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Description of an onsite school-based intervention aimed at increasing influenza vaccination uptake among children in an Italian Local Health Authority

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Abstract

Introduction. Onsite school-based intervention represents a key strategy to increase influenza vaccination uptake and improve knowledge of children, parents and school staff. This study aims to quantitatively describe an intervention in Local Health Authority Roma 1.

Methods. Vaccination was offered to children aged 2-6 years. A quantitative descriptive analysis of vaccination coverage and population variables was performed.

Results. 29 schools were included. Out of 2,424 eligible children, 405 were vaccinated (16.7%). Of these, 218 (53.8%) were male and 187 (46.2%) female, mean age 4.4 years old. 177 (43.7%) received one dose, while 228 (56.3%) were vaccinated for the first time. Of these, 150 students (65.8%) also received the second dose. 148 other people (parents, teachers and older children) decided to join the campaign, thus being vaccinated.

Conclusions. Community-based interventions in school settings increase adherence to health promotion campaigns. It is necessary to continue researching and investing in such activities.

Key words

- vaccine hesitancy
- onsite vaccination
- influenza
- children
- vaccine delivery

INTRODUCTION

Influenza vaccination has proved to be one of the main strategies to prevent seasonal influenza and to reduce its health, social and economic impact [1, 2]. Thus, it is important to promote strategies aimed at increasing coverage among target populations that present a risk for influenza-related complications, such as adults over 65 years of age, individuals with high-risk medical conditions, pregnant women and children [3, 4], even in the healthy pediatric population [5-7]. Indeed, the latter group considered generally reaches the highest rates of contagion, with an important burden in terms of illness, hospitalization and health complications [8-12]. For example, an Italian study reports that, over the 2013/14 - 2016/17 influenza seasons, children of 0-4 and 5-14 years of age had an estimated influenza-like illness (ILI) rate of 295.6 per 1000 and 160.3 per 1000, respectively, compared to 30.3 per 1000 observed in adults aged ≥65 years, with a relevant influenza attributable excess death rate [13]. Moreover, the American Centers for Disease Control and Prevention (CDC) reported during the 2018-2019 season a higher percentage of ILI in children 0-4 and 5-14 (10.2% and 21.6%) than in adults aged ≥65 years (8.7%), as well as of hospitalization (14.7% and 26.7% *vs* to 10.4%). In addition to the direct impact on health, children are the main source of spreading influenza to others, particularly within households [14, 15]. Therefore, annual childhood influenza vaccination is expected to directly protect those at highest risk of infection and produce external benefits by reducing disease transmission, illness, and complications [8, 9, 14]. While pediatric influenza has an important economic impact,

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both in terms of direct and indirect costs [16], vaccination has been shown to be cost-effective [17], thus confirming the importance of this practice in the pediatric population.

Despite the proven efficacy and effectiveness of pediatric influenza vaccination [1], coverage rates in Italy remain low [18], due to vaccine hesitancy and poor perception of the risk related to the virus in pediatric age [19]. In addition, logistical difficulties such as the need to accompany the child to the vaccination center or pediatrician represent further important barriers [20-22]. Therefore, it is important to promote a type of intervention that can, on the one hand, disseminate appropriate information about vaccination increasing the health literacy of parents, children, and people who are in contact with children (such as teachers and educators) and, on the other hand, promote vaccination adherence by overcoming logistical problems. Thus, highly integrated community programs based on a multidisciplinary approach to disease prevention and control are valuable organizational models for engaging the population and promoting healthy lifestyles [23].

In this context, the aim of this study is to describe the on-site school intervention implemented in the Local Health Authority (LHA) Roma 1, Italy, and to analyze the results of vaccination uptake reached among children.

METHODS

Study design, setting and intervention period

The Vaccination Department of the LHA Roma 1 promoted an onsite school-based intervention in health district 14, which corresponds to municipality XIV of the city of Rome, aimed at increasing adherence, knowledge and influenza vaccination uptake among children aged 2-6 years old during the flu vaccination campaign 2021/2022, from November 2021 to January 2022. A multidisciplinary team designed an intervention to involve community stakeholders like schools and parents, through an active call for school involvement, training activities through webinars, and onsite vaccination in schools.

School involvement

Kindergartens insisting on the territory of municipality XIV were identified through records available on the municipality of Rome and from the administrative flows and of the LHA Roma 1, as well as derived from the COVID-19 emergency management and through direct knowledge related to other projects developed in the LHA Roma 1. Thus, the total number of kindergartens identified and involved was 50.

Target population and type of vaccination

Vaccination was offered to children aged 2-6 years with the Fluenz Tetra® vaccine. This is a live attenuated, quadrivalent nasal spray suspension vaccine, indicated and recommended by the CDC and the World Health Organization (WHO) for influenza prophylaxis in people aged 2-49 years [24, 25]. This vaccine, available in Italy from the 2020/2021 season, is administered to children and adolescents aged 2-18 years old as a single 0.2 mL dose divided into two nostrils (0.1 mL administered to each nostril). In previously unvaccinated children a second dose is recommended at least 4 weeks after the first dose [26].

Primary and secondary endpoints

The primary endpoint of the present paper is to describe an effective and reproducible organizational model aimed at promoting vaccination among children aged 2-6 years with a multidisciplinary school-based intervention designed to increase both influenza vaccination coverage and the knowledge and engagement of children, parents and teachers.

The secondary endpoint was the vaccination of school staff, teachers, parents and other students aged >6 years old, with the injectable flu vaccine (Flucelvax®).

Participation and ethical approval

Vaccination was offered free of charge to all the participants, both children and adults. Participation in the project by both schools and parents with their children was completely voluntary, and consent could be withdrawn at any time. No further approval by the ethics committee was needed, as the flu vaccination campaign, for which the LHA is responsible each year, was conducted by the same health professionals working in the vaccination centers, following the same standards in terms of privacy. Moreover, at the end of the campaign, the participants' file was anonymized and then sent to the data analysts.

Data analysis

We performed descriptive analysis calculating the vaccination coverage (first and second dose) and the variables of our population such as median age (25° and 75° percentile, interquartile range), gender, and school distribution. All the analysis was performed using the Stata software, version 14, StataCorp limited partnership (LP), College Station, Texas (TX).

RESULTS

Description of the school-based intervention

The intervention took place from November 2021 to January 2022 and was aimed at the kindergartens in the territory of health district 14. The project included an initial phase of school involvement. Next, a vaccination promotion intervention was conducted with parents and teachers through two webinars, in which healthcare workers explained the project and gave information on pediatric influenza vaccination. Finally, an onsite school-based intervention was conducted in schools that had joined the initiative. At the end of the intervention period, a focus group among all the health staff involved was organized to discuss the barriers and facilitators. *Figure 1* shows the different phases and institutions involved in the project.

Phase 1: schools' involvement

The Vaccination Unit of the LHA Roma 1 contacted schools' representatives by phone and email, to briefly share information about the project, present the intervention methods and timing, and planned the online

webinars. In this context, 50 schools were contacted and 29 (58%) confirmed their participation in the project, potentially involving a total of 2,424 children aged between 2 and 6 years old, with the number varying per school from a minimum of 20 to a maximum of 298 children. *Figure 2* shows the distribution of the schools in the district 14 territory.

Phase 2: online webinars and informed consent

Two webinars were organized, the first addressed only to school staff and the second open to parents. During the first online meeting, the school staff was involved in the intervention design and organizational and logistic aspects were discussed. Healthcare professionals shared information about the importance of the influenza vaccination in the healthy population, and school staff proposed topics of interest to explore with families.

Thus, a second meeting was organized following the received indication, dealing with the epidemiology of influenza, risks and benefits of vaccination in children, timing and schedule, and vaccine mechanisms of actions and compositions. Moreover, the consent form was shown and explained, together with the intervention design. Finally, parents were instructed to follow the vaccination schedule, which included one or two doses depending on the children's vaccination status. For naive children, they were exhorted to complete the

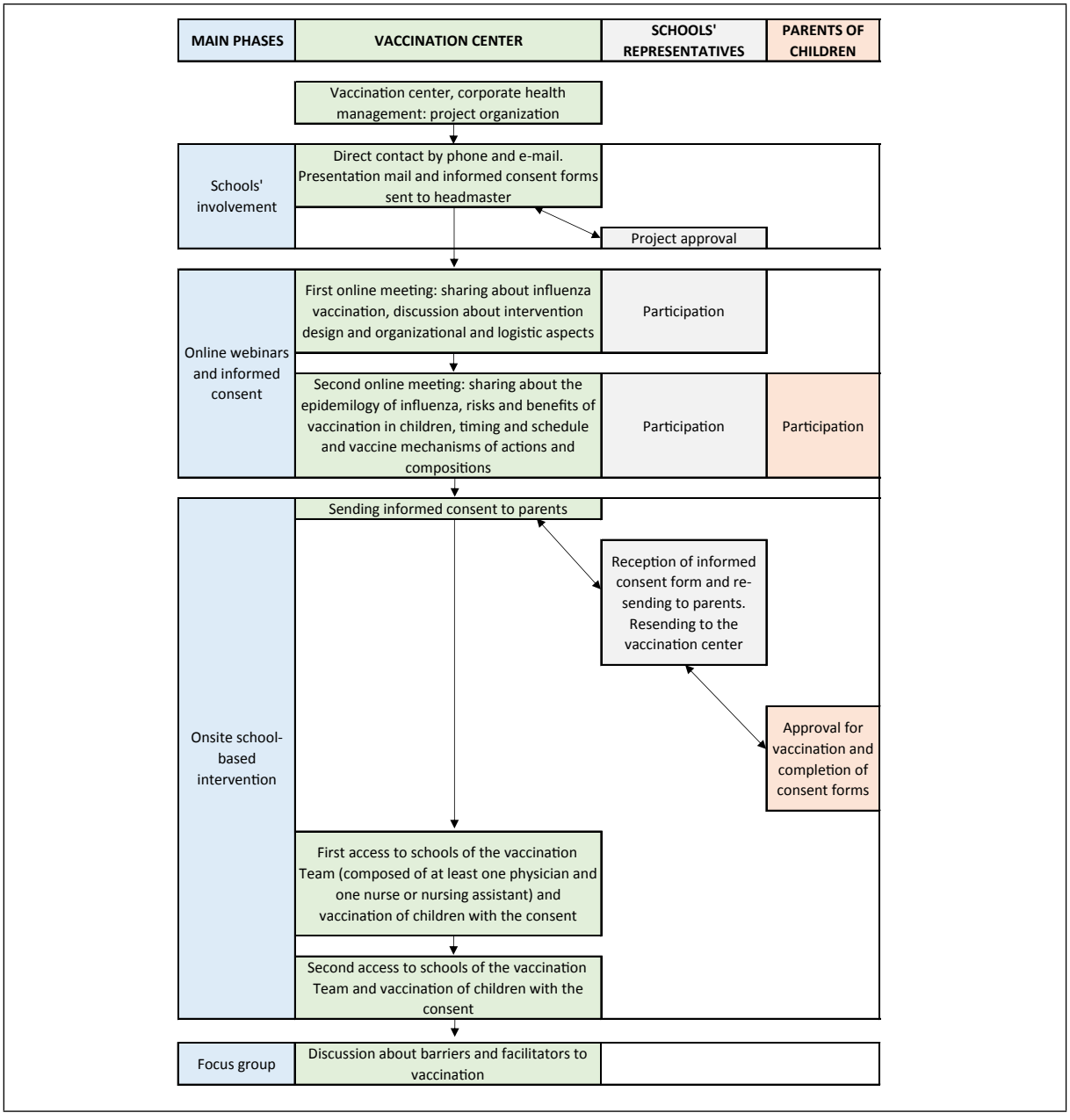

Figure 1
Project flowchart, including schools' involvement, webinars, onsite intervention and evaluation of the activity.

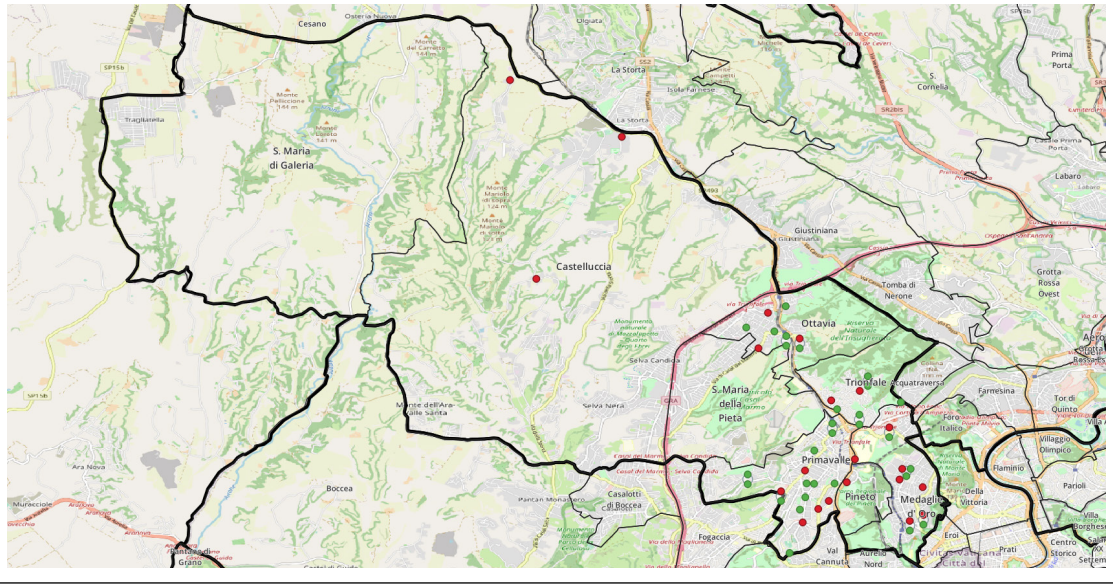

Figure 2
School distribution in the health district 14 of the Local Health Authority Roma 1.
Red dots correspond to schools that were contacted but did not participate, while green dots correspond to schools that confirmed their participation to the project.

vaccination cycle, with a second dose at school and, where it would not be possible (due to school closure or the child's absence on the day of the visit) at the family pediatrician or by going to the vaccination center. Almost 150 parents participated in the webinar. The day after the meeting, informed consent was sent to the schools, and then distributed from schools to parents to be filled out and signed. In this way, children could be vaccinated without the presence of their parents on the day the intervention was scheduled.

Phase 3: vaccination team (VT) and onsite school-based intervention

The VT consisted of at least one physician and one nurse or nursing assistant. The LHA scheduled the site visit based on the availability of the VT, in agreement with schools. At least two accesses were scheduled for each school, to vaccinate those children who were not present at school on the first access and to administer the second dose to those children who had not previously been immunized. The school was asked to prepare a separate room with chairs and a table so that health personnel could work safely without entering the classrooms. One week, before access, each school had to communicate the number of children to vaccinate. On the day of the intervention, Fluenz Tetra® vaccines were properly prepared to transport, along with some doses of injectable influenza vaccine. The VT went to schools according to the shared planning, with all the necessary equipment (i.e., drugs to manage allergic reactions), including COVID-19 personal protective equipment (PPE) that must be changed for each school. All schools provided a reserved room where health personnel could wear PPE, evaluate the consent forms, and administer vaccines. If the consents were complete and without contraindications, enrolled children were invited to the room. By engaging them through storytelling, the administration was carried out and the children were allowed to return to their classrooms. The VT waited 15 minutes after the last administration before leaving the school. The same process was followed for vaccinations of children who were in the secondary endpoint. Regarding adult vaccination, clinical history was individually taken, and informed consent was signed on-site.

In the intervention period, COVID-19 incidence among school-aged children was rising, and in Italy, quarantine measures were applied to a class with one confirmed case [27]. For this reason, additional information on quarantine dispositions in the selected schools was retrieved from the LHA database.

Vaccination uptake of children aged 2-6 years

Overall, out of 2,424 eligible children aged 2-6 years, 405 were vaccinated (16.7%). Of these, 218 (53.8%) were male and 187 (46.2%) were female, with a mean age of 4.4 years old (Interquartile range: 1.5 years). Out of 405 vaccinated children, 177 (43.7%) received only one dose, as they had already been vaccinated at least once in their lives, while 228 (56.3%) were vaccinated for the first time against influenza (*Table 1*). Of these, 150 students (65.8%) also received the second dose, as per the vaccine schedule: 26 (17.3%) were vaccinated in other settings (such as family pediatricians and vaccination centers), while 124 children (82.7%) received the second dose during the second school visit. Thus, among children who have never been vaccinated in their lives, 78 did not receive the second dose.

Indeed, due to the COVID-19 pandemic wave, at the beginning of 2021, schools were closed, and it was not possible to continue the onsite campaign in this setting.

Table 1
Number and percentage of vaccinated children in the enrolled schools with a second dose

School	N. of first doses* (%)	N. of second doses (%)	Second doses made at school^ (%)	Second doses made in another setting^^ (%)
1	4 (16)	3 (75.0)	3 (100.0)	0 (0.0)
2	9 (8.7)	1 (12.5)	0 (0.0)	1 (100.0)
3	1 (5)	0 (0)	0 (0.0)	0 (0.0)
4	9 (20.5)	8 (88.9)	5 (62.5)	3 (37.5)
5	6 (10)	5 (83.3)	4 (80.0)	1 (20.0)
6	5 (4.5)	5 (100.0)	5 (100.0)	0 (0.0)
7	4 (4.8)	4 (100.0)	4 (100.0)	0 (0.0)
8	6 (8.8)	5 (83.3)	5 (100.0)	0 (0.0)
9	2 (2.7)	1 (50.0)	1 (100.0)	0 (0.0)
10	28 (9.4)	23 (82.1)	22 (95.7)	1 (4.4)
11	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
12	7 (6.9)	6 (85.7)	6 (100.0)	0 (0.0)
13	3 (10.3)	3 (100.0)	0 (0.0)	3 (100.0)
14	18 (11.6)	0 (0.0)	0 (0.0)	0 (0.0)
15	16 (23.5)	14 (87.5)	14 (100.0)	0 (0.0)
16	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
17	17 (16.2)	14 (82.4)	11 (78.6)	3 (21.4)
18	31 (16.2)	21 (67.8)	17 (81.0)	4 (19.0)
19	2 (3.9)	1 (50.0)	1 (100.0)	0 (0.0)
20	10 (10.3)	8 (80.0)	7 (87.5)	1 (12.5)
21	5 (5.4)	5 (100.0)	5 (100.0)	0 (0.0)
22	2 (3.8)	2 (100.0)	2 (100.0)	0 (0.0)
23	10 (10.0)	5 (50.0)	3 (60.0)	2 (40.0)
24	11 (27.5)	7 (63.6)	7 (100.0)	0 (0.0)
25	3 (4.3)	3 (100.0)	1 (33.3)	2 (66.7)
26	6 (14.0)	4 (66.7)	0 (0.0)	4 (100.0)
27	9 (9.3)	1 (11.1)	1 (100.0)	0 (0.0)
28	2 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)
29	2 (2.8)	1 (50.0)	0 (0.0)	1 (100.0)
Overall	**228 (9.4)**	**150 (65.8)**	**124 (82.7)**	**26 (17.3)**

*Number of fist doses administered on the total number of children in that school; ^percentage of second doses delivered in school setting out of the total number of second doses; ^^percentage of second doses delivered in other settings out of the total number of second doses.

For that reason, a highly variable range of adherence to the second dose is observed (*Table 1*). Vaccination rates vary among schools, ranging from a low of 2.8% (2 children out of 71 children enrolled in the school) to a high of 48.0% (12 children out of 25 children enrolled in the school) (*Table 2*).

Vaccination of other categories

Vaccination was also offered, free of charge and on-demand, to teachers, staff, parents and children aged >6 years old. In this context, 130 teachers, 8 parents, and 10 children (mean age of 9.8 years) were vaccinated. Notably, the parents and children turn out to be those in a class with an immunocompromised child. Since this was a free and on-the-spot offering, it was not possible to relate the number of vaccinations to the total number of teachers and parents in the schools.

Phase 4: focus group

A concluding focus group was conducted among the healthcare workers who had been involved in the intervention. Overall, the program was deemed effective and feasible. One of the most important barriers was the pandemic, which had a twofold effect: first, the use of protective equipment made it difficult to interact with children and engage them; second, quarantines precluded the organization of visits from being fruitful. The adoption of a more flexible agenda has been proposed as a possible solution to the organizational issue. Facilitators were described as connected to the trust relationship built with schools during the previous year. Thanks to the intervention, 130 teachers decided to vaccinate, and healthcare workers shared during the focus group how the mere availability of a vaccine at work can in-

Table 2
Number and percentage of vaccinated children in the enrolled schools

School	N. of registered children	N. of vaccinated children	Vaccinated (%)
1	25	12	48.0
2	103	24	23.3
3	20	1	5.0
4	44	19	43.2
5	60	9	15.0
6	111	7	6.3
7	83	16	19.3
8	68	9	13.2
9	74	6	8.1
10	298	38	12.8
11	78	4	5.1
12	101	15	14.9
13	29	4	13.8
14	155	36	23.2
15	68	22	32.4
16	43	5	11.6
17	105	24	22.9
18	191	49	25.7
19	51	2	3.8
20	97	15	15.5
21	92	8	8.7
22	52	2	3.8
23	100	16	16.0
24	40	18	45.0
25	70	5	7.1
26	43	8	18.6
27	97	23	23.7
28	55	6	10.9
29	71	2	2.8
Overall	**2,424**	**405**	**16.7**

duce workers to protect themselves. The episode of the immunocompromised child, who encouraged parents and classmates to vaccinate, was an example of how the perception of the importance of a preventive intervention is critical to increasing adherence.

In the end, healthcare workers reported that more physicians and, in general, healthcare personnel were needed to implement this public health program effectively in the coming years.

DISCUSSION

Our study shows how an active onsite vaccination campaign in schools, where children spend most of their time and are therefore easily reachable, leads to the achievement of valuable vaccination coverage. Specifically, this study describes the implementation of an organizational model offering a preventive intervention to citizens within a community health approach. Influenza vaccination uptake enhancement programs for children, such as onsite school-based intervention, represent an important preventive action [28, 29]. For example, the experience in the United Kingdom shows good vaccine uptake levels within the targeted population, which is 7.1% higher than the non-targeted population. Moreover, among the target population, almost 55% of the pilot areas achieved vaccine uptake of more than 60% [30]. Similarly, a study from Canada confirms that immunization in school-based clinics is associated with increased vaccine uptake [31]. Onsite school vaccination has also proven to be a useful tool impacting health outcomes: indeed, a Japanese study shows that the initiation of the school-based vaccination program prevented about 37,000 to 49,000 deaths per year, equal to 1 death for every 420 children vaccinated. As the vaccination of schoolchildren was interrupted, the excess

mortality rates in Japan increased [32]. The United Kingdom experience also demonstrates that general practitioner (GP) ILI consultation rates and influenza swab positivity in primary and secondary care were lower in pilot areas compared with rates in non-pilot areas across all age groups [30]. This strengthens the choice of a school-based administration to achieve high childhood vaccination uptake [33].

Recently, Roncaglia et al. observed how the vaccination coverages of children included in the school vaccination program were higher than the coverages observed in children attending other schools (67.9% *vs* 56%) [34]. Another study showed how vaccination rates were significantly higher in schools with onsite vaccination options compared to the control group, confirming the usefulness of such interventions [35]. Similarly, school vaccination campaigns in France resulted in an increase in overall coverage (mandatory and recommended vaccines) from 10.7% to 65.7% for diphtheria-tetanus-poliomyelitis-pertussis (DTaP/IPV), hepatitis B virus (HBV), measles-mumps-rubella (MMR), meningococcal C, and human papillomavirus (HPV) vaccines [36]. Another study showed how the school-based health promotion project was effective in improving immunization uptake, especially for those recommended [37].

In our context, the intervention included an important part of training to engage teachers and families. Education and information activities of children, parents and teachers is a key factor [28]. The meetings held with teachers, parents and children, in fact, encouraged the spread of knowledge countering false myths and fake news related to vaccination, fostering a two-way relationship and building trust between the LHA and citizens. Indeed, the involvement of parents and teachers in this intervention allowed us to extend the vaccination to them as well, reaching 148 people.

Several studies have shown how educational programs can increase vaccination coverage [35, 38-40]. In Germany, for example, it was observed how the onsite vaccination offered in combination with an educational intervention showed a stronger increase in vaccination rates against MMR and DTaP/IPV vaccines [39]. Hu et al. have recently shown that multifaceted strategies (including health education course to students, educational videos to parents, involving parents in student-parent collaborative homework, and messages on different occasions to remind parents of vaccination) contribute significantly to increasing influenza vaccination coverages [40]. Finally, in Spain, it was observed that such education and knowledge-sharing activities had positive results in terms of parent and teacher attitudes [41].

A further consideration is related to the type of vaccine. Having a non-invasive inhalable vaccine available, in fact, can facilitate the organization and logistics aspects and reduce possible fears of children and parents related to injectable vaccines [42]. Our study has limitations. First, we were unable to know what the vaccination adherence was in the pediatric population 2-6 years old in previous years in the area of LHA Roma 1; however, the primary endpoint of our study was to promote a multidisciplinary school-based intervention, providing a valuable and replicable organizational model. Second, our study did not investigate whether any factors (social, cultural, and economic) may influence parents' acceptance or refusal of vaccination. In fact, the variability in coverage found in schools suggests that the area where the school is located might reflect the different income and living conditions of families and this condition provides an important cue for subsequent studies to investigate these issues. Third, in Italy, the incidence of COVID-19 infections began to rise in November 2021, peaking on January 10, 2022, so all the intervention was carried out during the period of highest viral circulation, and many classes were in quarantine during the visits. For this reason, the value of vaccination coverage is underestimated because the number of those enrolled in school was used as the denominator since it was not possible to estimate the number of those present on the days of the accesses.

CONCLUSIONS

Community-based interventions increase adherence to health promotion campaigns. It is, therefore, necessary to continue investing in activities aimed at engaging the population, facilitating access to care settings and, as in this case, integrating the healthcare setting into the school setting. Being affiant to health education actions, such interventions are useful tools to increase public confidence and fight vaccine hesitancy.

Authors' contributions

All Authors contributed to the study conception and design. Material preparation and data collection were performed by LV, MTR, PL, AB and AS. LV and PL performed the statistical analysis. The first draft of the manuscript was written by LV, MTR, MDP, and AB. AS, MG, MM and PP commented on the latest version of the manuscript. SA, PP and GQ supervised the study. All Authors read and approved the final manuscript. All Authors attest they meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship.

Conflicts of interest statement

The Authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Availability of data and material

Data was collected and analyzed by ASL Roma 1. Data are property of LHA Rome 1 and are available for reasonable requests.

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