

2019-nCoV importation risk to Europe

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NOTE: This is a brief report with preliminary estimates based on limited information available.

23/01/2020 (DATA UP TO 23/01/2020, 11AM CET)

CURRENT SITUATION

Starting December 2019, cases of pneumonia of unknown etiology were reported in the city of Wuhan, in the province of Hubei in China [1]. The infective pathogen was later identified to be a novel coronavirus, called 2019-nCoV [2].

China's National Health Commission stated on 23/01/2020 that 571 confirmed cases of 2019-nCoV have been reported in China. Affected areas include the provinces of Hubei where Wuhan is located, Beijing, Shanghai, Guangdong, Shanxi, Fujian, Guizhou, Hebei, as well as Ningxia Hui, Macau and Hong Kong [3]. A larger number of cases have been confirmed by other sources, in addition to suspected cases in multiple provinces [4,5].

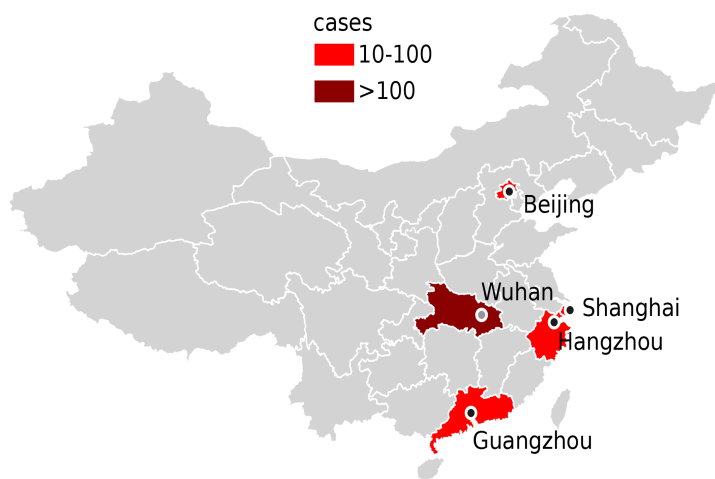
Outside China, a total of 7 imported cases were reported as of 23/01/2020 (3 cases in Thailand, 1 in Japan, 1 in South Korea, 1 in Taiwan, 1 in the US) [6], with reported travel date from Wuhan between 06/01/2020 and 20/01/2020.

Chinese authorities declared that on 23/01/2020 flights out of Wuhan were temporarily suspended from 3AM Central European Time in a step to contain the virus [7]. Later in the day, also the cities of Huanggang and Ezhou in the province of Hubei were imposed strict travel bans [8].

AIM & METHODS

We estimate the risk of importation of 2019-nCoV cases to Europe from infected areas in China by air travel.

Given the travel ban from Wuhan, Huanggang, and Ezhou, we consider as possible seeds of case exportation out of China the largest international airports in each province reporting [10-100] infected individuals [3]. This multi-source seeding includes (see map below) Guangzhou (in the province of Guangdong), Beijing (Beijing), Shanghai (Shanghai), Hangzhou (Zhejiang).



Color coded map of Chinese provinces reporting more than 10 cases [5]. The 4 airports selected for the multi-source seeding are shown with black dots. Wuhan (grey dot) is not considered as a seed due to the current travel ban.

We consider a **low exportation scenario** assuming a baseline rate of case exportation from China equal to 7 travel-related cases in 2 weeks (coming from any of the 4 cities). This is the same observed from Wuhan prior to the flight ban. This baseline exportation rate is also used to compare the estimated risk of a multi-source seeding with the one estimated for a single-seed (Wuhan) only.

In addition, we consider a **high exportation scenario**, compatible with a growing number of cases in China [5]. Exportation rate is assumed to be 3 times larger than the one in the low exportation scenario.

The risk of importation in Europe is estimated as the probability that at least 1 case is imported from the infected provinces to Europe in a time period of 2 weeks. The risk is computed for Europe overall, and for each European country (EU-28 Member States only), showing also a breakdown of contribution to the risk by airport of arrival. The computation of the risk is based on estimates from the platform EpiRisk [9] and accounts for origin-destination air travel flows of January from 2019 OAG database of the GLEAM Project [9-11]. See footnote [12] for the computation details.

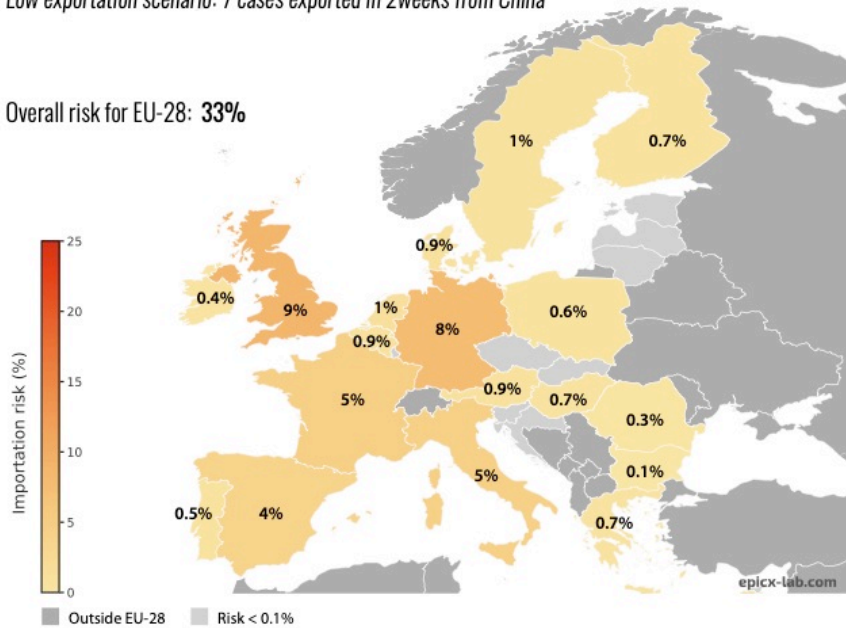
For sensitivity, we tested whether the risk changes considering air travel flows of the month of February. We also limited the multi-source seeding area to Beijing and Shanghai only, to assess the impact of the airports of the top 2 largest cities in China for population size [13].

Maps below use the same color code for comparability.

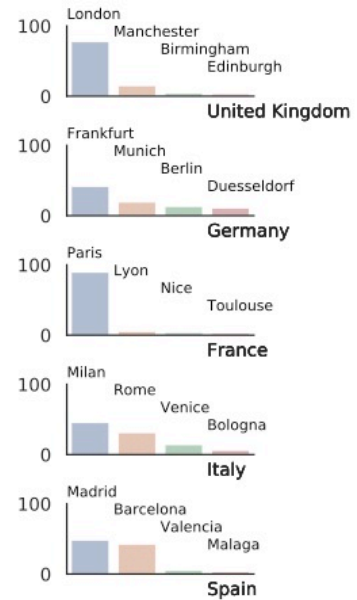
ESTIMATED IMPORTATION RISK FROM INFECTED PROVINCES IN CHINA

Risk of importation of at least 1 case from Beijing, Shanghai, Hangzhou, Guangzhou in 2w
 Low exportation scenario: 7 cases exported in 2weeks from China

Overall risk for EU-28: 33%



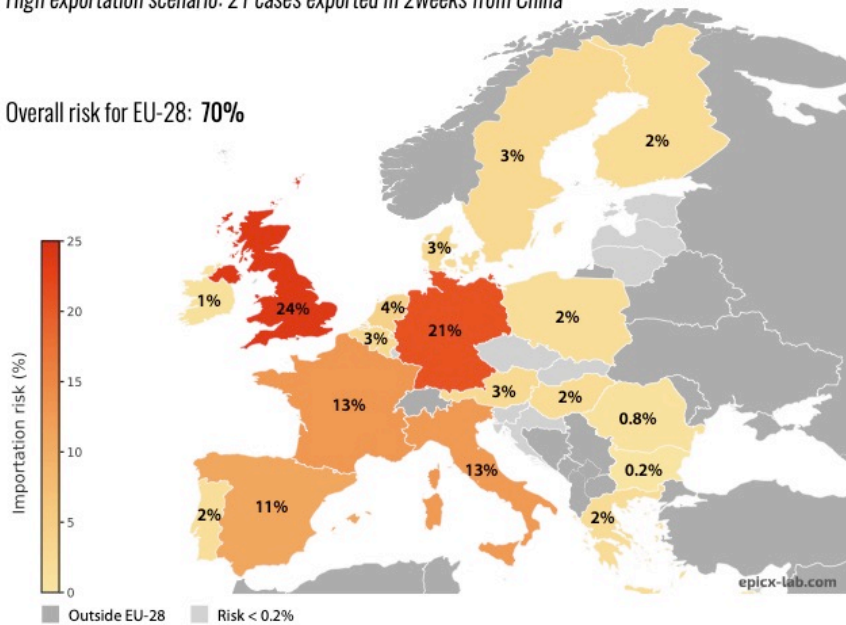
Relative contribution by airport*



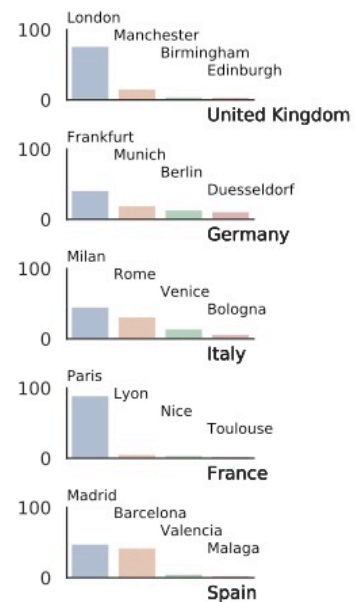
*Only the top 4 airports with largest contributions are shown

Risk of importation of at least 1 case from Beijing, Shanghai, Hangzhou, Guangzhou in 2w
 High exportation scenario: 21 cases exported in 2weeks from China

Overall risk for EU-28: 70%



Relative contribution by airport*



*Only the top 4 airports with largest contributions are shown

The overall risk of importation of at least one 2019-nCoV case in Europe in 2 weeks ranges from 33% in the low exportation scenario, to 70% in the high exportation scenario. The risks are higher for the UK

(from 9% to 24% depending on the scenario) and Germany (8%, 21%), followed by France (5%, 13%), Italy (5%, 13%), and Spain (4%, 11%). Western Europe is at higher risk than Eastern and Northern Europe.

For the top 5 countries at higher risk of importation, histograms display the airports that are more likely to import cases (only the 4 top airports are displayed for the sake of visualization). In some countries, importations are likely to occur at multiple airports (e.g. Germany and Italy), whereas in others the risk is mostly concentrated in airports serving the capital city (e.g. in the UK, where London contributes to 75% of the risk, and in France, where Paris contributes to 89% of the risk).

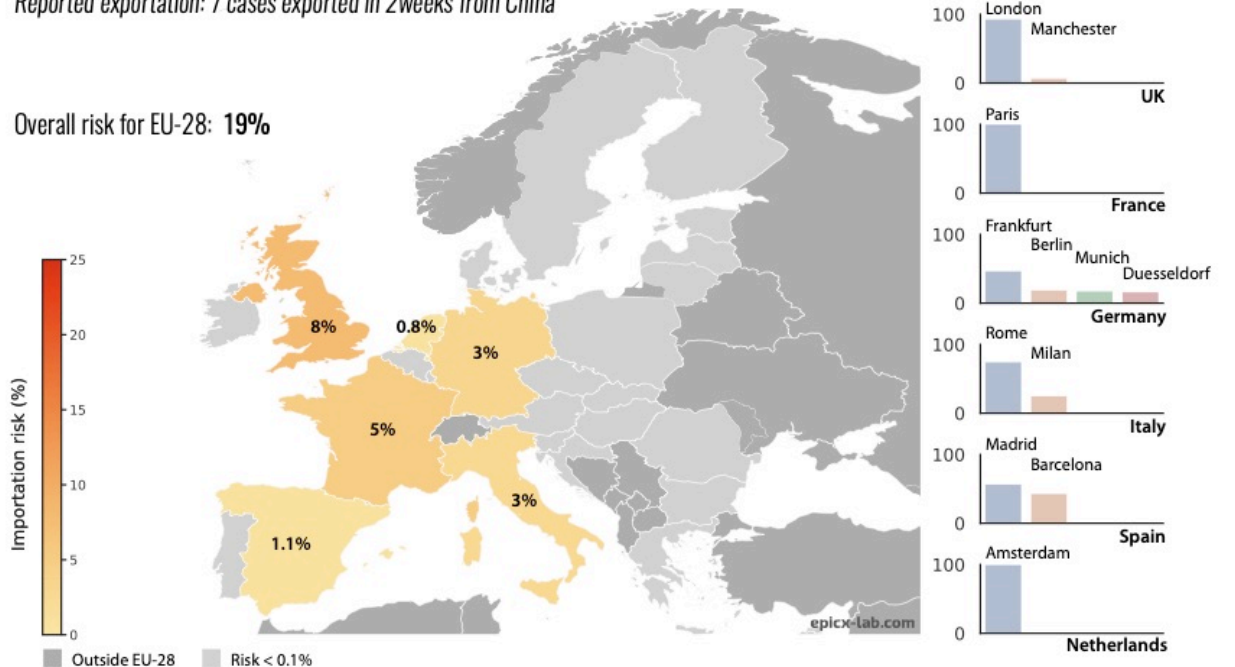
No change is estimated to occur when considering travel flow data from the month of February (not shown). The estimated risks are mainly driven by importations from Shanghai and Beijing (not shown).

ESTIMATED IMPORTATION RISK FROM WUHAN PRIOR TO THE FLIGHT BAN

Risk of importation of at least 1 case from Wuhan in 2w prior to the flight ban

Reported exportation: 7 cases exported in 2 weeks from China

Overall risk for EU-28: 19%



Compared to what estimated in a multi-source seeding scenario, the situation prior to the travel ban corresponded to a 19% risk of importing an infected case in 2 weeks in Europe from Wuhan only. Moreover, the risk was localized in Western European countries. This is due to the smaller connectivity of the European continent to Wuhan compared to the multi-source seeding.

CONCLUSIONS

The travel ban imposed on Wuhan and neighboring cities in the province of Hubei is meant to halt the exportation of cases from the most affected province. Four other provinces reported however a number of cases between 10 and 100 as of 23/01/2020. Here we explore the possibility that these provinces may act as new seeding for the international spread, considering two different exportation scenarios.

We estimate that the European risk of importing at least 1 case in 2 weeks ranges between 33% and 70% depending on the assumed exportation rate from China. Given the limited information on the epidemic at the origin, it is hard to accurately estimate the potential number of cases traveling out of China in the next two weeks. The two countries at higher risk are the UK and Germany.

The low and high exportation rates are meant to provide plausible scenarios, not predictions. Our scenarios are set on current detection practices. The importation risk would increase if milder cases, likely to go undetected, were to be included.

The risk pattern of 2019-nCoV importation estimated for Europe varies considerably depending on the geographical extent of the infected area in China. Travel restrictions currently in effect in Hubei province will reduce the risk of international exportation only if this province remains the sole 2019-nCoV hotspot in China. Stopping air travel from Hubei will not prevent exportation if large-scale outbreaks are confirmed also in the areas considered (Guangdong, Beijing, Shanghai, Hangzhou). In particular, Shanghai and Beijing would be responsible for a higher and more widespread risk for Europe.

Risk maps will need to be rapidly updated as the outbreak situation evolves.

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- [11] GLEAM Project. Available at: <https://www.gleamproject.org/>
- [12] For each destination i the risk of importation is computed as $1 - (1 - p_i)^N$, where p_i is the probability of importation of a travel-related case to the destination i [8], and N is the total number of exported cases during the 2 weeks period.
- [13] Wikipedia. List of cities in China by population. Available at: https://en.wikipedia.org/wiki/List_of_cities_in_China_by_population

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