The questionable impact of population-wide public testing in reducing SARS-CoV-2 infection prevalence in the Slovak Republic

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Abstract

Mina and Andersen, authors of the Perspectives in Science: "COVID-19 Testing: One Size Does Not Fit All" have referred to results and adopted conclusions from recently published governmental report Pavelka et al. “The effectiveness of population wide, rapid antigen test based screening in reducing SARS-CoV-2 infection prevalence in Slovakia” without critical consideration, and rigorous verification. We demonstrate that the authors refer to conclusions that are not supported by experimental data. Further, there is a lack of objective, independent information and studies regarding the widespread, public testing program currently in force in the Slovak Republic. We offer an alternative explanation of observed data as they have been provided by the Slovak Republic government to fill this information gap. We also provide explanations and conclusions that more accurately describe viral spread dynamics. Drawing from available public data and our simple but rigorous analysis, we show that it is not possible to make clear conclusions about any positive impact of the public testing program in the Slovak Republic. In particular, it is not possible to conclude that this testing program forces the curve down for the SARS-CoV-2 virus outbreak. We think that Pavelka et al. did not consider many fundamental phenomena in their proposed computer simulations and data analysis - in particular: the complexity of SARS-CoV-2 virus spread. In complex spatio-temporal dynamical systems, small spatio-temporal fluctuations can dramatically change the dynamics of virus spreading on large scales.

INTRODUCTION:

Mina and Andresen in the paper [1] refer to mathematical models that incorporate relevant variation in viral loads and test accuracy [2]. On that basis, they

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suggest that - with frequent, large-scale sampling of a population - detection of herd effects was possible. The authors referred to the public testing currently in effect in the Slovak Republic. Unfortunately, they have adopted research conclusions that are not supported by appropriate mathematical models, which require additional variables and factors. Further, the authors of the initial report have not rigorously compared the results with actual measurement data from the Slovak Republic over a longer term window, i.e. a few weeks before and after public-wide testing (31. October - 1. November 2020). Our independent and simple analysis of WHO available global data from Slovak Republic (S1) shows quite the opposite effect and throws into doubt the conclusions the authors.

RESULTS:
We have analyzed the scaling properties of daily count $i(t)$ as well as cumulative count $I(t)$ of infected cases where $t$ is time in days during the first and second SARS-CoV-2 virus waves. Our results Figure 1 show scaling properties of $i(t) \sim t^{\pm \beta}$, $I(t) \sim t^\alpha$ where $\alpha$ and $\beta$ are scaling exponents. Double logarithmic scales Figure 1 are much more suitable to demonstrate scaling properties and to identify significant changes of virus spread dynamics, for example to recognize outbreak waves as well as the dynamics of outbreak growth and decay during a time of the wave.

A power law decay of daily count of infected cases $i(t) \sim t^{-\beta}$ shows that a decay of outbreak follows a slow dynamics and can take a long time depending on both an exponent $\beta$ and a number of daily infected cases $N$ in tipping point of daily count of infected cases $i(t)$ (in a preparation to publish).

We have analyzed only one component of mobility Figure 2 (S2): retail and recreation, that carries important information about the effectiveness of public policy measures i.e. demonstrating that these measures decrease average mobility and therefore the average number of daily personal contacts.

In Figure 1 we can identify in these neighbor countries a common tipping point of daily count of infected cases $i(t)$ on 1. November 2020. We compare a temporal evolution of a retail mobility Figure 2 (A) and rescaled daily count of infected cases Figure 2 (B) in Czech Republic and Slovak Republic). You can see common features of retail mobility and daily count of infected cases before the tipping point and quit different features of mobility as well as daily count of infected cases subsequent the tipping point. Retail mobility Figure 2 (A) and daily count of infected cases Figure 2 (B) clearly demonstrate that, if countries applied similar public policy measures to decrease mobility, that the dynamic of virus spread has similarly decayed in both countries. After public-wide testing in the Slovak Republic (31. October-1. November 2020), mobility dynamics Figure 2 (A) as well as rescaled daily count of infected cases Figure 2 (B) dramatically changed in the Slovak Republic. The rescaled daily count of infected cases in Slovak Republic shows a much more higher daily count of infected cases as when both countries shared similar public policy measures to control low mobility.

DISCUSSION:
Our criticism is focused on the work of Pavelka et al. We think that
Figure 1: Scaling properties of cumulative count $I(t) \sim t^\alpha$ and daily count of infected cases $i(t) \sim t^{\pm \beta}$ in (A) Czech Republic and in (B) Slovak Republic, time $t$ is measured from 3. January 2020 (S1).
Figure 2: (A) Community Mobility Reports in the Czech Republic and Slovak Republic provided by Google (S2). (B) Linear-linear plot of rescaled daily count of infected cases $i(t)$ in the Czech Republic and Slovak Republic. Time $t$ is measured from 1. September 2020 (S2).
Pavelka et al. [3] made several conceptual mistakes during their analysis of available data and their assumptions regarding governmental public policy measures. Most egregiously, they did not discuss the potential effects of false negative results in that report [3]. SD Biosensor claims that a combined negative agreement with PCR tests is 99.7% (see the company data sheet regarding tests results in Switzerland). Based on data provided by the authors [3] and SD Biosensors, we estimate 15600 false negative tests (i.e. the infected cases that were falsely evaluated as negative cases). Shortly after the public testing phase, the Slovak Republic government permitted the free movement of tested persons Figure 2 (A), while it has drastically restricted the free movement of healthy persons that opted to not participate in the public testing program.

This increase in mobility of tested population (Figure 2 (A)) - including persons who have false negative test results - would logically suggest an uncontrolled increase of infection in all regions of the Slovak Republic within the following 7-14 days after testing. This has now been confirmed by publicly available data Figure 1 (B) and Figure 2 (B). We note that it is necessary to consider the long incubation period of SARS-COV-2 virus and the average time when first syndromes could occur [5]. The authors [3] have not discussed the important impacts of other measures that were applied before public testing began, for example a decrease in mobility - very similar to that experienced in Czech Republic and Slovak Republic Figure 2 (A) who share the same tipping point of daily count of infected cases at 1. November 2020 Figures 1 (A), (B), and 2 (B). We note that, at this tipping point, the reproductive number has been $R < 1$ and public testing program in the Slovak Republic had been started. Importantly, the author’s computer simulations [3] did not take into account the influx of new infected cases from abroad due to periodic - and massive - migration of work forces between the Slovak Republic, Czech Republic and other countries.

The history of the SARS-CoV-2 outbreak in the Czech Republic and Slovak Republic - prior to the Slovak’s Republic testing program Figures 1 (A), (B), and 2 (B) - show that these countries were strongly coupled, with similar daily counts of infections and similarly decreasing infection trends due to low-mobility and other important public-policy measures taken in the Slovak Republic and neighboring countries. Subsequent to the "tipping point", the decreasing trend in daily infections in the Slovak Republic virtually stopped within a few days. Daily count of infected cases Figure 2 (B) started again to increase. This is in contrast to the situation in the Czech Republic Figures 1 (A), (B) and 2 (B). This directly demonstrates that the public testing program has not had any positive effect on daily infection rates. We show in Figure 2 (B), that public testing - in an environment where tests are not precise and there is a relative high mobility of tested persons (many with false negative test results) - can initiate new outbreaks. Our interpretation of available data is entirely contrary to the interpretations and conclusions as presented in [3] and uncritically adopted by other authors [1]. We are confident that our conclusions are well supported by other authors who have investigated the SARS outbreak and mathematically investigated the impacts of quarantine and other public-policy measures in the
past \cite{6}. These authors concluded that quarantine appears to have formed the most effective basis for control in several countries and should be equally effective on a smaller scale, likely contributing to the prevention of major outbreaks in other countries. On the other hand, in the absence of such effective measures, SARS has the potential to spread very widely. Considerable effort will be necessary to implement such measures in those settings where transmission is ongoing, but such efforts are essential to quell local outbreaks and reduce the risk of further global dissemination \cite{6}. We think that in the context of large scale populations, it is very difficult to control the effectiveness of wide public quarantine (personal remark: i.e. without drastic violation of human rights) due to the complexity of virus spread as well as of personal contact interactions \cite{4}.

**CONCLUSIONS:**

We believe that a detailed and correct analysis of SARS-CoV-2 virus spread in the Czech and Slovak Republics is very important and could be useful for a better understanding of dynamic of SARS-CoV-2 outbreak. Both the Czech Republic and Slovak Republic have been successful in stopping the first wave of SARS-CoV-2 outbreak Figure 1. On the other hand, the countries have not be able to smoothly manage the second wave. The current approaches to manage the outbreak in these countries are quite different. In the case of the Czech Republic, the main tools are to limit mobility and increase testing, while the Slovak Republic engages in a model of very intensive and frequent testing virtually everywhere \cite{2,3} with a relative high mobility allowed in tested populations. Since the tipping point (1. November 2020), the data does not support any positive impact of this approach in the Slovak Republic Figure 2 (B). We think that this is due to the complexity of virus spread, rapid and uncoordinated shifts in public policy, non-optimal communication with citizens and a very low effectiveness of quarantine control on large scales \cite{6}.

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**Supplementary materials**

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