COVID-19 MITIGATION BY DIGITAL CONTACT TRACING AND CONTACT PREVENTION

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ABSTRACT

A plethora of measures are being combined in the attempt to reduce SARS-CoV-2 spread. Due to its sustainability, contact tracing is one of the most frequently applied interventions worldwide, albeit with mixed results. We evaluate the performance of digital contact tracing for different infection detection rates and response time delays. We also introduce and analyze a novel strategy we call contact prevention, which emits high exposure warnings to smartphone users according to Bluetooth-based contact counting. We model the effect of both strategies on transmission dynamics in SERIA, an agent-based simulation platform that implements population-dependent statistical distributions. Results show that contact prevention remains effective in scenarios with high diagnostic/response time delays and low infection detection rates, which greatly impair the effect of traditional contact tracing strategies. Contact prevention could play a significant role in pandemic mitigation, especially in developing countries where diagnostic and tracing capabilities are inadequate. Contact prevention could thus sustainably reduce the propagation of respiratory viruses while relying on available technology, respecting data privacy, and most importantly, promoting community-based awareness and social responsibility. Depending on infection detection and app adoption rates, applying a combination of digital contact tracing and contact prevention could reduce pandemic-related mortality by 20–56%.

INTRODUCTION

The COVID-19 pandemic has challenged health authorities around the world since December 2019. Many governments immediately implemented physical distancing and self-isolation measures, ranging from simple “stay-at-home” recommendations to strict lock-downs1. Although straightforward, fast and effective in controlling the propagation of the virus, rigorous lock-downs are emergency measures which imply profound economical and social consequences, and cannot be sustained over long periods of time, specially in underdeveloped and developing countries. Sustainable and widely applied nonpharmaceutical interventions such as effectively communicating prevention measures, cancellation of large-scale public gatherings, widespread/mandatory mask utilization, and travel restrictions have proved to be insufficient to contain viral spread in many countries2. In this context, Contact Tracing (CT) has been extensively used to attempt to control outbreaks3 by identifying and isolating close contacts of diagnosed patients as soon as possible, to prevent further transmission. However, the efficiency of the approach in diminishing COVID-19 propagation strictly depends on how quickly, broadly, and accurately the contact tracing process is4. In particular, it is crucial to minimize delays in diagnostics, contact determination and detection, as well as the subsequent isolation of all possibly infected individuals5. This argues in favor of so-called digital CT, where smartphones automatically store and report contact information3 using mainly Bluetooth Low Energy (BLE) technology for proximity detection between devices6. The effectiveness of CT has been enhanced by embracing this technology in several countries7,8,9, although not free of data privacy concerns, among other controversies10,11. Both manual and digital CT evidenced a common disadvantage intrinsic to the very nature of this reactive strategy: it depends largely on the percentage of infected individuals which are successfully and quickly diagnosed with COVID-19. However, this issue has been scarcely documented and noted by the community, even though infection detection rates are estimated to be below 12% for most countries, and 16% or less even for developed countries such as the United States of America, Canada, China, Sweden and The United Kingdom12. Accordingly, an analysis for the city of New York estimates an Infection Detection Rate (IDR) of 15–20%13. Undetected infections are a key characteristic of the COVID-19 pandemic that severely impacts CT strategies, as no contact tracing is possible without diagnosis, which is most generally triggered by symptom onset. We argue this CT limitation is the main reason for observing satisfactory results only when combined with other policies such as detection and isolation via enhanced/random testing or contact avoidance via household quarantine14. In this work, we analyze the impact of different IDRs and time delays on the effectiveness of CT. With the aim of reducing the dependency on these factors, while improving data privacy, we introduce community-based Contact Prevention (CP). CP is a novel strategy that attempts to diminish viral transmission by warning users from infection risks due to their current social activity. To quantitatively assess CT and CP in realistic COVID-19 scenarios, a detailed COVID-19 simulation model based on agents, which we named SERIA, is presented. This model leverages several COVID-19 statistical distributions such as social and household contact profiles, IDRs, population age, viral latency period, and fatality rates. We then evaluate and compare the effect of CP and CT strategies on final epidemic size (FES) and mortality (deceased agents as a percentage of the total simulated population).

EXISTING SYSTEM

- Reopening schools is an urgent priority as the COVID-19 pandemic drags on. To explore the risks associated with returning to in-person learning and the value of mitigation measures, we developed stochastic, network-based models of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission in primary and secondary schools.
- The existing system find that a number of mitigation measures, alone or in concert, may reduce risk to acceptable levels. Student cohorting, in which students are divided into two separate populations that attend in-person classes on alternating schedules, can reduce both the likelihood and the size of outbreaks. Proactive testing of teachers and staff can help catch introductions early, before they spread widely through the school. In secondary schools, where the students are more susceptible to infection and have different patterns of social interaction, control is more difficult.
- Especially in these settings, planners should also consider testing students once or twice weekly. Vaccinating teachers and staff protects these individuals and may have a protective effect on students as well. Other mitigations, including mask wearing, social distancing, and increased ventilation, remain a crucial component of any reopening plan.

DISADVANTAGES

1) . There is no Digital contact tracing (DCT) which is a new and valuable technology based on mobile applications to understand the routes and timings of transmission.

2). There is no Transmissibility of Different Infection Models.

PROPOSED SYSTEM

- Digital contact tracing (DCT) is a new and valuable technology based on mobile applications to understand the routes and timings of transmission [28]. Tracing devices, e.g., mobile phones or RFID, can log their mobility or close contacts with other devices so that wearers can monitor their virus exposure in a timely fashion [29]. Many governments have used smartphone contact tracing apps to automate the difficult task of tracing all recent contacts of newly identified infected individuals [30]. Researchers have verified the effectiveness of DCT by constructing a contact network of 115 students at a certain university [31] or setting a model of individual-level transmission based on 40 162 participants [32].

- At present, there are few DCT studies on the cluster environment, and considering the easiness of technology adoption, this method can potentially provide a cost-effective solution to early detection, case isolation, and outbreak prevention of COVID-19 in certain environments where the population density is high, such as on campus.
- In this study, the system examines the effectiveness and cost of several mitigation strategies on campus, including the ones that utilize the newly proposed DCT technology. The effectiveness is measured by the number of infected students and the cost of the quarantined students. Compared with traditional suspension and closure methods, the DCT-based quarantine strategy can control disease-spreading much more efficiently. Necessary conditions for ensuring the DCT-based strategy's effectiveness and possible auxiliary strategies that provide further enhancement are also explored, including the social distancing strategy, the DCT device adoption rate, the influence of community infections, and the asymptomatic infections in the population. The results obtained from this study are expected to significantly impact the making of school policies in the post-pandemic era.

ADVANTAGES

- The system more effective due to Quarantine Strategy Based on Digital Contact Tracing techniques.
- The gives accurate results due to presence of Epidemic Model With Variable Infection Rate.

MODULES

SERVICE PROVIDER

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as

Train & View Mitigating COVID19 Transmission, Find Mitigation of COVID19 Transmission Ratio, View All COVID19 Transmission Prediction, Download Trained Data Sets, View All Remote Users, View Mitigation of COVID19 Transmission Ratio Results, View Mitigation of COVID19 Transmission Ratio in Bar Charts, View School Children Oxigen Results,Remote User.

VIEW AND AUTHORIZE USERS

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

REMOTE USER

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like POST SCHOLL DATA SETS, PREDICT MITIGATION OF COVID19 STATUS, VIEW YOUR PROFILE.

CONCLUSIONS

DCT with wearable hardware is a new and effective epidemic mitigation strategy that could be used to fight against highly infectious diseases, such as COVID-19. In this study, we proposed to examine its effectiveness and cost, quantified by the numbers of infections and quarantined individuals, respectively, in controlling disease spreading on campus. Two empirical high-resolution on-campus interpersonal close contact data sets and a modified SEIR model with a variable infection rate setting are employed to simulate epidemics. Compared to traditional mitigation strategies, such as the closure of classes, grades, and the whole school, the DCT quarantine strategy can achieve a similar effect as more rigid strategies but with a much smaller cost. Several factors can strongly affect the mitigation effectiveness of the DCT-based strategy. First when the probability of asymptomatic is high, the prevention and control effects of various strategies will be weakened as they can transmit the disease for an extended period than symptomatic infections, who are isolated as soon as they show any symptom. Second, community-introduced infections can jeopardize the efforts made by any mitigation strategy. Third, the adoption rate of teachers and students profoundly affects the effectiveness of the DCT-based strategy. Fourth, social distancing can help with the mitigation strategy and further increase its effectiveness.

In light of the above results, we make the following recommendations to the on-campus mitigation of COVID-19. First, a DCT-based strategy is encouraged in schools. Second, the strategy's adoption rate must be monitored and assured continuously. Third, whenever an infection is detected on campus, rigid virus testings must be carried out to a larger extent of the population for asymptomatic or community introduced case discovery. Fourth, social distancing measures must be placed in schools to minimize the probability of disease spreading.

Note that the density of the primary school empirical contact network is much higher than that in the high school. Although the contact data are collected from two individual schools in a particular period, we argue that this phenomenon can be universal, as pupils in primary schools are more physical activity-intensive (i.e., having more physical contacts) than students in the high schools, who are in contrast more academic activity-intensive. Therefore, we warn that primary schools have a higher risk than high schools in disease transmission, thereby less suitable for pushing school reopens.

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