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RESEARCH ARTICLE

Factors Influencing School Closure and Dismissal Decisions: Influenza A (H1N1), Michigan 2009

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ABSTRACT

BACKGROUND: In fall 2009, many US communities experienced school closures during the influenza A H1N1 pandemic (pH1N1) and the state of Michigan reported 567 closures. We conducted an investigation in Michigan to describe pH1N1-related school policies, practices, and identify factors related to school closures.

METHODS: We distributed an online survey to all Michigan K-12 school principals. Descriptive statistics and chi-square tests summarize school policies, practices, adherence to government guidelines, and differences between schools that closed and those that remained open during the pandemic.

RESULTS: Of 4441 traditional K-12 Michigan schools, 937 (21%) principals responded to our survey representing approximately 374,000 students and 17,700 teachers. The majority (88%) of schools had influenza preparedness plans and followed government school influenza guidelines. Among respondents, 15% (137/937) of schools closed in fall 2009 with high absenteeism as the primary reason for closure. Schools that closed reported significant illness in their school, had <300 students, and had invested substantial resources preparing and responding to influenza.

CONCLUSIONS: Adherence to government guidelines for schools appears high in Michigan. Closures occurred in schools that reported significant illness and were likely motivated by excessive absenteeism. Understanding factors related to closures during pH1N1 may inform future pandemic preparedness efforts.

Keywords: influenza; Michigan; non-pharmaceutical interventions; pandemic flu; school closure policy.

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Approximately 55 million children attend school each day in the United States. Schools are unique settings that can impact influenza (flu) transmission dynamics in a community.[1] The Centers for Disease Control and Prevention (CDC) estimated that 41-84 million cases of pandemic influenza A H1N1 (pH1N1) occurred from April 2009 to mid-January 2010, with roughly 19 million (range 13-27 million) of the cases among ≤17-year-old children.[1] School closure is cited in published reports as a possible strategy to mitigate pandemic flu.[2-11] To prepare for pH1N1 in the 2009-2010 school year, the CDC provided the following document, ''Guidance for State and Local Public Health Officials and School Administrators (K-12).''[12] Many states also provided guidance to school administrators regarding pH1N1. Federal recommendations for the 2009-2010 school year included a variety of strategies, such as separating ill students and staff, promoting hand hygiene/respiratory etiquette, and routine cleaning. School dismissal was recommended for certain circumstances based upon the local situation, such as high absenteeism, protection of high-risk students, or increased severity of illness.

School closures were reported from communities across the United States as a result of pH1N1, primarily due to high absenteeism.[13] In Michigan, the Department of Community Health (MDCH) recorded 567 school closures, affecting an estimated

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188,000 children and teachers, in the second wave of pH1N1during fall 2009 (MDCH unpublished data, 2009). The majority of these closures occurred from mid-October to mid-November (MDCH unpublished data, 2009). The peak of closures occurred on October 22, 2010, when 82 schools were closed in a single day (MDCH unpublished data, 2009).

The MDCH requested the CDC's assistance in conducting an investigation in November and December 2009 to (1) describe pH1N1-related school policies and practices; (2) measure school adherence to CDC and MDCH guidelines during a period of increased influenza-like illness (ILI) reporting in fall 2009; and (3) identify the factors impacting decision making related to pH1N1 school closures. The investigation, conducted during December 2009, focused specifically on such policies and practices as influenza preparedness, communication, and use of non-pharmaceutical interventions (NPIs) in schools.

METHODS

Participants

At the time of the survey, approximately 4777 public and non-public schools in Michigan represented over 1.5 million students. There were 791 local educational agencies or ''school districts,'' which were aggregated into 58 intermediate educational service agencies, which coordinate administrative services among multiple school districts. The state's 83 counties were divided into 8 public health preparedness regions.

Survey recruitment was conducted with the assistance of the Michigan Department Education (MDE). An e-mail describing the survey, with a link to a secure online survey generator, was sent by the MDE to all superintendents and principals of K-12 schools in the state. This included traditional K-12 schools, as well as non-traditional educational entities such as special education centers, early childhood education centers, preschools, or adult education centers. Surveys were to be completed by school superintendents and principals or designee such as a school administrator, a school nurse, or other school official with an understanding of the characteristics and policies of the school or school district.

Survey Instrument and Procedure

The survey collected school-related demographic information, including characteristics of the school, staff, and students, as well as access to health-care personnel such as a school nurse, influenza preparedness plans and practices, and influenza communication strategies. Schools were provided a list of possible interventions and asked if the intervention was part of their flu plan. Schools that had closed were asked additional questions related to closure decision making, closure dates, and information on class attendance before and after these dates. The survey could be completed in 15 to 20 minutes. Participants had the option of completing the survey online or faxing the completed survey to the MDCH.

Data Analysis

Survey data were cleaned and analyzed in SAS 9.2 (SAS, Cary, NC). If duplicate surveys were received, the most complete survey was retained for analyses. Respondent schools were linked to the Michigan Center for Educational Performance and Information (CEPI) database, which contained key school-level information on enrollment, educational level (elementary, middle, and high school), geographic location, and student/teacher ratios of both public and non-public schools. For all public school respondents, data also were obtained on student race and ethnicity, sex, and the percentage of students eligible for free and reduced lunch programs. On the basis of the Michigan CEPI database, we estimated that there were 4441 traditional public and non-public schools during the study period. Of these schools, 3363 were public schools, 289 public school academies (PSA), and 789 were non-public schools. Non-traditional facilities, including special education centers, early childhood education centers, preschools, or adult education centers were excluded from our analysis, because these facilities were likely to have policies and practices different from those of traditional schools. Traditional schools which could not be linked to the CEPI database were also excluded. Our analysis focused on surveys received from school principals from the 4441 traditional K-12 schools, due to difficulties in obtaining district-level demographic data for entire school districts.

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Descriptive statistics were generated to summarize characteristics of the respondent schools, and bivariate analysis by Pearson chi-square tests was used for comparisons. A p value of .05 was used to assess statistical significance. Missing values for survey questions were excluded from the analysis.

RESULTS

A total of 1214 principals and superintendents responded to the survey. Seventy-two respondents whose survey could not be linked to the CEPI database were excluded from the analysis. Twenty-seven respondents representing non-traditional schools and 178 surveys received from school district superintendents were also excluded. Our analysis included the remaining 937 school principal respondents from traditional K-12 schools, reflecting a school-level participation rate of 21% (937/4441). All 8 public health preparedness regions and 92% (76/83) of all Michigan counties were represented in the survey. All intermediate Educational Service Agency (58/58) and 53% (422/791) of school districts were represented. Responders and nonresponders differed in several areas (Table 1). Statistically, more public schools responded than PSA and non-public schools ($p < .01$). Survey response was also statistically associated with school institutional level (Table 1).

Table 1. **Demographic and Socioeconomic Characteristics of Respondent and Nonrespondent K-12 Schools—Michigan, 2009**

	Responders		Nonresponders		p
School Characteristic	**(N = 937)**	**%**	**(N = 3147)**	**%**	**Value**
School type					
Public school	749	80.4	2268	72.1	<.01
Public school academy (PSA)	48	5.0	229	7.3	
Non-public school	140	14.3	650	20.7	
Number of students	374,023 (798)		1,046,399 (2417)		
Number of teachers	17,729 (793)		49,985 (2406)		
Pupil/teacher ratio	21.1		20.9		
Instructional level					
Elementary-high school	46	4.9	246	7.8	<.01
Elementary	423	45.1	534	17.0	
Elementary-middle	136	14.5	1288	41.0	
Middle school	114	12.2	369	11.8	
Jr/Sr high school	30	3.2	160	5.1	
High school	188	20.1	543	17.3	
Sex					
Male	191,772	51.3	536,334	51.3	.854
Female	182,251	48.7	510,065	48.7	
Students eligible for free meals/ reduced meals*	159,470	41.7	485,594	43.9	<.001
Ineligible	223,026	58.3	621,549	56.1	
Ethnicity*					
American Indian	3303	.9	9426	0.9	<.001
Asian	9039	2.4	28,549	2.7	
African American	51,453	13.8	197,347	18.9	
Hispanic White	460	0.1	1275	0.1	
White	290,681	77.7	745,771	71.3	
Hispanic	15,969	4.3	51,395	4.9	
More than one race	3118	0.8	12,636	1.2	

*Note that only public schools had data on several variables including free and reduced lunch, and race and ethnicity. Pupil/teacher ratio was calculated using sex data and full-time teacher data; however, 144 schools were missing data on either sex or full-time teacher data in the CEPI data set.

School Policies and Practices Regarding Flu

Of the 43% (381/891) of respondents reporting student access to a school nurse, the majority (90%, 347/391) were public schools. Only 4% (36/910) of respondents reported having a health center, staffed with an onsite physician assistant, nurse practitioner, or physician. Overall, 88% of school respondents stated their school had a flu plan, with 57% (497/869) stating their school flu plan remained unchanged during the 2009 fall term and 31% stating that they made changes to their flu plan sometime during the fall.

About 52% (480/919) of respondent schools reported that pH1N1 flu caused significant illness in their school during the fall. About 78% (720/918) stated that their school invested a lot of time and resources preparing for pH1N1 flu, and 65% (597/916) stated that school staff had spent significant time and resources responding to pH1N1. Finally, 87% (796/915) reported that they believed their interventions made a difference in preventing flu in their school.

The most common source of influenza information was the local health department (92%), followed by MDCH (80%), CDC (69%), and MDE (63%). Roughly 65% of respondents indicated that they also received information from their local school district. Other sources of information included the media (27%) or local physicians (17%).

School staff communicated with parents using letters, handouts, meetings, and postings on the school website, and with students through school announcements and posters (Table 2). Prevention messages addressed recommendations for proper cough etiquette, good hand hygiene, and staying home when sick. A small percentage of schools (18%) reported developing influenza material in another language, most commonly in Spanish and Arabic.

Adherence to MDCH and CDC Guidelines for Increased Influenza-like Illness in Schools

Survey respondents indicated that school staff implemented many of the NPI measures recommended by the MDCH and CDC for managing influenza. About 61% of schools reported having a room exclusively dedicated for the isolation and care of students and staff with ILI, and 86% reported following MDCH and CDC guidelines recommending that children with ILI symptoms stay home until they are free

Table 2. **Survey Responses Regarding Messaging and Use of Non-Pharmaceutical Interventions in Schools — Michigan, 2009**

Messaging and Use of Non-Pharmaceutical Interventions (NPIs) Regarding the Flu	Number of Participants	Percentage
Communication to parents		
Letters sent home	775/832	93
Handouts for parents	729/802	91
Parent meetings	330/666	50
Posting to school website	662/770	86
Communication to students		
School announcements	560/705	79
Posters	663/757	88
Prevention messages to students		
Cover your cough	871/877	99
Wash your hands	876/877	99
Stay home when sick	870/876	99
Use hand sanitizer	847/861	98
Eat healthy food	704/787	89
Get adequate rest	756/827	91
See your doctor for flu-like symptoms	733/821	89
NPI used by schools		
Room dedicated exclusively for ill children/staff	534/881	61
Recommended ill children stay home for 24 hours post fever resolution	761/880	86
Hand sanitizer available in classroom	491/881	56
Hand sanitizer available in cafeteria	317/881	36
Tissues available in classroom	860/881	98
Tissues available in offices	836/881	95
Increased cleaning of surfaces	764/822	93
Using all 4 interventions (increasing tissue, soap, sanitizer, and more frequent cleaning)	484/836	58

Table 3. **Demographic and Socioeconomic Characteristics of K-12 Schools That Closed During Fall 2009 Term vs Schools That Did Not, Michigan 2009**

	School Closure				
School Characteristic	Yes (N = 137)	%	No (N = 800)	%	p Value
School type					
Public school	111	81.0	638	79.8	.93
Public school academy (PSA)	7	5.1	41	5.1	
Non-public school	19	13.9	121	15.1	
Number of students	46,390		327,633		
Number of teachers	2312		15,417		
Pupil/teacher ratio	20.1		21.3		
Instructional level					
Elementary-high School	9	6.6	37	4.6	.07
Elementary school	54	39.4	369	46.1	
Elementary-middle school	23	16.8	113	14.1	
Middle school	12	8.8	102	12.8	
Jr/Sr high school	9	6.6	21	2.6	
High school	30	21.9	158	19.8	
Sex					
Male	23,939	51.6	167,833	51.2	.13
Female	22,451	48.4	159,800	48.8	
Students eligible for free meals or reduced meals*	21,571	48.3	137,899	40.8	<.001
Non-eligible	23,068	51.7	199,958	59.2	
Ethnicity*					
American Indian	1082	2.3	2221	0.7	<.001
Asian	412	0.9	8627	2.6	
African American	1866	4.0	49,587	15.1	
Hispanic White	58	0.1	402	0.1	
White	41,082	88.6	249,599	76.2	
Hispanic	1518	3.3	14,451	4.4	
More than one race	372	0.8	2746	0.8	

*Note that only public schools had data on several variables including free and reduced lunch, and race and ethnicity. Pupil/teacher ratio was calculated using sex data and full-time teacher data; however, 144 schools were missing data on either sex or full-time teacher data in the CEPI data set.

of fever for at least 24 hours without the use of fever-reducing medications. Some schools reported additional requirements, such as a physician's note (16%), staying home for at least 3 days (3%), or staying home for 1 week (1%).

Over half of schools (58%) reported using a combination of four interventions (increasing sanitizer, tissues, soap, and cleaning) at some point during the fall term, and some sustained interventions throughout the entire 2009 fall term (Table 2). Roughly 4% of respondents canceled or postponed activities such as field trips, music/theater practices or performances, or after-school programs, and 9% canceled sporting practices or games. The majority of cancelations occurred from mid-October to late November 2009.

The 3 NPI measures that schools most frequently reported implementing were active screening of students and staff for respiratory or ILI (14%), extending the recommended period for ill persons to stay home (21%), and moving desks further apart (9%). Dividing classes into smaller groups, holding classes outdoors, moving classes to larger spaces, and employing crowd-reducing methods of transportation were not part of respondent's school flu plans.

Factors Associated With School Closures

Overall, 15% (137/937) of school principals responding to this survey indicated that their school had closed during the 2009 fall term. The majority (81%, 111/137) of closures affected public schools. Roughly 14% of non-public schools (19/137), and 5% of PSA (7/137) had closed (Table 3). The four most important reasons cited by principals for school closure were excessively high student absenteeism (91%, 125/137), to prevent the spread of flu (89%, 122/137), to clean the school (60% 82/137), and because of a district-wide closure in which all schools in the district were closed (43%, 59/137). School superintendents (92%, 117/127), school principals (66% 83/126), and the local health department staff (53%, 63/118) were cited as the personnel being highly or

moderately involved in the closure decision-making process.

Of the 111 schools providing their school closure data, the average duration of school closure was 4.7 days with a range of 1-8 days. Principals were asked to estimate their daily rate of absenteeism in their school 3 days before and 3 days after closure. Median absenteeism rose steadily, from 15% 3 days prior to 23% on the day before school closure and declined from 12% to 8% in the 3 days after school reopening.

Schools that closed (Table 4) were more likely to report that the flu caused significant illness in their school during the fall (86% vs 46%, $p < .0001$) and state that they invested resources preparing (85% vs 77%, $p = .04$) and responding to flu (86% vs 62%, $p < .001$). Schools that stated that their interventions made a difference in preventing flu were less likely to close (79% vs 88%, $p < .0004$). School type whether a school was public or non-public, and educational level were not significantly associated with school closure ($p = .20$). However, the size of the school was associated with school closure, with smaller schools (<300 students) more likely to close than larger ones (42% vs 33% $p = .04$). Schools that closed were more likely to cancel or postpone at least one extracurricular activity than those who did not (56% vs 4.5%, $p < .001$).

Table 4. **Characteristics and Practices of K-12 Schools That Closed vs Schools That Did Not—Fall 2009, Michigan**

Variable	School Closure Yes N (%)	No N (%)	Chi-Square p Value
Flu caused significant illness in my school (True)	118/137 (86)	355/769 (46)	<.001*
Invested resources preparing for flu (True)	117/137 (85)	595/768 (77)	.0369*
Invested resources responding to the flu (True)	118/137 (86)	472/766 (62)	<.001*
Our interventions made a difference preventing flu (True)	106/136 (78)	681/766 (89)	.0004*
School type (Public)	109/137 (80)	616/787 (78)	.735
Presence of school nurse (Yes)	58/135 (43)	323/756 (43)	.990
Presence of isolation room for sick students/staff (Yes)	68/123 (55)	461/744 (62)	.160
Educational level			
Elementary-high school	9/137 (7)	37/800 (5)	.204
Elementary-middle school	23/137 (17)	113/800 (14)	
Elementary school	54/137 (39)	369/800 (46)	
Middle school	12/137 (9)	102/800 (13)	
Jr/Sr high school	9/137 (7)	21/800 (3)	
High school	30/137 (22)	158/800 (20)	
School enrollment			
<300 children	57/137 (42)	263/787 (33)	.036*
301-500 children	53/137 (38)	289/787 (37)	
>501 children	27/137 (20)	235/787 (30)	
Flu plan			
No flu plan	11/110 (10)	46/704 (7)	.045*
We had a flu plan and was unchanged	73/110 (66)	413/704 (59)	
We had a flu plan but changed it this fall	26/110 (24)	246/704 (34)	
Canceled activities			
≥1 activity	66 (56%)	33 (4.5%)	.001*

*Denotes a statistically significant p value.

DISCUSSION

We analyzed data provided by principals of 937 schools in Michigan, representing approximately 374,000 students and 17,770 teachers in all 8 public health preparedness regions of Michigan. We found that most K-12 schools surveyed implemented influenza-specific policies and practices during the fall 2009 pandemic (Table 4). Adherence to state and federal influenza control guidelines for the second pH1N1 pandemic wave during 2009 fall term was good. School closures were most commonly reactive, due to high student and teacher absenteeism.

Our survey provides insight into school policies and practices related to pH1N1 in Michigan schools in terms of preparedness, communication methods, and sources of information. The majority of schools responding to the survey had a flu preparedness plan in place at the time of the pandemic. Roughly one-third of these officials reported updating some aspect of their flu plan during the 2009 fall term. Our survey did not capture what these changes or updates to flu plans entailed, but likely they concerned the dynamic nature of the pH1N1 epidemic, which required educators and public health professionals to learn and adapt during the fall of the 2009-2010 school year.

Schools communicated with parents and students in a variety of ways and messages focused on NPI measures to prevent the spread of disease, including hand hygiene/respiratory etiquette and isolating ill students and staff. The use of multiple communication methods increased the likelihood that parents received essential information on the pandemic. The main sources of information for Michigan schools were local health departments and the MDCH. This finding highlights the strong link between education and local public health departments and the state health department in Michigan.

School respondents adhered to many of the recommendations provided by the CDC and MDCH, which include excluding ill students and staff for 24 hours after resolution of fever, the use of a sick room for separating ill students, and NPIs such as hand hygiene and respiratory etiquette. NPIs such as hand hygiene and respiratory etiquette are important flu mitigation strategies, and our findings were similar to those of a review of 7 school-based investigations by Iuliano et al,[14] reporting good adherence to these measures during the first wave in spring 2009 of the pandemic. This survey highlights the utility of

federal and state guidelines in developing pandemic preparedness and response plans.

During the investigation period, approximately 15% of schools surveyed had closed, with the majority of closures occurring from mid-October to late November. This finding mirrored data collected by the MDCH, which estimated that 13% (567/4441) of schools in Michigan had closed (unpublished data, MDCH). The CDC and MDCH guidelines did not recommend school closure during the second wave of the pH1N1 pandemic in fall 2009. Both state and federal guidelines recommended keeping schools open unless the local situation warranted due to factors such as high absenteeism, protection of high-risk students, or increased severity of pH1N1 illness. In our survey we found that multiple factors impacted closure decisions, but the primary reason for school closure was excessive student absenteeism. Median absentee rates for schools that closed steadily increased in the 3 days preceding the closure to 23%, and then declined in the days after school reopening. High absenteeism rates can compromise schools' and school districts' ability to function normally. This was the primary reason for 2 districts in Kentucky to close during a seasonal influenza-related outbreak in 2008.[15] Although the Kentucky study primarily focused on the impacts of school closures on families, it reported influenza-related absenteeism rates of >15% prior to closure. Another study of a school-based outbreak of pH1N1 in a Chicago community during the first wave of the pH1N1 pandemic in spring 2009 reported an absenteeism rate of 15% in the 2 days prior to school closure.[16]

In our survey, schools that closed were more likely to report that they had significant illness in their school, had an enrollment of <300 students, and had invested significant resources preparing for and responding to flu. About 71% of schools that closed served elementary and middle school students; this finding also is supported by published reports that younger children were disproportionally affected by the pH1N1 pandemic than older age groups. Unpublished syndromic surveillance data from the MDCH suggest that schools in regions where daily rates of emergency room visits for ILI in children aged 5-18 years were higher than the state average and were more likely to close than ones in regions reporting ILI visits below the state average.

Limitations

This investigation is subject to several limitations. First, the participation rate was 21%. This participation rate is similar to other school-based studies during pH1N1, where participation rates of less than 50% were cited as one of the common challenges of school-based surveys.[6] Due to time constraints and competing obligations, many school principals may not have adequate time to participate in optional surveys such as this one. The survey was administered during the preholiday period of December 7-24, 2009, which may have further added to our low response rate. Second, due to differences between responders and nonresponders, the results of the survey are unlikely to be representative of all K-12 schools in Michigan. Finally, we were unable to examine the influence of school district attendance policies in school closure decisions. Despite the fact that school closure was not a recommended strategy by either the CDC or MDCH, for the second wave of the pandemic, many schools in Michigan did choose to close. Schools may have closed as a result of school or school district attendance policies, and the interaction of high rates of absenteeism with attendance policies could not be directly addressed. However, in this survey, school principals ranked attendance policies below student absenteeism, preventing the spread of disease, and school cleaning as the most important factor in the school closure decisions, indicating that absenteeism may have been a central factor in the decisions. Measuring the relationship between state-level attendance policies and school closure decisions would be a valuable study for the future.

IMPLICATONS FOR SCHOOL HEALTH

We observed good adherence to state and national guidelines for schools during a period of increased influenza-like illness reporting and the pH1N1 pandemic in the state of Michigan. Schools in our study adhered to federal and state guidelines, but modified these guidelines to their situation. Therefore, future guidance should provide clear and actionable, but modifiable information on what schools can do to plan for and respond to pandemics such as flu. About 88% of schools had a plan in place, and 30% reported modifying their plan during 2009. Schools reported investing considerable time and resources preparing and responding to flu. However, many also felt their interventions made a difference. This may be related to the fact that schools and school officials had taken time to put a plan in place prior to the second wave of the pH1N1 pandemic. We found that schools closed as a strategy to prevent the spread of flu and because of high student absenteeism. On the basis of the best available evidence, federal and state guidelines should provide information to guide the need for school closure based on the characteristics of the outbreak, and if school closure is recommended, guidance on the timing, extent and duration of closure based on parameters that can be applied to local situations. State and local school districts, in conjunction with local health departments, should establish guidance on the need for closures based on attendance criteria and update pandemic preparedness plans as

needed. Findings from this investigation may help inform planning and pandemic preparedness efforts in schools and provide insight into the school closure decision-making process.

Human Subjects Approval Statement

The survey protocol was reviewed by Human Subjects Coordinators at both the CDC and MDCH and was determined to be nonresearch.

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