

**Title:** International risk of the new variant COVID-19 importations originating in the United Kingdom

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**Abstract:** A fast-spreading SARS-CoV-2 variant identified in the United Kingdom in December 2020 has raised international alarm. We estimate that, in all 15 countries analyzed, there is at least a 50% chance the variant was imported by travelers from the United Kingdom by December 7th.

The United Kingdom (UK) has detected a new variant of SARS-CoV-2 from samples initially taken in Kent on September 20th and London on September 21st, 2020 (1), which was found associated with increased transmissibility (2). The UK government tightened measures in London and southeast England in mid-December to mitigate the transmission of the fast-spreading virus variant that includes deletions at amino acid sites 69 and 70 of the spike protein

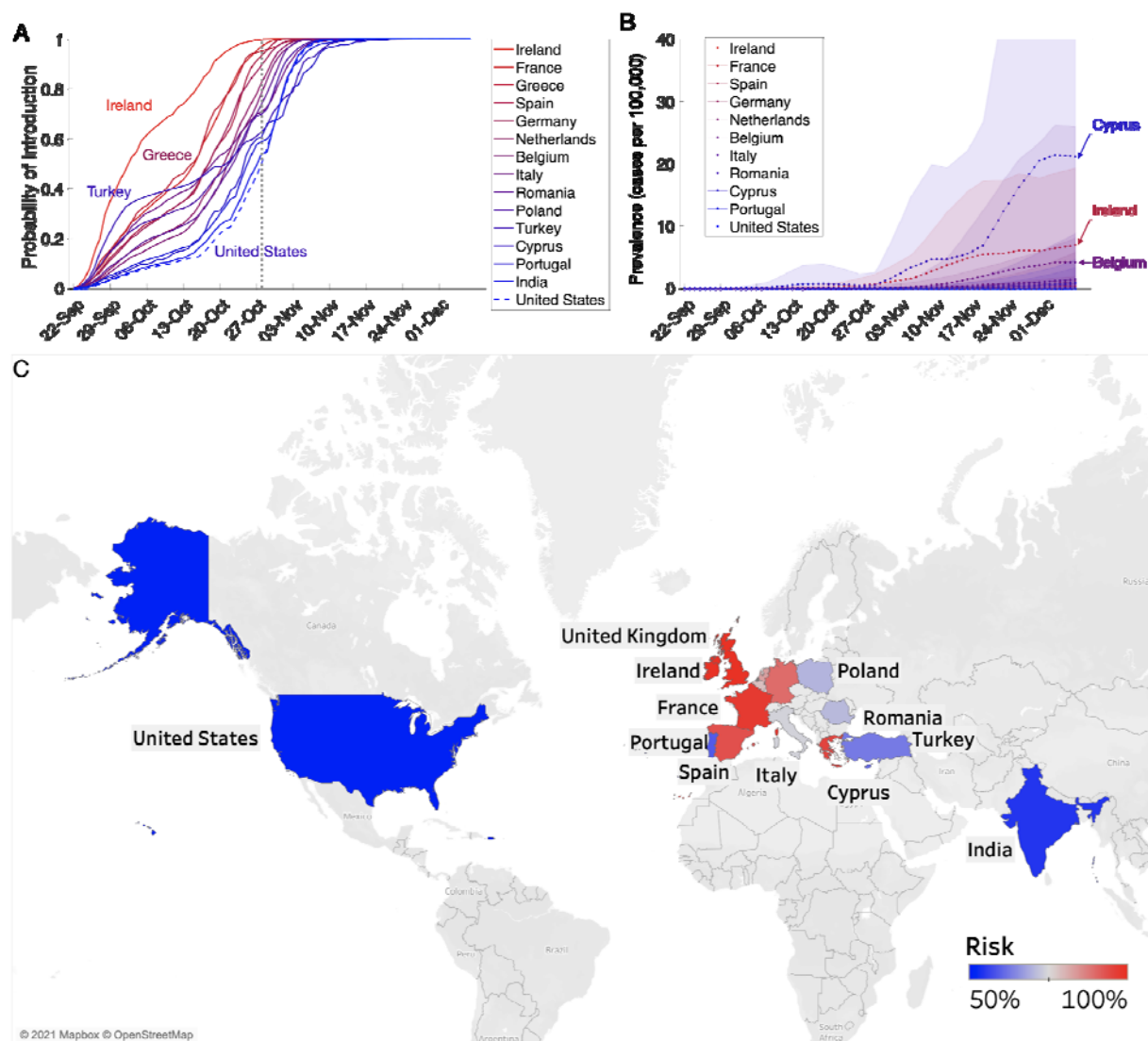
(3). On January 5th, 2021, England initiated a national lockdown including closure of all schools and non-essential businesses until mid-February (4). By December 20th, over 40 countries had implemented travel restrictions on travellers from the UK (5). The new variant was subsequently reported worldwide, including in the USA (6), Spain, Sweden and France, and might be spreading without detection in countries with limited virus sequencing capacity (5).

We collected the data from 15 countries and estimated the probability of introduction of this new variant by travellers from the UK to each of these countries and the extent of local transmission, based on the changing proportion of the new variant among infections identified in the UK (2) and population mobility from UK to each country, as estimated from Facebook Data for Good. Ireland had the highest importation risk between September 22 and December 7, 2020. By October 22 (a month after its first detection in the UK), 10 of the 15 countries had at least a 50% chance of receiving one imported case from the UK (**Figure 1**), except for Romania, Portugal, Cyprus, India, and United States, while they all had exceeded this risk threshold by November 1.

Using COVID-19 hospital admission data, we further estimated the local prevalence of the new virus variant in 11 of the 15 countries, assuming that the new variant is 50% more transmissible than the circulating 501N strain (**Figure 1**). The variant appears to have ascended fastest in Ireland before slowing in mid November and is expected to be spreading rapidly in many of the other countries. As of December 7, Cyprus has the highest expected prevalence of the variant (13 [95% CI: 0-79] cases per 100,000) and Ireland has the highest expected proportion of COVID-19 cases caused by the new variant (6% [95% CI: 0-38%]) (**Figures 1, S1 and S2**).

These projections suggested that countries with substantial population movement from the UK were likely to harbor cases of the new variant by late October, 2020. Our conclusions were based on several key assumptions. The mobility data, which includes ~3 million trips from the UK to the 15 focal countries, might be demographically biased by the user profile of Facebook, a major social media company with ~2.7 billion monthly active users in the third quarter of 2020 (7). We assume that all introductions during this early period occurred via asymptomatic travelers from the UK and ignore possible importations from other countries or by symptomatic cases traveling to seek healthcare. A sensitivity analysis suggests that these assumptions may cause a downward

bias in the estimated rates of global expansion (Figure S3). Furthermore, we assume a 10-day lag between infection and hospitalization based on estimates from the United States (8) and Europe (9) and estimate the daily prevalence of the new strain using the method introduced in ref. (2), under the assumptions that the two variants (501Y and 501N) share the same natural history (2) and symptomatic proportion (10,11). Should future studies reveal significant epidemiological differences between the variant and wildtype, then these estimates can be readily updated using the full equations provided in ref. (2).



**Figure 1. Estimated risks for introduction of the 501Y variant of SARS-CoV-2 from the UK to other 15 countries before December 7, 2020.** (A) The probability that at least one person infected with the new COVID-19 variant has arrived at the target country from the UK by the date indicated on the x-axis, based on Facebook mobility data. The dotted gray vertical line indicates October 28, 2020, the date that the introduction risk for the USA surpasses 50%; line colors correspond to the relative risk of importations as of that date. (B) Estimated daily prevalence of the 501Y variant of SARS-CoV-2 in 11 countries between September 22 and December 7, 2020, assuming that the variant is  $\sigma = 50\%$  more transmissible than the 501N variant (11). Points and bands indicate means and standard deviations based on 100 simulations. (C) Probability of at least one variant importation by October 28, 2020. Grey indicates countries/regions where mobility data were not available.

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