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Comment on “Poorly known aspects of flattening the curve of COVID-19”

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ABSTRACT

This short research note describes and summarizes several recent peer-reviewed and non-peer-reviewed studies on the concept of flattening-the-curve (FTC) in the context of the COVID-19 pandemic. This note also highlights contradictory findings of these studies in terms of the effect of FTC on the total number of infections (the final epidemic size), and poses a research problem for future studies.

In the fight against COVID-19 pandemic, the phrase “Flattening the curve” (FTC) has become a rallying cry and entered our collective consciousness. The aim of FTC is to slow down the outbreak and win us time to improve the healthcare system. However, there is a common misunderstanding of the effect of FTC on the final epidemic size. It is often claimed that the total number of infections (or the final epidemic size) will remain the same, as exemplified in the following two analogies, which can be found in the news outlet or on the social media.

Your workplace bathroom has only so many stalls. If everyone decides to go to the restroom but spread over several hours, it’s all ok (Bergquist, Mar 11, 2020).

Think of the health care system capacity as a subway car that can only hold so many people at once. During rush hour, that capacity is not enough to handle the demand, so people must wait on the platform for their turn to ride. Staggering work hours diminishes the rush hour and increases the likelihood that you will get on the train and maybe even get a seat (Roberts, Mar 27, 2020).

In a recent article published in this journal, Debecker and Modis claim that FTC results in an increase in the total number of infections and possibly the total number of deaths too (Debecker and Modis, 2021). They established correlations between the parameters of the logistic equation, namely the level of the final ceiling (the niche capacity) and the rate of growth (the slope α).

However, other studies (two peer-reviewed and three non-peer-reviewed) claimed that FTC would actually reduce the final epidemic size to a certain degree (Gizler and Sobhanzadeh, 2021). Cooper et al. (Cooper et al., 2020) simulated an augmented classic Susceptible-Infected-Removed (SIR) model and showed that the implementation of intervention measures can reduce the final epidemic size. Höhle used a SIR model to show that the drastic reduction of contacts or isolations will produce a 17% decrease in the total number of infections (Höhle, Mar 16, 2020). Bolker and Dushoff used a SIR model with a doubling time of 6 days and a maximum basic reproduction number of 2.5 to illustrate how a reduction in transmission will produce an 11% decrease in the total number of infections (Bolker and Dushoff, Mar 15, 2020). Feng et al. simulated a Susceptible-Exposed-Infected-Recovered-Dead (SEIRD) model and showed that FTC will decrease the final epidemic size (Feng et al., 2020). The authors claimed the total number of infections will only remain the same if the mean interval between being infected and infecting others, or generation time is changed. They found that physical distancing produces up to 31% decrease in the final epidemic size. Churches and Jorn (Churches and Jorn, Mar 24, 2020) used a stochastic individual contact model and showed that the strong public health actions, such as intensive case-finding and strictly enforcing isolation and quarantine, will result in fewer COVID-19 infections and deaths by around 1/3. The details of these studies are summarized in Table 1.

Furthermore, Bergstrom claimed that the notion that FTC will not reduce the epidemic size is a very basic fallacy about the effect of FTC (Bergstrom, Mar 22, 2020). He tweets:

Almost *any* reasonable epidemiological model you use, from SIR to all sorts of fancy spatial PDE or agent-based approaches, will show that decreasing transmission rate decreases total epidemic size.

Therefore, a further study is required to explain the difference in the findings and determine whether (and under what conditions) FTC will actually increase or decrease the final epidemic size. It is important because the correct conclusion may have practical implications and will contribute greatly to informing policy. If it is true that FTC will increase
the final epidemic size, it will raise another complicated optimization problem for further studies, as suggested by the authors.

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Table 1

Summary of the studies which found that FTC will reduce the final epidemic size.

| No | Status       | Authors & Year | Methodology | Effect on the final epidemic size |
|----|--------------|----------------|-------------|-----------------------------------|
| 1  | Peer-reviewed | Cooper et al., 2020 | Augmented SIR model | reduced                           |
| 2  |              | Feng et al., 2020 | SEIRD model  | up to 31% decrease                |
| 3  | Non-peer-reviewed | Höhle, 2020 | SIR model | 17% decrease                      |
| 4  |              | Bolker & Dushoff, 2020 | SIR model | 11% decrease                      |
| 5  |              | Churches & Jorm, 2020 | Stochastic individual model | about 1/3 decrease               |