

Feasibility of elementary school children's use of hand gel and facemasks during influenza season

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Accepted 15 April 2010. Published Online 7 June 2010.

Background The feasibility of non-pharmacologic interventions to prevent influenza's spread in schools is not well known.

Objectives To determine the acceptability of, adherence with, and barriers to the use of hand gel and facemasks in elementary schools.

Patients and Methods *Intervention:* We provided hand gel and facemasks to 20 teachers and their students over 4 weeks. Gel use was promoted for the first 2 weeks; mask use was promoted for the second 2 weeks. *Outcomes:* Acceptability, adherence, and barriers were measured by teachers' responses on weekly surveys. Mask use was also measured by observation.

Results The weekly survey response rate ranged from 70% to 100%. Averaged over 2 weeks, 89% of teachers thought gel use was *not* disruptive (week 1 – 17/20, week 2 – 16/17), 95% would use gel next winter (week 1 – 19/20, week 2 – 16/17), and 97% would use gel in a pandemic (week 1 – 20/20, week 2 – 16/17). Averaged over 2 weeks, 39% thought mask use was *not* disruptive

(week 1 – 6/17, week 2 – 6/14), 35% would use masks next winter (week 1 – 5/17, week 2 – 6/14), and 97% would use masks in a pandemic (week 1 – 16/17, week 2 – 14/14). About 70% estimated that their students used hand gel $\geq 4\times$ /day for both weeks (week 1 – 14/20, week 2 – 13/17). Students' mask use declined over time with 59% of teachers (10/17) estimating regular mask use during week 1 and 29% (4/14) during week 2. By observation, 30% of students wore masks in week 1, while 15% wore masks in week 2. Few barriers to gel use were identified; barriers to mask use were difficulty reading facial expressions and physical discomfort.

Conclusions Hand gel use is a feasible strategy in elementary schools. Acceptability and adherence with facemasks was low, but some students and teachers did use facemasks for 2 weeks, and most teachers would use masks in their classroom in a pandemic.

Keywords Hygiene, influenza, masks, school health services.

Please cite this paper as: Allison et al. (2010) Feasibility of elementary school children's use of hand gel and facemasks during influenza season. *Influenza and Other Respiratory Viruses* 4(4), 223–229.

Introduction

The outbreak of pandemic H1N1 2009 influenza has highlighted the role of school-aged children in influenza transmission and the potential importance of non-pharmaceutical interventions (NPIs) to prevent the spread of influenza in schools settings.^{1–5} At the onset of an influenza pandemic, such as the recent pandemic H1N1 2009 outbreak, vaccine and antiviral supplies are limited so NPIs including social distancing (i.e., school closure), hand hygiene, and use of facemasks may be the only options to reduce the spread of influenza.^{6,7} Analyses of data from the 1918 influenza pandemic suggest that timely and effective implementation

of NPIs may have reduced the impact of influenza in some United States cities,^{8–10} and national pandemic influenza guidelines recommend the use of layered interventions.^{6,7} However, data are limited regarding the feasibility and effectiveness of NPIs in reducing the transmission of influenza in today's society, particularly in school settings.^{11,12}

Evidence is mixed regarding the effectiveness of school closures in reducing influenza transmission and suggests that early and prolonged school closures may be necessary to have a substantial effect on transmission.^{13–16} In addition, school closures during the pandemic H1N1 2009 outbreak demonstrated that this method of reducing influenza

transmission among schoolchildren is socially and financially disruptive^{5,17}. Therefore, attempting to reduce the spread of influenza in schools through the use of hand gel and facemasks is appealing. National guidelines recommend use of hand washing or hand gel in school settings in the event of pandemic influenza.⁶ While the effect of hand gel use on reducing the spread of influenza in schools has not been reported, current evidence suggests that hand gel use reduces student and teacher absenteeism and respiratory illness, and hand gel has been shown to reduce influenza on human hands.^{18–24}

Pandemic influenza guidelines do not specifically recommend the use of facemasks in schools, but do advise their use in “crowded public spaces”.⁶ The public’s acceptance of and adherence with these recommendations is unclear. During the 2003 SARS epidemic, residents of Hong Kong did adhere to recommendations to wear facemasks,^{11,25} but whether US citizens would do so and whether it would be feasible to do so in schools has not been well studied.^{11,12} Aiello and colleagues conducted a trial of facemask use to prevent *primary* transmission of influenza among university students living in dormitories and found that mask use did reduce influenza-like illness.²⁶ Students enrolled in the study reported using masks for an average of 3–4 hours per day over 6 weeks.²⁶ Two recent trials of facemask use in households during influenza season found that mask use appeared to decrease *secondary* transmission of influenza or prevent influenza-like illness in household contacts; however, adherence with mask use was less than 50% in both studies.^{27,28}

The effectiveness of NPIs as part of a national strategy to reduce the spread of pandemic influenza and other respiratory pathogens would require that their use be acceptable and adhered to by the target populations. Prior to conducting studies to evaluate the effectiveness of hand gel and facemasks as components of a school-based intervention to reduce the transmission of influenza, it is critical to determine whether their use in a school setting is actually feasible. Therefore, we conducted a pilot study to determine the acceptability of use, adherence with use, and barriers to use of alcohol-based hand sanitizing gel and facemasks in an elementary school setting.

Methods

Subjects and setting

The study was conducted in two K-6 elementary schools in Salt Lake City, Utah, over a continuous 4-week period beginning January 22, 2007. The Salt Lake City School District and the University of Utah institutional review boards approved the project. Each school sent information about the use of hand gel and facemasks in the classroom to parents in the form of a letter or newsletter. Students and

their parents were informed that they were free to use or not use the hand gel and/or facemasks without penalty. Both schools had sinks in every classroom, but neither school had hand gel dispensers or regular access to hand gel. Neither school had access to nor had ever used facemasks in the past.

Intervention

The intervention was conducted in two phases with each lasting 2 weeks. Prior to phase 1, we conducted a 30-minute school assembly to describe influenza and the proper use of hand gel and facemasks to prevent the spread of influenza. We also provided teachers with information and educational resources about seasonal and pandemic influenza. During phase 1, we provided hand gel, asked students and teachers to use gel at least four times per day, and provided reminders regarding gel use. Each class was provided with one large hand gel dispenser as well as a small bottle of hand gel for each student. During phase 2, we provided disposable surgical ear-loop facemasks, asked students and teachers to wear facemasks, and provided reminders regarding facemask use. For both hand gel and facemasks, the study team provided reminders on 1 day mid-week for each of the 4 weeks of the study. Reminders included flyers and small gifts such as pencils and stickers. Teachers could choose to provide additional reminders, but we did not specifically ask them to do this as part of the study. We provided enough facemasks for each student and teacher to have one new mask per day. Students in Kindergarten through fourth grade received child-sized facemasks with Disney[®] characters printed on them. All teachers and the students in the fifth and sixth grades received plain adult-sized facemasks. Students were not asked to wear masks during lunch and recess. All students and teachers were encouraged to wear facemasks whether or not they had symptoms of illness to better reflect overall student willingness to wear masks and to address parental concern about children being singled out to wear masks. Teachers could choose to continue hand gel use during phase 2, but we did not provide specific reminders about hand gel use during this phase.

Instruments and data analysis

To assess teachers’ attitudes about seasonal and pandemic influenza prior to the intervention, teachers were asked to complete a survey based on the Health Belief Model and adapted from a previous study;²⁹ the survey also included a question about whether the teachers had received the influenza vaccine “this fall or winter”. During the intervention, we used a weekly teacher survey to assess the *acceptability*, *adherence*, and *barriers* to use of both hand gel and facemasks. The survey was developed by the investigators and pre-tested on teachers at an elementary school that was not

participating in the study. Teachers rated *acceptability* on a four-point scale by indicating the degree of disruptiveness to classroom activities and by indicating their willingness to use hand gel or facemasks again next year and during an influenza pandemic. *Adherence* with hand gel use was estimated by teachers who reported the number of times students were observed using hand gel using a four-point scale (once a day, 2–3 times a day, 4–5 times a day, and more than five times a day). *Adherence* with facemask use was measured in two ways. First, teachers estimated the proportion of students who always wore facemasks while in their classrooms using a four-point scale (0–25%, 26–50%, 51–75%, and more than 75%). The second measure was obtained by a research assistant who recorded the proportion of students wearing masks. The research assistant arrived unannounced and observed mask use on 1 day each week. Teachers described *barriers* to use by answering an open-ended question on the weekly survey. Teachers were also asked to solicit students' comments about barriers to use of hand gel and facemasks. Some teachers obtained students' comments via writing assignments. Teachers were given additional opportunities to provide feedback in follow-up meetings.

We used descriptive statistics to describe teachers' attitudes about influenza and acceptability of and adherence with hand gel and facemask use. We used Fisher exact tests to determine whether teachers' attitudes about influenza and receipt of the influenza vaccine prior to the intervention were related to adherence with hand gel and facemask use. Statistical significance was defined as $P < 0.05$

Results

Twenty teachers in 19 elementary classrooms with 503 students participated. All teachers ($n = 17$) participated at school A, while three teachers participated at school B. We believe the difference in teachers' willingness to participate between schools was related to differences in school climate, principals' leadership style, and our ability to "sell" our study in these settings. Given the small sample size for this pilot study, data from both schools were combined. Most students (85%) in the participating classrooms were white and non-Hispanic, and 9% qualified for free or reduced lunch (a marker of economic status). Ninety percent of teachers (18/20) responded to the pre-intervention survey. Fifty percent thought that they were likely to get sick from influenza, and 83% thought that schoolchildren were likely to get sick; however, 61% thought influenza is usually a mild disease. The majority (>80%) thought using hand gel and facemasks at school would reduce illness and absences. Only 61% thought pandemic influenza is likely to cause serious illness in the United States. Forty-five percent reported receiving the seasonal influenza vaccine "this fall

Table 1. Teachers' assessments of acceptability of and adherence with hand gel use

	Week 1 N = 20 teachers (SRR = 100%)	Week 2 N = 17 teachers (SRR = 85%)
	n (%)	n (%)
Acceptability		
Moderately or severely disruptive	3 (15%)	1 (6%)
Would use next winter	19 (95%)	16 (94%)
Would use in a pandemic	20 (100%)	16 (94%)
Adherence		
% of teachers reporting that their students used hand gel ≥ 4 times/day	14 (70%)	13 (76%)

SRR, survey response rate.

or winter". Response rates on the weekly teacher survey were phase 1, week 1: 100%; phase 1, week 2: 85%; and phase 2, week 1: 85%; phase 2, week 2: 70%.

Acceptability, adherence, and barriers to hand gel use

As shown in Table 1, acceptability of and adherence with hand gel use were high. Few teachers in either week reported that hand gel use disrupted classroom activities, and nearly all agreed that they would be willing to use it again next winter or during a pandemic. On the weekly surveys, most teachers estimated that their students used hand gel four or more times per day. Teachers' attitudes about influenza and receipt of the influenza vaccine as measured by the pre-intervention survey were not related to adherence with hand gel use. The major barrier to hand gel use was distraction. A typical statement from teachers was "Students play with the bottles." For this reason, most teachers preferred the wall dispensers over the individual bottles. Teachers also reported that some students did not like the smell of the hand gel.

Acceptability, adherence, and barriers to facemask use

As shown in Table 2, facemasks had low acceptability among teachers; the majority reported that facemask use was disruptive, and few would be willing to use masks next year. However, most agreed that they would use masks in an influenza pandemic.

Adherence with facemask use decreased over time. Table 2 shows the teachers' reports of facemask use by their students. During week 1, 59% reported regular ($\geq 50\%$ of students wearing masks in class) mask use. During week

Table 2. Teachers' assessments of acceptability of and adherence with facemask use

	Week 1	Week 2
	N = 17 teachers (SRR = 85%)	N = 14 teachers (SRR = 70%)
	n (%)	n (%)
Acceptability		
Moderately or severely disruptive	11 (65%)	8 (57%)
Would use next winter	5 (29%)	6 (43%)
Would use in a pandemic	16 (94%)	14 (100%)
Adherence		
% of teachers reporting that >50% of students wore masks while in class	10 (59%)	4 (29%)

SRR, survey response rate.

2, regular mask use was reported by 29% of the teachers. Table 3 shows the results of direct classroom observation of facemask use by the research assistant. Although the research assistant was unable to observe some classrooms

because the students were at lunch or recess, divided in activities throughout the school, or on a field trip, 18 classrooms were observed during week 1 and 14 classes were observed during week 2. During week 1, 30% (119/391) of the observed students were wearing masks; this decreased to 15% (46/310) in week 2. As indicated in the table, no obvious pattern of mask use could be identified by grade. Teachers' attitudes about influenza and receipt of the influenza vaccine were not related to adherence with mask use; however, the number of teachers for this analysis was small.

Teachers reported that facemask use produced distraction and physical discomfort and made it difficult for students and teachers to read each other's facial expressions. Typical statements from teachers were "Facial expressions are an important part of communication and I felt inhibited using the mask," and "The masks were hot." Some teachers mentioned that they would have to change their teaching style if they were going to use facemasks in the case of an influenza pandemic. In addition to complaining that the masks were hot, typical responses from students were "(The mask) traps the air that you breathe," and "The masks are very itchy." Finally, some of the third and fourth grade students found that the child-sized masks

Table 3. Proportion of students and teachers observed to be wearing facemasks by class and grade

Grade	Week 1			Week 2		
	# of classes observed	Teachers wearing mask	Proportion of students wearing mask	# of classes observed	Teachers wearing mask	Proportion of students wearing mask
All students (19 classes)	18	63% (7/11)	30% (119/391)	14	38% (6/16)	15% (46/310)
Kindergarten (3 classes)	2	Rm A 0 Rm B 0 Rm C n/o*	Rm A 95% Rm B 0 Rm C n/o	1	Rm A n/o Rm B n/o Rm C 0	Rm A n/o Rm B n/o Rm C 0
First (2 classes)	2	Rm A 1 Rm B 1	Combined 75%	2	Rm A 1 Rm B 0	Rm A 59% Rm B 0
Second (4 classes)	4	Rm A n/o Rm B n/o Rm C n/o Rm D 1	Rm A 0 Rm B 0 Rm C 45% Rm D 100%	3	Rm A 0 Rm B 0 Rm C 1 Rm D n/o	Rm A 0 Rm B 0 Rm C 24% Rm D n/o
Third (2 classes)	2	Rm A n/o Rm B 1	Rm A 0 (recess) Rm B 0 (lunch)	2	Rm A 1 Rm B 1	Rm A 43% Rm B 0 (recess)
Fourth (2 classes)	2	Rm A n/o Rm B n/o	Rm A 0 Rm B 0	2	Rm A 0 Rm B 0	Rm A 0 Rm B 0
Fifth (3 classes)	3	Rm A 0 Rm B 1 Rm C 1	Rm A 11% Rm B 53% Rm C 8%	3	Rm A 0 Rm B 0 Rm C 1	Rm A 0 Rm B 0 Rm C 12%
Sixth (3 classes)	3	Rm A 0 Rm B n/o Rm C 1	Rm A 0 Rm B 0 Rm C 37%	1	Rm A 0 Rm B 0 Rm C 1	Rm A n/o Rm B n/o Rm C 46%

n/o, not observed.

were too small, while others complained that the characters printed on the mask were too childish, so wearing adult-sized masks became desirable among students in these grades.

Conclusions

To determine whether an influenza prevention strategy that includes the use of NPIs among elementary school students can be successful, we first need to determine whether elementary schools can reasonably be expected to implement these NPIs. In our pilot study, we found that regular hand gel use is acceptable to teachers and students and adherence with its use is high. Facemask use was less acceptable and adherence with use was low. However, some students and teachers did use facemasks for 2 weeks and most teachers indicated that they could overcome barriers to use and would use facemasks in an influenza pandemic.

Our findings about acceptability of hand gel and facemask use are similar to a survey of elementary school teachers in several urban elementary schools by Stebbins and colleagues.¹² They found that regular hand hygiene and hand gel use were among the most acceptable NPIs to teachers, while mask use was among the least acceptable. One reason teachers may have found regular hand hygiene and hand gel use more acceptable than other NPIs is because they had prior experience using these NPIs in their classrooms. We assume that most teachers have not had prior experience using facemasks. Therefore, our study design differed from that of Stebbins and colleagues because we asked teachers about their acceptance of facemasks after enabling them to experience their use in the classroom. Our finding of low acceptability of and adherence with facemask use among teachers and students is not surprising, given that recent studies in households and healthcare settings showed that children, adults, and even healthcare workers were unwilling to wear facemasks during a seasonal influenza epidemic.^{27,28,30} The barriers to facemask use were similar among teachers and students in our study and household contacts and healthcare workers in previous studies.^{27,28,30}

While we did not identify specific class level determinants of hand gel or mask use, we did observe that students usually were not using masks if their teachers were not using masks. In addition, classes whose teachers integrated the use of hand gel and facemasks into their curricula appeared to be more likely to adhere to both hand gel and facemask use. For example, one teacher had her students conduct a class science fair project about sneezing. Another had her students grow bacterial cultures from skin before and after hand gel use.

We conducted this study prior to the outbreak of pandemic (H1N1) 2009 influenza. Prior to 2009, most experts

thought that the next influenza pandemic would be caused by H5N1 influenza which had caused relatively few human infections with high mortality. We hypothesize that schools' experiences with pandemic H1N1 2009 influenza may affect students' and teachers' willingness to use NPIs. In particular, schools that had extensive outbreaks or experienced severe illness or deaths among the school community may be more willing to use NPIs.

This study has several limitations. Our small sample size may limit the generalizability of our findings to other school settings and limited our statistical power to determine if teachers' attitudes about influenza were related to adherence with hand gel and facemask use. Teachers who responded to the weekly surveys may have had less difficulty with hand gel and facemask use compared to teachers who did not respond leading to bias in favor of hand gel and facemask use. For hand gel, our adherence estimates are based solely on teachers' reports in a weekly survey rather than objective measurements and may be subject to recall bias. For facemasks, we were not able to observe all classes each week. We assessed facemask use in the second half of the study when classrooms may have already been fatigued from participating in the hand gel phase of the study. This may have made students less likely to wear masks than if they had been asked to wear masks for the first half of the study. Finally, compliance with facemask use may have been higher than it would be in a real pandemic because teachers and students were only asked to use facemasks for 2 weeks and received weekly reminders about their use.

While it was a limitation, the difficulty of counting how many students were wearing masks because of the students' mobility in the classroom and in different locations around the school is instructive for pandemic planning purposes. When public health and school officials are considering NPIs in school settings to mitigate the spread of influenza, they should consider policies to reduce students' mobility by limiting use of shared spaces such as libraries or computer laboratories and even reducing teachers' use of shared spaces such as learning stations in the classroom.

Our study shows that an investigation into effectiveness of hand gel and facemasks to prevent influenza transmission in elementary schools is possible. In addition, by conducting this study, we demonstrated that the state and local health departments, an academic institution, and the local school district can effectively collaborate for the purpose of research as well as for preparation for an influenza pandemic. Future research will examine the determinants of student, teacher, and school adherence with NPIs and the effectiveness of elementary school-based NPIs in controlling the spread of respiratory illness including influenza.

Acknowledgements

This study was supported by the Department of Pediatrics, the Primary Care Research Center, and the Child Health Research Center at the University of Utah and Primary Children's Medical Center, the Rocky Mountain Center of Excellence in Public Health Informatics (funded by the Centers for Disease Control and Prevention), the Salt Lake

Valley Health Department, and the Utah Department of Health. Kimberly Clark Corporation donated hand gel and facemasks. We thank the Salt Lake City School District and the students and teachers from the participating elementary schools. None of the authors have a financial relationship with the Kimberly Clark Corporation. Preliminary results from this study were presented at the Pediatric Academic Societies meeting in May, 2007.

Authors' contributions

Mandy Allison, MD, MSPH
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As primary investigator and author, Dr. Allison was involved in all aspects of the study including study design, obtaining school district and school approval, conducting the study, analyzing and interpreting the data, and writing the paper.

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As study coordinator with previous research experience in school settings, Ms. Guest-Warnick contributed her expertise in implementation of the study in a school setting and maintaining a positive relationship with the schools. She was instrumental in conducting the study and contributed to writing the paper. She attended regular meetings of the study group during the study period.

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As a parent of a student attending one of the study schools, a member of the Salt Lake City school board, and academic pediatrician, Dr. Nelson contributed significantly to study design, obtaining school district approval, conducting the study, interpreting the data, and writing the paper. He attended regular meetings of the study group during the study period.

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Dr. Pavia contributed to study design, interpreting the data, and writing the paper. He attended regular meetings of the study group during the study period.

As a parent of a student attending one of the study schools and a health services researcher, Dr. Srivastava contributed to the study design, analyzing and interpreting the data, and writing the paper. He attended regular meetings of the study group during the study period.

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As a parent of a student attending one of the study schools, a member of the School Community Council, and an academic pediatrician, Dr. Gesteland was involved in study design and was instrumental in obtaining school approval. He contributed to writing the paper and attended regular meetings of the study group during the study period.

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As the State Epidemiologist, Dr. Rolfs was instrumental in providing health department support for this project. He contributed to study design, interpreting the data, and writing the paper. He attended regular meetings of the study group during the study period and helped obtain funding for the study.

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As the Director of Student Services for the Salt Lake City School District, Ms. Andersen was instrumental in study design, obtaining school district approval, conducting the study, and analyzing the data. She also contributed to writing the paper. She attended regular meetings of the study group during the study period.

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As a school nurse and member of the school district pandemic influenza planning committee, Ms. Calame was involved in study design – especially practical aspects of implementation, conducting the study, and writing the paper. She attended regular meetings of the study group during the study period.

Paul Young, MD
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As one of Dr. Allison's co-mentors, Dr. Young was involved all aspects of the study including study design, analyzing and interpreting the data, and writing the paper. He attended regular meetings with Dr. Allison during the study period.

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As Dr. Allison's primary mentor, Dr. Byington was involved all aspects of the study including study design, conducting the study, analyzing and interpreting the data, and writing the paper. She attended regular meetings of the study group during the study period and helped obtain funding for the study.

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