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COVID DEATH SPREAD RATE

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ABSTRACT

Throughout the course of pandemic April 2020 through May 2022, the author conducted a data analysis of patterns of coronavirus deaths worldwide using Worldometer Coronavirus. Common characteristics were identified for world's deadliest coronavirus regions. Introduction of coronavirus into populated areas simultaneously with normal polluting activities under meteorological temperature inversion conditions routinely led to rapid rise of coronavirus daily deaths, typically many months duration, depending on government response to establish lock down conditions. Lock downs typically included mask wearing and restrictive public curfews. During lock downs substantial curtailment of transportation, eventually manufacturing and ultimately creation of pristine environments ended each death cycle.

Exposure to pollution particulate matter was identified to be paramount, as it caused immunity deficient populations from long term chronic exposure and acute exposure by providing micron-sized surfaces for absorbance of coronavirus aerosols capable of being inhaled into and through lungs into stomachs and bloodstreams. Under temperature inversions these aerosol-particulates drifted many miles from coronavirus source due to typically low, gentle wind speeds. Not only Air Quality Index measured PM10 and PM2.5 particulates exhibited this behavior, but also PM1 and ultra-fines, not measured by AQI. These "fines" are present in world's largest cities at ratios of 0.75:1.00 vs PM10 and PM2.5 particulates combined.

Worldometer Coronavirus provides death rates for each country, defined as deaths per million population. Unit is not helpful, however, in predicting coronavirus death spread rates for newly exposed highly polluted areas, without substantial vaccinations of vulnerable population, when lock downs are lifted. This paper focuses on determining a COVID Death Spread Rate, which could be used to predict number of deaths which will occur in China in 2023.

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INTRODUCTION

This paper is a continuation of the evaluation conducted from April 2020 through May 2022 on "World's Coronavirus Death Regions and Why" [1]. The full evaluation includes eleven PowerPoint presentations completed through December 2021 plus five articles published January 2022 through May 2022. All of this information is stored in a WordPress.com website created November 2021.[Website link: https://worldscoronavirusdeathregionswhy.wordpress.com] This work proposed a "Pathway to Creation of World Deadly Coronavirus Regions" updated on Figure 1 [2, 3] and defined the critical world regions and limited number of countries accounting for the vast majority of coronavirus deaths [3, 4].

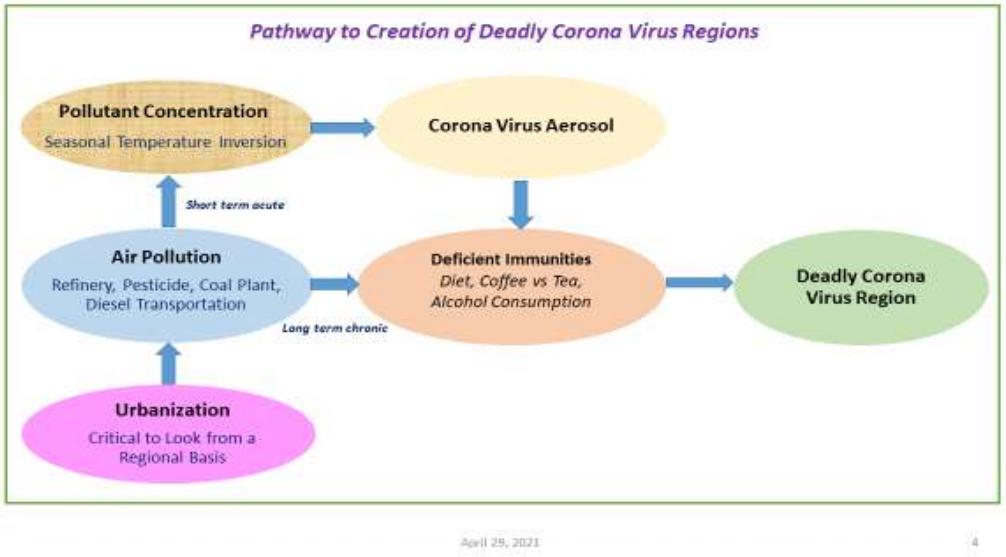

Figure 1: [2, 3] Updated Pathway to Creation of Deadly Coronavirus Regions

The Worldometer Coronavirus [5] was chosen for the data evaluation for ease of extracting data and consistency with other world coronavirus data providers. During the period of April 2020 through April 2022, the impact of vaccinations on curtailing the spread of coronavirus around the world was limited. Deaths by coronavirus in each region and country exploded into peaks of daily deaths lasting a few months to as long as a year dependent on individual regions and countries. These explosions of deaths didn't peak until governments decided to establish lock downs, meaning severe people curfews and mask wearing. Once these were in place, traffic became substantially limited, manufacturing facilities were put on standby due to lack of employees and sales, and eventually pristine air was established not experienced for many years. The patterns of death explosions, peaks, and curtailment were similar in every country and region. Realization of these findings made it obvious that pollution was critical to coronavirus transmission. But pollution was existent in these areas year round, and deaths only occurred during specific periods and at different times around the world. Heavy populated areas were always prerequisite, but they existed year round also.

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Recognition that world transmission of coronavirus [6] was from Italy and Western Europe (winter 2020) to East Coast USA (spring 2020) to Brazil (mid-year 2020) to India (3rd quarter 2020) and the author's previous experience with temperature inversions, requiring manufacturing interruption from resultant low elevation pollution concentration in the Delaware River Valley East Coast USA, provided the basis for a hypothesis "that coronavirus death explosions required simultaneous occurrence of introduction of coronavirus to heavily populated areas with normally heavy polluting traffic and manufacturing under temperature inversion conditions". It was verified that temperature inversions typically occur in northern Italy in January-February, East Coast USA late winter to early spring, Sao Paulo Brazil May-June, India, etc. These inversions are so routine that fruits and coffee are grown in these regions on the sides of mountains to take advantage of the higher elevation temperatures caused by temperature inversions. Concentrated pollution problems in the valleys during temperature inversions were well known and similar findings were verified in the regions of Tehran, Moscow, Johannesburg, and Jakarta [7] to test the hypothesis. Air Quality Index (AQI) [8] is measured worldwide to assess polluted conditions and includes measurement of inhalable (deep into the lungs [9]) particulate matter at aerodynamic diameter of 10 and 2.5 microns as well as carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and lead. Particles less than 2.5 micrometers in diameter pose the greatest risk [9]. The AQI analytical procedure utilized worldwide does not focus on measuring finer particulate sizes such as PM1. "PM1 consists of the smallest particles: those under 1 micrometer in diameter. Though it may potentially be more harmful to human health due to its small size, there is limited evidence of its negative health effects because of the lack of widespread monitoring or regulation – PM1 is not monitored routinely as PM2.5 and PM10 as it is not a subject of most air quality standards. However, it is theorized that PM1 may contribute to a significant portion of PM2.5's health effects because of its small particle size. [11]" Scientists have determined that particulates of one micron and ultrafines (size of pigments and cosmetics) exist in all world's major cities at a ratio of 0.75 to 1.00 of combined PM10 and PM2.5 particulates [12]. Particulates of these sizes are capable of passing through human lungs and into stomachs and bloodstreams [9, 11], affecting people's immunity systems. Hence long term chronic exposure to these fine particulates renders a portion of world's population highly susceptible to introduction of something like coronavirus. Recent scientific efforts have also determined that these fine particulates can be carriers of coronavirus aerosols [12] and that coronavirus absorbed on these particulates can have half-lives of 3-4 days [13]. Under typical temperature inversion conditions with gentle wind speed range of 3-4 miles per hour, aerosol-particulates can drift hundreds of miles in a couple days from original coronavirus aerosol source. This is a primary transmission of coronavirus within regions exposing maximum number of people. It has been further found that 85% of the world's coronavirus deaths have occurred in countries bordering the world's seas and oceans [2]. Between these aqueous sources and mountain ranges are where temperature inversions originate and exist seasonally. These areas are heavily populated, considered the most corrosive areas in the world by paint and galvanizing manufacturers, and routinely experience acid rain due to heavy carbon dioxide emissions.

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In 2022, Craven had published review articles entitled East-Central Europe – World's Deadliest Coronavirus Center [3], Lands Abutting Seas and Oceans, 85% of Covid-19 Deaths [2], and Pesticides and Covid-19 Deaths [4]. These articles focused on world coronavirus death data at six million death milestone, March 3, 2022. Articles emphasized role of fine sized pollutants, from a variety of sources under temperature inversion conditions, as carriers of coronavirus aerosols and as principal mechanism for transmission of coronavirus intra-regions [12, 13]. Tables 1 and 2, taken from these articles, summarize eight coronavirus death regions and delineate the ranking of the 42 deadliest countries accounting for 99.8% and 90% of world's coronavirus deaths respectively. These Tables show the death rate defined by Worldometer Coronavirus as deaths per million people, which is based on accumulated deaths which occurred in these regions and countries over the course of the pandemic. What these death rates do not do is provide a COVID Death Spread Rate. Why might this be of importance?

China does not appear in either Table and through November 2022 had less than 5,000 total coronavirus deaths. The eastern half of China borders the Yellow and East China Seas, is heavily populated and known to be heavily polluted and to experience seasonal temperature inversions. The elderly population of China is not significantly vaccinated and China in December 2022 abandoned it zero-Covid policy. If all of the information published by this author is correct, then coronavirus deaths in China in 2023 are going to repeat the explosion histories that occurred in rest of world. So what will be the Death Spread Rate? Can this unit be defined via analysis of the data previously presented?

Figures 2, 3, 4 provide typical coronavirus death explosion patterns in 2020 under similar conditions as China now finds itself. Figure 2 shows the first explosion or peak of deaths in Spain as an example. Duration of the peak was nearly two months. The column presentation of daily deaths was extracted from the Worldometer Coronavirus into Excel, which enabled creation of the polynomial curve with convincing R-squared. Figure 3 compares the curve for Spain with similar death peak curves for Italy, France, and UK. All four curves are the same. Figure 4 provides death peak curve for Iran in 2020 and shows three peaks. During three years of pandemic, most countries experienced multiple peaks. Iran ended up with five peaks.

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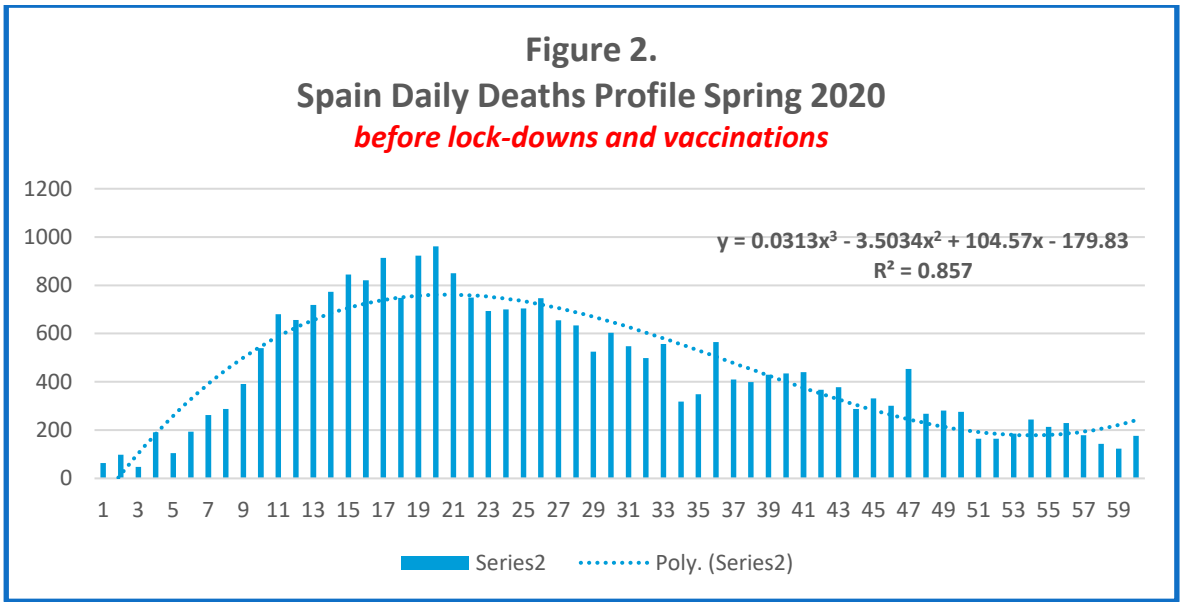

Figure 2: [6] Typical country daily death profile displayed as columns and via an Excel developed polynomial curve and associated R-squared.

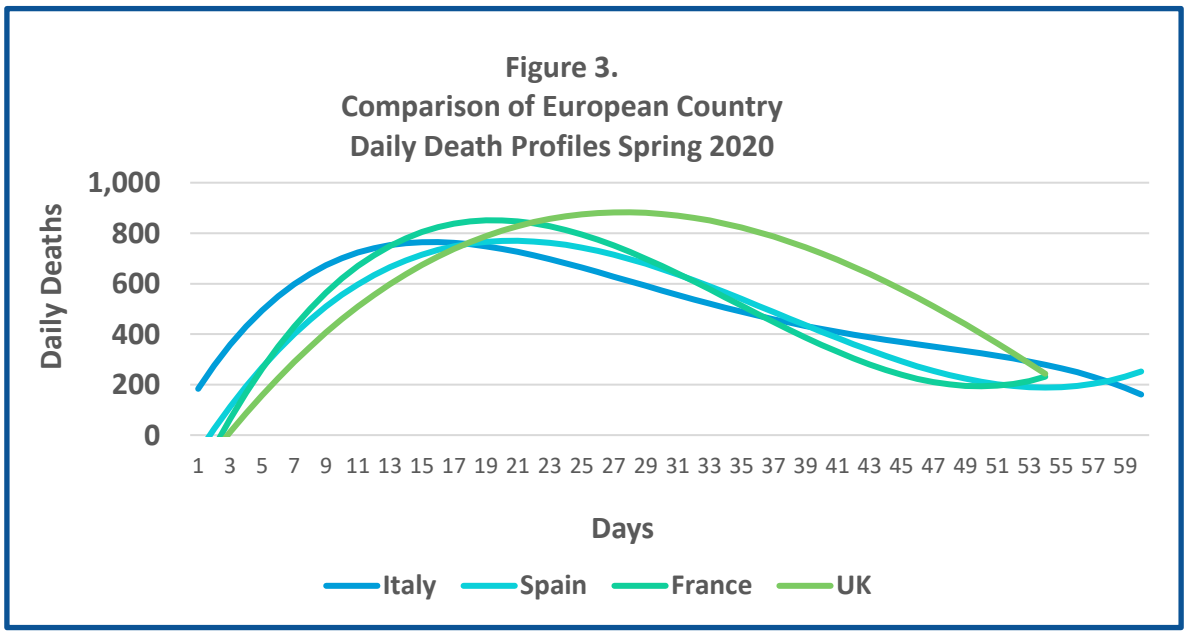

Figure 3: [6] Excel developed curves comparing daily death profiles of multiple countries illustrating overlapping curves.

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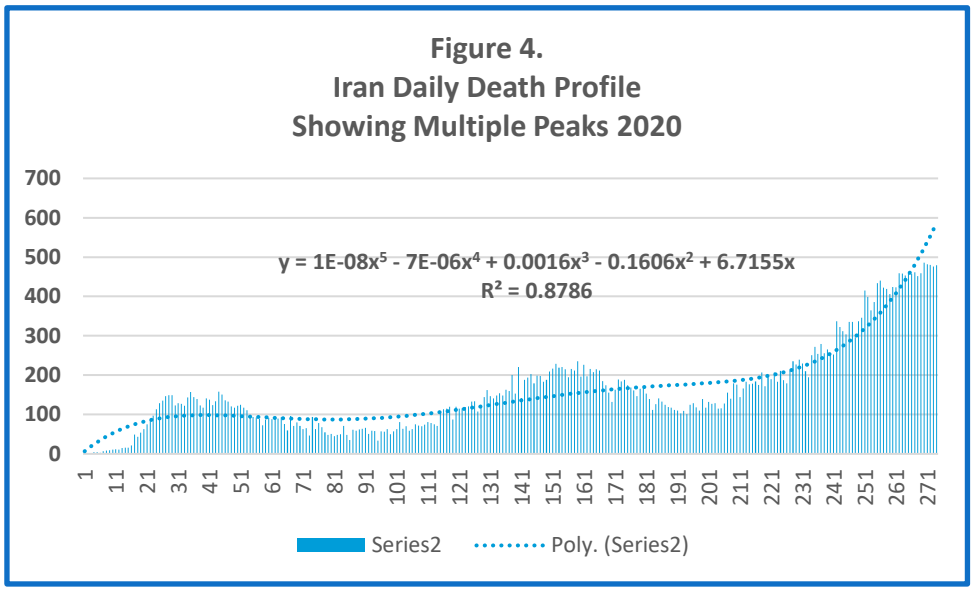

Figure 4: [6] Many countries had multiple death peaks throughout pandemic as Iran in 2020.

To attempt to define a Death Spread Rate, the author selected one peak for 25 of the deadliest countries, and utilized the Cumulative Death Curves by country in Worldometer Coronavirus. The number of deaths and days from start to end of the worst death peaks for each country was determined and the ratio provided an average Death Spread Rate for the selected peaks for each country. The 25 countries have vastly varying populations, so ratio of deaths per day was modified to provide deaths per million population per day. The results are provided in Table 1 and Figure 5. The worst death peaks for each country were selected since China's goal is to accomplish full economic production, maintaining minimum requirements for maintaining public health.

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The following table provides an estimate of data for continuous death cycles from about 100 deaths/day to peak back to 100 deaths/day, which occurred in these 25 countries without lockdowns and full production and associated pollution. It each case, the deadliest peak was chosen. Data source was the" cumulative death curves" of each country per the Worldometer Coronavirus.

	Death Spread Rate	*Table constructed January 30, 2023*			
Country	deaths/MMpop/day	days	deaths	population, MM	Death Rank
Philippines (no real peak)	1.3	252	35,730	113	21
India (2nd peak)	2.0	86	241,157	1385	3
Turkey (3rd peak)	2.5	204	43,228	86	19
Indonesia (main peak)	3.1	102	87,978	274	17
Canada (1st peak)	3.3	55	6,802	38	24
Iran (5th peak)	3.7	146	45,944	84	13
USA (2nd peak)	4.4	283	415,860	332	1
Mexico (2nd peak)	4.5	244	141,887	130	4
South Africa (3rd peak)	5.0	85	26,004	61	16
Russia (3rd peak)	5.1	365	265,511	144	6
Germany (2nd peak)	5.2	153	67,053	84	12
Brazil (2nd peak)	5.7	365	440,694	213	2
Netherlands (1st peak)	5.8	55	5,457	17	30
Argentina (2nd peak)	6.7	206	62,376	45	11
UK (1st peak)	7.5	78	39,721	68	7
Poland (2+3 Peak)	7.8	219	65,014	38	15
Sweden (1st peak)	7.9	65	5,143	10	38
Italy (1st peak)	8.2	60	29,645	60	8
France (1st peak)	8.4	45	24,523	65	9
Colombia (2nd peak)	8.6	136	59,799	51	10
Ukaine (3rd peak)	9.9	93	39,643	43	16
Spain (1st peak)	10.6	50	24,967	47	14
Belgium (1st peak)	12.1	58	8,745	13	26
Peru (2nd peak)	15.9	172	90,373	33	5
Romania (3rd peak)	21.8	62	25,727	19	20
Average	7	146			

Table 1: Covid-19 Average Death Spread Rates for Deadliest Peaks by Country

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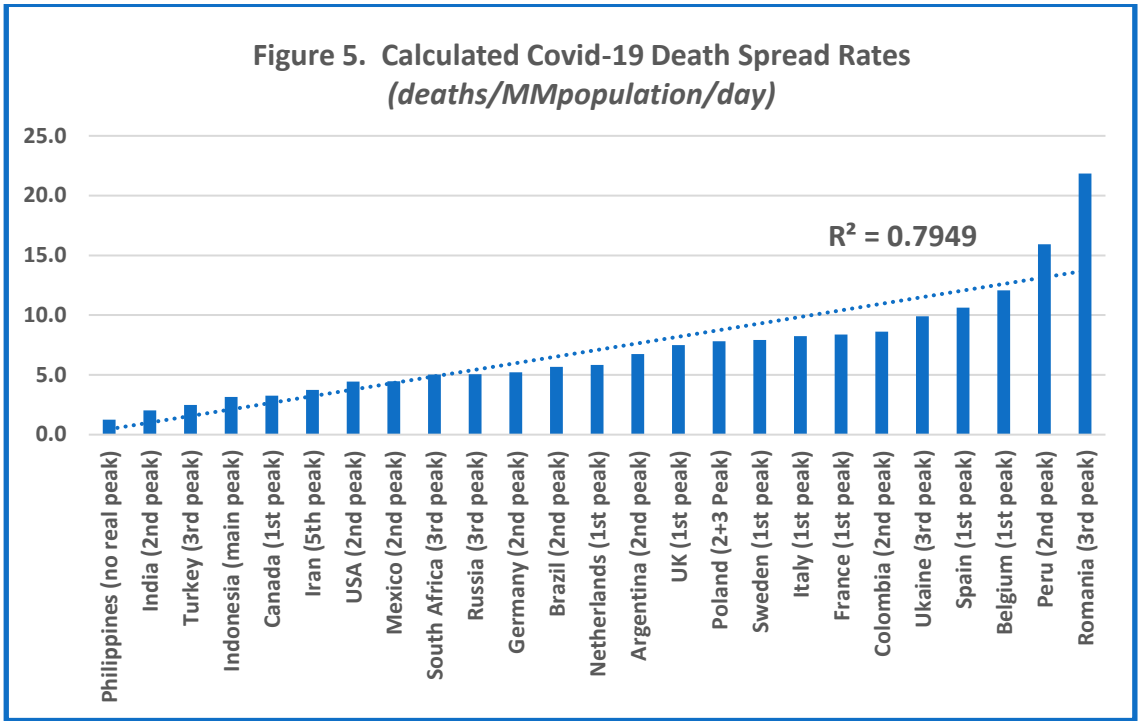

Figure 5: Graphical Representation of Table 3 Covid-19 Death Spread Rates

As shown in Table 3, the average Covid Death Spread Rate is 7 deaths per million population per day. Range is from 1.3 to 21.8. There is a pattern in COVID Death Spread Rate results, similar to the variance in Worldometer Coronavirus death rates by region in Table 2. The Western European countries show consistent COVID Death Spread Rates at 7-10. USA, Mexico, Brazil, Argentina show consistent at 4.4-7.6. These two groups of countries bounded the average of 7. Philippines, India, Indonesia, however, are remarkably lower by 50-80% versus average of 7.

Region	Ave Death Rate	Deaths	MM pop	% Urban pop
Eastern Europe	2,952	917,645	311	64%
South America	2,915	1,273,654	437	75%
North America	2,512	1,377,722	549	73%
Western Europe	1,525	867,563	569	75%
Middle East	807	350,335	434	71%
Southwest Asia	331	621,525	1,880	30%
Africa	175	244,129	1,394	46%
Far East	151	333,669	2,207	63%
Totals	769	5,986,242	7,780	
3-Mar-22		6,000,753	7,800	
Percent of World		99.8%	99.7%	

Table 2: Total Covid-19 Pandemic Deaths, Death Rates, Population by Region – March 3, 2022 [2]

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A closer look at Tables 1 and 2 further emphasizes a difference in Worldometer Coronavirus defined deaths rates. The North and South American countries were 1525 to 2952. Southwest Asia and Far East were 151 to 331. Figure 6 is a plot of Coronavirus Average Region Death Rates vs Region Average % Urban Population using the data from Table 1. There seems to be a correlation, but R-squared is not convincing. The eleven countries with Coronavirus Death Spread Rate above the average of 7 all had populations below 68 million and their geographies can be described to be relatively compact. This actually provides confidence in concept for a calculated COVID Death Spread Rate. The countries - regions more compact geographically are potentially impacted much worse than countries - regions far more vast in geography. Philippines and Indonesia are in fact countries with multiple discrete islands.

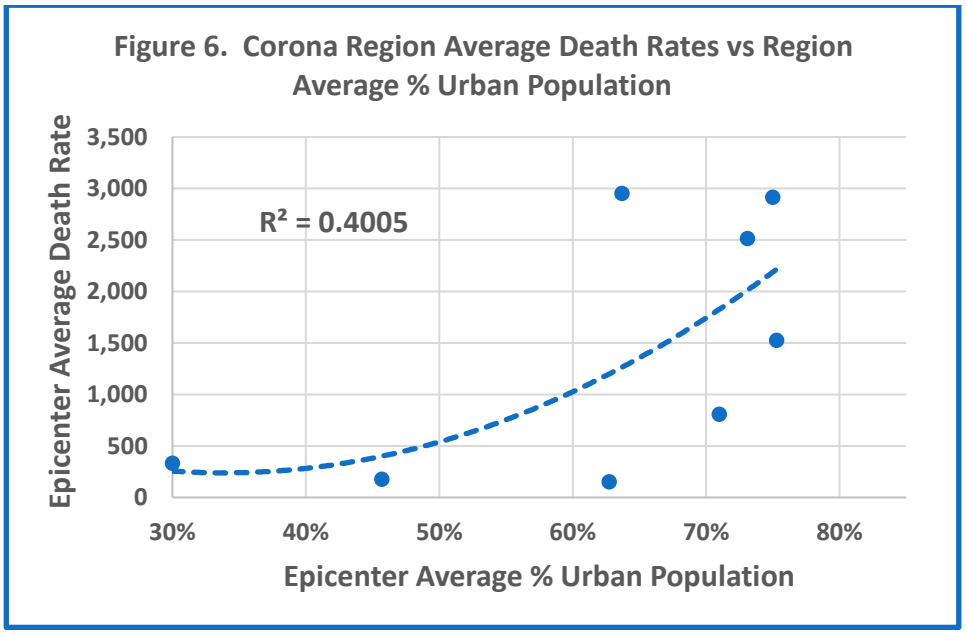

Figure 6: Coronavirus Region Average Death Rates vs Average % Urban Population

However, various research articles [14, 15, 16] address the capability of data gathering to assess public health impacts during the pandemic in low to middle income countries, where mortality surveillance before the pandemic was patchy. Each article estimates India's excess deaths during pandemic at 8-10x the reported Covid-19 deaths. This would mean that the Worldometer Coronavirus death rate for India is near 3,000 vs 367 in Table 3. This would also mean that the death explosion peak for India is drastically understated and that its actual value would be above 10 instead of 2.0.

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Rank	Country	Deaths	Death Rate	Acc vs World	Rank	Country	Deaths	Death Rate	% of World
1	USA	981,729	2,937	16%	22	Chile	42,683	2,201	81%
2	Brazil	650,646	3,025	27%	23	Hungary	42,211	4,596	81%
3	India	514,620	367	36%	24	Vietnam	40,547	410	82%
4	Russia	354,011	2,424	42%	25	Czechia	38,787	3,611	83%
5	Mexico	318,835	2,430	47%	26	Canada	36,843	962	83%
6	Peru	210,851	6,250	51%	27	Bulgaria	35,716	5,205	84%
7	UK	161,898	2,364	53%	28	Equador	35,264	1,949	84%
8	Italy	155,399	2,577	56%	29	Malaysia	33,028	999	85%
9	Indonesia	143,361	517	58%	30	Pakistan	30,237	133	85%
10	France	138,942	2,121	60%	31	Belgium	30,217	2,588	86%
11	Colombia	138,939	2,683	63%	32	Bangladesh	29,058	174	86%
12	Iran	137,439	1,602	65%	33	Tunisia	27,857	2,317	87%
13	Argentina	126,531	2,757	67%	34	Greece	26,036	2,518	87%
14	Germany	124,265	1,475	69%	35	Iraq	25,028	600	88%
15	Poland	112,130	2,968	71%	36	Egypt	24,149	229	88%
16	Ukraine	105,505	2,437	73%	37	Japan	24,092	191	89%
17	Spain	100,239	2,143	75%	38	Thailand	23,073	329	89%
18	So Africa	99,499	1,643	76%	39	Netherlands	21,589	1,255	89%
19	Turkey	95,025	1,107	78%	40	Bolivia	21,433	1,796	90%
20	Romania	63,782	3,353	79%	41	Portugal	21,141	2,083	90%
21	Philippines	56,538	505	80%	42	Myanmar	19,379	352	90%

Table 3: [2] Total Covid-19 Pandemic Deaths, Death Rates, Accumulative by Country – March 3, 2022

Figure 7 was extracted from the research article in Nature December 2022 [16]. The data shows that both India's and Indonesia's excess deaths are significantly higher than the data in the Worldometer Coronavirus. This Figure also shows that Russia, Mexico, Pakistan and Bangladesh have excess deaths higher than the data reported in the Worldometer Coronavirus.

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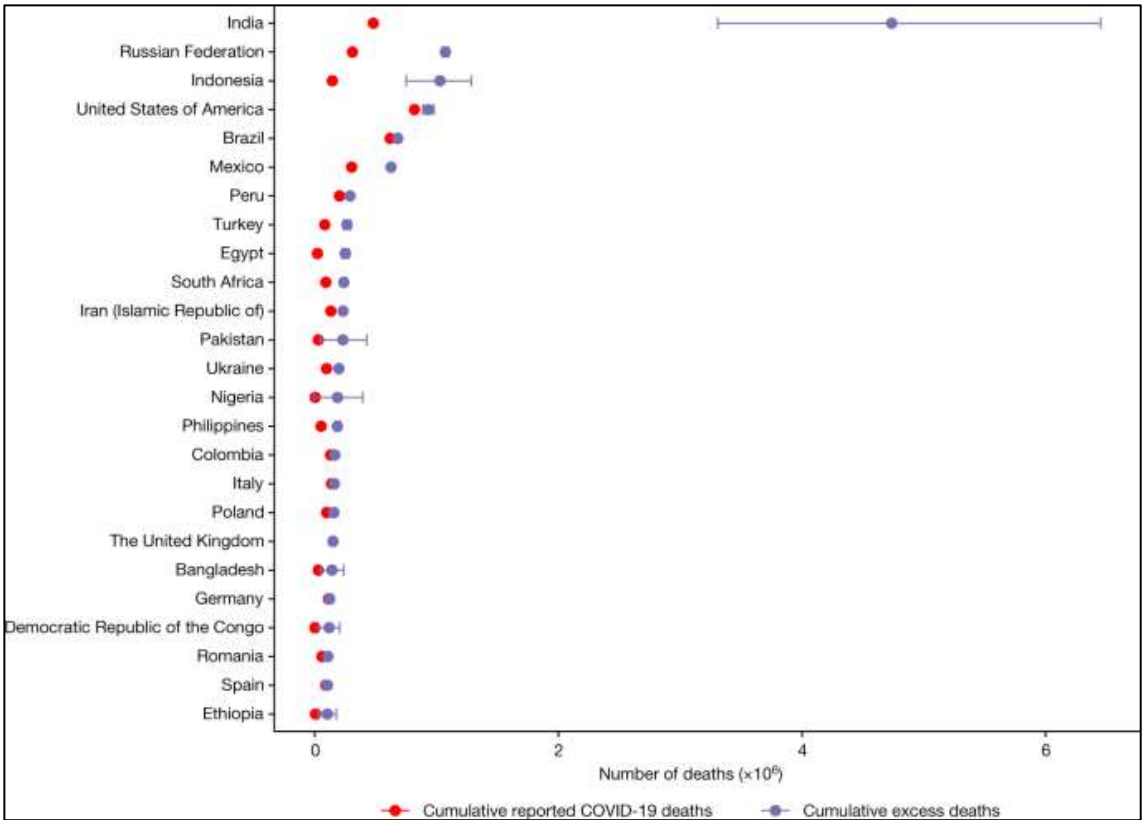

Figure 7: The 25 countries with the highest total estimated excess deaths between January 2020 and December 2021.

The red dots show the total reported COVID-19 death numbers. The purple dots show the mean total estimated excess death numbers with the width of the bars showing the 95% uncertainty intervals.

Figure 8 summarizes the top ten most polluted cities in the world in 2022 and the World Health Organization 2022 map of Global Pollution Levels Figure 9. Overwhelmingly the most polluted regions in the world include (1) the countries bounding the Arabian Sea – India, Bangladesh, Pakistan, Nepal, Afghanistan, Iran, Iraq, Tajikistan, Kyrgyzstan, Oman, Saudi Arabia, the Arabian Peninsula – and (2) China and Mongolia.

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Top 20 Most Polluted Capital Cities 2022 Ranking

Rank	Country	PM2.5
1	New Delhi, India	85
2	Dhaka, Bangladesh	78.1
3	N'Djamena, Chad	77.6
4	Dushanbe, Tajikistan	59.5
5	Muscat, Oman	53.9
6	Kathmandu, Nepal	50.9
7	Manama, Bahrain	49.8
8	Baghdad, Iraq	49.7
9	Bishkek, Kyrgyzstan	48.3
10	Tashkent, Uzbekistan	42.8
11	Islamabad, Pakistan	41.1
12	Jakarta, Indonesia	39.2
13	Doha, Qatar	38.2
14	Kabul, Afghanistan	37.5
15	Hanoi, Vietnam	36.2
16	Beijing, China	34.4
17	Yerevan, Armenia	33.9
18	Abu Dhabi, UAE	33.8
19	Ulaanbaatar, Mongolia	33.8
20	Riyadh, Saudi Arabia	32.5

Figure 8: [17] Top 20 Most Polluted Capital Cities 2022 Ranking

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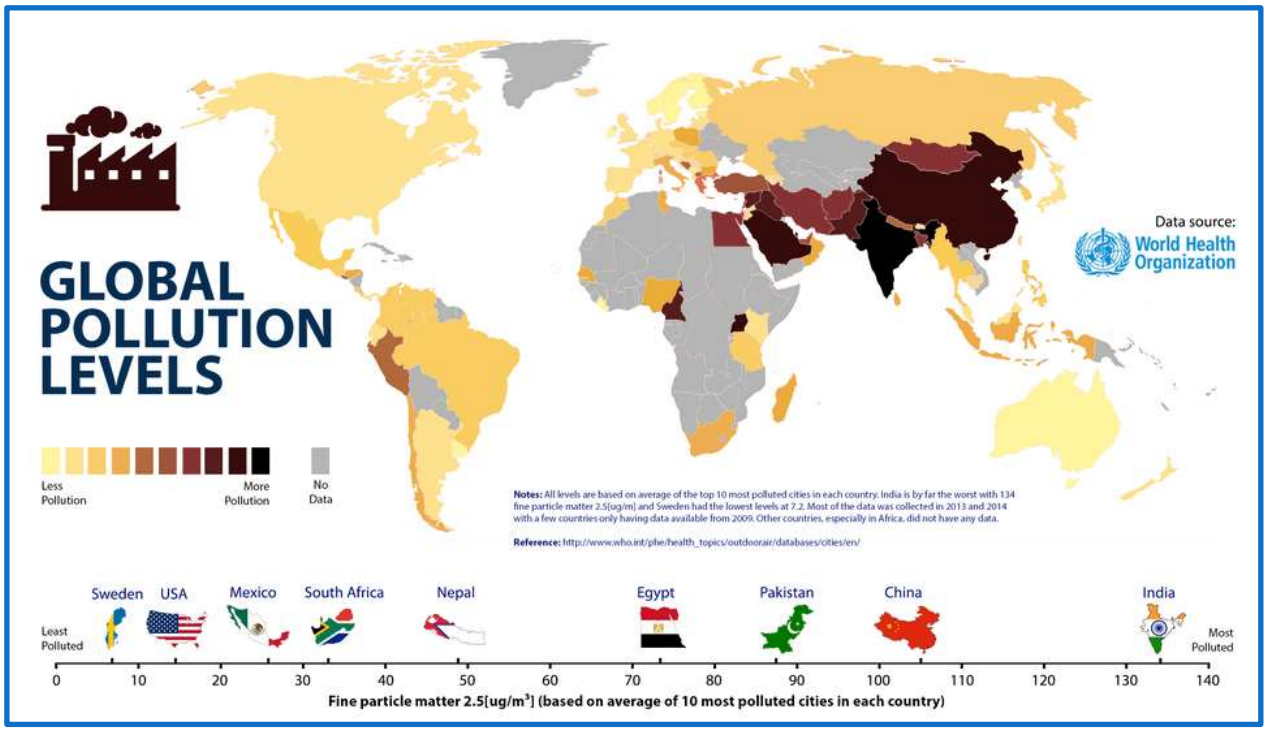

Figure 9: [18] World Health Organization Map of Global Pollution Levels

Weighing all this information leads to the conclusion that an average COVID Death Spread Rate of 7 deaths per million population per day is a good estimate and appropriate to be considered to predict the public health impact to China in 2023.

CONCLUSION

This paper has derived a COVID Death Spread Rate that can be used to assess the potential number of deaths which will occur in China in 2023, now that it has lifted its zero-COVID policy. Twenty-five of the deadliest coronavirus countries, accounting for 85% of the world's deaths were assessed and the average result determined was 7 deaths per million population per day. Geographical complexity of a given country – region may affect predictions to some extent. Interpretation of the data suggests China will likely experience a Coronavirus Death Spread Rate between 7 and India's actual value based on excess mortality during the pandemic (above 7).

China's coronavirus death total could range from 1.8 million in six months to 3.5 million in a year. How many of these deaths will be actually be reported as coronavirus deaths vs counted as excess deaths is uncertain. What actions the Chinese government will take to curtail the likely death explosion is also an uncertainty.

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