Compliance With a Multilayered Nonpharmaceutical Intervention in an Urban Elementary School Setting

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Objectives: The purpose of this study was to determine to what extent school-aged children can learn hygiene-based nonpharmaceutical interventions (NPIs) and persist in these behavioral changes over the duration of an influenza season. If this can be done successfully, it may be a preferable pandemic mitigation strategy to much more disruptive strategies such as whole-scale school closure. **Methods:** The Pittsburgh Influenza Prevention Project (PIPP) is a prospective, controlled, randomized trial of the effectiveness of a suite of hygiene-based NPIs in controlling influenza and related illnesses in elementary schools in the City of Pittsburgh. During the 2007–08 school year, the project measured adoption of NPIs by students in five elementary schools through surveys of home-room teachers before, during, and after influenza season. **Results:** Results showed highly statistically significant improvement in students' daily practice of nearly all of the NPIs, including hand washing and sanitizer use and covering coughs and sneezes. **Conclusions:** The study provides evidence that children can learn, implement, and persist in the behaviors of a multilayered suite of NPIs over a typical flu season. These results will be useful to public health policy makers and practitioners considering methods of infectious disease prevention in school-based settings.

KEY WORDS: **behavior change, influenza, elementary school, nonpharmaceutical intervention**

Pandemic influenza poses significant risks to human health and society. It threatens to overwhelm medical care systems in the United States and throughout the world. Effective vaccines may not be available during the initial phases of a pandemic, and antiviral medications may also be in limited supply. Nonpharmaceutical interventions (NPIs) such as infection control measures and behavioral changes may be the primary means to decrease the spread of pandemic influenza.[1]

In 2007, the US Centers for Disease Control and Prevention released the Community Strategy for Pandemic Influenza Mitigation. This compilation of individual and population-based interventions includes school closure as a leading pandemic influenza mitigation strategy. Individual and whole-scale school closure may aid in the prevention and spread of influenza, as well as the protection of vulnerable populations.[2] However, there are significant disadvantages to this strategy including huge increases in the need for alternative methods of child supervision, loss of access to school meal programs, loss of parents/guardians to the workforce, as well as the risk that out-of-schools students will find alternative ways to mix and share viruses in the community.

This research was supported by Cooperative Agreement number 5UCI000435–02 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC. The authors wish to acknowledge Dr Donald S Burke, PI of the Pittsburgh Influenzas Prevention Project for his leadership and support. We also wish to recognize Janet Yuhasz, Dr Barbara Rudiak and the Pittsburgh Public School who were tremendous partners in this research. This work is their accomplishment.

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J Public Health Management Practice, 2010, 16(4), 316–324

The sheer number of children who could be involved magnifies these problems. Twenty-seven percent of the population aged 3 years and older in the United States—75 million people—was enrolled in schools in 2004.[3,4] In addition, guidance over the decisions of when to close schools and for what duration is a topic of significant discussion and debate among local, state, and federal governments and public health authorities. With limited pharmaceutical options and concerns over the negative impact of school closures, efforts have been made to evaluate the effect of various NPIs on controlling the transmission of influenza. The Centers for Disease Control and Prevention has suggested that the use of multiple, partially effective NPIs–a layered approach—could be effective in breaking the path of transmission of disease and, thereby, reduce the risk of influenza transmission within schools and families of school-aged children.[5] Computational modeling has previously demonstrated the value of blunting the peak impact of a pandemic through targeted and layered NPIs.[6]

The purpose of this study was to determine whether children can learn a suite of multilayered NPIs, change their behaviors as a result of this learning, and persist in these behavioral changes over the duration of an influenza season. If this can be done successfully, it may reduce the risk of schools as settings for the transmission of influenza, thus allowing schools to remain open during a pandemic and reducing the likely societal disruption that would occur from wide-scale school closure.

Background

Previous studies have examined compliance of single and multilayered NPIs over a range of time periods and with varying numbers of schoolchildren. Five studies[7–11] were single layer and were also limited by using a small number of students (263–769) and being of short duration (4–12 weeks). Hammond et al[12] were more complete, using 6 000 students over an entire school year, but was again only a single-layer intervention. All six previous studies found improvements in absentee rates but did not measure behavioral changes. Sandora et al[13] conducted a multilayered trial, using hand sanitizer and surface disinfection, but included only 285 students and lasted only 8 weeks. It found compliance with the intervention through the use of materials but did not measure behavioral change of students. It found, as the others, an improvement in absentee rates but only from gastrointestinal diseases.

The study by Snow et al[14] is the only study to directly measure behavior change. The study used a single NPI (hand hygiene) with 492 students over 3 months, having students sanitize or wash before lunch. Teachers observed compliance with this regimen by recording student attempts at hand hygiene and measuring the percent of students attempting to sanitize or wash. Snow found a statistically significant increase in behavior by intervention students—78 percent versus 38 percent for control. Snow et al measured intervention 3 months postintervention and found that the behavior persisted, as the rates of compliance were unchanged. Snow did not measure any outcomes arising from the adoption of the hand-hygiene regimen.

To our knowledge, Pittsburgh Influenza Prevention Project (PIPP) is unique in the combination of magnitude (3 800 students in 10 schools), longevity (6 months), use of a large control population, and measurement of behavioral change using a complex measurement tool. Compliance of NPIs was measured using multiple teacher observational surveys.

Methods

The PIPP is a prospective, controlled, cluster-randomized trial of the effectiveness of a suite of multilayered NPIs in controlling influenza and related illnesses in 10 K-5 elementary schools in the Pittsburgh Public School District (Pittsburgh, Pennsylvania). The intervention and control arms were statistically not different, each with approximately 1 900 students, who were 69 percent subsidized school lunch and 46 percent African American.

Prior to and throughout flu season, all students and staff in the five schools in the intervention arm were trained in a suite of NPIs including hand hygiene, hand etiquette, and "cover your cough" behaviors, and the schools placed and maintained supplies of alcohol-based hand sanitizer in all classrooms and common areas. In addition, parents and guardians in intervention schools received educational materials regarding NPIs and home isolation practices. The five schools in the control arm received no NPI or hand sanitizer intervention.

The PIPP adopted and slightly adapted the key elements of the City of Berkeley Public Health Division's "WHACK the Flu" campaign as the main intervention structure.[15] This intervention has been shown to be safe, appropriate, and acceptable to the target population.[16] WHACK stands for:

- **W**ash or sanitize your hands often
- **H**ome is where you stay when you are sick
- **A**void touching your eyes, nose, and mouth
- **C**over your coughs and sneezes
- **K**eep your distance from sick people

This campaign engaged key school personnel (teachers, nurses, and administrators), students, and

parents in a series of educational activities aimed at increasing basic understanding of the flu, why flu prevention is important, and ways to prevent the spread of flu. In addition, staff and teachers received grade-appropriate information about "germs" and influenza, called "Flu101." The PIPP created presentations built around two core educational videos ("Scrub Club,"[17] "Why Don't We Do It in Our Sleeves"[18]). These curricula provided the context for the intervention and also allowed for integration into existing school and science curricula and projects (as appropriate per school). The PIPP provided materials and information for teachers to integrate into existing health/science lessons.

The PIPP staff provided a comprehensive intervention for students in the fall of 2007, which included the topics of germs and how they are spread, and the WHACK principles, with specific material on hand washing and using sanitizer and covering coughs and sneezes. Hand sanitizer was provided to intervention schools. It was placed in classrooms and other common areas such as the cafeteria, gymnasium, office, and school nurse's office. Schools were asked to adopt the use hand sanitizer four times per day—upon arrival, before lunch, after lunch, and before departure.

The behavior change associated with the intervention was evaluated through a survey of homeroom teachers in intervention schools conducted on three occasions: prior to the flu season and the application of the intervention (October 2007), during flu season (February 2008), and post–flu season (May 2008). These time points were chosen to establish a baseline, assess whether the students adopted the interventions, and persisted in using them over an extended period of time. Only data from homeroom teachers were used, and only when the same teacher was present for all three surveys. This was done to ensure consistency of observation throughout the school day and year. Teacher participation was voluntary and they were offered a $5 gift card as an incentive to complete each survey.

Teachers were asked to observe their students in multiple ways regarding "WHACK"-based activities. Class behavior was scored by the teacher as an aggregate, based on observations of individual students. The survey also attempted to measure perceptions about the frequency with which sick children came to school (despite public health and school recommendations to stay at home). Table 1 details the survey. There was no opportunity for teachers to observe the last "WHACK" message—"Keep your distance from sick people"—among the students.

The surveys were also administered to all homeroom teachers in control schools after flu season (May 2008) to provide a comparison between schools that received the intervention and those that did not.

A repeated-measures ANOVA was used comparing the change in mean scores over time for each teacher to assess adoption and persistence of NPI use. Adoption is a measure of the students' ability to change behavior and persistence is a measure of the students' ability to continue the behavior over an extended period (6 months). Adoption of the NPI compared the change in mean score between the preintervention period and the intervention period. Persistence of the NPI compared the change in mean score between the intervention period and the postintervention period. To account for the possibility that teacher responses may have clustered by school, we incorporated school as a class variable that served as a between-subjects factor. The interaction effect tested whether the change in scores over time varied by school. Each test was conducted at the 0.05 significance level. No a priori hypotheses were made regarding the change in mean scores; thus, an alpha correction factor was not used. All analyses were conducted with the SAS system 9.2 (SAS, Cary, North Carolina).

All research protocols were approved by the University of Pittsburgh Institutional Review Board #REN08060022/PRO07060250.

Results

The survey sample consisted of 74 of 82 homeroom teachers (90%) in the intervention group, and 77 of 85 homeroom teachers (91%) in the control group. The difference in the response rate is not statistically different. From the eight surveys missing in the intervention group, there were one instance where the homeroom teacher changed during the school year, three instances where the homeroom teacher was on leave during a survey period, and four instances where the teachers would not complete the survey. Two teachers completed the first two surveys but not the third and were included in the first part of the analysis only. In the control group, all eight missing did not respond.

Eighteen of the 19 survey questions were specifically related to knowledge and behavior regarding four of the five letters in WHACK (not the K), and students' or teachers' knowledge about the spread of germs ("Flu 101") and individual responses for each question are grouped into related sections as noted later. Question 12 asks teachers to report the general number of students coughing/sneezing during class as a measure of illness in the class (Table 2).

Students were observed to make and persist in meaningful and statistically significant improvements in their hand-washing frequency and in using hand sanitizer at least twice per day. The number of students using hand sanitizer four times per day

TABLE 1 ● Survey instrument

Please CIRCLE the best answer. These questions refer to activities you participate in or observe *in your classroom.* CIRCLE YOUR ANSWER

1. How many of your students wash their hands more than 3 times per school day?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

2. The number of times I wash and/or sanitize my hands each day is _____.

3. How many parents in your school keep their children home from school when they show signs of illness?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

4. How many of your students cover their coughs and sneezes?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

5. How many of your students pick their noses?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

6. How many of your students use hand sanitizer at least twice a day?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

7. How often do you have an ill student(s) report to your class?

1	2	3	4	5
Daily per week	2–3 times	Weekly	Monthly	Never

8. When your students cough or sneeze, how many do so into their elbow or their shirts?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

9. How many of your students rub their eyes?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

10. How many of your students sneeze into their bare hand?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

11. How often do you have to send a student to the nurse or office due to illness?

1	2	3	4	5
Daily per week	2–3 times	Weekly	Monthly	Never

12. During winter cold/flu season, how many students are coughing/sneezing in class?

1	2	3	4	5
Almost none are	Few are	About half are	Most are	Almost all are

13. How many students use hand sanitizer at least 4 times per day?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

14. How many of your students put their hands in their mouth?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

15. On average, the number of times per day my students either wash or sanitize their hands is_____.

16. How often do your students cough/sneeze into the air?

1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do

(*continues*)

TABLE 1 Survey instrument (*Continued*)

17. My students understand how to stop the spread of germs?				
1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do
18. My students care about preventing the spread of germs in school?				
1	2	3	4	5
Almost none do	Few do	About half do	Most do	Almost all do
19. The students, staff, and faculty in our school are concerned about spreading germs.				
1	2	3	4	5
Almost none are	Few are	About half are	Most are	Almost all are

significantly increased during flu season but did appear to drop off somewhat after flu season (though still remaining substantially higher than prior to flu season). Interestingly, teachers did not report increasing their hand washing/sanitizer use during flu season and even reported some decline post–flu season. All responses except teacher usage were significantly higher in intervention than control schools (Table 3).

Students were observed to make and persist in meaningful and statistically significant improvements in their understanding of the main points of the "Flu 101" curriculum. Intervention school students were observed to be more knowledgeable than their control school counterparts (Table 4).

Students were observed to make and persist in meaningful and statistically significant improvements in all categories in this section, including covering coughs and sneezes, increasing their frequency of coughing into their elbow or shirt, and decreasing their frequency of coughing or sneezing into the air or into their hand. All responses were significantly higher in intervention than control schools (Table 5).

TABLE 2 Mean teacher survey observations regarding behaviors related to "Wash or Sanitize Your Hands Often"

	Pre–flu season, mean	Flu season, mean	Within subject, *P*	School effect, *P*	Interaction, *P*
Adoption of behavior in intervention schools: Pre–flu season versus flu season results					
Q1: Students wash hands more than 3× day	2.67	3.88	<.0001	.2165	.4717
Q2: Teacher wash/sanitize: times per day	7.73	7.38	.483	.0164	.672
Q6: Students use hand sanitizer 2× day	2.71	4.59	<.0001	.0493	.0099
Q13: Students use hand sanitizer 4× day	1.88	3.79	<.0001	.6027	.0075
Q15: Average number of times students wash/sanitize: times per day	2.74	3.88	<.0001	.1836	.0061
Persistence of behavior in intervention schools: Flu season versus post–flu season results					
Q1: Students wash hands more than 3× day	3.87	3.71	.2913	.8128	.1965
Q2: Teacher wash/sanitize: times per day	7.32	6.42	.0295	.022	.5991
Q6: Students use hand sanitizer 2× day	4.58	4.38	.0641	.216	.6432
Q13: Students use hand sanitizer 4× day	3.70	3.18	.0027	.0865	.2163
Q15: Average number of times students wash/sanitize: times per day	3.88	3.95	.4745	.1832	.3864

Note. There are small differences in the flu season mean values here and those above. Two teachers did not complete post–flu season surveys and were not included in this analysis.

	Intervention, mean	Control, mean	*P*
Intervention versus control (post–flu season)			
Q1: Students wash hands more than 3× day	3.71	3.35	.0415
Q2: Teacher wash/sanitize: times per day	6.42	6.53	.8608
Q6: Students use hand sanitizer 2× day	4.38	2.82	<.0001
Q13: Students use hand sanitizer 4× day	3.18	1.89	<.0001
Q15: Average number of times students wash/sanitize: times per day	3.95	3.08	.0144

TABLE 3 ● Mean teacher survey observations regarding behaviors related to: Student learning and caring about the spread of germs

	Pre–flu season, mean	Flu season, mean	Within subject, *P*	School effect, *P*	Interaction, *P*
Adoption of behavior in intervention schools: Pre–flu season versus flu season results					
Q17: Students understand how to stop spread of germs	2.9	3.94	<.0001	.0181	.2757
Q18: Student care about spread of germs	2.84	3.78	<.0001	.0313	.4073
Q19: Students, faculty and staff care about spreading germs	4.39	4.48	.6084	.0686	.0735

	Flu season, mean	Post–flu season, mean			
Persistence of behavior in intervention schools: Flu season versus post–flu season results					
Q17: Students understand how to stop the spread of germs	3.94	4.00	.6097	.1915	.553
Q18: Student care about the spread of germs	3.78	3.82	.8573	.5508	.1036
Q19: Students, faculty, and staff care about spreading germs	4.49	4.57	.2556	.2295	.1619

Note. There are small differences in the flu season mean values here and those above. Two teachers did not complete post–flu season surveys and were not included in this analysis.

	Intervention, mean	Control, mean	*P*
Intervention versus control (post–flu season)			
Q17: Students understand how to stop the spread of germs	4.00	3.14	<.0001
Q18: Student care about the spread of germs	3.82	2.99	<.0001
Q19: Students, faculty, and staff care about spreading germs	4.57	4.15	.0032

TABLE 4 ● Mean teacher survey observations regarding behaviors related to "Cover Your Coughs and Sneezes"

	Pre–flu season, mean	Flu season, mean	Within subject, *P*	School effect, *P*	Interaction, *P*
Adoption of behavior in intervention schools: Pre–flu season versus flu season results					
Q 4: Students cover coughs and sneezes	3.16	3.69	<.0001	.6818	.8281
Q8: Students cough or sneeze into elbow or shirt	2.26	3.14	<.001	.1329	.6445
Q10: Students sneeze into base hand	3.63	2.73	<.0001	.8358	.7495
Q16: Students cough/sneeze into air	2.66	2.34	.0395	.6878	.9652

	Flu season, mean	Post–flu season, mean			
Persistence of behavior in intervention schools: Flu season versus post–flu season results					
Q 4: Students cover coughs and sneezes	3.68	3.76	.309	.9332	.3151
Q8: Students cough or sneeze into elbow or shirt	3.13	3.52	.0016	.3851	.9772
Q10: Students sneeze into base hand	2.72	2.78	.7332	.2134	.1095
Q16: Students cough/sneeze into air	2.34	2.37	.8521	.5728	.841

Note. There are small differences in the flu season mean values here and those above. Two teachers did not complete post–flu season surveys and were not included in this analysis.

	Intervention, mean	Control, mean	P
Intervention versus control (post–flu season)			
Q 4: Students cover coughs and sneezes	3.76	3.29	.0019
Q8: Students cough or sneeze into elbow or shirt	3.52	2.36	<.0001
Q10: Students sneeze into base hand	2.78	3.33	.0028
Q16: Students cough/sneeze into air	2.37	2.74	.0269

TABLE 5 Mean teacher survey observations regarding behaviors related to "Home Is Where You Stay When You Are Sick"

	Pre–flu season, mean	Flu season, mean	Within subject, *P*	School effect, *P*	Interaction, *P*
Adoption of behavior in intervention schools: Pre–flu season versus flu season results					
Q3: Parents keep sick child home from school	3.09	3.36	.0126	.0073	.839
Q7: Ill student reports to class	3.03	2.99	.3998	.6327	.3295
Q11: Send an ill student to nurse	3.4	3.40	.9227	.1877	.8751
	Flu season mean	**Post–flu season mean**			
Persistence of behavior in intervention schools: Flu season versus post-flu season results					
Q3: Parents keep sick child home from school	3.35	3.26	.4005	.0064	.9545
Q7: Ill student reports to class	2.97	3.29	.008	.9124	.3671
Q11: Send an ill student to nurse	3.36	3.53	.0762	.399	.5711
	Intervention, mean	**Control, mean**	***P***		
Intervention versus control (post–flu season)					
Q3: Parents keep sick child home from school	3.26	3.23	.8282		
Q7: Ill student reports to class	3.29	2.78	.0007		
Q11: Send an ill student to nurse	3.53	3.1	.0018		

Note. There are small differences in the flu season mean values here and those above. Two teachers did not complete post–flu season surveys and were not included in this analysis.

Teachers reported that parents were more likely to keep their sick children at home during flu season, and this behavior persisted over time. Ill students were less likely to report to class, but only during the later part of the flu season. The necessity of sending an ill student to the school nurse was unchanged. All responses were significantly higher in intervention than control schools, except for responses to question 3, which were not different (Table 6).

Teachers did not observe any measurable differences in the students touching their eyes, nose, and mouth over time. Students in intervention schools were observed to pick their noses less with borderline significance.

Students were observed in class during winter cold/flu season (Question 12). Question 12 asks teachers to estimate the general number of students who are coughing and/or sneezing in class during the winter cold/flu season. There was no significant difference between control and intervention schools (3.41/5 intervention vs 3.50/5 control, $P = .5425$).

Interactions

The significant interaction *P* values for hand washing/sanitizing (questions 6, 13, and 15) reflect differences in mean scores by school, indicating that at least one school had a larger mean increase than the other schools. Two schools had used sanitizer previously on a regular basis, one in classrooms and the other in the school cafeteria. No other questions had significant interaction *P* values.

Conclusions and Discussion

The PIPP study provides evidence that children can learn about, implement, and persist in performing a suite of hygiene-based NPIs in an urban school setting during influenza season. Children not only improved hygiene behavior but with rare exceptions also retained it for more than 4 months after the final educational intervention. They washed their hands more, used alcohol-based hand sanitizer frequently and safely, covered their coughs and sneezes, and gained an improved understanding of the nature and danger of "germs" such as influenza. Parents appeared to keep their sick children home more in the intervention schools, suggesting that they had also been positively affected by the "WHACK the Flu" campaign.

The PIPP is the first full-scale test of a multilayered NPI from before, during, and after flu season. The behaviors included in the WHACK message are likely to be useful in the prevention of seasonal influenza, pandemic influenza, and for other microbes that can be prevented using these simple techniques.

Although the data are derived from teacher observation and reporting, the authors believe that there

TABLE 6 Mean teacher survey observations regarding behaviors related to "Avoid Touching Your Eyes, Nose, and Mouth"

	Pre–flu season mean	Flu season mean	Within subject, *P*	School effect, *P*	Interaction, P
Adoption of behavior in intervention schools: Pre–flu season versus flu season results					
Q5: Students pick noses	2.33	2.33	.8637	.6955	.9449
Q9: Students rub eyes	3	3.11	.5744	.8562	.0928
Q14: Students put hand in mouth	2.77	2.59	.3515	.8203	.3083
	Flu season, mean	**Post–flu season, mean**			
Persistence of behavior in intervention schools: Flu season versus post–flu season results					
Q5: Students pick noses	2.33	2.32	.822	.8817	.8361
Q9: Students rub eyes	3.13	3.04	.6009	.4546	.2113
Q14: Students put hand in mouth	2.61	2.66	.917	.4873	.2453
	Intervention, mean	**Control, mean**	***P***		
Intervention versus control (post–flu season)					
Q5: Students pick noses	2.32	2.66	.0498		
Q9: Students rub eyes	3.04	3.08	.883		
Q14: Students put hand in mouth	2.66	2.9	.1724		

Note. There are small differences in the flu season mean values here and those above. Two teachers did not complete post–flu season surveys and were not included in this analysis.

is evidence that these changes were real. The teachers' responses about their own hand-washing behavior were both stable over time and not different between intervention and control schools. In addition, teachers noted the greatest improvements in the categories that received the most emphasis or were taught most creatively—Wash or sanitize your hands, Flu 101, and Cover your coughs and sneezes. The parts of the program that showed the least effect ("avoid touching your eyes, nose, and mouth") were also the ones that received the least emphasis during the "WHACK the Flu" training sessions. So the teachers' observations are consistent with the staff's perception of the various training elements. In addition, although the study ensures that the same homeroom teachers answer each survey, the surveys were several months apart and the teachers did not have access to their previous answers; these factors may reduce the chances of systematic bias.

In addition, the overall study design was robust. It was a randomized trial that used a quantitative methodology to measure change in behavior, included the observations by 149 home room teachers of 3 800 students in 10 schools, and was of extended duration.

The study has real limitations. More rigorous methods of behavioral measurement, such as independent observations of behaviors, like hand sanitization and covering of coughs and sneezes, could have been performed. Independent observation of behavior, although difficult to arrange in a public school setting, would certainly remove the concern of reporter bias. Student self-reports could also have been used to augment the teacher observations, although the young age of the students (grades K-5) would limit this option to the higher grades. Teachers could also have felt pressure to produce the "right" answers, those that the investigators expected, or that reflected their pride in their children learning the lessons that had been taught. Teachers in the intervention schools were taught the intervention and this might have led to bias in their perceptions.

Control or intervention schools having significantly greater illness could be a confounding factor in this analysis. While question 12 in the survey attempted to assess this and found no significant difference in control and intervention schools, a more rigorous measurement would have included some external measurement of illness.

While the results of this study suggest that a multilayered intervention can be implemented and adopted by elementary school students, additional research is warranted. Improvements in the manner and style of the intervention might show better results in the weaker categories. This study could be repeated as a multicenter study with urban, suburban, and rural populations in order to represent a more comprehensive cross section of the country. Additional grades should be included, and this same process should be applied to preschools and daycare centers. Future studies should

identify less subjective measures of change that are not subject to personal perceptions. Our analysis did not evaluate the effect of NPI use by age or grade, which should be the subject of future research as significant variation may exist. Lastly, because the "intervention" was really a suite of multiple and related interventions, it is not possible to estimate which may be more important than the other. Future research could try to separate out the individual elements and provide more data regarding the effect of each activity.

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