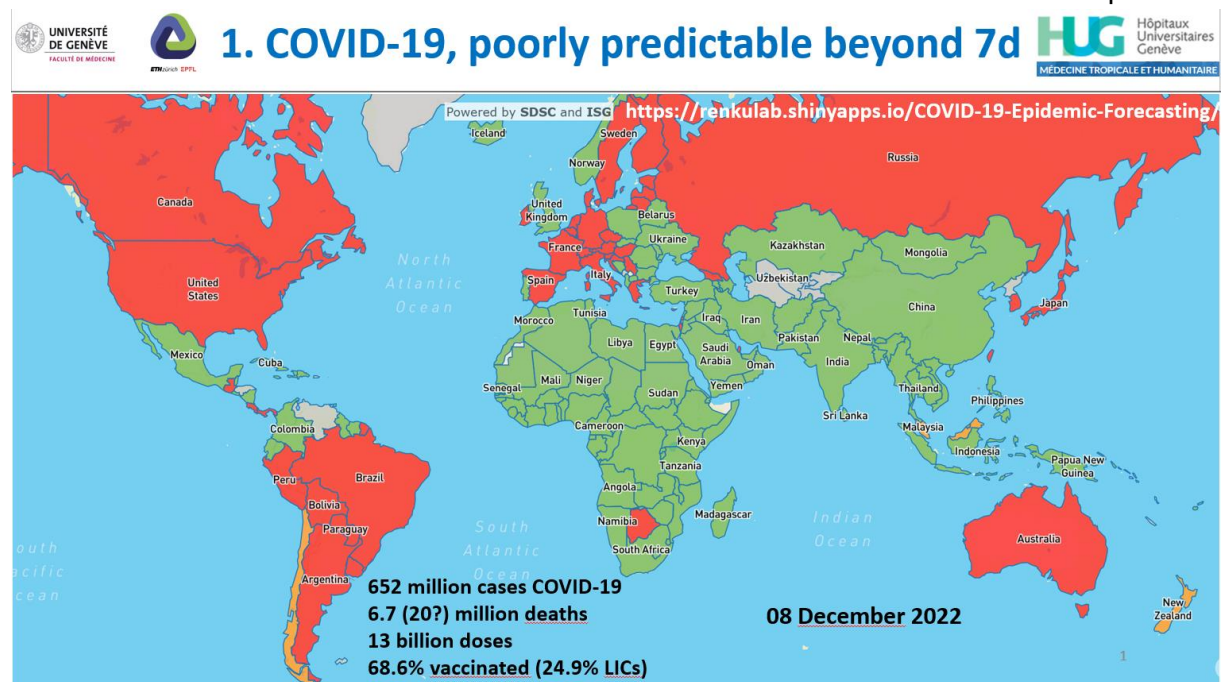


ANTOINE FLAHAULT

Director of the Institute of Global Health at the University of Geneva,
 Deputy Director of the Swiss School of Public Health, former Founding
 Director of EHESP

We would like to outline the epidemic situation by drawing four lessons from the COVID-19 pandemic, and then consider together possible future scenarios.

The first lessons of this pandemic



Lesson 1: COVID-19 is not very predictable beyond 7 days. Although it should be noted that COVID-19 is indeed a pandemic of the twenty-first century, because for the first time we all have near real-time information on the epidemiological situation from a large number of countries around the world. The complete genome sequence of the virus was published by Chinese researchers very quickly after the first notification to the WHO of the emergence of the virus in Wuhan, and helped to develop diagnostic tests and vaccines in record time.

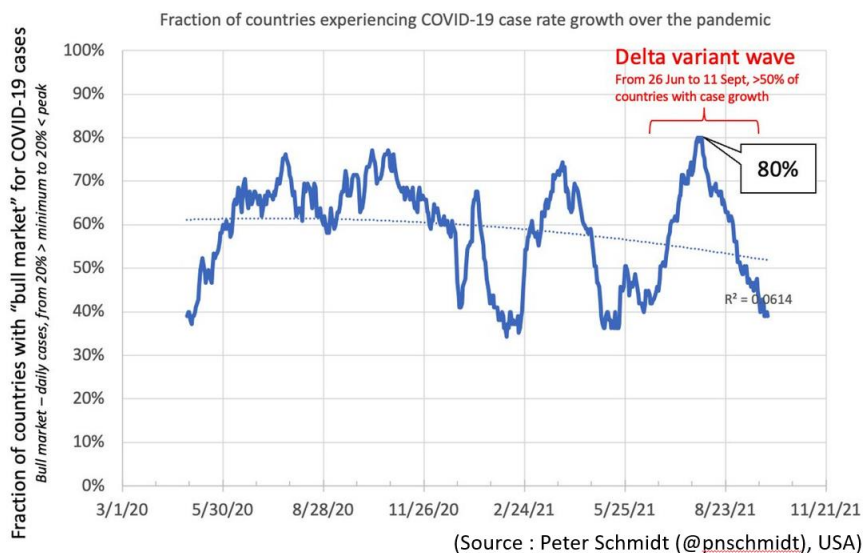
On the other hand, it must be said that in most countries of the world, health surveillance remains of rather poor quality. The United Kingdom is one of the few countries that stands out for the reliability and accuracy of its COVID-19 estimates. The Office for National Statistics (ONS) has been producing weekly estimates of coronavirus circulation since the start of the

pandemic from a representative sample of the population of its four nations, from among which PCRs are routinely performed and exhaustive sequencing of all samples identified as positive is carried out. The Netherlands has implemented a system of daily sewage testing, sampling over 350 sewage plants, to assess the level of coronavirus circulation in the community. This methodology, which has also been applied in other regions of the world, has shown a close correlation with the number of infections, hospitalizations and deaths occurring in the study area. But the almost universal lack of accurate and reliable data makes epidemiological predictions very uncertain. The Institute of Global Health of the University of Geneva, in collaboration with the Federal Institutes of Technology in Lausanne and Zurich, produce forecasts that we refrain from extending beyond 7 days, because even in the short term, errors and inaccuracies spread rapidly.

From the beginning of the pandemic until December 2022, 650 million cases had been reported worldwide and 6.7 million deaths (the real estimate is over 20 million). At the same time, 13 billion doses of vaccine had been delivered worldwide, representing a vaccination coverage of almost 70% of the world's population, with major disparities, since only 25% of the populations of the world's poorest countries had received at least one vaccine dose. As of 11 December 2022, a new wave of infections was underway, the ninth since the start of the pandemic, expected to peak by mid-month in both Europe and the Americas. High activity was also reported in Asia, notably in Japan and China. Notably, on 7 December, China had just abandoned the zero Covid strategy that it had maintained for nearly three years, and we will come back to the possible consequences of this decision later.



2. High Synchronism in Pandemic Waves



Lesson No. 2: the waves of COVID-19 are highly synchronized around the world. This is a little-reported observation, but it is worth noting. Although, as we have just seen, health surveillance is not precise regarding the number of infections in a given territory, the imprecision that taints it is relatively constant over a short period of time in a given country, and the trends that emerge are fairly reliable. Thus, the health surveillance available in many

countries allows us to identify an increase in contamination, a peak or an epidemic decline. What is particularly notable is the strong synchronization observed during previous waves, in particular during the waves driven by the Alpha and Delta variants for which we have these analyses. More than 80% of countries reported the same upward or downward trend at the same time. We are now seeing a similar global synchronization with the ninth wave, due to several Omicron sub-variants.

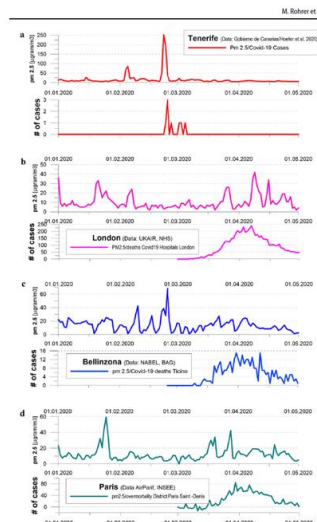
3. COVID-19 is mostly an Airborne Disease



Lesson 3: SARS-CoV-2 transmission is almost exclusively by aerosol. The transmission of coronavirus by the aerosol route has now been validated by the CDC of Atlanta, Stockholm and Addis Ababa, and also by the World Health Organization. But the lessons from such a finding have not really been learned by most governments, at least in the West. It is estimated that 95-99% of infections occur in enclosed, crowded and poorly-ventilated places such as nurseries, schools, universities, hospitals, bars, restaurants, clubs, gyms, churches, shared offices and public transport. Apart from some countries, such as the United States and Belgium, which have implemented initiatives and aligned investments to improve indoor air quality, most other countries have not yet launched national or regional plans and large-scale investments to address such challenges. Japan, Taiwan and South Korea seem to be more aware of the importance of ventilation and indoor air purification, but overall efforts in this area are still too modest. In this context, more and more studies show the superior effectiveness of a mask obligation compared to the simple recommendation to wear a mask in enclosed spaces and in public transport, when the circulation of the virus is high in a territory, as it reduces the risk of infection from respiratory viruses, such as COVID-19, influenza and RSV, which were actively circulating during the autumn of 2022 throughout the northern hemisphere.

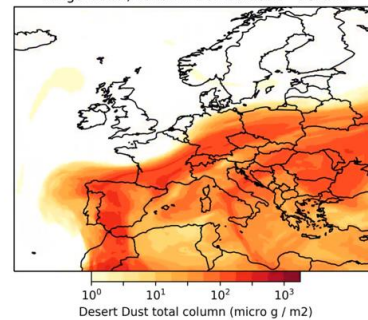


4. Air Pollution as Strong Determinant of COVID-19



Fine Particles (PM 2.5) and COVID-19 outbreaks

MULAG: regional - Meteo France
forecast from Wed 24 Feb 2021 - 00 UTC
range +56h, valid Fri 26 Feb 2021 - 08 UTC



Source : Rohrer M, Flahault A,
Stoffel M. Earth Systems and
Environment, 2020

Lesson 4: Fine particle air pollution is an important determinant of COVID-19 and its severity. The role of fine particles in outdoor air pollution, whether from fossil fuel combustion or desert sands, was already recognized in influenza epidemics. It has been shown to be a major determinant of COVID-19 epidemics, increasing contamination and severity of infection. Peaks in infections, hospitalizations and deaths have been observed all over the world following air pollution peaks, not only in the Paris region, London and Milan, but also in India, China and Brazil. Air pollution particles appear to act as abrasives on the mucous membranes of the respiratory tree, facilitating contamination. Their fine size causes deep damage to the respiratory tree, making severe forms more likely, especially in people with co-morbidities, particularly pre-existing chronic respiratory disease.

I will now present the scenarios for the future of the pandemic. Although we are not able to predict the future of this pandemic, both because of the evolution of the virus variants and because of public policies and social behaviors, we can however envisage different scenarios for the coming months, bearing in mind that it will probably be another pandemic that occurs.

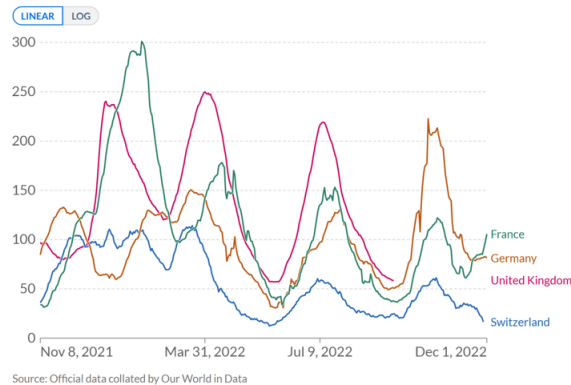
First Scenario for this Winter (1/4)

Prolonged calm period, no new variant...

Weekly new hospital admissions for COVID-19 per million people
Weekly admissions refer to the cumulative number of new admissions over the previous week.

Our World
in Data

01 December 2022

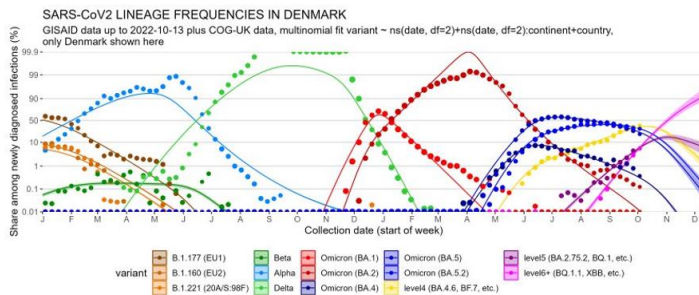


Scenario 1: A prolonged lull. With a bit of optimism, up until mid-November 2022, it was still possible to predict a respite in the succession of pandemic waves. Indeed, the eighth wave was receding by then, and no new variant seemed to be clearly in the lead to replace the Omicron BA.5 sub-variant, which had already been responsible for two pandemic waves in 2022, one in the summer and the other in early autumn, probably leaving fairly strong herd immunity in the global population. Without being specific about how long such a lull would last, there was a hope that it would continue as it did after the first wave in the spring of 2020, until the appearance of a new variant that evaded this acquired immunity. The summer of 2020, following the first wave of the pandemic, passed quietly, at least in the northern hemisphere. Hospitals had emptied and mortality had fallen to almost zero. But by the time of the WPC in December 2022, unfortunately a ninth wave had already started in many countries, including in Western Europe, as mentioned above, driven by new Omicron sub-variants. This first optimistic scenario was therefore quickly ruled out.



Second Scenario (2/4)

«Business as usual»: 9th wave succeeding the 8th one (prevailing variant)



Moritz Gerstung
@MoritzGerstung

The next few months may be a tight race between the BQ.1.1 and XBB.1 SARS-CoV-2 variants.

- Globally BQ.1.1 grew ~12% faster than BA.5, ranging from ~10% in Belgium to ~15% in Germany.

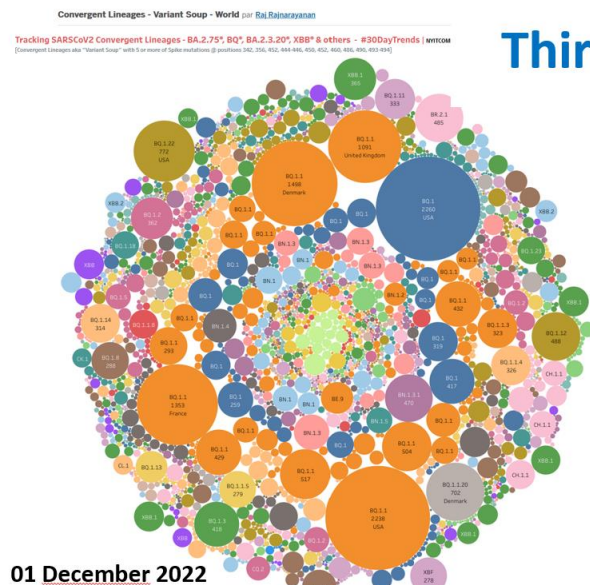
- XBB.1 grew >20% faster than BA.5 in Singapore, ~13% in the U.S., but only ~7% in Denmark.

Scenario 2: "Business as usual", a 9th wave after the 8th pandemic wave. With no respite, without hospitalizations falling back to a level similar to the lulls of the first years of the pandemic, and without deaths falling to zero, a ninth wave [could emerge], driven by new Omicron sub-variants, all more transmissible than BA.5, notably a descendant of BA.5, called BQ.1.1. in Europe, a recombination of two Omicron sub-variants, called XBB in certain Asian countries. These sub-variants have no clinically distinguishing features from their predecessors, except for their greater evasion of monoclonal antibodies, leaving no treatment option for severely immunocompromised patients who could benefit from them to prevent hospitalization or death. The peak of this ninth wave could occur before the end of 2022, followed by a decline in hospitalizations and deaths. This scenario suggests an uninterrupted succession of waves, without a long respite between each wave.

Third Scenario (3/4)

A non paved road in this pandemic: The variant soup

High plateau?



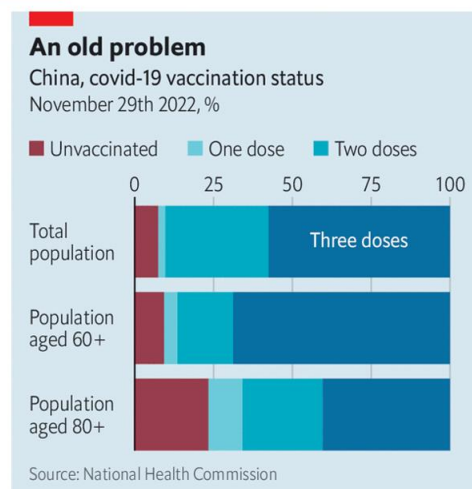
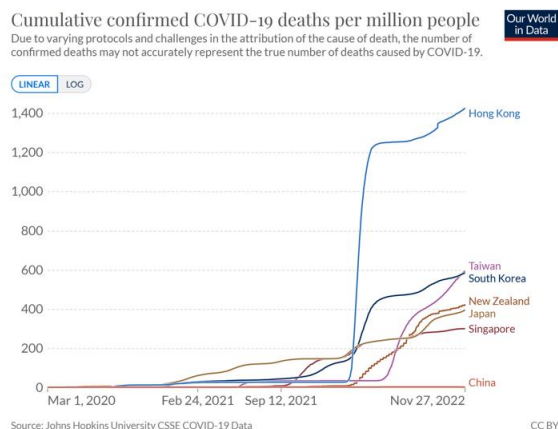
<https://github.com/gerstung-lab/SARS-CoV-2-International>

[illegible]

Scenario 3: A plateau with high epidemic activity. This scenario, which is more pessimistic than the previous one that evoked a succession of waves, envisages that a soup of variants - more than 500 Omicron sub-variants were listed in the world in the autumn of 2022 - would be ready to take over from the previous ones. These variants are even more transmissible, not necessarily more virulent, maintaining a high plateau of COVID-19 activity in most countries of the world, without any real epidemic decline, generating almost permanent pressure on hospitals, and also with a fairly high mortality rate. In 2022, mortality in Europe was found to be 4 to 5 times that of seasonal influenza, placing COVID-19, after three years of pandemic, among the leading causes of death in most of the world where it is measured.

Fourth Scenario (4/4)

When China awakes...



The Economist

Scenario 4: "When China wakes up...". This fourth scenario considers the health, social and economic consequences of the lifting of the "zero Covid" policy by the Chinese authorities on 7 December 2022. Their decision was not the cause of the outbreak in China at the end of 2022, but rather the consequence. Indeed, since the beginning of autumn 2022, locally-based journalists, experts and expatriates have reported an alarming upsurge in the circulation of SARS-CoV-2 in mainland China. The country had previously managed to contain its first wave in Wuhan, and then had not let in the Alpha, Delta and then the assault from the Omicron sub-variants in the early months of 2022. But a highly transmissible Omicron sub-variant, called BF.7, seems to have succeeded in breaking through all the fire-walls of the 'zero Covid' strategy. It was a veritable tsunami that began to spread across the country, especially in Beijing, by the time of the WPC in December 2022. Hong Kong had negotiated its way out of zero Covid with great difficulty, due to the low vaccination rate among its elderly population, which suggested an equally difficult future for the Chinese population, where more than 60% of the over-80s did not appear to have received the three doses of vaccine that would provide sufficient protection against severe forms of COVID-19. There were fears that hospitals would be overcrowded, being less well equipped than in Hong Kong or the West, with ten times fewer intensive care beds than in Germany, for example. There were also fears of high mortality. Some experts, seeking to transpose the Hong Kong figures to China, have cited 1 to 2 million deaths from COVID-19 expected in the coming months. In addition to the health consequences, it is difficult to predict the political and social impacts of this health crisis, but the overall impact of an economy brought to a standstill by major absenteeism could be significant. Among the other unknowns in this scenario is the question of the emergence of new variants, bearing in mind that the immune profile of the population in which COVID-19 is spreading in China is not the same as that of the rest of the world, which is much more immune to the series of waves referred to above. The Chinese population in late 2022 is more similar – in terms of immunity – to the European population in the first two years of the pandemic, when it had not yet been exposed to the virus and the Alpha, Beta, Gamma, Delta and then Omicron variants rapidly emerged. Should we expect the emergence in China of a variant that the WHO will name with a new letter of the Greek alphabet or new sub-variants of Omicron? It is still too early to tell.

- **2020** : Two waves: Surprise, Fears, «Middle Age» response
- **2021** : Two waves, 12 New vaccines, the «Modern Era»
- **2022** : Five waves, pandemic acceleration, pandemic fatigue, politicians move on
- **2023 et après** : How many more waves? Which scenario? Which new variants? Which impact? Which learned lessons?

In conclusion, in the year 2020 there were two waves. It was a year of surprise created by the emergence of a new coronavirus affecting the entire population of the planet. It was also a

year of fear. The response was more or less coordinated, but its contours were necessarily 'medieval'. It was a time of lockdowns, quarantines and curfews.

The year 2021 also saw two pandemic waves. But it was a year of hope, with 12 new vaccines on the global market and promising treatments for the most vulnerable. Most of the world has now moved into a more modern era in the methods of fighting this pandemic.

In 2022 alone, five waves occurred. And yet, President Joe Biden of the United States quietly assured us that the pandemic was over, and the Director-General of the WHO also believed he could see the finish line by the end of the summer. The reality that caught up with us was that the pandemic was not only not over, it was accelerating. The population was showing worrying signs of fatigue, health workers were exhausted. It was increasingly difficult to demand collective or individual protection efforts. Even China, with its authoritarian government, experienced social unrest in the autumn and expressed its deep dissatisfaction with the management of the pandemic.

What will 2023 and beyond be like? How many waves will occur and under what scenario? What will emerge from the "soup" of variants and what will be their impact on the population and the global economy? And finally, what lessons can we learn from the first years of this pandemic? Again, it seems too early to tell.

[...]

Michel Kazatchkine, Special Advisor to the World Health Organization Regional Office for Europe, Senior Fellow at the Global Health Centre of the Graduate Institute for International and Development Studies in Geneva

Maybe before we move to Christian, I would like to ask Antoine to say a few words about the other countries that went into lockdown very early on in the pandemic. Of course, we saw two patterns in the first months of 2020. Countries that had experienced SARS in the past, China, South Korea, Hong Kong, Singapore, Taiwan and to some extent Australia and New Zealand, reacting very fast with strict measures, whereas many others across the world, including in Europe and the US, waited until 10 or 15 March 2020 before they put measures in place. How did the transition and when did that transition to a more liberal system occur in those countries? Then Qiao Yide, maybe you could react, how much could that serve as a model for the transition that you mentioned is now happening in China.

Antoine Flahault

You remember that I mentioned that in March 2022, Hong Kong experienced a huge wave with high mortality. At the same time, New Zealand, Japan, South Korea, Singapore, and Taiwan did not experience such a wave of mortality but like us, they experienced a huge wave of Omicron, Covid-19. They quit their zero-Covid strategy in early 2022, simply because they thought Omicron was mild. They also had a high level of vaccine coverage, more than 80%, like in Europe, so they thought they could now really face the Omicron wave because they had sufficient vaccination. Hong Kong thought that too, but it was not the case due to the low coverage of the elderly, the people over 80.