**////Title: Controlling the Worldwide chaotic Spreading of COVID-19 Through Vaccinations**

**////Stand-first**:

Amid the global COVID-19 pandemic, we face challenges that require innovative and strategic responding. Dr Aldo Bonasera at Texas A&M University in the USA and Laboratori Nazionali del Sud, Istituto Nazionale di Fisica Nucleare in Italy, and Dr Hua Zheng at the School of Physics and Information Technology, Shaanxi Normal University in China, have taken a mathematical approach to compare the current COVID-19 pandemic with the Spanish Flu. Their findings have led to important recommendations for managing the current pandemic through vaccination programmes.

**////Body text:**

The Spanish Flu of 1918 emerged in the aftermath of World War 1. Although the historical data are not complete, we do know that the disease was associated with a devastatingly high mortality rate, particularly within younger age groups. Of particular interest as well as topical concern is the successive waves of the disease, which may have been attributable to seasonal variations but perhaps more plausibly, an evolution of the disease. In the case of the Spanish Flu, this specifically refers to the development of new and increasingly more fatal variants over time.

The World Health Organization declared the coronavirus (COVID-19) outbreak a Public Health Emergency of International Concern on 30th January 2020, and a pandemic on 11th March 2020. The world is still struggling to meet the challenges that COVID-19 is presenting to humanity.

Fortunately, due to tremendous advances in science and medicine over the last century, we are better equipped than ever to understand the spread of potentially fatal viruses. Contributing to this important effort is Dr Aldo Bonasera at Texas A&M University in the USA and Dr Hua Zheng at the School of Physics and Information Technology, Shaanxi Normal University in China.

Taking a mathematical approach, Dr Bonasera and Dr Zheng have created using a logistic map to make comparisons between the Spanish Flu and COVID-19. Logistic maps can be used to model population dynamics, providing a methodology that is applicable not only to understanding the spread of infectious disease, for example, but also other diverse biological systems.

In their recent paper, Dr Bonasera and Dr Zheng describe how in 1918, the world population was about 2 billion, and around 0.8 billion individuals were infected by the Spanish Flu between 1918 and 1920. Of those who were infected, 2% died, giving rise to a catastrophic 16 million deaths worldwide.

Thinking now to the current situation in 2021, the global population is around four times larger, meaning of course, that estimates of infection and death should also be multiplied by four.

But what is different in our current era is the availability of effective vaccination as a preventative strategy against the viral outbreak. Dr Bonasera and Dr Zheng note that as of November 2021, at least 7.3 billion vaccine doses have been administrated worldwide, which means that about 3.65 billion people have been fully vaccinated.

The upshot of this is that the current number of recorded deaths – namely, 5.1 million – is much lower than would have been the case, as predicted by the logistic map, if vaccines had not been made available.

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Dr Bonasera and Dr Zheng argue that these findings underscore the urgency of making vaccines available worldwide, and note that the sooner this is achieved, the more positive the outcomes are likely to be for children and people with medical conditions who cannot be safely vaccinated at the current time. The urgency and necessity of this is compounded by vaccine refusal by some sections of the population.

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Dr Bonasera and Dr Zheng warn that even if widespread vaccination is achieved within an adequate timeframe, a further difficulty would arise with the emergence of new, potentially more threatening, variants of COVID-19. The Delta variant has demonstrated that herd immunity is unlikely to be achieved. Nonetheless, the researchers provide mathematical evidence to support their argument that vaccines are working and, in particular, that the approach used in the UK is the most effective probably due to the initial fast vaccination rate predominantly using the AstraZeneca vaccine. This is particularly relevant since this vaccine is rather cheap to produce and distribute thus affordable for third world countries.

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Dr Bonasera and Dr Zheng’s elegant and complex modelling provides evidence that, as the result of vaccination strategies to date, the probability of death arising from COVID-19 has been largely reduced, affecting almost exclusively those who remain unvaccinated.

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Looking to the future, the researchers remind us of the need to bear in mind the potential loss of vaccine efficacy with time, and the potential need for additional dosing to compensate for this. On this issue, Dr Bonasera and Dr Zheng point to the utility of excluding individuals who can be confirmed to already carry sufficient antibodies via blood testing.

Further work could also usefully consider the effects of different vaccine types to inform the development of additional vaccines to confront new variants of COVID-19 if they emerge.

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Dr Bonasera and Dr Zheng conclude with the observation that testing positive for COVID-19 at some stage is a high probability for each and every one of us. Given this probability, and the proven efficacy of vaccines in dramatically reducing the risk of death, they note the clear necessity of being vaccinated to ensure that we are both ready and able to face – and ultimately – overcome this global challenge. Their findings and recommendations are unchanged even after the occurrence of the new Omicron variant.

This SciPod is a summary of the paper ‘Controlling the Worldwide chaotic Spreading of COVID-19 through Vaccinations’, published in the Journal of Modern Physics. DOI: 10.4236/jmp.2022.131001.

For additional reading, see:

<https://www.frontiersin.org/articles/10.3389/fphy.2020.00171/full> <https://link.springer.com/article/10.1140%2Fepjp%2Fs13360-020-00494-6> <https://link.springer.com/article/10.1140%2Fepjp%2Fs13360-020-00811-z>

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