New Journal of Physics
The open access journal at the forefront of physics

Deutsche Physikalische Gesellschaft DPG
IOP Institute of Physics

Published in partnership with: Deutsche Physikalische Gesellschaft and the Institute of Physics

OPEN ACCESS

RECEIVED
3 January 2021

REVISED
18 March 2021

ACCEPTED FOR PUBLICATION
1 April 2021

PUBLISHED
20 April 2021

PAPER

Community lockdowns in social networks hardly mitigate epidemic spreading

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Keywords: complex system, social network, epidemics, communities, cooperation, lockdown

Supplementary material for this article is available online

Abstract

Community lockdowns and travel restrictions are commonly employed to decelerate epidemic spreading. We here use a stochastic susceptible-infectious-recovered model on different social networks to determine when and to what degree such lockdowns are likely to be effective. Our research shows that community lockdowns are effective only if the links outside of the communities are virtually completely sealed off. The benefits of targeting specifically these links, as opposed to links uniformly at random across the whole network, are inferable only beyond 90% lockdown effectiveness. And even then the peak of the infected curve decreases by only 20% and its onset is delayed by a factor of 1.5. This holds for static and temporal social networks, regardless of their size and structural particularities. Networks derived from cell phone location data and online location-based social platforms yield the same results as a large family of hyperbolic geometric network models where characteristic path lengths, clustering, and community structure can be arbitrarily adjusted. The complex connectedness of modern human societies, which enables the ease of global communication and the lightning speeds at which news and information spread, thus makes it very difficult to halt epidemic spreading with top-down measures. We therefore emphasize the outstanding importance of endogenous self-isolation and social distancing for successfully arresting epidemic spreading.

1. Introduction

The structure of social networks critically affects epidemic spreading [1, 2]. Research has shown that properties that are universally associated with social networks, such as small characteristic path lengths, high clustering [3], and broad-scale degree distributions [4], often work together to provide an environment where epidemics spread fast and virtually uninhibited across the population [5–11]. This spreading is often accelerated further by the temporal component of social networks [12], where traveling and mobility, in particular, play an important role [13–20]. Furthermore, social networks exhibit strong community structure [21], which has not only proven to importantly and in a non-trivial way affect the epidemic spreading [22–26], but has also implications for how networks can be protected from major outbreaks [27].

However, the structure of social networks also affects many other aspects of our behavior, especially how we interact and perceive others. We do not simply strive to amass the greatest amounts of conveniences with the least possible effort as 'economic man' would, but because we are connected to others in intricate ways, we often sideline our inherent self-interest and take their wellbeing into account as 'network man' would