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EDITORIAL

Visualizing the Impact of Europe's Slow COVID-19 Vaccine Rollout

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1. INTRODUCTION

On 31 March 2021, the WHO Regional Office for Europe issued a formal statement of concern regarding the slow vaccine rollout across Europe [1]. The WHO noted that the "Region remains the second most affected by SARS-CoV-2 of all the world's regions" which was worrying, especially because the more transmissible B.1.1.7 was now dominant in the region [1]. It further contrasted this with the experiences of the UK, by noting that according to data from Public Health England, "COVID-19 vaccines have saved, at the very least, over 6,000 lives among people over 70 since vaccination started in December 2020". Beyond such statements and a general awareness that many countries within the EU, in particular, lag behind in terms of vaccination, the impact of this policy failure remains poorly understood. One issue that appears to be hampering a European-wide debate regarding this issue, is the fact that globally the link between curbing COVID-19 and progress in vaccination is not entirely straightforward. Here, we will attempt to highlight the human cost of this EU policy failure by reference to recent patterns of COVID-19 deaths across several large EU countries.

Globally, COVID-19 vaccination rates differ widely, and as of 3rd March 2021, countries such as Israel, Chile, the UK, and also the EU member state, Hungary, are among the top performers in terms of vaccine rollout with administered rates of 130, 78, 75 and 63 doses per 100 people, respectively [2]. As of 2nd May 2021, the rolling seven-day average for daily new confirmed COVID-19 deaths, nonetheless, is very high for Hungary with 17.4 per million inhabitants, above average for Chile with 5.27, and very significantly below the global average for the UK with 0.24, and Israel with 0.23 deaths per million [3]. For the UK and Israel, the recent data on COVID-19 deaths reflect the actual impact of vaccination on COVID-19 risk because those two countries started vaccination on a major scale toward the end of December 2020 and eased lockdown restrictions carefully. For Hungary and Chile, by contrast, these data do not reflect the positive impact of vaccination due to a number of potentially interacting factors including the later start of the vaccination campaigns, their reactive nature, as well as other socio-political factors such as the premature easing of lockdown restrictions [4, 5]. Notwithstanding these outliers, for EU member states, in particular, the contrasting rates of COVID-19 deaths, when compared to the UK, allow for an assessment of the impact of Europe's slow COVID-19 vaccine rollout alluded by the WHO; and this is what this editorial focuses on.

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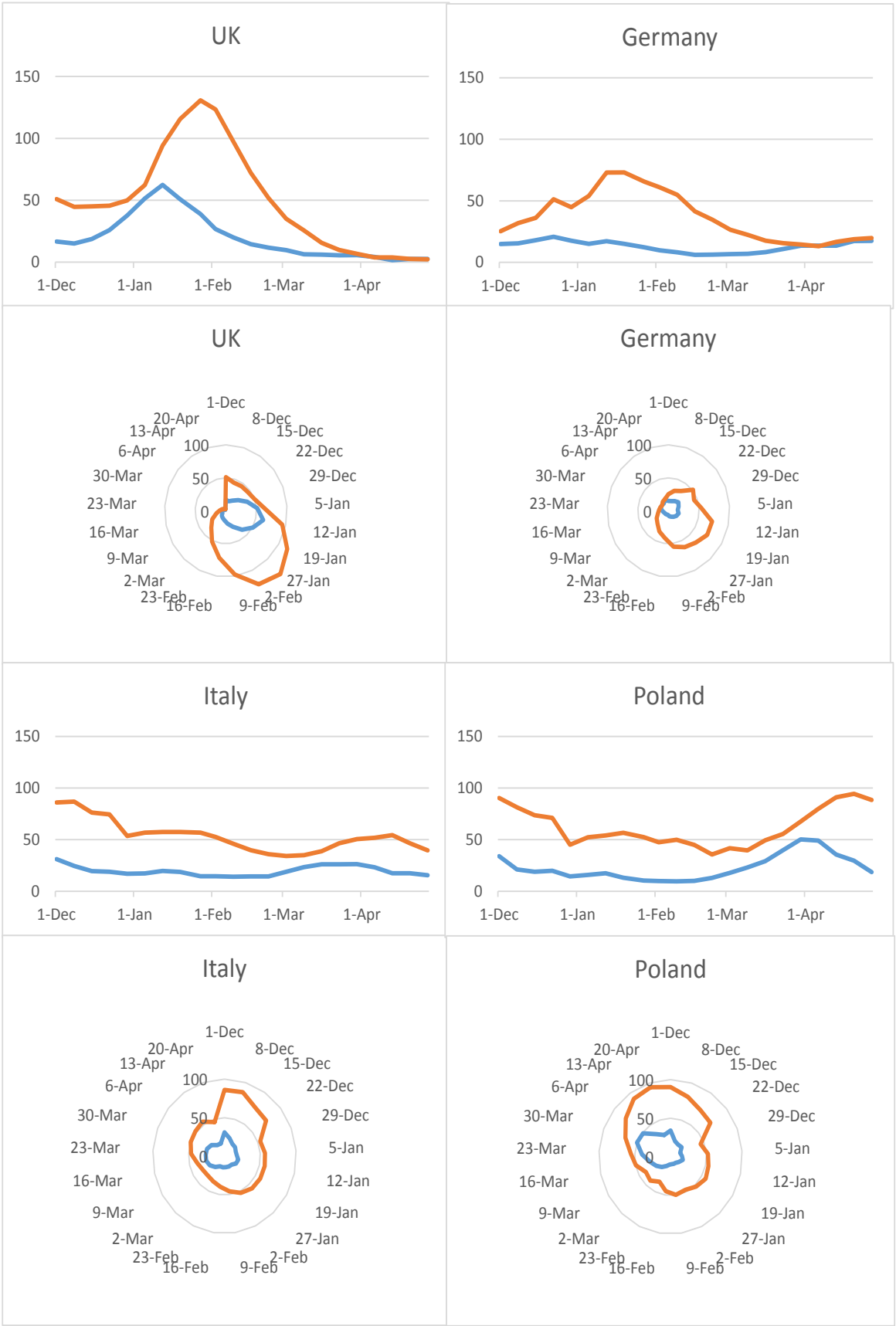
2. COUNTRY COMPARISONS

The impact of vaccinations on COVID-19 deaths can be visualized in a number of ways. Here we choose a combination of time series charts and radar plots. Our data on COVID-19 deaths and cases are drawn exclusively from WHO sources [6] and we limit our analysis to those countries for which currently available data represent a relatively reliable time series which has not been affected by major corrections. In terms of time frame, we focus first on the twenty-two-week period from 1st December 2020 to 25th April 2021. This allows us to visualize the gradual impact of vaccinations which commenced for some countries like Israel as early as 20th December 2020. For country population data, we utilize the recent data made available by the UN [7]. Fig. (**1**) displays data first for the UK, which has administered the largest number of vaccine doses per person within the European Region. The EU countries following this are arranged by population size and include Germany, Italy, Poland, Netherlands, Belgium, Sweden and Greece. Data within the time series chart and the radar plot are scaled so as to allow for direct comparisons. For both time series charts and radar plots, the orange line represents new COVID-19 deaths occurring during the week per million population, while the blue line represents new COVID-19 cases occurring during the week per 10,000 population. This shift in the ratio allows for both variables to be displayed on the same graphs.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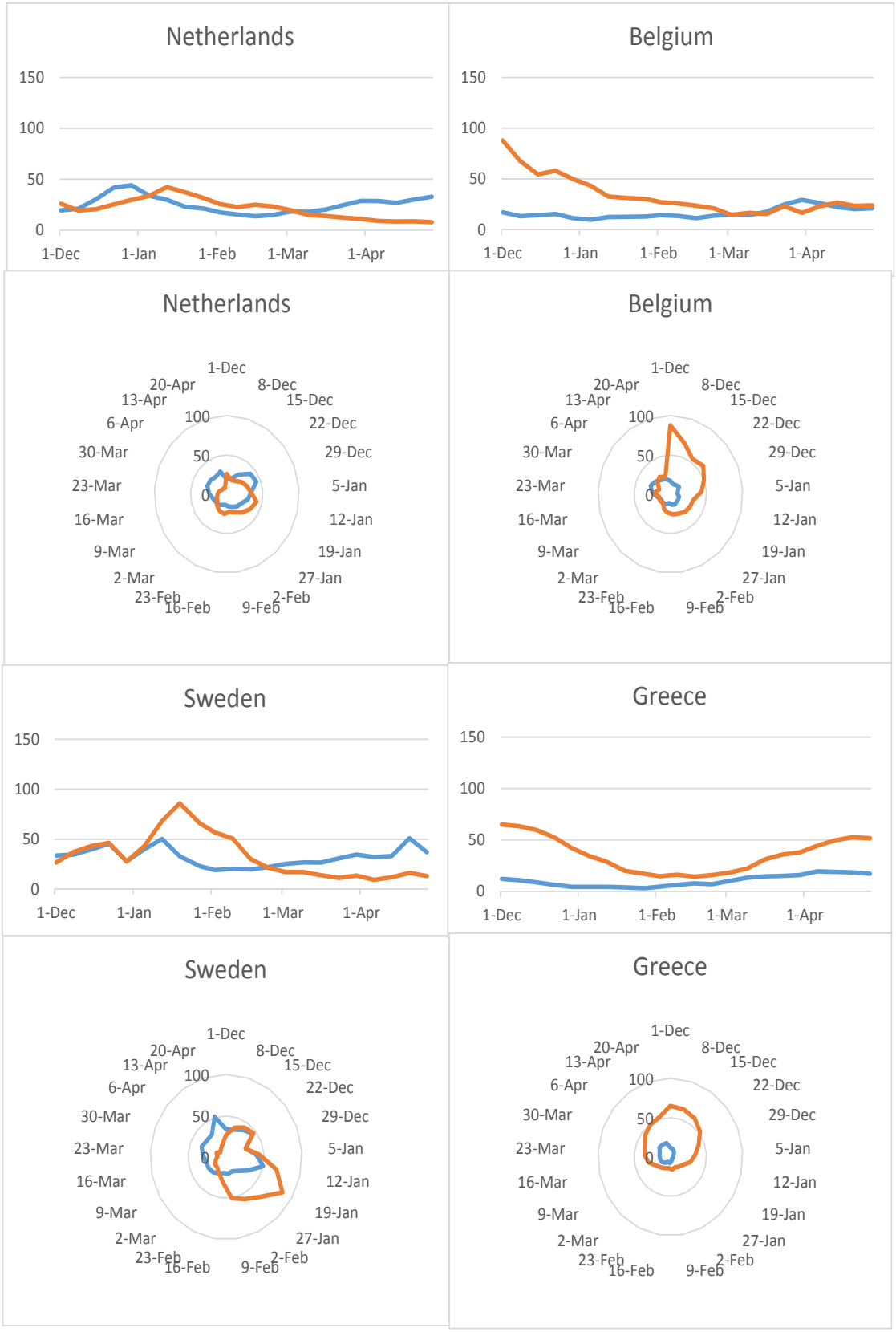

Fig. (1). COVID Deaths (per million population) and COVID Cases (per 10,000 population) from 1st December 2020.

For the UK, a pronounced vaccination effect is discernable in both the line chart and the radar plot. As shown in the line chart, COVID cases per population [blue line] peak in mid-January but then decline swiftly to a near zero level. COVID

deaths per population (orange line) peak around the beginning of February and then also decline to a near zero level, illustrating the positive effects of early and swift vaccine rollout for the UK. This is illustrated in the radar plot by the fact that the orange line representing COVID deaths per population gradually moves toward the zero point, while exhibiting a kink toward the final weeks of the series which is characteristic of successful vaccination campaigns nearing completion.

The picture for Germany differs from this. As shown in the line chart, COVID deaths per population (orange line) peak in mid-January, albeit at a much lower rate than in the UK, and then fall. However, unlike in the UK, the downward trend does not continue but rather reverses itself as of early April. This could have been prevented by a faster vaccine rollout and it is not surprising that the corresponding radar plot for Germany does not show the pronounced kink typical of successful vaccination campaigns which we see for the UK.

This picture is mirrored by Italy, where the per population rate of COVID deaths falls slowly but steadily until early March, when this trend reverses and the number of deaths and cases increases again. Unlike for Germany, for Italy, however, the most recent data shows a continuing downward trend, which also explains the more pronounced vaccination kink in the radar plot for this country for the most recent weeks.

For Poland, the data closely mirror the observations made for Italy. There is however a major difference in that the reversal of the downward trend which occurs in early March is more dramatic, leading to a higher rate of COVID deaths, which only begins to decline in the most recent weeks of late April. Due to this pronounced increase in COVID deaths since early March, the radar plot for Poland does not show the characteristic vaccination kink, indicating that the positive effects of vaccination are only slowly affecting COVID deaths and cases in that country.

The Netherlands shows an altogether more positive picture. Here, the COVID death rate (orange line) has declined relatively steadily since its peak in mid-January. However, this death rate has been stagnating for the most recent weeks and, unlike in the UK, is not approaching the zero axis. Interestingly, the COVID case number rate has not increased since early March, which suggests that some gains in terms of the reduced death rate might also be due to improved treatment. As regards the radar plot for the Netherlands, we can identify a small kink for the orange death rate line during the most recent weeks which, as previously noted, is likely to mirror vaccination effects and improved treatment.

For Belgium, the COVID death rate (orange line) declines from a highly elevated level, comparable to that of Poland, since December. This trend reverses itself in late March and again in early April, which is indicative of the slow vaccine rollout and the dangers this has brought. In terms of the radar plot, Belgium still shows the characteristic kink in the death rate which is due to the very high initial death rates at the beginning of this time series window in early December.

Sweden shows a delayed peak in its COVID death rate (orange line) in mid-February. Since then a decline in the COVID death rate occurred, which temporarily reversed itself in April, and again would likely have been avoidable by a faster vaccine rollout. The radar plot for Sweden, hence, does not show the characteristic vaccination kink for the most recent weeks.

Death rate patterns (orange line) for Greece are similar to those for Poland, albeit that the periods of increase are not as pronounced. While initially falling, improvements in the COVID death rate reverse themselves as of early March, with a leveling off only occurring in the most recent two weeks. As in the case of Poland, this may be due to the beginning of a vaccination effect. However, as a time series, the COVID death rate patterns are indicative of the slow vaccine and only show a leveling off in the most recent two weeks of this time series. As for Poland and Sweden, the radar plot for Greece does not show the characteristic kink in the death rate a swift vaccine rollout would have brought.

Table 1. Expected *vs* actual COVID deaths applying UK benchmark for week ending March 28th to week ending April 25th.

Country	Observed	Population	Expected	Actual	Number
-	COVID deaths	in million	COVID deaths	COVID deaths	Excess
-	per million	-	-	-	COVID deaths
-	-	-	19.387x[a]=[b]	-	-
-	-	[a]	[b]	[c]	[c]-[b]
-	-	-	-	-	-
uk	19.387	66.797	1295	1295	0
nl	44.245	17.584	341	778	437
se	63.846	10.353	201	661	460
de	82.942	83.191	1613	6900	5287
be	113.361	11.556	224	1310	1086
gr	235.936	10.719	208	2529	2321
it	242.671	59.258	1149	14379	13230
pl	421.373	38.244	742	16115	15373

3. OVERALL ASSESSMENT

The previous data analyses suggest that all of the EU countries examined here fared considerably worse in terms of the COVID death rate than the UK did, once the UK vaccine rollout covered a significant portion of vulnerable populations, which occurred around mid-April 2021. Available WHO country data allows for an assessment of the overall effects of the EU's vaccination delay for the countries discussed above, for which weekly data is relatively smooth and has not been corrected and revised for recent weeks [6]. Table **1** provides a simple assessment where we examine the number of COVID deaths which occurred in these countries during the weeks ending 28th March 2021 to the week ending 26th April 2021, using the latest available UN population estimates [7]. For this period, the UK COVID death rate amounted to 19.37 per million inhabitants. We apply this death rate to the population count for the countries in question and compare the resultant 'expected' COVID death rates with those actually observed. Using this approach, the number of 'excess' deaths is the smallest for the Netherlands as we would expect from the previous visualizations with 437.2 excess deaths (compared to the UK benchmark), and the largest for Poland with 15,373.4 excess deaths.

Overall this data is indicative of the importance of rapid progress in COVID vaccination. This is particularly the case for those countries which experienced high COVID rates during the second wave. In the absence of rapid vaccine rollout in Europe and other heavily affected regions, death rates are likely to remain high, while a pronounced third wave becomes a distinct possibility.

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