ECDC **GUIDANCE**

Risk assessment guidelines for diseases transmitted on aircraft

PART 2: Operational guidelines for assisting in the evaluation of risk for transmission by disease

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Abbreviations

CDC	Centers for Disease Control and Prevention, Atlanta, USA
ECDC	European Centre for Disease Prevention and Control, Stockholm, Sweden
ELISA	Enzyme linked immunosorbent assay
EU	European Union
GRADE	Grading of recommendations assessment, development and evaluation
HEPA-filter	High efficiency particulate air filter (in passenger aircraft cabins)
IATA	International Air Transport Association
IMD	Invasive meningococcal disease
IPT	Isoniazid preventive therapy
MDR	Multi-drug resistant
PEP	Post-exposure prophylaxis
RAGIDA	Risk assessment guidance for diseases transmitted on aircraft
RT-PCR	Reverse transcription polymerase chain reaction
SARS	Severe acute respiratory syndrome
SARS-CoV	SARS coronavirus
SIGN	Scottish Intercollegiate Guidelines Network
TB	Tuberculosis
WHO	World Health Organization
XDR	Extensively drug resistant

Introduction

The founding regulation[i] establishing the European Centre for Disease Prevention and Control (ECDC) gives ECDC a mandate to strengthen the capacity of the EU for the prevention and control of infectious diseases. One of the approaches is to provide independent scientific advice, as well as scientific and technical assistance to assess health threats.

The emergence of severe acute respiratory syndrome (SARS) illustrated the potential for a new disease to suddenly appear, spread and threaten the health, economic and social life of European citizens. The fact that there are more than 700 million passengers carried on national and international flights within the European Union (EU)[ii] alone highlights the potential risk of the introduction and spread of infectious diseases during air travel. Early recognition of disease and appropriate risk assessments are needed in order to initiate the most appropriate public health response when passengers and/or crew members become exposed to an infectious or potentially infectious passenger during a flight without unnecessarily alarming the public or disrupting air traffic.

In order to assist national authorities in the EU Member States in the assessment of risks associated with the transmission of various infectious agents on board airplanes, ECDC commissioned the production of this guidance documents through a call for tender with the Robert Koch Institute, Germany in 2007. Hereafter, this project will be referred to as 'the risk assessment guidance for diseases transmitted on aircraft', or RAGIDA.

The RAGIDA project

The project consisted of two different parts, described below.

Part 1: Systematic literature review and expert interviews

As a first step, a systematic review of over 3700 peer-reviewed articles and grey literature was performed for the following 12 diseases: tuberculosis, influenza, severe acute respiratory syndrome, meningococcal disease, measles, rubella, diphtheria, Ebola hemorrhagic fever, Marburg hemorrhagic fever, Lassa fever, smallpox and anthrax. In addition, general guidelines on risk assessment and risk management from international aviation boards and national or international public health agencies were systematically searched. Standardised questionnaires were used to interview national and international experts to systematically assess case-based information on events.

The results of this first part of the project are available at the following link: RAGIDA pdf

Part 2: Operational guidance for assisting in the evaluation of risk for transmission by disease

As a second step, the production of a series of operational guidance documents for assisting in the evaluation of risk for transmission of ten diseases prioritised by the Advisory Forum (AF17/2008) was initiated. In June 2009, ECDC convened a technical expert consultation that focused on tuberculosis, new emerging airborne diseases (e.g. SARS) and meningococcal infections. In 2010, other expert consultations will follow covering diseases such as measles, rubella, hemorrhagic fevers, diphtheria, and bioterrorism agents (smallpox, anthrax). Described below are both the methodology and the structure of the guidance documents finalised in part 2 of the project.

[i] Regulation 851/2004 of the European Parliament and of the Council

[ii] Total number of passengers carried in 2005 (arrivals and departures for national and international), Europe in Figures, Eurostat yearbook 2006-07

Methodology

A) Selection of the working group participants

Small, multidisciplinary expert working groups were established for each of the following three diseases: tuberculosis, new emerging air borne diseases and meningococcal infections. The participants were selected to include:

- representatives of national public health authorities, including those with experience in the investigation and follow-up of incidents involving infectious diseases in travellers;
- European and international disease experts;
- international experts in microbiology and mathematic modelling;
- representatives of the ECDC disease specific programmes;
- representatives of the European Commission and;
- representatives of the WHO International Health Regulations Coordination Programme, Geneva.

All participants completed a Declaration of Interest form. No conflicts of interest were declared by any of the participants.

B) Base of evidence

Evidence obtained for the three guidance documents included:

- the review of the published literature by disease, related to air travel (see RAGIDA part 1);
- the review of data in air travellers obtained from national public health authorities (see RAGIDA part 2);
- expert opinions from the working group participants.

The quality of available evidence was assessed by the experts, using elements of the "Scottish Intercollegiate Guidelines Network" (SIGN) and the "Grading of Recommendations Assessment, Development and Evaluation" (GRADE), by not only taking into consideration the available scientific evidence for transmission but also wider aspects including the following examples: case fatality rate, the potential for public health intervention and availability of treatment.

An illustration of the type of considerations used by the experts in order to assess the evidence can be found in annex 1.

C) Development of the final guidance documents

The final recommendations proposed by the three expert groups were shared for comments and suggestions with the members of the ECDC Advisory Forum (AF19/2009), which have been integrated in the current document.

Structure and use of the guidance document

The current document consists of three disease-specific chapters, using the following outline:

- Literature review
- Suggested approach
- Criteria to be considered
- Other considerations
- Draft Q&A for contact tracing

These guidance documents may be adapted to the local situation, national and international regulations or preparedness plans.

These guidance documents represent the views of the experts. If new, relevant evidence becomes available, the RAGIDA documents will be updated accordingly.

1. Tuberculosis

1.1 Literature review

The detailed systematic review of the literature identified a limited number of incidents with evidence for tuberculosis (TB) transmission during air travel; additionally, there was insufficient evidence of the effectiveness of contact tracing [1]. Three studies identified in the review [2–4] presented evidence of tuberculin skin conversion among contacts; however, one was associated with transmission [3] from a crew member to colleagues [2] and another involved passengers from a high incidence country where boosting could not be excluded [4]. A single study provided clear evidence of transmission. This was associated with a long-haul flight following exposure to a sputum smear-positive patient with evidence of transmission to household contacts prior to air travel [4]. No case of TB disease as a consequence of transmission during air travel has been described in the literature so far. The resource implications of the contact tracing processes are high [5,6] and there is no available preventive treatment for Multi-Drug Resistant (MDR) or Extensively Drug-Resistant (XDR) TB. Furthermore, evidence for compliance with isoniazid preventive therapy (IPT) among passengers presenting a positive tuberculin skin test following air travel is also limited.

Using the Scottish Intercollegiate Guidelines Network (SIGN) approach for developing guidelines [7], the working group reviewed the evidence base and concluded that the quality of evidence is weak. Recommendations were formulated for investigating air travel related tuberculosis incidents. These recommendations are all graded D [8].

1.2 Suggested approach

Contact tracing of passengers exposed to tuberculosis during air travel should only be undertaken following a careful risk assessment based on the infectiousness of the index patient, the amount of effective contact/exposure and where possible an assessment of the susceptibility of exposed individuals, as it is done during any routine contact investigation.

An assessment based on the following criteria should follow the outline in figure 1. Where these conditions are met, exposed passengers in the relevant rows should be contacted using the procedures outlined in the WHO guidelines [9] and investigated and managed for latent tuberculosis infection according to national guidelines.

1.3 Criteria to be considered

The index case

- **Index case with confirmed infectious pulmonary TB:** Defined as culture or molecular probe-confirmed cases with positive sputum smear microscopy (including induced sputum or bronchoalveolar lavage);
- **The infectiousness of the index case:** Evidence of transmission in other settings, such as transmission to household members or other close contacts.

Effective exposure

- **Duration of flight:** Flight duration equal to or exceeding eight hours of flight time including ground delays (www.flightstats.com);
- **Location onboard:** Evidence for onboard TB transmission is very low for passengers seated more than two rows ahead or two rows behind the index case; therefore, contact tracing is only recommended for passengers sitting in the same row, two rows ahead and two rows behind the index case.

1.4 Other considerations

Before the flight

- Patients with confirmed infectious pulmonary TB should avoid air travel.
- If a patient with confirmed infectious pulmonary TB requires unavoidable flight, ask the patient to delay travel until after the patient has received a minimum of two weeks of adequate treatment with clinical improvement. If it is not possible to delay travelling for two weeks, then a travel protocol should be agreed between the patient, the local public health authority (public health team) and the airline in question. Instruct the patient to cover nose and mouth while coughing to reduce exposure, isolate the patient for the

duration of travel and provide a face mask for the patient (educate on how to use it). The risk of infection of passengers with MDR and XDR TB should be assessed using national guidelines.

During the flight

- During a flight, if a passenger is suspected of having TB—as with any other respiratory infection—the potentially infectious traveler should be relocated to an isolated seat separate from other travelers (if possible) and be provided with a surgical face mask and a sufficient amount of disposable tissues. Flight attendants should follow IATA guidelines for infection control and, if possible, collect locator cards from travellers to facilitate contact tracing, if needed.

1.5 Draft Q&A sheet for tuberculosis contact tracing

The following is a template for public health experts who need to quickly develop a Q&A sheet to complement contact tracing activities. This template should be adapted according to the individual situation and to the decisions made by the public health authorities in charge.

When should contact tracing be considered?

If the index case is confirmed as having infectious pulmonary TB (sputum smear positive, including induced sputum or bronchoalveolar lavage) and there is evidence of transmission to other contacts (refers to cases with evidence of transmission in household or other close contacts)

and

the duration of the flight is longer than eight hours

and

the time elapsed between the flight and diagnosis of the case is not longer than three months.

When is a patient infectious?

Patients with sputum smear-positive for pulmonary TB are considered infectious.

Who should be considered for contact tracing?

We recommend limiting contact tracing to passengers sitting in the same row, two rows ahead and two rows behind the index case in accordance with the WHO guidelines [9].The exposure of the cabin crew is generally less intensive and should be assessed by the airline's medical service.

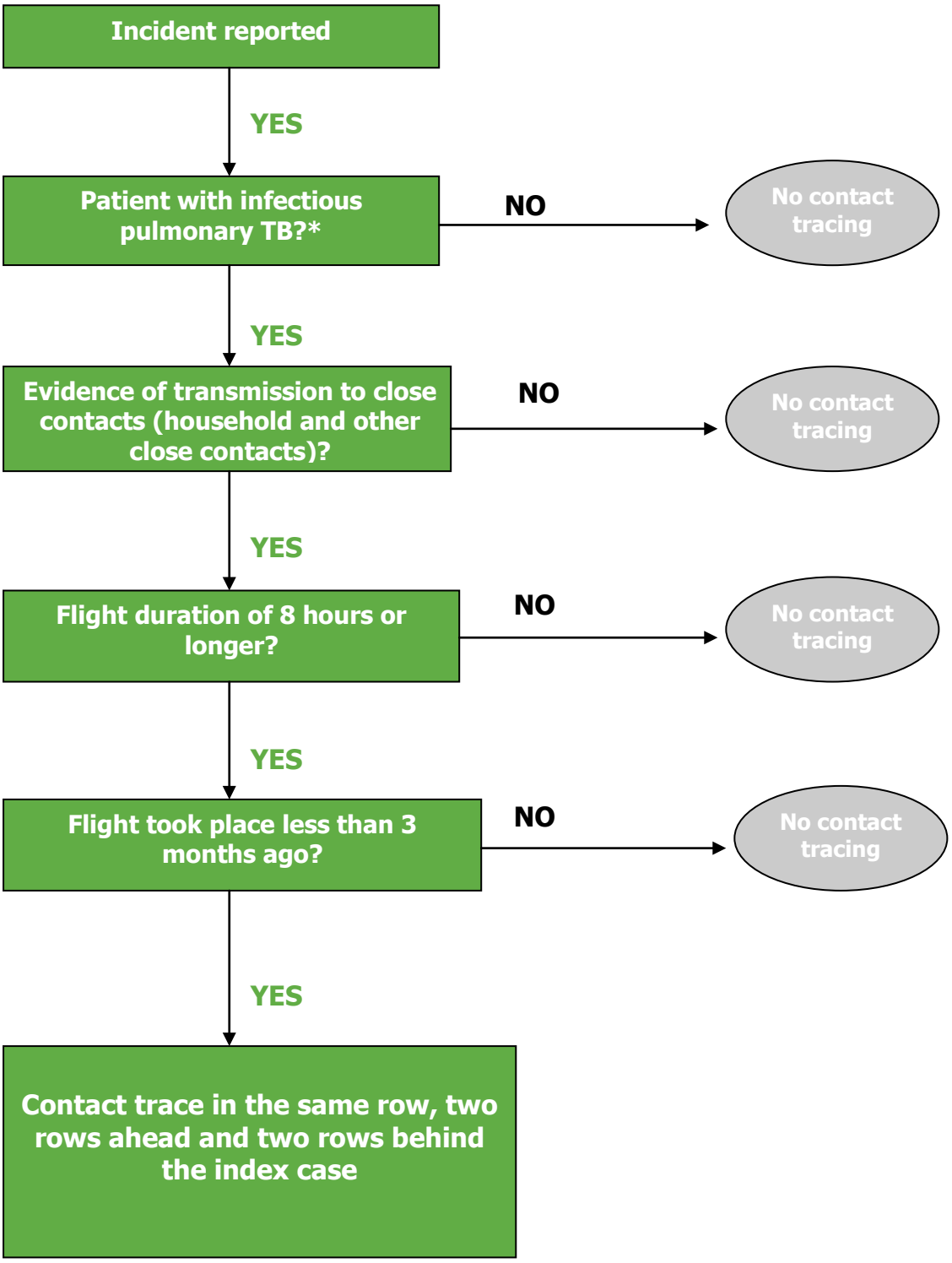
Are there special considerations for MDR/XDR TB?

There is no evidence that patients with MDR or XDR TB are more infectious than patients with sensitive TB; however, the potential clinical implications of these conditions could be more serious [10]. There is also no effective treatment for latent infection caused by MDR or XDR TB [11].

Are there special considerations for individuals of higher susceptibility?

If contact tracing is decided after the risk assessment and there is evidence that passengers with higher susceptibility to TB, such as infants or children, travelled in the same row or two rows ahead or behind the index case, special efforts should be initiated to contact trace them.

Figure 1.1: Risk assessment algorithm tuberculosis



**Infectious pulmonary TB is defined as culture or molecular probe confirmed cases with a positive microscopy sputum smear (including induced sputum or bronchoalveolar lavage).*

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2. Severe acute respiratory syndrome

2.1 Literature review

The detailed systematic review of the literature identified four documented events including 26 passengers with evidence for transmission of severe acute respiratory syndrome (SARS) during air travel [1]. The evidence for on-board transmission was high in 24 of the 26 of the passengers and medium and low for the other two passengers. Seat locations of infected contacts in relation to the index case[i] were available for two events and ranged between the same row and seven rows away. All cases with reported transmission were symptomatic during the flight [2–10].

2.2 Suggested approach

An assessment of possible transmission of SARS on an aircraft should be undertaken on a case-by-case basis. This should occur after careful individual risk assessment, taking into account the index case status, the symptoms of the index case, the epidemiological situation for SARS in country of origin/departure and country of destination/arrival and the purpose of the contact tracing. The undertaken assessment should follow the outline in Figure 2.

2.3 Criteria to be considered

The index case

The index case is a probable or laboratory confirmed case of SARS (see below for ECDC case definitions).

- **The severity of the symptoms and infectiousness of the index case:** There are no reported cases of transmission before onset of symptoms [2]. Transmission is most likely from severely ill patients or those experiencing rapid clinical deterioration, usually during the second week of illness [3].

Epidemiological situation

- **The evidence of transmission in country of origin and country of destination:** The decision to perform contact tracing for either laboratory confirmed SARS cases with symptoms during a flight or when a probable SARS case had been on a flight should be based on existing evidence for transmission of SARS in the country of origin (see the following three scenarios):
  - **No evidence of transmission in country of origin.** Early phase of a potential outbreak: The diagnosis of SARS cases might be delayed because clinicians do not consider SARS as a differential diagnosis. To ensure that no secondary SARS cases are missed, it is suggested that contact tracing be initiated when a laboratory confirmed SARS case had been symptomatic on a flight that occurred within 20 days (twice the maximum incubation period) after the onset of symptoms;
  - **Evidence of ongoing transmission in country of origin, but no cases in country of arrival.** In this situation, it is suggested that contact tracing be initiated when a probable or laboratory confirmed SARS case had been symptomatic on a flight that occurred within 20 days after onset of symptoms. Comprehensive contact tracing should be considered to prevent potential secondary and tertiary cases;
  - **Evidence of ongoing transmission in country of origin and country of destination**. In this situation, it is suggested that contact tracing be initiated when a laboratory confirmed SARS case had been symptomatic on a flight that occurred within 10 days (the maximum incubation period) after the onset of symptoms.

Effective exposure

Although there is no evidence of on-board SARS transmission beyond seven seating rows, a comprehensive contact tracing of confirmed SARS cases—especially in the inter-epidemic period—should be considered. If all passengers can not be contacted, contact tracing efforts should at least concentrate on the following:

- passengers seated in the same row as the index case;
- passengers seated two rows in front or behind the index case;

[i] Person identified as the initial case.

- persons providing care for the index case;
- persons having intimate contact with the index case;
- persons having contact with respiratory secretions of the index case;
- passengers living in the same household with the index case and;
- all crew members.

If a crew member is the index case, all passengers seating in the area the crew member was working during the flight should be regarded as contacts, as well as the other members of the crew.

2.4 Other considerations

During the flight

- During the flight, if a passenger is suspected of having SARS—as with any other respiratory infection—the potentially infectious passenger should, if possible, be isolated and provided with a surgical face mask. The flight attendant should follow the IATA guidelines for infection control.
- Contacts should provide to the health authorities their identification and valid contact addresses for 14 days after the flight (locator cards) in order to facilitate contact tracing, if needed.
- Captains should radio ahead to the airport of destination informing it of a suspected SARS case on board (International Health Regulation 2005, Article 28. Available at IHR 2005).

2.5 Draft Q&A sheet for SARS contact tracing

The following is a template for public health experts who need to quickly develop a Q&A sheet to complement contact tracing activities. This template should be adapted according to the individual situation and to the decisions made by the public health authorities in charge.

When should contact tracing be considered?

After reviewing individual risk assessments considering the global epidemical situation for SARS and susceptibility of passengers, contact tracing should be initiated if these three conditions are met:

if there was a probable or confirmed case on board (see case definitions)

and

if the patient was possibly infectious

and

if the flight occurred within the last 10 or 20 days (see algorithm).

When is a patient infectious?

There are no reported cases of transmission before the onset of symptoms [2]. Based on the data collected by the World Health Organization (WHO), transmission is most likely from severely ill patients or those experiencing rapid clinical deterioration, usually during the second week of illness [3]. The literature review revealed that, in the four events in which transmission occurred, three index patients were symptomatic during the flight. In another case, the clinical status of the index case during flight was unknown [4–7].

Who should be considered for contact tracing?

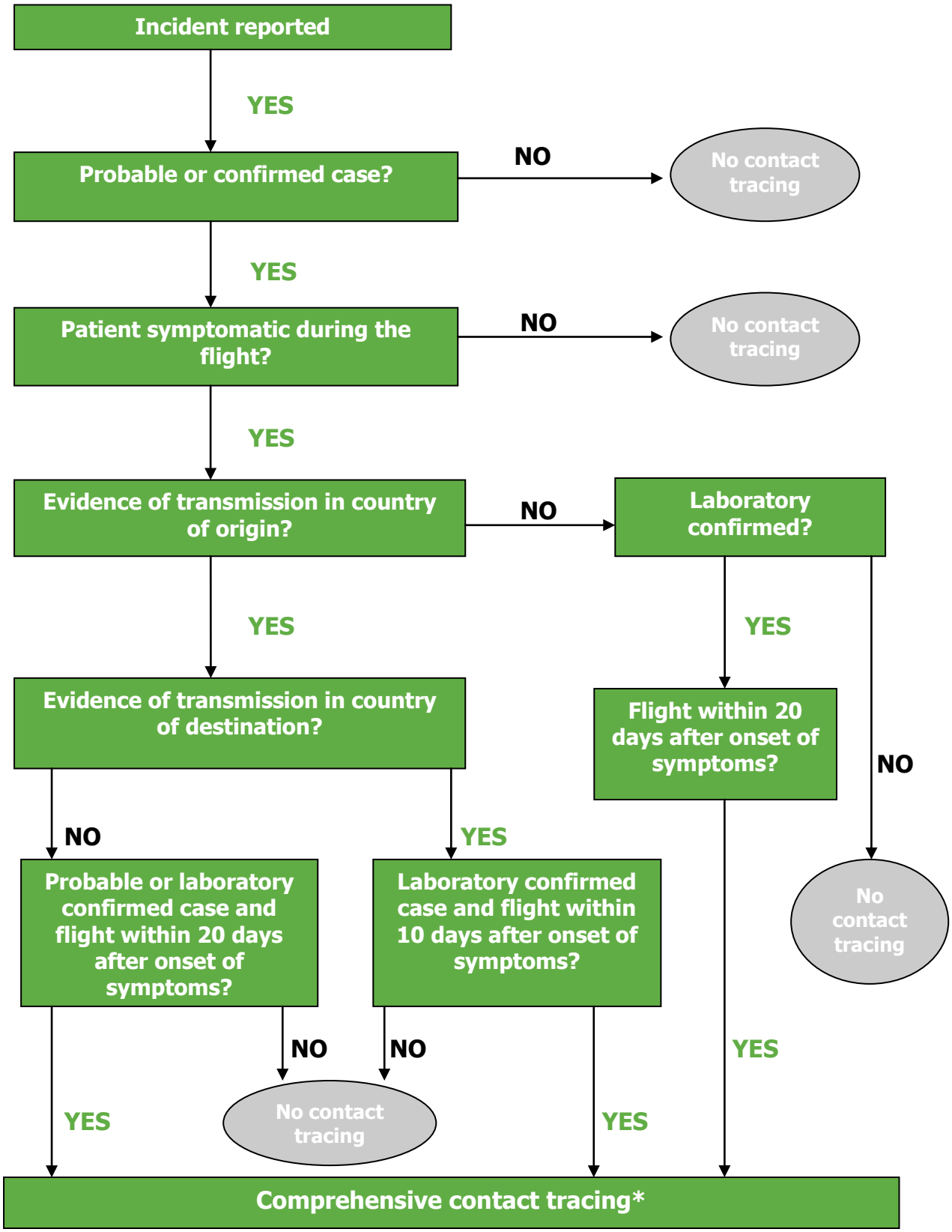
In eight out of nine flights with SARS events, comprehensive contact tracing (aiming to identify every passenger) was initiated. In one event, passengers seated in the same row as the index case and the two rows in front or behind the index case were traced 90 days after the flight in order to determine the seroprevalence of SARS antibodies in passengers [8]. Of the 36 out of the 250 (14%) passengers successfully traced, none were infected.

In two of the four events in which transmission occurred, the infected contacts were seated between 0 and seven rows away from the index patient [6,7]. Although evidence for transmission of SARS in a distance beyond seven seating rows does not exist, especially in the inter-epidemic period, a comprehensive contact tracing of probable or confirmed SARS cases should be considered to prevent potential secondary and tertiary transmission.

Does the flight time play a role in contact tracing?

In four out of nine events in which transmission occurred, the flight time exceeded eight hours [4–6]. Nevertheless, in another event with highly plausible evidence of transmission, the flight time was only three hours [7]. Therefore, we suggest not limiting contact tracing to long-haul flights only.

Figure 2.1: Risk assessment algorithm SARS



** If all passengers cannot be contacted, contact tracing efforts should at least concentrate on the following: passengers seated in the same row as the index case; passengers seated two rows in front or behind the index case; persons providing care for the index case; persons having intimate contact with the index case; persons having contact with respiratory secretions of the index case; passengers living in the same household with the index case and; all crew members.*

Is there evidence as to whether the on-board HEPA-filter makes a difference?

None of the retrieved and analysed publications mention the functionality of the on-board HEPA-filter systems. In consequence, evidence for a possibly increased risk of SARS transmission on board in case of non-functioning HEPA filters is inconclusive.

2.6 Case definitions (ECDC, 2008)

The Commission of the European Communities; Commission decision of 28/IV/2008 amending decision 2002/253/EC laying down case definition for reporting communicable diseases to the Community network under Decision No 2119/98/EC of the European Parliament and the Council, 2008.

Clinical criteria

Any person with fever or history of fever and at least one of the following three:

a cough,

difficulty breathing, or

shortness of breath

and

at least one of the following four:

radiographic evidence of pneumonia,

radiographic evidence of acute respiratory distress syndrome,

autopsy findings of pneumonia,

autopsy findings of acute respiratory distress syndrome

and

no alternative diagnosis which can fully explain the illness.

Laboratory criteria

Confirmed case

A laboratory confirmed case includes at least one of the following three:

- isolation of the virus in cell culture from any clinical specimen and identification of SARS coronavirus (SARS-CoV) using methods such as reverse transcription polymerase chain reaction (RT-PCR);
- detection of SARS-CoV nucleic acid in at least one of the following three: at least two different clinical specimens; the same clinical specimen collected on two or more occasions during the course of the illness or; two different assays or repeat RT-PCR using a new RNA extract from the original clinical sample on each occasion of testing;
- SARS-CoV specific antibody response by one of the following two: seroconversion by enzyme linked immunosorbent assay (ELISA) or immunoflourescent assay (IFA) in acute and convalescent phase serum tested in parallel or; fourfold or greater rise in antibody titre in between acute and convalescent phase sera tested in parallel.

Probable case

A probable case, based on laboratory findings, includes at least one of the following two:

- a single positive antibody test for SARS-CoV;
- a positive PCR result for SARS-CoV on a single clinical specimen and assay.

Epidemiological criteria

Epidemiological criteria include at least one of the following three:

- any person with at least one of the following three: employed in an occupation associated with an increased risk of SARS-CoV exposure (e.g. lab, handling animals); close contact of one or more persons

with confirmed SARS or under investigation for SARS or; history of travel to or residence in an area experiencing an outbreak of SARS;
- two or more healthcare workers with clinical evidence of SARS in the same healthcare unit and with onset of illness in the same 10 day period or;
- three or more persons with clinical evidence of SARS with onset of illness in the same 10 day period and epidemiologically linked to a healthcare facility.

Case definition for inter-epidemic period

Possible case

Any person meeting the clinical criteria and with an epidemiological link.

Probable case

Any person meeting the clinical criteria

and

an epidemiological link

and

that meets the laboratory criteria for a probable case.

Confirmed case

Nationally confirmed:

Any person meeting the clinical criteria and the laboratory criteria for case confirmation where the testing has been performed at a **national reference laboratory**.

Confirmed case:

Any person meeting the clinical criteria and the laboratory criteria for case confirmation where the testing has been performed at a **WHO SARS-verification** and **reference laboratory**.

Case definition during an outbreak[i]

Possible case

Any person meeting the clinical criteria.

Probable case

Any person meeting the clinical criteria

and

with an epidemiological link to a nationally confirmed or a confirmed case.

Confirmed case

Nationally confirmed:

Any person meeting the clinical criteria

and

the laboratory criteria for confirmed case where the testing has been performed at a national reference laboratory.

Confirmed case:

One of the following three:

- any person meeting the clinical criteria and the laboratory criteria for case confirmation where the testing has been performed at a WHO SARS verification and reference laboratory;
- any nationally confirmed case with an epidemiological link to a chain of transmission where at least one case has been independently confirmed by a WHO SARS reference and verification laboratory;

[i] Applies during an outbreak in a country/area where at least one person has been laboratory confirmed by a WHO SARS verification and reference laboratory.

- any person meeting the clinical criteria and with laboratory criteria for probable case with an epidemiological link to a chain of transmission where at least one case has been independently confirmed by a WHO SARS reference and verification.

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3. Invasive meningococcal disease

3.1 Literature review

The detailed systematic review of the literature [1] identified one documented incident with strong evidence for transmission of invasive meningococcal disease (IMD) during air travel, probably from an asymptomatic carrier to two persons sitting 12 rows apart and without contact with each other [2]. In at least 25 events[i] with symptomatic index cases, no transmission was observed [3–5].

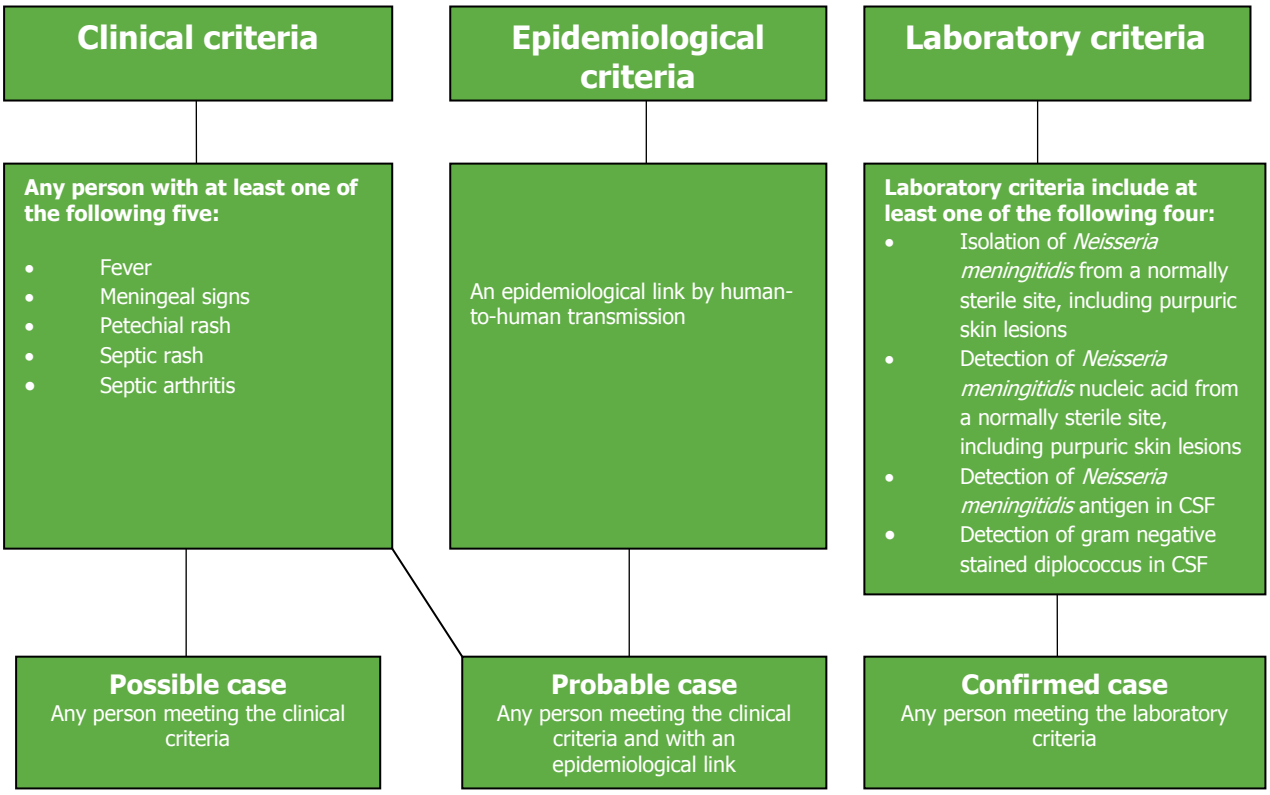
The available evidence base is poor, but the paucity of published events suggests that the risk of meningococcal disease transmission on board aircrafts is low. There is a lack of evidence to indicate that passengers merely sitting beside an index case in airplanes are subject to an increased risk of acquiring meningococcal disease, unless the passenger is already identified as a close contact (e.g. household contact).

3.2 Suggested approach

The assessment of possible transmission of meningococcal disease on an aircraft should be undertaken on a case-by-case basis. This should occur after careful individual risk assessment, taking into account the symptoms of the patient and the duration and closeness/type of contact to fellow travellers and crew. The undertaken assessment should follow the outline in figure 3.2.

3.3 Criteria to be considered

Figure 3.1: EU case definition for invasive meningococcal disease, 2008 [6]



[i] An event is described as an incident during which the possible transmission of invasive meningococcal disease from one or more index cases through contact with other travellers during air travel can be suspected, proven or ruled out.

The index case

The index case is a probable or confirmed case of meningococcal disease (figure 3.1).

- **The symptoms and infectiousness of the index case:** Cases are often considered as potentially infectious from seven days before onset of symptoms to 24 hours after onset of effective treatment [7]. However, the infectious period is not known and it is quite possible that cases of meningococcal disease are not infectious before the onset of symptoms [8].

Timing of flight

- **Flight occurrence within past 10 days:** Published guidelines recommend chemoprophylaxis for contacts within 10–14 days of symptom onset in the index case: The incubation period is 3–4 days and ranges between 2–10 days [9–11]. Thus, even if the assessment reveals that either the passengers or crew had unprotected contact to nasopharyngeal secretions from the patient, consideration of contact tracing (contact tracing) is only warranted if administration of chemoprophylaxis is possible within 10 days of exposure.

Effective exposure

- **Type and length of exposure:** Passengers at risk are those who have been directly exposed to the index case's nasopharyngeal secretions. For close contacts, defined as household-like contacts of a case or individuals with intense unprotected contact to the nasopharyngeal secretions of an infected person (e.g. exposed to cough secretions, intubating, resuscitating or examining the oropharynx without wearing a mask), chemoprophylaxis is ideally administered within the first 24 hours and at the latest within 10 days after exposure. There is a lack of evidence to indicate that passengers merely sitting beside an index case in airplanes are subject to an increased risk of meningococcal disease, unless the passenger has already been identified as a close contact. Thus, routine follow up of passengers sitting beside the index case is not recommended by the expert group. Contact tracing should only be considered if there is evidence that other passengers or crew members were exposed to nasopharyngeal secretions of the patient during contact that occurred either while the patient was symptomatic or in the seven days prior to the onset of symptoms.

3.4 Other considerations

- **Purpose of contact tracing** (e.g. administration of post-exposure prophylaxis (PEP), interruption of infection chains, scientific research): There is no evidence to support the provision of widespread chemoprophylaxis for persons who are not close contacts. Widespread use may result in eradication of benign strains of *Neisseria* that provide protective antibodies, the generation of drug-resistant strains and an increase in the prevalence of drug-related adverse events [12]. Gathering scientific data may be justification for contact tracing.
- **Status of air ventilation–HEPA filter**: In view of the vertical air circulation in airplanes with little horizontal flow in combination with the HEPA filters, prolonged close contact is likely required for transmission to occur onboard aircraft [13,14]. In one event, no transmission occurred even though the HEPA-filter was not functioning [1].

3.5 Draft Q&A sheet for meningococcal disease contact tracing

The following is a template for public health experts who need to quickly develop a Q&A sheet to complement contact tracing activities. This template should be adapted according to the individual situation and to the decisions made by the public health authorities in charge.

When should contact tracing be considered?

Contact tracing should be considered if the index case is a probable or confirmed case of IMD (see EU case definition, 2008, figure 1) *and* the flight occurred within the previous 10 days *and* the case travelled within seven days prior to symptom onset *and* there is evidence that crew members or fellow travellers had intense exposure to nasopharyngeal secretions of the case.

When is a patient infectious?

Cases are often considered as potentially infectious from seven days before the onset of symptoms to 24 hours after the onset of effective treatment [2]. However, the infectious period is not known and it is quite possible that cases of meningococcal disease are not infectious before the onset of symptoms [2].

Who should be considered for contact tracing?

Passengers and crew with close contact to nasopharyngeal secretions should be considered for contact tracing. The expert group defines close contact as:

- household-like contacts of a case *or*;
- individuals with intense, unprotected contact to the nasopharyngeal secretions of an infected case (e.g. exposed to cough secretions, intubating, resuscitating or examining the oropharynx without wearing a mask).

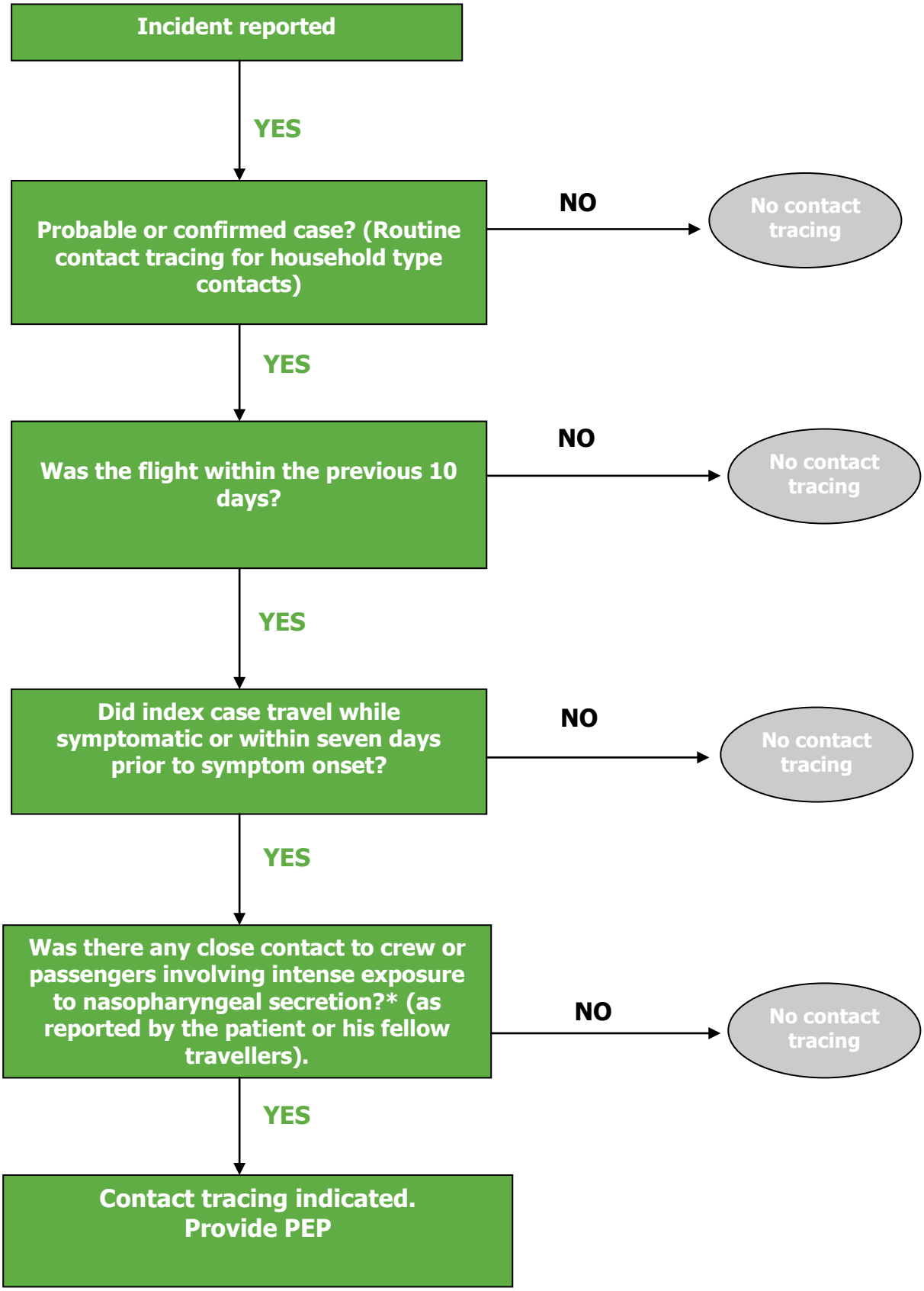
Are there special considerations for certain serogroups?

Serogroup B (currently not vaccine preventable) is the most common serogroup in Europe. Therefore, waiting for the results of serogrouping is of little use; the timely administration of PEP to passengers who have been identified as close contacts should be given first priority.

Are there special considerations for individuals of higher susceptibility?

As so few cases of IMD have been described in association with air travel, it is not known whether fellow passengers with a higher susceptibility for IMD (e.g. infants younger than one month old and persons with congenital or acquired immune deficiency, terminal complement defects) would be at a higher risk of contracting the disease. In many cases, predisposing factors will not be known to those affected; even if they were, they could only be identified by exhaustive contact tracing, which would only be indicated if the conditions under section 3.5.1 are met.

Figure 3.2: **Risk assessment algorithm invasive meningococcal disease**



**Unprotected contact with patient, e.g. exposure to cough secretions, intubating, resuscitating or examining the oropharynx without wearing a mask.*

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Annex 1: Examples of considerations for assessing evidence

The quality of available evidence was assessed by the experts, using elements of the Grading of Recommendations Assessment, Development and Evaluation (GRADE), by not only taking into consideration the available scientific evidence for transmission but also wider aspects. The following list includes examples of the considerations used by the experts in order to assess the evidence.

- Contact tracing requires significant resources (human, money, time) and should be implemented wisely.
- Aircraft manifests lack uniform standards across airlines and passenger manifests are rarely kept after 48 hours, which limits the possibility to trace and detect events.
- Multiple factors need to be taken into account for decision making on contact tracing, such as the following:
  - the epidemiological situation in the country of origin and destination of a flight, the distribution of the disease by geographic region;
  - infectivity of the index case during the flight amidst symptomatic or pre-symptomatic stage;
  - evidence on potential transmission of disease during flight;
  - susceptibility of the population for the disease;
  - the maximum incubation period, as this reflects the time period during which it is possible to intervene with public health measures. Beyond this, contact tracing could be initiated for scientific purposes;
  - mode of transmission (airborne, droplet, contact);
  - ethical aspects (e.g. is treatment available, are containment and/or mitigation measures acceptable?);
  - actions that follow contact tracing should be a part of the decision making (e.g. what are the public health actions taken after identification of infected individuals? What can be offered to the infected individuals identified by contact tracing?);
  - possible alternatives for contact tracing (e.g. leaflets for passengers of the flight; information on airports?);
  - the susceptibility of the affected passengers;
  - level of vaccine coverage;
  - pathogen type/subtype, antibiotic resistance and;
  - the quality of the cabin air (e.g. influenced by length of ground delay).
- Purpose of identifying potential infected flight passengers by contact tracing, for example:
  - to initiate disease containment measures;
  - to initiate disease mitigation measures;
  - to delay spread of the disease;
  - to eradicate the disease.