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Responding to a school SARS-CoV-2 outbreak: Insights and policy implications emerging from the pandemic

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Abstract

Background. *The SARS-CoV-2 pandemic has affected also the school environment. Prolonged closures and the weakness of available data prevent a definitive answer to the question of school transmission. We report our experience of responding to COVID-19 cases in the school setting, presenting a case study of the management of an outbreak in a large school.*

Methods. *The LHA/ASL Roma 1 has organized the School Units with a structure firmly rooted in the territory. At the local level, the District Unit mainly manages the relationship with schools, while the Hygiene and Public Health Service of the Prevention Department holds a coordinating and facilitating role. The HPHS carries out contact tracing activities facilitated by the schools, through the figure of the COVID-19 Contact Person, who is specifically trained to manage the preliminary stages of the reports.*

Results. *Following several reports of COVID-19 suspect cases from two schools and, after a complex phase of contact tracing, it was possible to identify the major transmission chains. Furthermore, we performed a population-based screening on the entire school. Beyond the known transmission chains, for which quarantine was already in place, only five additional cases emerged, all asymptomatic, out of 1,231 swabs tested with RT-PCR.*

Conclusions. *Our experience confirms that an active interaction between the school and the School Unit made it possible to quickly control a potentially dangerous outbreak. The large-scale screening test demonstrated the substantial absence of collateral transmission chains. Effective contact tracing allowed to set forth a successful response. Our model of intervention can be used to support public health protocols regarding school outbreaks.*

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Introduction

Schools involve most of the young population (6-18 y), in permanent close contact with one another and are settings where infectious diseases can spread quickly. An outbreak can quickly lead to school closures and cause considerable disruptions for the school community (1). Effective responses are essential not only because of the size of the population at risk but also because of the potential spread of infection into families and the whole community. Furthermore, well-timed interventions can reduce the psychological impact on children and adolescents.

For the past twenty years, the focus of infectious disease surveillance and control in Italian schools gravitated mostly around measles, tuberculosis, and gastrointestinal disease outbreaks (2-4). Well-established guidelines and interventions were available to Local Health Authorities (LHAs, or, in Italian, *Aziende Sanitarie Locali,* ASL). According to the Italian NHS, the direct responsibility of fighting infectious diseases in school is up to the Department of Prevention, present in every LHA/ASL, which acts through one of its Services, the Hygiene and Public Health Service (HPHS, from the Italian *Servizio di Igiene e Sanità Pubblica - SISP*).

Not since World War II had schools faced generalized closures until March 2020. When the COVID-19 pandemic escalated in Italy, cases and deaths increased in such an extreme way that the Government "locked down" the whole country. National lockdown continued until May, after which there was a gradual reopening of several activities, but not schools. Students – put to distant learning - waited until the second half of September 2020 to return. However, attendance was not continuous, older students were sent back to partial distance learning soon after. Regions applied containment measures according to the number of cases, with worsening conditions resulting in additional school closures. Although the scientific debate is ongoing about the effectiveness of school closures on reduction of virus transmission, long-term school closures have implied by sure detrimental social and health consequences for students and families (5, 6).

Furthermore, emerging Sars-Cov-2 variants, and the lack of knowledge about their potential impact in the school setting after they have been reopened, posed an additional obstacle to in-person learning. During the period under review, there was little local knowledge of the prevalence of variants of SARS-CoV-2. The Ministry of Health had issued a policy report on 31/01/21 (6) with regulatory value, which provided very stringent indications regarding the containment of the diffusion of variants. However, this report did not address the school environment specifically and, in fact, its literal application required the entire school complex to be closed pending the results of molecular tests. At the time, the only scientific evidence available concerned the greater diffusivity of the Alpha variant, and the greater severity of the pathology regarding the Lineage P1 variant, also known as the Gamma variant (7-9).

To mitigate the negative effects of school closures, the Lazio Region decided that every LHA/ASL establish the so called *anti-Covid Schools Units*, responsible for managing SARS CoV-2 cases and outbreaks following guidelines formulated jointly by the ad hoc National Covid-19 Scientific Technical Committee (CTS) and the Italian National Institute of Health, INIH (Istituto Superiore di Sanità, ISS). Every Unit is composed of medical specialists (Public Health and Infectious Diseases), nurses, prevention technicians, and health assistants. Under the responsibility of the HPHS of the Prevention Department, it operates in each of the Districts, the territorial declination of the LHAs/ASL that provide first level services to specific community areas. In addition, each school nominates a *COVID-19 Contact*

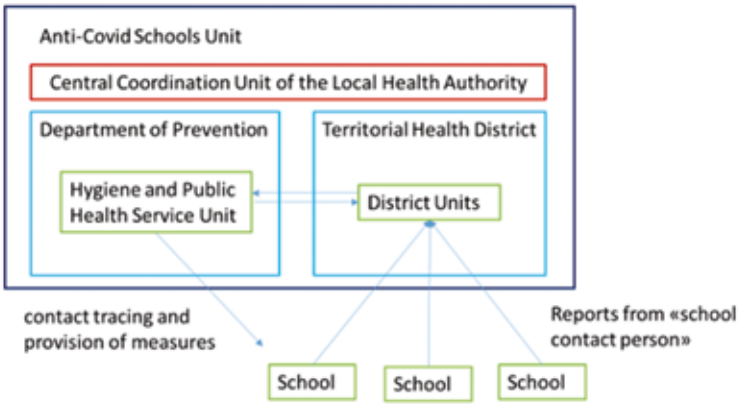

Figure 1 - Organization scheme of the Anti-COVID Schools Unit in the Roma 1 LHA/ASL.

Person in charge of reporting suspected cases to the Covid School Unit, allowing for prompt epidemiological monitoring and response. a scheme of the organization is presented in figure 1.

While the health emergency highlighted the need for strengthened interaction between the community and the Health Authorities, the Covid-19 Units and the Covid-19 Contact Persons allowed the basis for a continuous communication system, facilitating institutional collaboration between the LHA/ASL's HPHSs and the Schools, which represent two of the most important Public Administrations in Italy. This paper examines, first, the experience of a Covid-19 outbreak in a large school in Rome, and, later, discusses the policy implications emerging from the Covid-19 pandemic, attempting to contribute to fight the research gap.

This study aims to critically evaluate the diffusion and related containment measures implemented in school contexts. It does not aim to exhaust the discussion on the safety of school environments; a discussion that we believe has been excessively polarized by interventions often with a media appeal rather than a scientific approach, but to provide elements for a possible managerial strategy. In fact, in a context in which a "controlled circulation" strategy has been adopted, it is not possible by definition to eliminate the risks of any occupational or social context, but it becomes necessary to learn how to manage the various situations through refined, qualitative tools, and with deep roots in daily practice. This has strong public health implications, as it allows us to better define how integrated operating methods could be successful in limiting an outbreak through public health measures such as quarantines and isolations, through a timely activation of school containment protocols. In view of the reopening of schools in Italy and Europe in general, this work aims to contribute to the discussion about the measures to better limit the spread of SARS-CoV-2 in the school environment, while guaranteeing the highest possible level of safety in school contexts, especially in countries where viral transmission in the population remains high.

Methods

A strong communication system was established, following the WHO Guidelines (10), to promote inclusive and prompt collaboration between stakeholders. Information

exchange between the School, the District, and the HPHS School Unit of LHA/ASL Roma 1 was carried out mainly by e-mails and phone calls. The school provided lists of students and employees, which were essential for rapid decisions about isolation, contact tracing, RT-PCR screening tests programming, and quarantine RT-PCR final test.

The request for genetic sequencing RT-PCR tests by the HPHS Covid-19 School Unit of LHA/ASL Roma 1 was made by e-mail to the designated regional laboratory (11).

The recording of cases took place on a regional platform and the School Unit dedicated database was the basis for data elaborations to monitor and manage the cluster in both cases of its development or reduction.

The data collected included: student population, cases, early symptoms, results of RT-PCR tests, and contact tracing information. A database model was also developed for assessing the risk of the presence of the SARS-CoV-2 variants. It allowed, in prospect, to read the trend of infection within the school environment, highlighting the presence of outbreaks, reconstructing the chains of contagion, and any collateral chains due to links between the classes (for example teachers in common, or siblings in different classes). This model was used as an administrative database to assess whether or not to place the "suspected variant" under the Italian legislation in force (6).

Statistical analysis

Ours is an observational study, all data were obtained from an in-depth collection during the process of taking charge and management of the outbreak. Therefore, only reprocessed data without statistical analysis are presented.

All data were collected starting from the class lists provided by the school, which made it possible to organize the testing sessions. The testing site staff then reorganized the names, maintaining the distinction by class, to be able to evaluate any new case and immediately prepare further measures.

The information flow then followed the samples, so that, once the results were obtained from the laboratory, it was possible to better understand the presence of any collateral contagion chains. The data were then reorganized for statistical purposes, to obtain prevalence tables.

Results

The School that is the focus of this study is located in the District II of the LHA/ASL Roma 1, with a population of around 170,000. Approximately 1,460 students and 230 staff attend the school, the majority of them living in the nearby area. The neighborhood is one of the most affluent of the city, with large families present for generations. Compared with the whole city of Rome, the District has the highest real estate prices, the highest percentage of high educational levels, and of high occupational status, with a strong homogeneity within the population of these social health determinants (12-14). The area is characterized by very cohesive relationships and strong social bonds, facilitated by the central role this school plays in strengthening social relationships.

Figure 2 provides a timeline overview of the events. On 2 February 2021, the COVID-19 Contact Person of a local nursery (children 3 months to 3 years of age) reported a series of suspect cases to the district Covid-19 Unit. Upon preliminary investigation, three educators, three children, and three school employees resulted positive after SARS-COV-2 tests. High-risk contacts (or the subjects inside the "bubble", the compartmentalized class organized in Italy within the kindergartens), received quarantine instructions, while the rest of the nursery population was invited to undergo

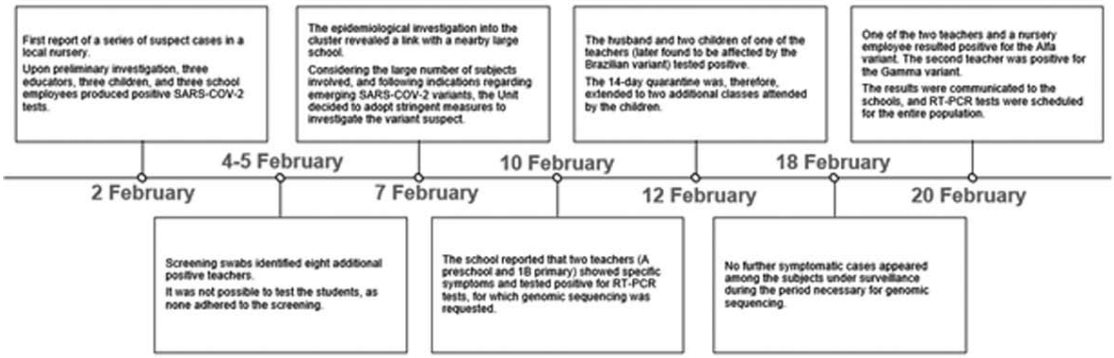

Figure 2 - Timeline of events.

an RT-PCR screening test. Swabs carried out between 4 and 5 February identified eight additional positive teachers. In contrast, it was not possible to test the students, as none of the parents adhered to the screening.

On 7 February, the epidemiological investigation into the cluster revealed a link with a nearby large school of around 1,700 people including students (3 years to 14 years of age), teachers, and staff. Three students, siblings of a case from the nursery, tested positive and generated quarantine for their respective classes (A preschool, 1B, and 3B primary). Considering the large number of subjects involved, and following indications from the Lazio Region regarding emerging SARS-COV-2 variants, the Unit decided to adopt stringent measures to investigate the suspect variants. On 10 February, the school reported that two teachers (A preschool and 1B primary) showed specific symptoms and tested positive for RT-PCR tests carried out on 11, for whom genomic sequencing was requested.

On 12 February, the husband and two children of one of the teachers (later found to be affected by the Gamma variant) tested positive. The 14-day quarantine was, therefore, extended to two additional classes attended by those children (4B primary and 2H middle school).

No further symptomatic cases appeared among the subjects under surveillance during the period necessary for genomic sequencing. End quarantine swabs were programmed for 18 February, resulting in only one secondary case, with an epidemiological link with one of the two teachers.

On 20 February, regional authorities communicated that one of the two teachers and a nursery employee resulted positive for the Alpha variant. Two days later, regional authorities confirmed the second teacher was positive for the Gamma variant. The results were communicated to the School and the interested subjects, and RT-PCR tests were scheduled for the entire population.

Tests were performed between 25/02/2021 and 02/03/2021, with a strong involvement of the Rome 1 LHA/ASL's nursing staff, who guaranteed the execution of a mean of 225 daily tests at the Rome 1 LHA/ASL test Center. Swabs were analyzed by RT-PCR at the laboratory of the San Filippo Neri Hospital, managed by the Rome 1 LHA/ASL. Two teachers obtained the swab at another facility, independently. Out of 1,231 swabs analyzed (Table 1), 5 were positive, among them a teacher who had obtained the test at another facility, and a primary school pupil involved in a separate chain of family infection. A total of 1,357 subjects were involved in the screening, and 1,226 tested negative.

Table 1 - Summary of the screening program conducted in the school.

Educational attainment	Class	Students			Teachers/staff		
		Total	Tested	Positive	Total	Tested	Positive
Nursery	6	105	86	0	22	20	0
Elementary	22	489	435	3*	68	56	0
Middle school	24	563	532	0	110	102	2**
Total	52	1157	1053	3	200	178	2

*Household transmission chain
**Including one teacher who tested positive in another region

Out of the 14 quarantined classes, in addition to the index cases, 4 cases emerged during the quarantine period (symptomatic subjects who undertook control swabs), and 5 cases at the end of the 14-day quarantine. A total of 296 subjects were tested, out of 323 subjects involved in the default measure, net of the primary cases that generated the intervention (Table 2).

Discussion

The data presented show that, in the case under examination, despite the documented presence of two distinct variants of SARS-CoV-2, and despite numerous other cases not connected each other, the collateral infection diffusion in the school environment, beyond classes already in quarantine, has

Table 2 - Summary of primary and secondary cases in quarantined classes.

Class			Students				Teachers/staff			
Educational attainment	Year	Section	Involved	Initial Cases	Tested	Secondary Cases	Involved	Initial Cases	Tested	Secondary Cases
Nursery	1	A	21	1	18	1	7	1	6	0
	1	C	21	0	18	0	2	1	1	0
	1	I	17	1	12	0	4	0	3	0
Elementary	1	B	25	1	24	0	5	1	2	0
	2	D	22	2	21	0	3	1	1	0
	2	F	19	1	18	2	0	0	0	0
	3	B	25	1	24	0	3	0	2	0
	3	E	19	1	18	0	3	0	2	0
	4	B	25	1	21	0	3	0	0	0
Middle school	2	C	21	1	19	1	***			
	2	H	25	1	24	0				
	3	A	24	1	22	0				
	3	B	22	1	20	1				
	3	E	21	1	20	0				
Total			307	14	279	5	30	4	17	0

***Middle school teachers were tested during the screening.

been marginal. In any case, the outbreak was controlled by promptly implementing the procedures related to the containment of the SARS-CoV-2 infection.

The cases identified were immediately submitted to isolation measures and contact tracing interviews. Identified contacts were invited to carry out the mandatory 14 days quarantine, followed by an RT-PCR test at the end of the period with a negative outcome for readmission into the community.

Considering the rapid increase of cases in the school, and following national and regional updates regarding the diffusion of new SARS-CoV-2 variants, risk assessment, and control measures, the HPHS's School Unit deemed the circulation of these variants within the setting to be plausible.

Thanks to a timely intervention, positive nasopharyngeal swabs were subjected to genetic sequencing by the regional appointed laboratory. This was requested for random positive swabs from the cluster, following regional guidelines (11). However, this resulted in a suboptimal waiting time, as there was only one regional laboratory authorized at the time. As a result, it was possible to identify the B.1.1.7, or Alpha variant demonstrated to be more contagious than the previous strain circulating in Italy. Importantly, we identified the P.1, or Gamma variant, for the first time in the city of Rome. The prevalence of these variants in the Lazio Region, by 18/02/2021, was estimated to be 34.0% and 13.2% respectively (15).

The Unit also carried out a retrospective search of contacts, i.e. beyond 48 hours and up to 14 days before the onset of the symptoms of the case, or execution of the swab if the case was asymptomatic, to identify the possible source of infection and further extend contact tracing to all identified cases.

The proposal was to provide a possible model of intervention that, integrated with the standard preventive measures, such as mandatory face masks and regular hand cleaning (16-19), can provide an additional support to schools. We believe that the main strengths of the School Unit of the LHA/ASL RM1 intervention, can be summarized in three points.

First of all, *strong local roots*. This implies having territorial variations of the service, which are capable of managing the interface between the Health Service and the Schools. This includes specific skills of health professional (nurse, GP, Public Health Doctor, health visitor, etc) operating in the community (20, 21). In the case of the School Unit, these skills were acquired specifically in the field, by constantly filing and adjusting their language and approach, following the feedback received from the schools. This also made it possible to enter into the social and cultural context in-depth, facilitating the understanding of family dynamics at the basis of collateral transmission chains.

The second point concerns *the construction of a strong relationship between two fundamental institutions, such as schools and healthcare organizations*, which are, first of all, public administrations. This means that they speak different languages, use different communication tools, and respond differently to external stimuli. By way of example, only in September 2020, with the reopening of schools, we found out that schools communicated exclusively via certified e-mail and registered notes, tools that are unsuitable for responding promptly to situations of risk of viral spread. The approach was therefore gradual, through the development of specific health forms, agreed with the schools, and by implementing IT management systems that were used in the initial contact phases.

Our third and final point concerns the *multidisciplinary and multi-professional structuring of the School Unit*. In addition to doctors and nurses, we have prevention technicians, health visitors, and other professionals in the healthcare field. This made it possible to carry out activities capable of

responding globally to the needs of schools. In recent months, in addition to carrying out swabs and imposing isolation measures, we have carried out inspections, provided help in the re-planning of the internal spaces of the structures, trained teachers and COVID contact persons.

Conclusions

This work, as stated, does not aim to give a definite answer to the question of school safety. Indeed, we believe that it is wrong to think in these terms. From our experience, we know that schools are a porous environment with respect to the surrounding context, with available evidence on how the trend of epidemic curves in schools mirrors that of the general population (22-26). In our opinion, the focal point is how to contain the risk, knowing that as long as there is viral circulation, there is a risk linked to a meeting place *par excellence* such as schools.

We conducted an extensive screening action within the institute, which saw over 1,200 swabs carried out on teachers and students in six days, and the temporary closure of the school until completion of tests.

Thanks to the containment measures indicated above and to the active collaboration between local health authorities, Health Departments, Districts, families, and the school, it was possible to limit the spread of the infection almost exclusively within the classes subjected to the quarantine measure, thus avoiding the spread of the virus into the community.

The limitations of this intervention concern, in particular, the number of schools that fall within the area of our competence, and the peculiar characteristics of this particular neighborhood, ad described before. During an epidemic phase, with a medium/high prevalence of infections, within a highly interconnected urban context, unfortunately, the targeted closures of entire complexes are necessary to set a "zero point", which also allows gaining some waiting time for further diagnostic evaluations. However, our experience shows that, when the protocols in force are respected, when there is good integration between education and healthcare services, and when there is a high degree of adherence to Health Authorities' indications, the transmission chains remain limited within the identified areas. This allows a certain degree of safety even in the school context. Acting according to these criteria, therefore, makes it possible to control viral spread without having to resort to additional tools, such as timed screening, which could involve extra personnel and resources, without proven cost-effectiveness.

Riassunto

La gestione un focolaio di SARS-CoV-2 in una scuola: intuizioni ed implicazioni di politiche sanitarie da un'esperienza durante la pandemia

Premessa. La pandemia da SARS-CoV-2 ha colpito anche le scuole. Le chiusure prolungate e le problematiche relative ai flussi informativi non permettono di dare una risposta definitiva circa la trasmissione scolastica. Riportiamo in questo articolo la nostra esperienza di gestione di focolai di infezione da SARS-CoV-2 in ambiente scolastico, attraverso un caso studio di un grande Istituto Comprensivo italiano.

Metodi. La ASL Roma 1 ha predisposto l'Equipe Scuola con una struttura fortemente ancorata al territorio. Al livello locale l'Equipe Distrettuale gestisce maggiormente i rapporti con le scuole, mentre l'Equipe del Servizio di Igiene e Sanità Pubblica del Dipartimento di Prevenzione ha un ruolo di coordinamento e facilitazione del processo. L'Equipe del Servizio di Igiene e Sanità Pubblica svolge le attività di indagine epidemiologica, coadiuvando le scuole, rappresentate dalla figura del Referente COVID, un delegato della Scuola adeguatamente formato nella gestione delle prime fasi della segnalazione.

Risultati. Durante il lavoro di gestione di alcune segnalazioni di casi sospetti a cavallo di due scuole, dopo una complessa indagine epidemiologica, è stato possibile identificare le principali catene di contagio tra loro indipendenti. Successivamente è stato organizzato uno screening tramite test molecolari per l'intera popolazione scolastica. Al di fuori delle catene di contagio note, per le

quali erano già stati attivati i protocolli di contenimento, sono emersi solamente ulteriori 5 casi asintomatici su un totale di oltre 1.231 test molecolari eseguiti.

Conclusioni. La nostra esperienza conferma come una attiva collaborazione tra l'Equipe Scuola e l'Istituzione scolastica rende possibile contenere la diffusione dell'infezione, evitando possibili focolai. Lo screening su ampia scala ha dimostrato la sostanziale assenza di catene di contagio collaterali. Un tracciamento approfondito ha permesso quindi una risposta efficace. Il nostro modello di intervento può essere utile nello sviluppare protocolli di sanità pubblica funzionali, tali da garantire il contenimento dei focolai negli ambienti scolastici.

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