responsible for PoE. The document is primarily one for preparedness, but includes elements of infection prevention and control under operational arrangements, such as providing facilities for interviewing and assessment of affected persons, decontamination, and exit (screening) controls.

7.1.2 Existing sector-specific guidance

7.1.2.1 Airport: existing non-pathogen specific guidance

A key internationally relevant document is WHO’s *Handbook for the management of public health events in air transport*, (WHO 2015). The document, which is underpinned by a literature review and was updated following the Ebola outbreak, covers many aspects of preparedness and infection prevention and control, including risk assessment, event detection, screening, contact tracing, and the public health response. The guidance covers both airport and on board scenarios. The section on infection prevention and control incorporates general considerations as well as measures specific to gastrointestinal infections, respiratory infections and contact with body fluids. (p31-32 of that document)

Another useful document for routine infection prevention and control measures is the Airport Cooperative Research Program (ACRP) *Infectious disease mitigation in airports and on aircraft* (ACRP 2013). This document considers risks along the passenger journey. This document was a key source for the routine infection prevention and control guidance.

In response to the pandemic (although not influenza specific), in 2009, ACI, with ICAO, issued *Airport preparedness guidelines for outbreaks of communicable disease* (ACI 2009) which includes recommendations to reduce exposure to infection agents. The guidelines are intended to be modified to suit local situations. They make recommendations for the contents of an AIRPORT PREPAREDNESS PLAN. They also provide detail on communicating with travellers in the event of a communicable disease outbreak, and detail passenger screening (exit and entry). The guidelines emphasise the importance of PPE, and hand hygiene facilities and supplies for airport staff and include measures required in the event of an inbound aircraft carrying a passenger with a suspected communicable disease which may
pose a serious public health risk. These include use of PPE (appropriate to disease and transmission mode), potential use of face masks (by the ill passenger), and surface cleaning. Detailed advice is not provided; only comment that such detail may be provided by the national public health authority.

IATA issued a series of infection prevention and control guidance documents for several staff groups associated with air travel, including cargo and baggage handlers, passenger agents (in this PANDHUB document referred to as passenger service agents), maintenance crew, cabin crew and cabin cleaning crew (Suspected communicable disease: guidelines for cabin crew; guidelines for passenger agents etc., IATA 2015) (see Table 12). The guidelines for passenger agents and guidelines for cargo and baggage handlers are key sources for the PANDHUB action cards. The guidance is generic rather than for specific pathogens. Other relevant IATA guidance covers passive passenger screening (i.e. noticing signs of illness), passenger contact tracing, (Passenger contact tracing, IATA 2014) and a briefing paper on cabin air quality regarding the risk of communicable disease transmission/contagious viruses. (Briefing paper: cabin air quality - risk of contagious viruses, IATA 2009, updated to Briefing paper: cabin air quality - risk of communicable disease transmission in 2018)

7.1.2.2 Sea port: existing non-pathogen specific guidance

The requirements for dealing with public health events at ports is limited relative to that for events on board ships. A key guidance document is the WHO Handbook for the management of public health events on board ships (WHO 2016). Whilst this mainly covers events on board ship it includes some responses at port, such as dealing with an infected person disembarking. In terms of infection prevention and control there is a section that uses the example of VHF to describe the on board response and the response at a port. This document is a key source for the Ebola ACTION CARDS.

7.1.2.3 Land transport hub: existing non-pathogen specific guidance

No land transport hub guidance was identified, beyond that used by individual operating organisations.
7.1.3 Existing pathogen specific PoE guidance

7.1.3.1 Existing non-sector-specific EVD guidance

In September 2014, WHO issued interim guidance for preparedness and infection prevention and control: *Ebola event management at points of entry* (WHO 2014), which offered recommended actions at different points depending on where the passenger was on their journey when first suspected of having EVD. Pertinent to infection prevention and control, recommendations focused on supplies of PPE, cleaning supplies, and risk management. **This document is a key source for the Ebola ACTION CARDS.**

This guidance was rapidly followed by advice on exit screening, (*WHO Interim guidance for Ebola Virus Disease: exit screening at airports, ports and land crossings*, WHO 2014) and a technical note on preparedness for entry screening for EVD, prepared in conjunction with ICAO, IATA and CDC, Atlanta. (*Technical note for Ebola Virus Disease preparedness planning for entry screening at airports, ports and land crossings*, WHO 2014).

Around the same time WHO issued *Travel and transport risk assessment: Interim guidance for public health authorities and the transport sector* (WHO 2014) which has sector specific sections for international air transport and for ships, with most information targeted towards dealing with on board cases, emphasising the importance of distancing, contamination, hand hygiene, and PPE for cleaning (gloves, gown, overshoes, facial protection). **This document is a key source for the Ebola ACTION CARDS.**

Soon after the outbreak was established, the EC (with ECDC) produced a brief document advising travellers how to avoid infection, for both those arriving to, and those leaving affected areas (*Ebola virus disease – Information for travellers v3*, EC 2014). ECDC also issued guidance for managing healthcare workers returning from Ebola affected areas which focused primarily on monitoring those returning, depending on the likely level of exposure. (*Infection prevention and control measures for EVD management of healthcare workers returning from Ebola-affected areas*, ECDC 2014). Other ECDC public health guidance includes the managing of contacts (*Public health management of persons having had contact with EVD cases in the EU*, ECDC 2014) and technical guidance on medical evacuation flights to Europe (*Assessing and planning medical evacuation flights to Europe for patients with Ebola virus disease and people exposed to Ebola virus*, ECDC 2014). This latter guidance advises that the patient wears a filtering face piece (FFP) respirator (without an exhalation valve) whilst entering and exiting the evacuation aircraft.
7.1.3.2 Existing non-sector-specific influenza guidance

No guidance specific to influenza for PoE collectively was identified; the guidance available is sector specific, as detailed in section 7.1.4.

7.1.3.3 Existing non-sector-specific pneumonic plague guidance

There is little overarching PoE guidance regarding pneumonic plague as a person-to-person transmitted infection. Because it is rare, this infection tends to be covered in infection prevention and control advice for healthcare environments, or in preparedness and response advice in the event of a deliberate release. WHO issued a fact sheet in December 2017 (Plague fact sheet, WHO 2017). Following the outbreak in Madagascar in the latter half of 2017, ECDC issued Guidance for the management of suspected cases of pneumonic plague cases identified on aircraft and ships (ECDC 2017). They also issued a rapid risk assessment in conjunction with WHO: Outbreak of plague in Madagascar (ECDC 2017). The risk assessment includes infection prevention and control advice regarding preventative measures, for example using insect repellent, avoiding close contact with people with symptoms of pneumonic plague, and avoidance of crowded areas where pneumonic plague cases have been reported.

ECDC’s document (Guidance for the management of suspected cases of pneumonic plague cases identified on aircraft and ships) advises the use of a surgical mask (by suspected passenger and by other passengers) and standard infection control precautions if isolation is not possible. The guidance includes measures to be taken on arrival at a port (airport or seaport). This, and the ECDC risk assessment are key sources for the PANDHUB action cards for pneumonic plague.

Other useful documents were issued by the Health Service Executive in Ireland. These include an algorithmic risk assessment for ambulance services (Plague risk assessment for ambulance services, HSE 2017) and a document discussion the preparedness of the maritime transport sector. (Preparedness of the maritime transport sector calling on plague endemic areas or area with plague outbreaks, and options for public health measures in response to suspected plague affected ships, HSE 2017). Both of these are key sources for the PANDHUB action cards for pneumonic plague.
7.1.4 Sector-specific and pathogen-specific guidance

7.1.4.1 Airport: Existing EVD guidance

At an international level IATA produced a *Guidance note on Ebola* (IATA 2015) in August 2015, based on the PoE advice from WHO. This was a preparedness and response document rather than infection prevention and control *per se*.

At a European level ECDC issued guidance during the outbreak regarding screening for Ebola at airports (*Infection prevention and control measures for EVD: entry and exit screening measures*, ECDC 2014). The European Aviation Safety Agency (EASA) issued further guidance in November 2014: *Safety information bulletin- Ebola Virus Disease-operational recommendations* (EASA 2014) which recommended that flights to and from affected countries carried universal precaution kits. It also disseminated updated IATA guidance, *Guidelines for cabin crew*, (IATA 2015) regarding actions in the event of a suspected communicable disease case on board.

As an example of a national response, PHE, with the Department of Transport, produced guidance on Ebola for UK airlines and aerodromes: *West Africa Ebola outbreak guidance to UK airlines and aerodromes* (PHE 2014). Because, during the outbreak, the risks of an Ebola case entering the UK were considered very low for airports other than those in states with established transmission, or those airports with cases linked only to an imported cases, PHE referred readers to the IATA general communicable disease guidance, including that for specific staff groups, i.e. passenger agents and baggage handlers. The advice to airport staff, should a passenger display symptoms of Ebola post flight, i.e. in the terminal, was that existing airport procedures for response to a communicable disease case should be followed. The document also included advice for the management of suspected cases in flight.

PHE guidance also includes advice for airline and airport staff in countries where there is EVD transmission. Here the IATA guidelines were supplemented with some additional measures relating to hand hygiene (recommended), the use of gloves (not recommended), use of sanitiser (acceptable as a general hygiene measure only), facemasks (only in accordance with IATA guidance for dealing with suspected communicable disease cases), and enhanced cleaning (noted as already likely to have been instigated in affected countries).
Another example of national guidance was that produced by the Health Service Executive (HSE) in Ireland ‘Information and guidance for airport authorities and airlines on Ebola Virus Disease’ (HSE 2015). This guidance included advice for ground staff, should a case present at the airport and guidance specific to the customs service - EVD Revenue’s customs service guidance, (HSE 2015) The Executive also issued Environmental cleaning guidance for potential Ebola contamination for non-healthcare settings (HSE 2014) of relevance to airports. **The three HSE documents were used as key sources for the Ebola ACTION CARDS.**

Similarly Health Protection Scotland (HPS) issued a document entitled *Ebola: overview of activities at ports* (HPS 2014). This document was for both airports and seaports and as well as summarising the risks it included positioning on screening (exit and entry) and advice on contact tracing.

7.1.4.2 Seaport: Existing EVD guidance

Infection prevention and control for suspected VHF at ports is addressed in an updated WHO *Handbook for management of public health events on board ships* (WHO 2016). For personnel in contact with a passenger during medical evacuation, the level of PPE advised includes the use of an FFP/N95 mask for staff and a facemask for the passenger.

The IMO, in conjunction with WHO and other shipping bodies issued guidance for ships visiting ports in countries affected by EVD (*Ebola Virus Disease – information and guidance, circular letter No. 3484*, IMO 2014). This guidance was based on guidance from WHO and included the relevant extract from the WHO *Travel and transport risk assessment: Interim guidance for public health authorities and transport sector* (WHO 2014) guidance as an annex. This includes PPE required should an on board passenger be suspected of having EVD, as well as disembarkation procedures (suggesting a medical mask for personnel involved in disembarkation). Further details on PPE was provided by IMO at a later date in. *Personal Protective Equipment-Ebola virus disease, briefing note 3497* (IMO 2014).

At a European level SHIPSAN published a set of Q & As on their website, also disseminating this via publication (Mouchtouri and Nichols 2015). This addressed elements of preparedness and infection prevention and control such as response measures, transportation, PPE requirements etc.
An example of national level guidance was that issued by PHE. They released ‘*Ebola: guidance for harbour pilots and port operators*’ (PHE 2015) in conjunction with the UK Department for Transport, however this focuses on the management of an on board case. PHE also published *West Africa Ebola outbreak guidance for UK ports and shipping operators* (PHE 2014) which is preparedness orientated. It provides links to other maritime-focused Ebola information such as that issued by IMO and other shipping organisations.

7.1.4.3 Land transport hubs: Existing EVD guidance

No guidance specific to EVD for land transport hubs was identified. It would be reasonable for guidance for such a setting to be similar to that for other non-healthcare settings. An example of such guidance is was that issued by PHE for police forces, where staff protection is the key concern. In that guidance the ‘Talk-don’t touch’ approach is emphasised with advice on PPE in various scenarios, e.g. hand hygiene and gloves if contact required but the person has fever only, but use of a mask and apron if a detainee is very unwell; and instruction as to how to contact public health personnel.

7.1.4.4 Airport: Existing influenza guidance

In May 2009, in response to the emerging pandemic, WHO, in cooperation with ICAO and IATA, issued ‘*Technical advice for case management of Influenza A(H1N1) in air transport*’ (WHO 2009) which detailed immediate actions for public health at the arrival airport (see section 7.2.2 preparedness review). Advice therein includes the use of hand hygiene and PPE, (including facemask use by the passenger if possible), separating suspected passengers from other passengers, and cleaning of the aircraft. A checklist provided for actions regarding arriving and departing passengers includes infection prevention and control. **This is a key source for the PANDHUB action cards.**

ICAO guidelines (*Guidelines for States concerning the management of communicable disease posing a serious public health risk*, ICAO 2006) were written with the intention that they be incorporated into national preparedness plan guidelines. They were primarily written for States (public health) and directed readers to ACI and IATA guidelines for more detail. Whilst they were not entirely for pandemic influenza, the examples and scenarios are pandemic orientated. Other than screening, the guidelines do not include much detail on infection prevention and control. For example they state that ‘Airlines should establish guidelines for passenger service agents who may be faced with a suspected case of
communicable disease... at the airport and cooperate with the airport and public health authorities on the logistics such as dealing with ill passengers.’

An example of national guidance is that issued by HPS. They issued pandemic phase-specific guidance for airports (and for seaports). In the containment phase (a period of 11 weeks) close contacts were followed up by public health – however these were mainly fellow passengers from flights, not ships. In the treatment phase the advice became for affected passengers or staff on disembarkation to return home, preferably by private transport, and contact local medical services. For passengers identified on board the response depended on how ill the passenger was, and could include transport to a hospital if very unwell. (Guidance on action at airports for the treatment phase during the Influenza A (H1N1)v Pandemic, HPS 2009).

7.1.4.5 Seaport: Existing influenza guidance

In November 2009 WHO produced Interim technical advice for case management of pandemic H1N1 on ships (WHO 2009). Port personnel were part of the target audience for the document which details the role of the public health or other competent authority at the port and the management of cases at a port. Regarding infection prevention and control, the importance of hand hygiene, cough etiquette, interpersonal distancing, mask use, including during disembarkation, are included. This is a key source for the PANDHUB action cards. Influenza guidance based on WHO guidance was also issued by IMO: Influenza A (H1N1) Virus, circular no 2956 (IMO 2009)

For the EU the SHIPSAN ACT Joint Action produced a European manual for hygiene standards and communicable disease surveillance on passenger ships (EU SHIPSAN ACT Joint action 2016) which focuses on issues on board more than events at ports. It contains guidelines for prevention and control of influenza on passenger ships, designed to be modified during a pandemic. Competent authorities’ responsibilities are also detailed. It also contains basic infection prevention and control guidance eg, guidance on how to wash hands effectively.

As with airports (see above), HPS issued similar national guidance for sea ports. Guidance on action at sea ports for the treatment phase during the Influenza A (H1N1)v Pandemic, HPS 2009).
7.1.4.6 Land transport hub: Existing influenza guidance

Little land transport hub guidance was identified. A guidance note on *Contingency planning arrangements for flu pandemic* (ATOC 2009) to support government objectives with regard to continuity of services and return to normality makes some reference to infection prevention and control. This was primarily a preparedness document but it included discussion of prevention measures such as the preparation and communication of advice on personal hygiene, interpersonal distancing, changing working practices to hold fewer face to face meetings, and flexible working.

7.1.4.7 Airport: Existing pneumonic plague guidance

In 1994 Manitoba Public Health (Canada) produced *Guidelines for suspected plague cases at Winnipeg airport* (in response to an outbreak in India) which included advice for on board situations. These particular guidelines stated that respiratory protection (filtration at 1 micron; i.e. a respirator) was essential for staff in close contact with someone with pneumonic plague.

7.1.4.8 Seaport: Existing pneumonic plague guidance

Historic infection control advice for plague for ships and ports focuses on ridding ships of rats and investigating any rats found for fleas. (White 1935) ECDC’s technical document *Guidance for the management of suspected pneumonic plague cases identified on aircraft and ships* (ECDC 2017) suggests the use of a (surgical) mask and standard infection control precautions if isolation is not possible.

7.1.4.9 Land transport hub: Existing pneumonic plague guidance

No guidance was identified to address the risks of plague at a land transport hub.

7.1.5 Existing guidance for design and renovation of transport hubs

The ACRP guidance *Infectious disease mitigation in airports and on aircraft* (ACRP 2013) includes guidance for design and renovation of airports. In that document a number of issues and opportunities are highlighted:
• That security spaces are not being designed for the enhanced processes now in place across the world following the terrorist attacks of 2001 and the slower processes result in such areas being more prone to crowding

• The opportunity of new build to ensure that high density areas have good HVAC

• The opportunity for infection prevention and control considerations to be taken into account for washroom appliances including hand dryers, towel dispensers, taps, toilet flushes etc.

• The opportunity for advancing technology allowing for increased ticketing and boarding pass printing mechanisms external to the airport, or greater use of apps, which can decrease touch-ticketing requirements

7.1.6 PANDHUB infection prevention and control guidance for design and renovation

Some simple measures can be taken during new design or renovation that will help in infection prevention and control. Some examples are given below:

**Washrooms**

• Taps should be use non-touch (movement sensitive or foot operated)

• Ideally paper towel dispensers should be non-touch

• Good water temperature control (and safe – water does not need to be particularly hot for handwashing)

• Plentiful and convenient placing of liquid soap dispensers and dryers to encourage use

• Bins should be close to sinks and be hands-free (e.g. foot-operated), easily cleaned, and lined for health and safety

• Walls in shower rooms should be water resistant

• Some hand-washing facilities should be close to baby-change facilities
• Hand-washing facilities should be as convenient as possible for areas where cleaning equipment is stored

Ventilation

• When commissioning ventilation systems security should be considered e.g. the inlets to the ventilation system should not be easily accessible to an unauthorised person

• Ducts and grilles should be easily cleanable to prevent dust build up

• The use of volume flow controllers with CO₂ sensors in separate functional areas could be employed to facilitate demand controlled ventilation

Furnishings

• Furnishings should be easy to clean and maintain

• Flooring should be easy to clean and maintain

• Surfaces such as tables and desks should be durable, smooth and easy to clean; they should withstand disinfectants without damage and dry rapidly

• Consideration could be given to the use of antimicrobial coatings in some instances (for example copper has been used at border control counters and metro stations in Chile (Nasir, Campos et al. 2016))
7.2 Review of existing preparedness guidance

7.2.1 Existing general PoE preparedness guidance for communicable disease threats

A key finding of PANDHUB deliverable 4.3 is that no European-level cross-sector transport preparedness guidance exists to aid hub operators with the development of operational pandemic or serious biological threat contingency plans; the report recommends establishing such a framework. Nonetheless there are requirements for preparedness under IHR, and at an international level a number of preparedness documents for communicable disease threats exist.

Under IHR designated PoE must maintain public health contingency plans (a PHECP) to prevent the spread of diseases internationally. In 2012 WHO issued ‘A guide for public health emergency contingency planning at designated points of entry’ (WHO 2012). The document was based on ‘effective plans’ already in existence as well as lessons learned from the 2009 pandemic. It emphasises the importance of relationship building. Chapter 8 of the document suggests a structure for a PHECP, including command and control structures and a list of sections likely to be required in the operational response section of a plan. Recommendations are made regarding necessary supporting documentation, such as standard operating procedures and/or protocols for managing suspected and affected travellers, entry and exit screening, infectious disease specific information, infection prevention and control advice and protocols for disinfection and decontamination.

In 2017 WHO published ‘A strategic framework for emergency preparedness’ (WHO 2017); a document that covers all hazards, including pandemics but refers to PoE only in the context of tools for assessing capacity.

The European Commission Strategy for Generic preparedness planning; technical guidance on generic preparedness planning for public health emergencies dating from 2011 includes comments on point of entry measures such as traceability agreements and legal frameworks for obtaining passenger information. The document also includes checklists to guide Member States, the Commission and Community Agencies involved in health protection setting out the responsibilities of each including one entitled ‘interoperability’ which refers to cooperation procedures, data sharing, having dialogue between health and the private sector,
collaboration between European authorities and discussion at an international level for example with IATA, WHO etc.

7.2.2 Existing airport preparedness guidance (public health)

Under the Convention on International Civil Aviation, States must have a National Aviation plan for a public health emergency, and airports must have an Aerodrome Emergency Plan that includes procedures for public health emergencies.

A key preparedness document is WHO’s updated *Handbook for the management of public health events in air transport* (WHO 2015). The document covers all aspects of preparedness and infection prevention and control including risk assessment, communication, event detection, notification and response, screening, border controls and contact tracing, containment strategies, and medical assessments etc. It is not a technical operational guideline but it is underpinned by a literature review and is intended to support the development of national or site-specific guidelines and standard operating procedures.

The WHO, (with ICAO and IATA) document, ‘*Technical advice for case management of Influenza A(H1N1) in air transport*’ (WHO 2009) compiles recommendations from existing guidelines for air travel and health, and WHO guidelines related to influenza A(H1N1), applicable for air transport, and outlines some measures to be taken by aircraft operators, airport operators, airport personnel, crew members and national authorities. It is designed to be adapted to the local situation. The guidance details immediate actions for public health at the arrival airport including suitable parking of the aircraft, arranging medical access, care and transport for suspected passengers, safe disembarkation of passengers and contact tracing. The guidance also sets out public health responsibilities for risk assessment, communication, training for health assessment and PPE use.

ICAO guidelines (*Guidelines for States concerning the management of communicable disease posing a serious public health risk*, ICAO 2006) are influenza focused but include general preparedness and were written with the intention that they be incorporated into national preparedness plan guidelines. They send readers to ACI and IATA guidelines for more detail regarding airports and airlines, (although they repeat much of the ACI/IATA guidance in fact). The Guidelines describe exit screening and set out what a public health authority should do, in consultation with airport management - in brief, establishing a system to implement screening; establishing a system of assessing those who screen positive (such
assessment would be advised by public health), ensuring a means to incorporate screening results with national surveillance; logistics for baggage, customs etc; criteria for denial of boarding; and establishing a system for implementing screening.

In 2009 IATA published a template for an *Emergency Response Plan* (IATA 2009) for a Public Health Emergency, informed by experiences with SARS, primarily aimed at carriers, not airports. The template outlines preparedness for a public health emergency and provides checklists of actions regarding key elements of a public health emergency plan such as preparation for a public health emergency in broad terms, triggers for a public health emergency response, activation of an Emergency Response Team and Centre, and roles and responsibilities.

In a similar way ICAO issued a *Template for a national aviation public health emergency preparedness plan* (ICAO 2010) describing the measures to be adopted during a PHEIC, including considerations that guide the response and planning assumptions (based around a pandemic situation).

The ACI/ICAO document *Airport preparedness guidelines for outbreaks of communicable disease* (ACI 2009) includes recommendations to reduce exposure to infectious agents and outline the contents of an AIRPORT PREPAREDNESS PLAN, for modification to suit local situations. It offers guidance on communicating with travellers in the event of a communicable disease outbreak; on passenger screening (suggesting exit screening is a better use of resources than entry screening), and emphasises the importance of PPE, hand hygiene facilities and supplies for airport staff.

An ACI best practice paper ‘*Business continuity management framework and case studies for health-related disruptions at airports*’ (ACI 2009) preparedness for long disruptions (i.e. crises as opposed to short term incidents), addressed the gap looking at preventative measures and post-event response plans. The framework includes: establishing an oversight structure team, mapping core processes; conducting operational impact analysis; developing preventative measures; developing post event plans; crisis management capability; quality assurance for preparedness (prevention) and post event plans (scenario testing), and management review.

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A document that considers preparedness from the perspective of the operators is *Preparing airports for communicable diseases arriving on flights* (ACRP 2017). This is a synthesis of preparedness status in a number of US airports, and describes where airports feel their weaknesses lie.

CAPSCA aims to coordinate the international aviation response to public health events, ensuring compliance with IHR and it helps with the implementation of ICAO, WHO, ACI and IATA guidelines to foster harmonisation. As part of this CAPSCA undertakes visits which include reviewing preparedness plans.

The AIRSAN (coordinated action in the aviation sector to control public health threats) project outputs included a guide on contact tracing (*Coordinated action in the aviation sector to control public health threats: Contact tracing – collaboration between the public sector and the aviation sector*, AIRSAN 2015) and events on board (*Remote risk assessment and management of communicable disease events on board aircraft*, AIRSAN 2015).

### 7.2.1 Existing sea port preparedness guidance (public health)

A key preparedness document is WHO’s *Handbook for the management of public health events on board ships* (WHO 2016). The guidance document provides technical advice to competent authorities at ports to help them manage potentially internationally significant public health events at the ports. It covers many aspects of preparedness, including risk assessment (for actions at ports it tables the responsibilities of the competent authority), communication, event detection (though not pre-boarding), notification and response. In terms of response the document details the response measures dictated by IHR, including core capacities, as well as setting out competent authorities’ responsibilities and ship operators’ responsibilities. An event management flowchart is provided on p58 of the document. The document details the management of suspected cases of VHF at a port as well as on board.

Preparedness for exit screening is addressed. This includes the identification of suitable locations for both primary and secondary screening (conducted by public health). Other aspects covered include preparedness for legal measures concerned with screening and staffing and training needs. This document also contains, as an annex, guidance on establishing public health assessment interview spaces.
For the EU the SHIPSAN ACT Joint Action published a Q&A section (on their website) regarding EVD in the maritime transport sector, together with a linked paper. (Mouchtouri and Nichols 2015) Aspects of preparedness include planning for an event on board; response measures for the competent authority for suspected cases and for confirmed cases; transportation; and recommendations for port workers dealing with cargo for affected areas.

Following the outbreak of pneumonic plague in Madagascar in the latter half of 2017, ECDC and WHO issued risk assessments. In their first risk assessment WHO consider the risk for international spread to be very low. The ECDC risk assessment assesses the risk for importation to the EU to be low as well as the risk to EU citizens travelling to affected areas of Madagascar being considered to be very low.

7.2.1.1 Existing pandemic influenza preparedness guidance relevant to PoE

An early example of guidance is a 2005 document – a Checklist for influenza pandemic preparedness (WHO 2005). This featured transport only from a trade and travel restriction point of view, commenting that transport companies require clear instructions on epidemiological situations and human cases on board transport. The WHO website hosts links to national preparedness plans. ECDC offered advice on the preparation of these (Guide to revision of national pandemic influenza preparedness plans-lessons learned from the 2009 A(H1N1) pandemic, (ECDC 2017) framed within lessons learned from the 2009 pandemic.

7.2.1.2 Existing Ebola virus disease preparedness guidance relevant to PoE

ECDC published a number of documents regarding Ebola preparedness including a peer review of Public health emergency preparedness for cases of viral haemorrhagic fever (Ebola) in Portugal (ECDC 2015). This was not PoE focused, but identified airports and maritime ports as the initial ‘critical area of the potential pathway’ for a traveller with VHF and identified the border check point as a possible point to recognise a suspected case. Other publications from ECDC included guidance on exit screening for Ebola (Infection prevention and control measures for EVD: entry and exit screening measures, ECDC 2014) and a rapid risk assessment issued in October 2014. (Outbreak of Ebola virus in West Africa, ECDC 2014).
7.2.1.3 Existing plague preparedness guidance relevant to PoE

Guidance for the management of suspected cases of pneumonic plague cases identified on aircraft and ships (ECDC 2017) considers elements of preparedness such as training regarding awareness of plague, information for travellers, post-exposure prophylaxis etc.

7.2.2 Existing land transport hub preparedness guidance (public health)

An example of preparedness guidance for land transport in the UK comes from ATOC/National Rail. They issued a guidance note on Contingency planning arrangements for a flu pandemic (ATOC 2009) to support government objectives with regard to continuity of services and return to normality. This preparedness document was based on information provided by the UK Government Department of Health and the UK Government Cabinet Office and included advice on the identification of a point of contact; occupational health, and stockpiling of supplies.

8. Discussion

Infectious disease threats are by their nature unpredictable, therefore guidance that is principle driven is useful as it can be swiftly adapted to suit the local circumstances. There is no rationale to encourage implementation of measures in the hubs that would not be similar to measures in other public places, so, although guidance for the healthcare environment will be more stringent at times, for example the use N95/FFP3 respirators in some circumstances, the advice offered in this guidance is pragmatic and proportional to risks in transport hubs. It is also important that PPE is used only if people are trained in its use; therefore respiratory protection is only recommended in very particular circumstances, e.g. for first responders is some circumstances, as it requires fit testing to be effective.

From the reviews of evidence is it clear that there is inequality between transport sectors in terms of both guidance available and a coordinated approach to the management of communicable disease events. Most evidence of international collaboration is around air travel which is unsurprising given the risk this mode of travel presents. The needs of land transport hubs are understandably different.

Pandemic influenza is a focus of this guidance. It is worth noting that much of the guidance for pandemic influenza is basic infection prevention and control, and there are benefits in
following similar guidance during seasonal outbreaks of influenza. In addition much of it reflects good practices that should be adopted at all times, e.g. good hand hygiene and respiratory hygiene. Resources developed for the promotion of these practices in preparation for a pandemic could be usefully applied more widely.

Limitations include the broad rather than systematic nature of the literature review. Some documents of relevance could have been missed. Another limitation is that this customized guidance lacks a mechanism by which it can be updated.

Whilst guidance for passengers themselves has not been produced, the information noted in ‘what you need to know’ could provide a starting point for such guidance.

9. Conclusions

Infection prevention and control guidance customised to transport hubs can be generated using a framework of five common control principles, namely ventilation, exclusion of symptomatic persons, separation of international and domestic travellers, interpersonal distancing, and measures to reduce indirect contact transmission. Other important considerations are transmission routes and other pathogen characteristics. The resulting guidance, aimed at all transport hubs, but particularly suitable for international hubs, encompasses both advice for both routine circumstances and guidance for particular types of public health communicable disease threats.

Although not specifically explored, in conducting the review there was a sense that the approach to communicable disease threats has become increasingly cohesive since SARS and more specifically the adoption of IHR (2005) in which PoE gained a focus. Lessons learned from recent PHEICs have also had a major impact on the availability of guidance, in particular the influenza pandemic and the Ebola outbreak.

Whilst WHO advice underpins most of the guidance identified, different states and administrations build on that to varying levels of detail, and the advice from state authorities to transport sectors also varies in depth.

In terms of further work a stakeholder survey (of transport hub operators) may be useful to identify if there are situations in which where they feel more detailed, or, for example faster,
dissemination of advice on prevention or communicable disease threats might be of help, and identify if there are needs that could be better met.
10. Annexes

10.1 Annex 1: Modes of Transmission

The most traditional and commonly adopted categorisation of the modes infectious disease transmission is that of three principal modes: contact transmission (direct or indirect); droplet transmission, and airborne transmission. (Brankston, Gitterman et al. 2007) These categories were defined and published by the Healthcare Infection Control Practices Advisory Committee (HICPAC), in their widely adopted ‘Guideline on isolation precautions for healthcare settings’ from 2007. These routes are not mutually exclusive and pathogens may be transmitted via one or more than one route.

CONTACT TRANSMISSION

Indirect contact transmission (also known as fomite transmission) ‘involves the transfer of an infectious agent through a contaminated intermediate object or person’; examples are the transfer of infection through touching a contaminated object and then self-inoculating a mucosal surface such as the nose or mouth.

HICPAC define direct contact transmission as that occurring when ‘microorganisms are transferred from one infected person to another without a contaminated intermediate object or person’, for example contact with blood or other body fluids through breaks in skin, or contact with a mucous membrane e.g. kissing, or skin to skin contact.

Droplet transmission

Droplet transmission is (somewhat confusingly) technically considered (by HICPAC and others) a form of direct contact transmission. ‘Respiratory droplets carrying infectious pathogens transmit infections when they travel directly from the respiratory tract of an infected individual to a susceptible mucosal surface (of the eyes, nose, mouth and respiratory tract), generally over short distances’. Droplets are emitted during coughing, sneezing, talking. Droplets are considered to range from 5-100 µm in diameter and make

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direct contact with the mucosa, or smaller ones may be inhaled. When they settle on environmental surfaces they may also facilitate indirect contact transmission.

Coughs contain particles ranging from <1 to 2000 µm in size, but 99.9% (by volume) are larger particles (though aerosols are greater by number). (Nicas, Nazaroff et al. 2005) Whilst large droplets will be heavy laden with virus, most of them will not be inhalable due to their size. However the smaller particles can travel further which complicates defining a distance for safe interpersonal distancing. Historically HICPAC suggested droplets were transmitted over distances of only less than 3 feet, however in the light of evidence from SARS, this was reconsidered and the guideline was amended to say that that pathogens transmitting via the droplet route do not remain infective over ‘long distances’, recommending face masks (in healthcare environments) when within 6-10 feet for protection against infections transmitted via this route. Atkinson calculated that expelled respiratory droplets from coughs and sneezes would not travel beyond 60 cm. (Atkinson and Wein 2008)

Papers discussing particle sizes and their relevance to modes of transmission are numerous (Tellier 2006, Tellier 2009) (Milton, Fabian et al. 2013) however a detailed discussion on this is beyond the scope of this annex.

‘AIRBORNE’ TRANSMISSION

The traditional understanding of airborne transmission is that it is transmission by inhalation of small particles of a respirable size containing infectious agents that remain infective over time and can be dispersed over long distances (> 1 metre) by air currents, or the dissemination of droplet nuclei (droplets that have partially evaporated) – effectively aerosol transmission over a long range. There is general agreement that particles 1- 5 µm constitute droplet nuclei (defined as the airborne residue of a potentially infectious aerosol from which most of the liquid has evaporated (Wells 1934) and that particles up to this size can penetrate the lungs as far as the alveolar region; and particles >20 µm constitute large droplets, but there is some variation about terminology and characteristics of particle sizes between these two. (Tellier 2009) Tellier writes that particles in the 5-10 µm range can reach the tracheobronchial tree, whereas the Canadian Academies experts put this upper diameter at 20 µm. Particles that can reach the alveolar region are termed ‘respirable’; those breathed in through the nose and mouth are termed ‘inhalable’. However a consensus on particle size is lacking. Pathogens that are transmitted ‘truly’ by the traditional airborne route include
measles, TB and smallpox. It is also likely that some other pathogens are at least sometimes transmitted by this route, including influenza and SARS. (Tang, Li et al. 2006)

**Terminology**

In 2007, the Canadian Academies, in an assessment of the evidence for the role of personal protective Equipment (PPE) for influenza transmission, proposed use of the term ‘inhalation transmission’ to incorporate both droplet and airborne transmission. In a similar move, the Center for Infectious Disease Research and Policy (CIDRAP) published a website commentary and a paper (regarding Ebola) which argued that the distinction between particle sizes and transmission distance is ‘artificial’ and therefore proposed an ‘aerosol transmission route’ to ‘replace droplet and airborne’. Aerosol transmission is the inhalation of infectious aerosols suspended in the air either near a person or at a distance, and can involve particles of varying sizes that land on mucosal surfaces or are inspired deeper into the respiratory tract. ‘Respiratory transmission’ is a slightly narrower term as it encompasses only the generation of aerosols from the respiratory tract (whereas vomit and other body fluids can be a source of aerosols), which go on to cause infection via the droplet or airborne route. (Osterholm, Moore et al. 2015) Such terms address the difficulties of ‘airborne’ transmission being associated with transmission over long distances, and help emphasise the importance of aerosol transmission at short distances.

Of interest is that CDC’s current classification of modes of transmission differs from the traditional modes outlined earlier in several ways. Firstly they refer to droplet spread being the spray of relatively large ‘short range aerosols’. Secondly they classify airborne transmission as a sub-classification of indirect transmission as the infectious agents are carried by dust or droplet nuclei, and thirdly they classify blood as an indirect agent – a vehicle. This illustrates how this field is constantly changing.

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Definitions of transmission routes adopted for PANDHUB

Contact Transmission

*Figure 1 Indirect contact transmission*

- No direct person-to-person contact
- Contamination of surfaces by touching or by body fluids
- Survival of pathogens on hands/surfaces

*Figure 2 Direct contact transmission*

Physical contact between an infected and a susceptible person e.g. Kissing/other touch
Respiratory transmission (incorporating respiratory droplet transmission, aerosol transmission and airborne transmission)

Figure 3 Respiratory transmission

- Direct projection of infectious droplets to nose, mouth or eyes
- Inhalation of infectious aerosols
The PANDHUB pathogens and coronaviruses: transmission characteristics

Transmission of pneumonic plague

In the pre-antibiotic era pneumonic plague had a very high fatality rate – two major outbreaks in North East China (Manchuria) at the beginning of the 20th century had fatality rates approaching 100%, resulting in tens of thousands of deaths. (Chernin 1989) Effective antibiotics have reduced this rate but the fatality rate for pneumonic plague remains high relative to that for septicaemic or bubonic plague. Without prompt antibiotic treatment (within 18-24 hours), pneumonic plague is quite rapidly and nearly always fatal. (ACIP 1996)

Plague is a now rare infection in humans. In current times most cases are reported from Africa; cases in the Democratic Republic of Congo and Madagascar accounted for 92% of all plague cases reported between 2010 and 2015. (WHO 2016)

Plague can be transmitted to humans through a flea vector (most common); through direct contact with an infected animal; or via droplet transmission from animal to humans, or human to human. Droplet transmission would result in pneumonic plague – the infection of interest for PANDHUB. Transmission of pneumonic plague from person-to-person is more common in developing countries than developed countries. In the US, secondary transmission was last documented in 1924, when one man was thought to be responsible for transmitting pneumonic plague to about 30 individuals, constituting a super-spreading event. (Hinckley, Biggerstaff et al. 2012) In 2014 a possible US case of person-to-person transmission was reported from a patient with haemoptysis; although transmission from a dog (who passed it to three other people) could not be ruled out, the short incubation period supported person-to-person transmission. (Runfola, House et al. 2015)

In natural infection, pneumonic plague occurs most often secondary to bubonic plague – secondary pneumonic plague. It can also be transmitted from animals to humans or transmitted person-to-person at close contact (defined by CDC as within 6 feet) through inhalation of infectious droplets expelled during coughing, i.e. droplet transmission. However it can also be transmitted via aerosols at close distance. Such inhalation can cause primary pneumonic plague. Someone with secondary pneumonic plague can transmit infection onwards in this way. Historic laboratory work (dating from 1912, described in (Kool 2005) investigated airborne spread of pneumonic plague by placing agar plates at distances from
infected patients who were producing bloody sputum. Bacteria were found on plates up to one metre away, but not beyond.

Aside from droplet transmission, there are no reports of other contact transmission (i.e. other direct contact or indirect contact) for pneumonic plague. *Yersinia pestis* is generally reported as being short-lived outside of the host, and fragile, being sensitive to heat and sunlight. (Inglesby, Dennis et al. 2000) However in a study of survival on environmental materials, *Y. pestis* survived 2-4 hours on steel, polythene and glass and more than two days on paper, and in nutrient buffers (mimicking mucus), survival was longer – up to three days on the hard surfaces, and up to five days on paper. (Rose, Donlan et al. 2003). However there is no evidence that plague bacilli are an environmental threat following aerosolisation. (Inglesby, Dennis et al. 2000) The bacteria can be killed with cleaning agents that contain bleach.

Plague bacteria can survive in carcasses and in soil. Aerosolisation during a post mortem of a lion carcass is thought to have been responsible for pneumonic plague in one documented case. (Wong, Wild et al. 2009)

For primary pneumonic plague the incubation period is 2-4 days. (Kool 2005) Symptom onset is 2-4 days after exposure. (Pechous, Sivaraman et al. 2016) Assessments of transmissibility (basic reproductive number R0) for pneumonic plague vary, but are generally low, though methodology can impact on this. R0 was assessed to be nearly equal to 1 in the US. (Hinckley, Biggerstaff et al. 2012) Mathematical modelling using data from documented outbreaks estimates it to be 1.3 (Gani and Leach 2004) though other estimates have been higher, around 3, using different methodology. (Nishiura, Schwehm et al. 2006)

Data on pre-symptomatic infectivity is lacking. (Gani and Leach 2004) Reports on infectivity vary - Ratsitorahina suggests it is low (Ratsitorahina, Chanteau et al. 2000) and in archived documents, Public Health England state that 'the infection is not contagious until symptoms develop and patients have a productive cough'.

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Deliberate release

Deliberate release of aerosols containing *Y. pestis* with the intention to cause primary pneumonic plague is considered to be one of the most plausible and most serious deliberate release threats, due to the accessibility, capacity for mass production and ease of aerosolisation. (Inglesby, Dennis et al. 2000) Historically challenge experiments using aerosolised plague have been conducted in non-human primates to test vaccines. The average time to death was 6 days. (Speck and Wolochow 1957) In the air, plague aerosol is estimated to survive for up to one hour and for a distance of up to 10km (Inglesby, Dennis et al. 2000) although there are additives that can extend this time. (Casman and Fischhoff 2008)

Transmission of Anthrax

Anthrax cannot be transmitted person-to-person, except in rare cases of cutaneous anthrax through cuts in the skin. However if anthrax spores are released e.g. from animal hides, or through deliberate release, and inhaled, inhalation anthrax infection can result, particularly during the period of ‘primary aerosolisation’ when spores are first made airborne. (Inglesby, O'Toole et al. 2002) The fatality rate for inhalation anthrax without treatment approaches 100%. (Inglesby, O'Toole et al. 2002) Following the accidental release of aerosolised anthrax in 1979 in the Soviet Union, reports vary but around 86% of the patients reported to have inhalation anthrax, died. (Inglesby, O'Toole et al. 2002) The fatality rate was lower in the episode of deliberate release in the States in 2001, when there were 11 cases of inhalational anthrax, of whom five died, giving a fatality rate of 45%. (Jernigan, Raghunathan et al. 2002) Four who had severe disease before antibiotics could be started, died. (Jernigan, Stephens et al. 2001)

Given the ability of spores to persist, secondary aerosolisation of spores from contaminated surfaces was a concern following the 2001 attacks, but inhalation anthrax from such secondary aerosolisation has not been proven, and was not apparent in the Soviet Union incident, with the epidemic curve being typical of a common source outbreak. (Inglesby, Henderson et al. 1999)

Deliberate release

An aerosol release of *Bacillus anthracis* which would primarily cause inhalation anthrax, has been assessed as having the ability to travel many miles before dissipating and losing infectiousness; the timing for such dispersal has been estimated at hours to one day. (Inglesby, Henderson et al. 1999) Spores persist for many years (Inglesby, O'Toole et al. 2002) making environmental decontamination, both outside and inside buildings, extremely challenging.

**Transmission of Ebola Virus Disease (EVD)**

Transmission of EVD, both for the general population and for healthcare workers, is primarily associated with direct physical contact with people, or the body fluids (primarily blood, faeces and vomit) of people who are symptomatic with EVD, or contact with the bodies of those who have died from EVD. (Dowell, Mukunu et al. 1999) The most relevant modes of transmission are direct contact and indirect contact. Respiratory droplet/short range aerosol transmission is plausible (the virus is found in saliva) but there is no evidence of such transmission. However transmission from droplets or aerosols during vomit is likely. (Osterholm, Moore et al. 2015)

When patients are symptomatic, body fluids can be emitted in copious quantities and the viral load in these is very high. (Schieffelin, Shaffer et al. 2014) There is no evidence that people in the pre-symptomatic period transmit infection, probably due to low circulating virus (Leroy, Baize et al. 2000) (Borio, Inglesby et al. 2002), however people in early stage illness may be an infection risk, as family members exposed only during a prehospital phase have been infected. (Dowell, Mukunu et al. 1999) In the acute phase of EVD, in addition to blood, Ebola RNA has been found in breast milk, saliva, semen, stool, (Bausch, Towner et al. 2007) sweat (rare) and tears (Bausch, Towner et al. 2007) and urine. Ebola has been cultured from semen (convalescent), breast milk (acute and convalescent), saliva (acute), blood serum (Bausch, Towner et al. 2007) and urine. (Kreuels, Wichmann et al. 2014)

Ebola virus persists post recovery; Ebola RNA has been found in semen, breast milk, vaginal fluids, ocular fluid and cerebral spinal fluid. How long the virus persists is not known but Ebola RNA has been identified in semen up to 199 days or more after illness onset (Deen, Knust et al. 2015, Mate, Kugelman et al. 2015), vaginal fluids up to 33 days after onset of illness and in breast milk up to 15 days after onset (Bausch, Towner et al. 2007); in ocular fluid up to 98 days (Varkey, Shantha et al. 2015) and urine up to 30 days. (Kreuels,
Wichmann et al. 2014) Suspected Ebola transmission through sex (after recovery) has been documented (male to female) (Mate, Kugelman et al. 2015) therefore WHO advise condoms until two negative tests have been obtained. The risks associated with invasive procedures, for example on the eye or spinal column of survivors is not known.

For EVD the significance of indirect contact transmission is unclear because it is difficult to differentiate between exposure via direct body contact and body fluid contact, and exposure from contaminated fomites. (Dean, Halloran et al. 2016) However indirect contact transmission seems a possibility as sharing a sleeping mat, and sharing meals with a sick person have been reported as possible means of transmission. (Dowell, Mukunu et al. 1999) A recent systematic review and meta-analysis of risk factors for community transmission (so excluding transmission to healthcare workers) of Ebola and Marburg virus disease, which included the examples above, concluded that many forms of contact were not likely to result in transmission during the incubation period or early illness, but that the attack rate is higher later in the illness especially during severe illness, and that transmission is likely only in these later stages. (Brainard, Hooper et al. 2016) For example, in later illness sharing a meal and sharing a bed (i.e. not direct contact) had an adjusted prevalence rate ratio (PRR) of 2.2 (95% IC 1.2 - 4.0) and 2.2 (95% CI 1.2-4.2) respectively. Touching a feverish person and touching bodily fluids is much riskier (MOR 24 (95% CI3.2-1065) and OR 11 (95% CI 2.6-46.1) A difficulty highlighted in the review was that there is no ‘simple indicator’ for the transition to late illness when the risks increase. They found only one paper where data on risk was provided according to stage of infection.

Bausch tested a large variety of healthcare setting environmental samples but found only blood-stained samples (a doctor’s gloves and an intravenous site) to be polymerase chain reaction (pcr) positive. (Bausch, Towner et al. 2007) Fischer tested survival of Ebola on several surfaces (steel, plastic and Tyvek - a synthetic breathable/ water resistant material used for protective clothing) during the West African outbreaks and found it survived best in temperatures that represented controlled hospital conditions, rather than African tropical temperatures and the surface it survived longest on was Tyvek. (Fischer, Judson et al. 2015)

Person-to-person respiratory aerosol transmission of EVD is controversial. Aerosol transmission has been demonstrated in non-human primates (Jaax, Jahrling et al. 1995) although it has been argued that in some of the experiments other forms of contact with
bodily fluids could not be ruled out.\textsuperscript{14} Ebola may be an opportunist aerosol. (Osterholm, Moore et al. 2015) Respiratory transmission is theoretically plausible as cells that can be infected by Ebola are found throughout the respiratory system. Cough, sometime bloody, is quite common in patients with Ebola, affecting up to about a third of patients, (Team WHOER, 2014) however the presence of cough has not been found to predict secondary cases. (Dowell, Mukunu et al. 1999)

The potential of medical aerosol generating procedures (AGPs) to transmit EVD has not been assessed, though concerns that this may be a route of transmission have been raised.\textsuperscript{15} CDC issued a document in April 2015 setting out why they believe Ebola is not likely to become airborne, stating that a mutation would be required for it to become so, and that this is unlikely as it has proved to be a stable virus; it is only 3\% different now to when it was discovered in 1976.\textsuperscript{16}

For recent outbreaks, in initial growth periods, $R_0$ is estimated to be between 1.71-2.02, depending on the location. (WHO Ebola Response Team 2014)

**Transmission of MERS-CoV**

Person-to-person transmission of MERS-CoV occurs via droplets from coughing or sneezing and other close contact via direct and indirect contact. (Al-Tawfiq and Memish 2014) MERS CoV appears to survive well in aerosols (van Doremalen, Bushmaker et al. 2014) and transmission during AGPs is thought likely. (Memish, Al-Tawfiq et al. 2013) Household clusters have been reported (Memish, Zumla et al. 2013) but sustained community transmission has not been reported,\textsuperscript{17} suggesting close prolonged contact is required. Nosocomial transmission has been reported (Assiri, McGeer et al. 2013), and the change in

\textsuperscript{16} Why Ebola is unlikely to become Airborne. CDC, April 2015 At: http://www.cdc.gov/vhf/ebola/pdf/mutations.pdf
the epidemiological pattern seen in 2014 was attributed to poor infection control measures. (Al-Tawfiq, Zumla et al. 2014) Asymptomatic transmission cannot be ruled out (Assiri, McGeer et al. 2013) but the low transmission rates in family contacts is supportive of low infectivity in asymptomatic or only mildly ill cases. (Memish, Assiri et al. 2014) Aerosol transmission in circumstances other than AGPs has not been proven. (Al-Tawfiq and Memish 2014)

Vomiting and diarrhoea are common symptoms, and the virus has been isolated from stool, making contact transmission a possibility, although transmission by this route has not been documented. (Memish and Al-Tawfiq 2014) The virus can survive on inanimate surfaces (for longer periods than H1N1), and airborne transmission is thought a possibility as it remains stable during aerosolisation in the laboratory. (van Doremalen, Bushmaker et al. 2013)

Otter reviewed the role of dry surface contamination for MERS-CoV, SARS and influenza and determined that survival on surfaces for all these viruses depended upon several factors including strain, surface type, titre, temperature, humidity and methods used to determine viability. (Otter, Donskey et al. 2015) He concluded that all the steps exist for indirect transmission for MERS-CoV, but that direct contact was more important. A major difficulty with interpreting surface contamination studies is that whilst pcr detection of RNA indicates viral shedding, it does not necessarily mean that viable virus is present. Van Doremalen found that under experimental conditions MERS-CoV survived over 48 hours on steel and plastic at low relative humidity and temperature but survival was reduced at higher temperatures and humidity. (van Doremalen, Bushmaker et al. 2013) No studies have yet been published for survival of MERS-CoV in field settings. (Otter, Donskey et al. 2015)

The R0 for MERS-CoV is estimated to be below 1, around 0.7. With regards to travel, no in-flight transmission of MERS-CoV has been documented. (Al-Tawfiq, Zumla et al. 2014)

**Transmission of SARS**

SARS is transmitted via respiratory droplets, therefore droplet, direct contact and indirect contact are likely modes of transmission. (Lai, Cheng et al. 2005) The highest viral titres are found in sputum and stool; highest in the latter. (Lai, Cheng et al. 2005) Survival in respiratory specimens can be around five to seven days at room temperature (Lai, Cheng et al. 2005), and up to 26 days in stool. (Isakbaeva, Khetsuriani et al. 2004)
Indirect contact transmission of SARS is plausible as virus can survive on porous and non-porous surfaces for long periods; for example Chan found it survived for more than twenty days on plastic and like MERS-CoV, it is more stable at lower temperatures and lower humidity. (Chan, Peiris et al. 2011) Dose response is evident – more concentrated depositions survive longer, for example SARS survived for one hour on a disposable gown at $10^4$ TCID$_{50}$/ml, compared with 2 days at $10^6$. (Lai, Cheng et al. 2005) In field settings, environmental reservoirs have been detected through pcr (e.g. patients’ bedtable, interior door knob, ventilator control panel), but virus was unable to be cultured. (Dowell, Simmerman et al. 2004, Booth, Kournikakis et al. 2005)

Air samples from a SARS patient’s room in hospital were found to be pcr positive, suggesting aerosol generation. (Booth, Kournikakis et al. 2005) Transmission patterns of SARS aboard aircraft have been potentially suggestive of airborne transmission, although the flight reported where the numbers of SARS infections were highest, most infected cases were within three rows of the index case, therefore droplet transmission was also feasible (as were alternative sources). (Olsen, Chang et al. 2003) Analysis and modelling using epidemiological data from Hong Kong outbreaks of SARS, supports airborne transmission through virus laden-aerosols. (Yu, Li et al. 2004)

There is no published evidence of pre-symptomatic transmission of SARS. (Fraser, Riley et al. 2004)
Transmission of Influenza (seasonal and pandemic)

There is debate about the relative importance of different modes of transmission for influenza. Historically epidemiological data were seen to support contact and droplet transmission, though the importance of the latter has been questioned as modelling studies suggest the event is not particularly common. (Atkinson and Wein 2008, Weber and Stilianakis 2008) It is also not possible to adequately differentiate between droplet transmission and aerosol (droplet nuclei) transmission at close range. The roles of airborne/aerosol transmission for influenza are subject to extensive discussion. (Killingley and Nguyen-Van-Tam 2013) Brankston, in 2007, concluded that traditional long distance airborne transmission had little role to play (Brankston, Gitterman et al. 2007); in contrast Tellier argues that aerosol transmission has a significant role, at least over short distances. (Tellier 2006, Tellier 2009) This latter view has been supported by Milton and colleagues who collected samples of exhaled particles from volunteers with seasonal influenza. They found viral RNA copies were 8.8 times more numerous in fine particles (< 5 µm) compared with coarse particles (> 5 µm). Infectious virus was recovered from fine particle samples from volunteers with the highest number of viral RNA copies. (Milton, Fabian et al. 2013) Similarly Bischoff has shown that healthcare workers within 1.892m of patients with influenza could be exposed to influenza in small-particle aerosols. (Bischoff, Swett et al. 2013) Further support is offered by Cowling who, using modelling, concludes that, in households, approximately half of all influenza transmission events result from aerosol transmission, with the greatest risk being in close proximity to infected persons. (Cowling, Ip et al. 2013) It has been suggested that different routes may be acting to different extents depending on the environment. (Wong, Cowling et al. 2014)

Providing evidence of person-to-person transmission via aerosols has proved challenging and experimental evidence is lacking. (Killingley, Enstone et al. 2011) Survival of influenza in aerosols depends on relative humidity – survival is better at lower humidity, but results are inconsistent. (Brankston, Gitterman et al. 2007)

The results of household studies suggest shedding peaks within 1-2 days of illness onset with symptoms peaking at onset. Influenza virus shedding occurs both pre-symptomatically and asymptotically; infectiousness occurring prior to illness onset has been estimated at 1-8%. (Lau, Cowling et al. 2010) In a community-based study (i.e. natural infections), 14% of
infections with detectable shedding were asymptomatic with the degree of shedding lower than when symptomatic. (Lau, Cowling et al. 2010)

Laboratory studies, some of which are relatively old, have shown that influenza virus survives for varying periods on inanimate surfaces, particularly hard surfaces where survival is reported anything from hours to days. (Bean, Moore et al. 1982) (Greatorex, Digard et al. 2011) Results vary, as they are likely to be influenced by experimental conditions including the concentration of virus applied and detection methods used. Generally speaking virus survival on surfaces in healthcare or community environments does not match that found under experimental conditions, though there are exceptions: Macais found a bed rail in a patient’s room was positive by PCR after 72 hours, after terminal cleaning had been carried out. (Macias, de la Torre et al. 2009) The variation of results of influenza virus survival are presented and discussed by Otter in his 2015 review of the role of dry surface contamination for the transmission of SARS, MERS and influenza. (Otter, Donskey et al. 2015)

The role of indirect transmission is also uncertain. Some have concluded that that indirect contact transmission does not have a major role to play (Atkinson and Wein 2008), or others conversely that it is important in many scenarios. (Spicknall, Koopman et al. 2010) (Weber and Stilianakis 2008). Modelling studies suggest the dominant mode of transmission may be setting specific, related to ‘host, pathogen, and environment’. (Spicknall, Koopman et al. 2010) Indirect contact transmission will generally involve hands. Early work suggest survival on hands is only very short lived (Bean, Moore et al. 1982, Schurmann and Eggers 1983) but this may still be long enough to potentially allow transmission given how frequently people touch their own faces. (Weber and Stilianakis 2008) However recovery of viable virus from hands is an uncommon finding (Simmerman, Suntarattiwong et al. 2010), and onwards transmission has not been demonstrated.

Transmission of influenza through inoculation of the conjunctiva is biologically plausible (by virus passing through the lachrymal ducts to the nasal mucosa), but remains unproven. (Bischoff, Reid et al. 2011)
## Table 10 Routes of transmission

<table>
<thead>
<tr>
<th>CONTACT TRANSMISSION</th>
<th>INDIRECT TRANSMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIRECT</strong></td>
<td><strong>INDIRECT</strong></td>
</tr>
<tr>
<td><strong>Disease</strong></td>
<td>Respiratory droplet</td>
</tr>
<tr>
<td>Pneumonic plague</td>
<td>Yes</td>
</tr>
<tr>
<td>Ebola</td>
<td>Respiratory plausible but not evidenced - cough not predictive of secondary cases. However large droplets from other body fluids possible</td>
</tr>
<tr>
<td>Inhalation anthrax</td>
<td>No</td>
</tr>
</tbody>
</table>

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18 For this report this is defined as small particles of a respirable size containing infectious agents that remain infective over time and dispersed over long distances by air currents.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Respiratory Droplet</th>
<th>Direct contact</th>
<th>Indirect contact</th>
<th>Traditional (^1) airborne</th>
<th>Aerosol</th>
<th>Other</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza (seasonal/ pandemic)</td>
<td>Likely, as droplet sized particles constitute 99% of the volume of respiratory spray</td>
<td>As droplets</td>
<td>Likely: survival hours to days on various inanimate materials. However recovery of viable virus from hands and surfaces not frequently achieved</td>
<td>Yes, community and healthcare setting evidence increasingly points to short range aerosol transmission</td>
<td>Likely, as influenza survives in air for up to 24hrs at low humidity</td>
<td></td>
<td>Conjunctival transmission biologically plausible</td>
</tr>
<tr>
<td>MERS-CoV</td>
<td>Yes</td>
<td>Yes</td>
<td>High viral loads in stool and GI symptoms common, though oral-faecal route not documented</td>
<td>Possible, and assumed for infection control given lethality of virus</td>
<td>Most transmission has been nosocomial and considered to be short range rather than long range</td>
<td>Faecal-oral route possible but not documented</td>
<td>Direct and indirect contact, and droplet are all possible routes of transmission to humans from camels</td>
</tr>
<tr>
<td>SARS-CoV</td>
<td>Yes</td>
<td>Yes</td>
<td>Likely as survives on wide range of materials for long periods</td>
<td>Yes, and assumed for infection control given lethality of virus</td>
<td>Transmission pattern on aircraft suggestive of airborne transmission, and modelling studies support this</td>
<td>Faecal-oral route possible but not documented</td>
<td></td>
</tr>
</tbody>
</table>
Table 11 Disease characteristics

<table>
<thead>
<tr>
<th>Disease</th>
<th>Incubation period</th>
<th>Infectivity period</th>
<th>Symptoms</th>
<th>Transmission/ range</th>
<th>Attack rate (AR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonic plague</td>
<td>1-6 days, generally 2-4</td>
<td>Not infectious pre-symptomatically. Higher risk in later illness. 5-6 days without antibiotics; peaks with productive cough. Deliberate release aerosol up to 1 hr</td>
<td>Fever, headache, malaise, increased respiratory rate and heart rate, chest pain, and persistent cough; dry, becoming productive + possible haemoptysis</td>
<td>Droplet/short range aerosol. Historical experiments suggest around 1m; advice is 2 metres</td>
<td>Low risk of transmission if no close contact. Secondary household AR 14%</td>
</tr>
<tr>
<td>Ebola</td>
<td>2 to 21 days; average 8-10</td>
<td>Negligible infectivity during incubation and low infectivity during first week of illness; higher risk in later illness and after death</td>
<td>Early: fever, headache, muscle pain, weakness, sore throat; late: diarrhoea, vomiting, rash, abdominal pain, bleeding</td>
<td>Mainly direct physical contact. Severe so advice is keep 2 metres away</td>
<td>Household AR with direct contact 32%. With no direct contact AR 1%. Case fatality 50%</td>
</tr>
<tr>
<td>Inhalation anthrax</td>
<td>1-7 days but possible up to 2 months. Median 9 days (Sverdlovsk). Incubation period dose-dependent</td>
<td>No person to person transmission but aerosolised disperses within 1 day. Spores can survive for decades</td>
<td>Fever, sore throat, hoarseness, swollen neck glands, headache, diarrhoea and vomiting</td>
<td>n/a – no person to person transmission</td>
<td>High case fatality &gt;85% without treatment; 45% with aggressive treatment</td>
</tr>
<tr>
<td>Influenza (seasonal/pandemic)</td>
<td>1-4 days SR 1.4 days</td>
<td>From 1 day prior to symptoms to 5-7 days after symptom onset</td>
<td>Fever, sudden onset cough, sore throat, malaise, respiratory symptoms</td>
<td>Droplet and aerosol at close proximity</td>
<td>Seasonal influenza AR 15-45%</td>
</tr>
<tr>
<td>SARS</td>
<td>2-7 days; can be longer</td>
<td>No evidence of pre-symptomatic transmission. Most contagious in second week of illness</td>
<td>Fever, headache, muscle pain, dry cough, pneumonia, GI symptoms possible</td>
<td>Mainly droplet, also indirect. Potentially airborne. Advice 2 metres</td>
<td></td>
</tr>
<tr>
<td>MERS-CoV</td>
<td>2 to 14 days; average 5-6</td>
<td>Unknown. Higher risk in later illness. Virus is shed after symptom resolution</td>
<td>Fever, cough, muscle pain, shortness of breath, pneumonia, GI symptoms</td>
<td>Droplet, also indirect as survives on surfaces. Advice is 2 metres</td>
<td>Around 15%</td>
</tr>
</tbody>
</table>
10.2 Annex 2 Evidence for the infection prevention and control guiding principles

**Heating, ventilation and air conditioning (HVAC)**

There is an association between ventilation, air movement in buildings and the spread of some infectious diseases. (Li, Leung et al. 2007) Data supporting this dates from as far back as 1955 when Wells concluded that the incidence of airborne infection in susceptible hosts was inversely associated with the ventilation rate. (Wells 1934) Although studies demonstrate the importance of ventilation and airflows, there is insufficient data to quantify minimum ventilation requirements for various settings. (Li, Leung et al. 2007) Infectious dose and survivability are factors to take into consideration when establishing minimum ventilation requirements.

Evidence suggests that under-ventilation is a potential risk factor for transmission of airborne pathogens on aircraft, buses and in cars (Moser, Bender et al. 1979, Nasir, Campos et al. 2016) (Mangili and Gendreau 2005) (Sattar, Wright et al. 2016) (Edelson and Phypers 2011, Leitmeyer 2011) although the level of this risk is poorly quantified. (Mohr, Askar et al. 2012) In the context of risk of infection, cabin air is discussed in detail by Mangili. (Mangili and Gendreau 2005) In aircraft the air is of low humidity and the air flow rate is around 10-15 exchanges per hour, of which approximately half is outdoor air and half is high efficiency particulate air (HEPA) filtered air.19 (Re-circulation of air has been looked at with regard to increasing the risk of transmission (of TB) but no evidence was found to support this.) Data suggests that respiratory infections increase with lower ventilation rates. (Sundell, Levin et al. 2011)

Transmission of influenza has been shown to be most effective at low temperature and low relative humidity. Transmission via droplets ‘failed’ at high temperature and at high humidity. (Lowen, Steel et al. 2008) These features have been used to explain the difference in seasonality between tropical and other areas, giving rise to a hypothesis that influenza transmission in temperate zones is mainly by aerosol transmission, and in the tropics, by

contact transmission. (Lowen and Palese 2009) (Wong, Cowling et al. 2014) As high humidity removes droplets less than 5 microns, humidifiers could be used as an intervention to reduce transmission. (Yang and Marr 2011) Ultraviolet light is virucidal so can be used as an environmental control. (Weber and Stilianakis 2008) Its effectiveness depends on irradiation time and therefore on ventilation rate.

Exclusion of symptomatic persons

Exclusion of symptomatic persons at transport hubs can be achieved through several means. A formal means would be through exit screening or entry screening, but it can also be through informal screening for signs of communicable disease at a hub check in or at other points on the passenger journey such as passport control which could result in denial of boarding and medical referral.

Exit screening was employed at the request of WHO in affected areas during the SARS outbreak. In Canada where the outbreak was significant, no cases were detected through screening. It was also advised by WHO and used during the Ebola epidemic in 2014; however no Ebola cases were detected through it. (Cohen, Brown et al. 2016) Although a small number of cases of Ebola were exported by air travel, none were particularly symptomatic at the time. Modelling conducted during the Ebola outbreak had suggested that exit screening for Ebola would detect over a third of infected passengers (Read, Diggle et al. 2015) To mitigate spread of plague, exit screening was used at Antananarivo airport in Madagascar from October 8th 2017, using questionnaires and temperature screening.

Entry screening was used in a number of countries during the SARS outbreak and during the influenza pandemic. (Selvey, Antao et al. 2015) It was used in Canada during SARS, but no cases were detected; similarly in Australia, no cases were confirmed in those screened. It is not suitable (or effective) for pandemic influenza, and whilst it is better suited to SARS, where fever is more consistent, it is not recommended by CDC for either communicable disease. Cowling found that entry screening could provide a short term delay in local transmission, but this needed to be balanced against the resources required to conduct it. (Cowling, Lau et al. 2010)

Entry screening was employed by the UK during Ebola for arrivals from affected countries although this was not an advised measure at an international level. It was also put in place at five US airports for a short period. Read’s modelling results for Ebola indicated the numbers
of cases modelled to be detected by entry screening in the US and in the UK to be extremely small with efficiency estimations at 0.004% and 0.009% respectively. (Read, Diggle et al. 2015)

**Separation of international and domestic travellers**

Human movement patterns lend some evidence to the rationale of separating international and domestic travellers. (Gomes, Pastore et al. 2014) (Lau, Gibson et al. 2017) Travel brings geographically isolated populations together; if the bringing together can be limited, this will reduce, or at least delay, transmission opportunities. Nasir comments on the mixing of passengers in his paper on airborne hazards and urban transport infrastructure. (Nasir, Campos et al. 2016)

**Interpersonal distancing**

Jefferson defines social distancing as a separation of at least 1 metre between infected and non-infected. (Jefferson, Del Mar et al. 2011) Despite the logic that interpersonal distancing should limit transmission, in a major systematic review of physical measures to interrupt the spread of respiratory viruses (including hand hygiene, PPE (including facemasks) and social distancing), Jefferson concluded that evidence on the effectiveness of interpersonal/ social distancing was lacking with the small number of studies in existence not enabling firm conclusions to be drawn. (Jefferson, Del Mar et al. 2011)

Historically WHO suggested that avoiding crowding could reduce the peak of an epidemic and spread it over a longer period. (WHO 1959) Household crowding has been found to be a factor in the spread of influenza in the community, however the impact of living in close quarters on transmission is limited. (Aiello, Coulborn et al. 2010) A logical extension of this is that measures to avoid crowding in transport hubs may lower the risk of transmission.

An extension of interpersonal distancing is the use of respiratory hygiene/cough etiquette. Respiratory hygiene/cough etiquette includes covering the nose and mouth (generally with tissues) when coughing or sneezing. This, in theory, is a source control that will interrupt direct transmission, as it will reduce dispersal of droplets into the environment. (Zayas, Chiang et al. 2013) Using tissues will also catch large droplets from the nose and mouth, reducing the amount of cough deposited on hands relative to not using a tissue (so also reducing the indirect contact transmission risk).
Coughing into one’s elbow/sleeve is also frequently promoted. This appears to have been initially promoted by CDC in the US (possibly in response to SARS) and continues to be before it appeared in the EU and elsewhere, (it was mentioned in UK media in 2007, and promoted by ECDC in 2009) but the exact origins are not known. (Zayas, Chiang et al. 2013)

It is often advised in the absence of tissues, although it may be less effective than using a tissue. It also presents a risk in terms of indirect transmission from contaminated clothing. The recommendation is made on the grounds of plausibility rather than controlled studies. (Bell, Nicoll et al. 2006) However direct evidence for the effectiveness of respiratory hygiene is lacking. Alongside respiratory hygiene is avoiding touching ones face to avoid contact with the eyes, nose and mouth which reduces the risk of self-contamination. (Kwok, Gralton et al. 2015)

A review by MacIntyre describes several research papers exploring whether the use of masks reduces the acquisition of respiratory viruses. (MacIntyre and Chughtai 2015) Most trials of facemasks have focused on the use of masks to protect the well person, either in the healthcare settings (where they have sometimes been tested compared with respirators), or the community setting. One study described in the review looked at the use of masks by the infected person to prevent transmission to susceptible people. (Canini, Andreoletti et al. 2010) Although the evidence for this is limited, it is widely adopted advice.

Trials using masks can be difficult to interpret because of issues such as compliance and power. The trials indicated that facemasks and facemasks plus hand hygiene may prevent infection in community settings. (MacIntyre and Chughtai 2015) The general wearing of facemasks by the public during a pandemic is not generally recommended (CDC, WHO, ECDC), although in high risk circumstances, such as on public transport, they may be recommended. The WHO stance is that their use should be based on risk and that they are permitted but not required. During SARS Hong Kong residents often did wear masks but whether this was an effective intervention is uncertain. (Wu, Xu et al. 2004) (Lau, Tsui et al. 2004)

A systematic review by Cowling and colleagues in 2010 concluded that there was little evidence that wearing a facemask diminishes the acquisition of influenza infection, but that

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20 [www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm](http://www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm)

there was some evidence that an infected person wearing a mask can protect others from respiratory infection. (Johnson, Druce et al. 2009) (Cowling, Zhou et al. 2010)

**Measures to reduce Indirect contact transmission**

Substantial literature exists to demonstrate that hand hygiene practiced in primary school settings reduces the incidence of acute respiratory infection. This can be achieved in practice through a combination of cleaning of frequently touched surfaces, hand sanitation (via alcohol gels or washing with soap and water) and the adoption of ‘no-touch-face’ behaviours (Kwok, Gralton et al. 2015) and use of PPE. There is no evidence that antimicrobial soaps are better than standard ones. Some studies suggest that alcohol based sanitizers perform better than soap and water but this is debated. (Tuladhar, Hazeleger et al. 2015) (Savolainen-Kopra, Korpela et al. 2012) WHO recommend hand-washing for 40-60 seconds; CDC recommend 20 seconds. Globalhandwashing.org (a coalition of international stakeholders) explain this difference as 20 seconds being the time for using soap on hands whereas the 60 seconds is the time for the full procedure from wetting to drying.\(^{22}\) The NHS also recommend 20 seconds.\(^{23}\) The evidence around using hot or warm water vs cold water is limited. Although recent evidence suggested that washing with cold water is just as effective against bacteria as washing with hot water, the study was very small and was limited to *E.coli* infections. In healthcare environments the advice is to wash hands with warm or tepid water; hot water being avoided to decrease the risk of dermatitis, and cold water avoided because it is less comfortable. (Loveday, Wilson et al. 2014) In terms of duration for hand hygiene using alcohol hand sanitiser, evidence suggests that 15 seconds is not inferior to 30 seconds for reducing bacterial counts. (Pires, Soule et al. 2017) It is important to dry hands well. From a hygiene perspective, the use of paper hand-towels is more efficient for drying hands than using hot air, and also removes bacteria more effectively. (Huang, Ma et al. 2012) However, transport hubs are not clinical environments therefore there may be other priorities such as not accumulating waste which outweigh the superiority of towels in terms of infection control.

In terms of evidence, viruses, including influenza virus, can survive on some surfaces for several hours. (Weber and Stilianakis 2008) (Brankston, Gitterman et al. 2007) (Greatorex,

\(^{22}\) [https://globalhandwashing.org/about-handwashing/faqs/#are](https://globalhandwashing.org/about-handwashing/faqs/#are)

\(^{23}\) [https://www.nhs.uk/Livewell/homehygiene/Pages/how-to-wash-your-hands-properly.aspx](https://www.nhs.uk/Livewell/homehygiene/Pages/how-to-wash-your-hands-properly.aspx)
Survival persists on hard surfaces (e.g. steel) longer than on porous materials or skin. (Bean, Moore et al. 1982) (Greatorex, Digard et al. 2011) However it survives a shorter period on copper. (Noyce, Michels et al. 2007) A number of studies have looked at (influenza) virus survival on hand; the results indicate that it does not survive for long periods on hands (around 5 minutes), (Parker and MacNeal 1944) (Bean, Moore et al. 1982) however the few minutes it does survive is long enough for the virus to be transferred elsewhere, particularly as there is likely to be repeated touching. (Weber and Stilianakis 2008) Virus survival in mucus will be longer because of proteins and salts present. (Schaffer, Soergel et al. 1976)

Rhinovirus has been shown to survive on surfaces, by both pcr and culture, and transfer to hands from these contaminated surfaces was shown to occur for several hours after contamination. Such contamination could lead to infection by transfer to mucous membranes when people touch their faces. (Winther, McCue et al. 2007, Winther, McCue et al. 2011) Viruses have also been shown to survive on many other surfaces, particularly hard surfaces, for a number of hours. Studies conducted in hotels showed that many objects that had been touched were contaminated with rhinovirus, including door handles, light switches and remote controls. (Bloomfield, Carling et al. 2017) A similar study conducted in houses during the influenza pandemic found virus could be recovered from some surfaces in the near environment of people with influenza, although as a proportion of all surfaces samples this was small. (Killingley, Greatorex et al. 2016) Although onwards transmission from such contaminated fomites has not been investigated, it is plausible and likely that onward such transmission occurs so mitigation (through reducing touch, and through cleaning) is prudent.

Hand hygiene has been shown to decrease the risk of diarrhoeal infections. (Curtis and Cairncross 2003) (Freeman, Stocks et al. 2014) (Aiello, Coulborn et al. 2008) Aiello found the use of non-antibacterial soap combined with hand hygiene education offered the strongest protective effect. For influenza, cleaning the hands with soap and water (or sanitisers) has been demonstrated to reduce the viral load. (Grayson, Melvani et al. 2009) Hand hygiene was also show to be effective in preventing the transmission of SARS. (Fung and Cairncross 2006) For respiratory viruses in general, Jefferson found that as one element of a number of measures taken together, hand washing was effective in reducing viral transmission and concluded that hand-washing programmes should be implemented nationally. (Jefferson, Del Mar et al. 2011) Wong and colleagues conducted a systematic review and meta-regression to explore the efficacy of hand hygiene for influenza in the community. They concluded that
hand hygiene was effective for reducing influenza infections in the community when combined with facemasks, but not alone as an intervention, commenting that this is consistent with aerosol transmission being likely to be important, (so handwashing alone is insufficient to control infection). (Wong, Cowling et al. 2014) Similarly Warren-Gash and colleagues conducted a systematic review also on hand hygiene in the community, for influenza and influenza-like-illness or other acute respiratory infections and concluded that the effectiveness of the intervention depends on the setting, the context and compliance. One of their conclusions was that in a domestic setting, where there already an index case, hand hygiene alone did not prevent transmission. (Warren-Gash, Fragaszy et al. 2013)

Another measure that can be used to reduce indirect transmission is the use of antimicrobial materials or coatings. For example, copper has been used at border control counters in Chile.24

Cleaning removes visible matter (a bioburden) from objects or surfaces. Most standard cleaning products will contain detergent which will inactivate most viruses. Some viruses, including influenza can also be inactivated by everyday household products such as vinegar. (Greatorex, Page et al. 2010) This is unlikely to be useful in a transport hub; it would only be useful if supplies of normal cleaning products were completely depleted.

24 Copper for infection control at border control. https://www.antimicrobials Webseite
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