BITS :: Call for Abstracts 2021 - Oral communication

Type	Oral communication
Session	Bioinformatics challenges in the SARS-Cov-2/COVID-19 pandemic
Title	SARS-CoV-2 does not go to school. An agent-based model to support infection control strategies at school.
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Motivation

Despite the availability of vaccines, the uprising of several new variants of the pathogen responsible for the SARS-CoV-2 pandemic and the uncertainty of the immunity duration mark the need for developing protocols to handle the future coexistence with the SARS-CoV-2. Specifically, the protocols need to develop strategies to keep socio-economic activities running safely by minimising the risk of infection.
In our highly connected society isolating a single socio-economic activity might compromise the dynamics defining the activity itself. Following this line, activities prone to be studied in isolation are the ones that involve long-term social interaction, such as the ones occurring in offices and schools. With the current study, we are interested in evaluating the risk of infections associated with schools' activities and the possible control strategies, guaranteeing students their right to get an education.

Methods

We propose an Agent-Based Modelling and Simulation approach for studying and evaluating the risk of infection and its control within a scholastic environment.
The main idea is to develop an indicator ascribable to the population reproduction number (Rt), summarising the effects of the scholastic activities on the infection dynamic in a school. Thus, we propose the School's Multiplicative Factor (SMF), which can be easily formulated by computing the number of newly infected students generated in one day divided by the total number of infected students being at school that day, to evaluate whether the school becomes a hub for the infection or not. Keeping the school neutral to the spreading of the infection requires the implementation of some countermeasures, and the SMF is a fundamental indicator to compare and evaluate protocols for infection containment.
First of all, we evaluate the impact of one infected student entering a school including only susceptible individuals, assuming the scholastic personnel is immune to the infection. This hypothetical scenario is useful to evaluate how the school system behaves in terms of virus transmission in presence of one infected subject and different control strategies. Then, we investigate how the dynamics inside the school interact with the diffusion process, in the long run, simulating the infects daily arrivals into the school as a stochastic process. This analysis reflects a more realistic scenario, useful to understand what are the necessary conditions for the school's activities to keep running. That is, for a given containment protocol, what is the sustainable flow of daily infected individuals without the school becoming a hub for the infection's diffusion?

Results

In this section, we focus on a specific policy adopted in schools in Piedmont, Italy. This screening policy foresees to test every participant once a month. In each class, participants are divided into four groups, and for each week in a month, one different group is tested. Since participation in the screening campaign is voluntary, we analyse several proportions of participation and a base scenario not implementing the screening. It is worth noticing that in all the experiments, a testing process takes place also outside of the school, modelling the effects of external surveillance. Fig. 1-a) shows the cumulative number of infected individuals generated in one month and the screening detection error, given the initial condition of one infected student. Fig. 1-c) and 1-d) present two different metrics computed, the SMF and the average time before infection detection, respectively. One relevant aspect of Fig. 1 is that even if the participation ratio is low, the screening reduces the number of infected individuals at the end of the month. Furthermore, it is worth noting that this screening policy reduces the average number of days necessary to unveil the outbreak in the school. Reducing the days of exposure of a student directly reflects on the risk to its family, providing indirect protection to the overall population.

Info

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Figure

Availability	https://drive.google.com/file/d/1sp53mrjIz53KzLMKMVIM3k8nBIG3KtOl/view?usp=sharing

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