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Fighting Pandemics with Physical Distancing Management Technologies

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ABSTRACT

As COVID-19 continues to wreak havoc in everyday lives, the need to limit the spread of the virus remains a challenge, even with advances in medical knowledge, patient care, and vaccine development and distribution. Furthermore, COVID-19 is one in a recent series of airborne diseases, and probably not the last, given the ongoing encroachment of humans into animal habitat. This paper addresses the challenge of managing physical distancing, a highly effective, yet unnatural and contentious, mitigation strategy against infectious diseases. It presents a Pandemic Tech Stack and proposes that physical distancing management technologies are underutilized to fight pandemics. The latter can help ensure that people remain apart when they need to, support the transfer of activities to an online format, and, ultimately, facilitate the gradual reopening of our economies. The challenges associated with the development and use of these technologies are identified and discussed from both the technical and socio-psychological perspectives.

KEYWORDS

App, Coronavirus, COVID-19, Isolation, Physical Containment, Physical Distancing, Post-COVID-19 Era, Pre-COVID-19 Era, Tracing, Virus Containment

1. INTRODUCTION

COVID-19, the infectious disease caused by SARS-CoV-2 virus, has shaken the world. The severe acute respiratory syndrome coronavirus (SARS-CoV-2) is a virus of a "perfect storm," because it has shown to be capable of spreading from animals to humans (e.g., bats to humans) and vice versa (e.g., humans to minks) (Munnick et al. 2020). Officially characterized as a pandemic by the World Health Organization in March 2020 (WHO 2020), the disease remains rampant, taking away more and more lives while deepening social and economic hardships. Coronaviruses, present in bats and other animals, are capable of making new versions of themselves while trying to infect new hosts, including humans (Haseltine, 2020; Munnink et al. 2020; O'Leary, 2020).

The rapid spread of COVID-19 cases, and associated deaths, have triggered global containment and mitigation measures (e.g., government mandated shut-downs), as well as the large-scale adoption of infection prevention practices in efforts to "flatten the curve" (Anderson et al. 2020; OECD 2020a). Governments committed billions of dollars to medical research in a frantic effort to develop, produce, and deliver vaccines. The potential benefits from these efforts are now being reported, as the wide-spread distribution of vaccinations becomes a reality. However, the virus has continued to mutate into

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genetic variants (Lauring and Hodcroft 2021), so considerable time might elapse before effective, durable herd immunity is realized (Edridge et al., 2020; Randolph and Barreiro 2020).

Even more troubling is the fact that COVID-19 is one in a recent series of airborne diseases. It is probably not the last one, given the ongoing encroachment of humans into animal habitat (Plowright et al. 2017). In fact, just two years prior to the onset of COVID-19, the scientific journal *Nature Reviews Microbiology* published an article with this ominous question: "Are we prepared against the next influenza pandemic?" (Medina 2018). The article observed the increase in the number of viruses that jumped from animals to humans, asserting that a major pandemic was a real possibility. Scientists estimate that approximately 1200 viruses have the potential to create other pandemics (Baumgartner and Rainey 2020; O'Leary, 2020).

It is, thus, very likely that the infection prevention practices that have become part of our daily habits during the COVID-19 crisis (e.g., mask-wearing, tele working, hand hygiene, physical distancing) are likely to remain relevant. This is especially so as health and socio-economic systems transition to a "new normal" and become better prepared for future pandemics (Kasai 2020). Among the above-mentioned practices, physical distancing is currently the best available mechanism to slow the pace of disease transmission within communities and is especially important for highly contagious and deadly viruses such as COVID-19 (Chu et al. 2020). Physical distancing measures have been defined and executed heterogeneously across countries, but, in essence, they all aim at reducing the frequency of physical contacts and the contact distances between people during an infectious disease outbreak (Kelso et al. 2009). Physical distancing could appear to have all desirable attributes of a pandemic management tool: theoretically effective, easy and inexpensive to deploy. However, in practice, it has proven fallible and contentious (Baum et al. 2020; Jonaitis 2020; Marlow and Hong 2020). Furthermore, arguably no digital technology has managed to successfully address this critical issue yet.

The goal of this paper is to highlight the opportunities and challenges associated with the development, acceptance, and effective use of physical distancing management technologies. We define physical distancing management technologies (PDMT) *as a constellation of platforms, apps, websites, data analysis algorithms and analytics tools used to encourage, facilitate, monitor, or enforce physical distancing among humans*. The main application of PDMT is to combat contagious disease outbreaks, such as that of COVID-19. This is a type of technology which holds especial promise in the fight against COVID-19, and other contagious diseases, but so far, remains underutilized.

The information systems community has an important role to play in investigating the various ways digital technologies can be designed and used to prevent, mitigate, and cope with a pandemic (Ågerfalk et al. 2020; French et al. 2021; O'Leary, 2020; Shiau et al. 2021). We focus specifically on the use of information technology for physical distancing for two main reasons. First, physical distancing has a high potential to help address the *immediate* needs associated with reopening the economies shut down by the COVID-19 crisis and can support our *preparedness* in coping with future pandemics. Second, it is yet unclear how digital technology, as powerful as they are, can help communities manage a seemingly paradoxical situation: how to adhere to physical distancing practices while maintaining social closeness and solidarity (ECDC, 2020). Thus, PDMT requires a nuanced analysis accounting for the fact that, in the end, its true effectiveness may rely on its ability to keep people apart, while facilitating safe and responsible social interactions.

In the remainder of this paper, we present what we call the *Pandemic Tech Stack* to emphasize the far-reaching potential of digital technologies to assist in coping with pandemics. We then depict the nature and challenges of physical distancing and specify the key characteristics of PDMT and their specific applications. Doing so provides a foundation for identifying the challenges of PDMT and future research directions.