National Institute for Public Health and Environment (RIVM)
EU Joint Action Healthy Gateways consortium

Characteristics Port

Characteristics that influence the vulnerability of a point of entry
regarding the introduction of infectious diseases

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1. Volume of travelers

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
The average volume of travelers at the point of entry per year	Low number of travelers <...*	Medium number of travelers ...-...*	High number of travelers >...*

*https://www.statista.com/statistics/287111/cruise-passengers-by-source-country/ - not per point of entry

This is based on the assumption:
The more travelers arrive at a point of entry, the higher the risk of importation of an infectious disease.

This assumption is based on the following literature:
Migration of humans has been the pathway for disseminating infectious diseases (19).

Questions regarding characteristic and levels:
- What are high and low amount of travelers via air per year (or per day)?
- Are there records of this international transport (inside and outside Europe)?
- Is a medium level relevant with this characteristic?
- Does the risk from volume of travelers also relate to how large the port is?

2. Travelers from endemic areas

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
The number of travelers that arrive from geographic areas where other infectious diseases are endemic or epidemic than in the country of origin.	Low/no number of travelers from areas with different endemic diseases (<..%)* Or Areas/countries:*	Any number of travelers from areas with different endemic diseases (...-...%)* Or Areas/countries:*	High number of travelers from areas with different endemic diseases (>...%)* Or Areas/countries:* Africa South America

*relevant source not yet found for port

This is based on the assumption:
The more travelers from an endemic area arrive at a point of entry, the higher the risk of importation of the infectious disease.

This assumption is based on the following literature:
The amount of travelers between an endemic area and a travel destination influences the risk of importation of an infectious disease. In general, more travel poses a higher risk of importation (10, 3). Several studies conducted research about risk of international spread and the origin-destination flow and found that more travelers from endemic area pose a higher risk for importation of diseases (11, 12, 13 , 14, 6). Not only the endemic area, but also the number of cases in the origin location is also related to an increased risk of importation (10). In a modelling study related to the risk of exportation of Covid-19 from four Chinese cities shows that neighboring countries, USA/Canada, Oceania and European countries poses the highest risk of importation. The neighboring countries poses the highest risk of all. That local connectivity plays an important role is also shown in a model based on open flight data and in a research regarding effective distance, which means the minimum length of a path from origin to destination (15, 16). This showed that the stronger the relation with the endemic area the higher the risk of importation is. In the research regarding effective distance the data regarding MERS was used to find the area's most at risk. The areas were: North-America, Oceania, Middle East and Europe. In Europe, the western part is more international connected and therefore poses a higher risk of importation of, in this case, influenza (17). Most found literature was regarding air travel, which is a risk characterization for importation (18), but also general importation is mentioned in the found literature. This involves also other forms of transportation then air travel, such as automobile, train and ship (3). International travel from areas with epidemic and endemic diseases has resulted in continuous importation of infected person into Europe (3).

Questions regarding characteristic and levels:
- Do immigrants pose a higher risk for importation of infectious disease?
  (Data: Risk of importation of infectious disease (measles) from immigrants is low (6) Immigrant, emigrant, asylum seeker can be vulnerable to or contribute to spread of infectious diseases in origin country, in transit, or in destination country (3)).
- Are ports informed about outbreaks?

- How is information regarding outbreaks communicated between ports?

3. Duration of the journey

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
The duration of the traveler's journey between the start and end location	More than .. % arrives after a travel of <.. hours in a vehicle shared with others * Or A lot (..%) short distance travelers* Or There is knowledge of the arriving travelers form countries	More than .. % arrives after a travel of .... -... hours in a vehicle shared with others *	More than .. % arrives after a travel of >.. hours in a vehicle shared with others* Or A lot (..%) of long distance travelers* Or There is no knowledge of the arriving travelers form countries

*relevant source not yet found for port

This is based on the assumption:
The longer the duration in a vehicle, the higher the risk of importation/transmission of infectious disease.

This assumption is based on the following literature:
The risk of transmission increases with travel duration and seating proximity according to modelling studies of ground transportation (20). Transmission was highly suspected on an international long-distance train: mean reproduction number for influenza was >2 and risk increased linearly with journey duration. The risk of transmission is in theory the highest in air passengers seated close to an index case and increases with flight duration. No evidence of influenza or coronavirus transmission occurring at sea ports was found.

Questions regarding characteristic and levels:
- What would be a long and short travel duration via air?
- How realistic is it to identify the amount of time a passenger is travelling? For example in combination with ships and road/train.
- Do neighboring countries of an endemic area pose a higher risk of importation then other countries?
- Does the characteristics duration of journey and endemic areas have great overlap?

4. Vaccination status of travelers

Characteristic	Low vulnerability	High vulnerability
The percentage of travelers that received the vaccination for the vaccine-preventable diseases (1).	High percentage of travelers is vaccinated Or High control on vaccination status of travelers* Or There is knowledge at the point of entry regarding vaccination status	Low percentage of travelers is vaccinated Or Low control on vaccination status of travelers* Or There is no knowledge at the point of entry regarding vaccination status

*relevant source not yet found for port

Based on the assumption:
Unvaccinated travelers regarding a certain infectious disease pose a higher risk for importation of that infectious disease at the point of entry or in transit at point of entry.

This assumption is based on the following literature:
Travelers who are not vaccinated for a certain infectious disease pose a higher risk for importation of that infectious disease at the point of entry or in transit at point of entry (2, 3). In case of Hepatitis A travelers from Sweden were less vaccinated when travelling to Africa compared to Asia (4). Most cases from importation of Hepatitis A were from East Africa (14.1/100,000) followed by the Middle East and Indian countries (5.8/100,000). Another study showed that an airport can act as hotspot for travelers from endemic countries and unvaccinated persons (5). 5 people were infected with measles, 3 were unvaccinated and 2 unknown. Another study regarding measles showed that importation of measles in the USA was at higher risk by US residents travelling to endemic areas and travelers visiting US with a low vaccination coverage (6).

Questions regarding characteristic and levels:
- We are designing a generic risk tool (disease a-specific), what is the value of this attribute?
- Levels of vaccination differ per disease (average range: 35-89%). How can a division be made in high and low if the average of vaccination differs this much? (7, 8, 9)
- Is there any information available to your knowledge regarding the control on vaccination status of travelers?
- Would a division in three levels be recommended? Low, medium, high.
- Do ports undertake measures to assess the vaccination status of passengers?
- Do you think the characteristic vaccination status and endemic areas have great overlap?

5. International trade via point of entry

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
The amount of trade (cargo) between countries.	<30% of GDP is low amount of trade** Or Low amount (%) of imported and exported products (life stock and biological products)* Or Absolute value of imported and exported products (life stock and biological products) is lower than.. *	30-90% of GDP is medium amount of trade**	>90% is high amount of trade** Or High amount (%)of imported and exported products (life stock and biological products)* Or Absolute value of imported and exported products (life stock and biological products) is higher than ... *

** https://data.oecd.org/trade/trade-in-goods-and-services.htm
*relevant source not yet found for port

This is based on the assumption:
The import and export of goods and services across international borders provides higher risk of imported infectious diseases.

This assumption is based on the following literature:
Humans an food can move freely. Suboptimal food safety systems are a risk for international public health (3). Global trade, import and export of goods and services across international boundaries via ship, airplane, rail and truck, provides higher risk of imported diseases.

Questions regarding characteristic and levels:
- We expect that GDP will not be a sufficient measure, because the important aspect is the life stock/biological products/food per point of entry. Is this measurable for ports? How much are ports involved in the import and export of products?
- Is close contact with food/animals a relevant aspect for ports?
- Is there knowledge about the content of cargo?

6. Different vessels at point of entry

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
Certain type of vessels at point of entry can accelerate the importation of infectious diseases	…% of ……*	….% of ……*	….% of trains, ….*

*relevant source not yet found for port

This is based on the assumption:
Certain vessels have been proven to provide a higher risk of imported infectious diseases.

This assumption is based on the following literature:
Air transport and trains accelerate importation of influenza (20). Besides, Ferries have a higher risk of contamination of legionella then cruise ships (21). 91% of the ferries samples tested positive compared to 9% of the cruise ships. Earlier studies found 86% positive tested ferries and 40% of positive tested yachts.

Questions regarding characteristic and levels:
- Is there a substantial difference between vessels in ports that can pose a higher or lower risk?
- Are there specific points of entry (ports) handling (only) specific vehicles?
- Does this characteristic have substantial overlap with duration of journey?

7. Climate

Characteristic	Low vulnerability	Medium vulnerability	High vulnerability
The local climate in the region where the point of entry is located	…. Climate*	…. Climate*	…. Climate*

*relevant source not yet found for port

This is based on the assumption:
Humidity, wind, rainfall and temperature can have effect on the transmission of infectious diseases. In a country with multiple climates, the risk of importation can differ per climate in that area.

This assumption is based on the following literature:
Climate can affect the exposure pathways of foodborne and waterborne diseases (3). Opposing conditions for transmission of viruses in general (humidity and temperature) (22). Especially, vector borne disease are related to climate drivers (3). Temperature can affect growth of diseases in water. Rainfall can influence the transportation and dissemination of infectious agents. Longer seasons of mild temperatures influence transmission of vector borne diseases (not to warm or to cold) (23).

Questions regarding characteristic and levels:
- Most research is focusing mainly on vector-borne diseases. Other infectious diseases are mentioned briefly. Is climate a characteristic relevant for infectious diseases (not vector-borne)?

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