SURVEILLANCE, MONITORING ABSENTEEISM and RESPIRATORY TRANSMISSION in SCHOOLS (SMART^2)

A Report for the Canon-McMillan, Fox Chapel Area and Washington School Districts
October, 2016

INTRODUCTION

SMART^2 is a research study conducted by the University of Pittsburgh, Johns Hopkins University and the University of Florida. It is funded by the US Centers for Disease Control and Prevention (CDC). This study is part of a national effort to understand how children spread respiratory diseases, including influenza, in K-12 schools. This will help improve our public health response to pandemic influenza and other respiratory diseases. The first year of research was conducted from September, 2015 to May, 2016. This was a continuation of the SMART (Social Mixing and Respiratory Transmission) study conducted during 2011-2013.

For more information about SMART, SMART^2, the investigative team, and resources for fighting influenza, please visit our website at **www.smart.pitt.edu**

SCHOOLS

Three school districts in Western Pennsylvania (Pittsburgh, PA SMSA) participated in SMART^2, with students in grade levels K-12. Figure 1 shows the location of the three school districts in the study.

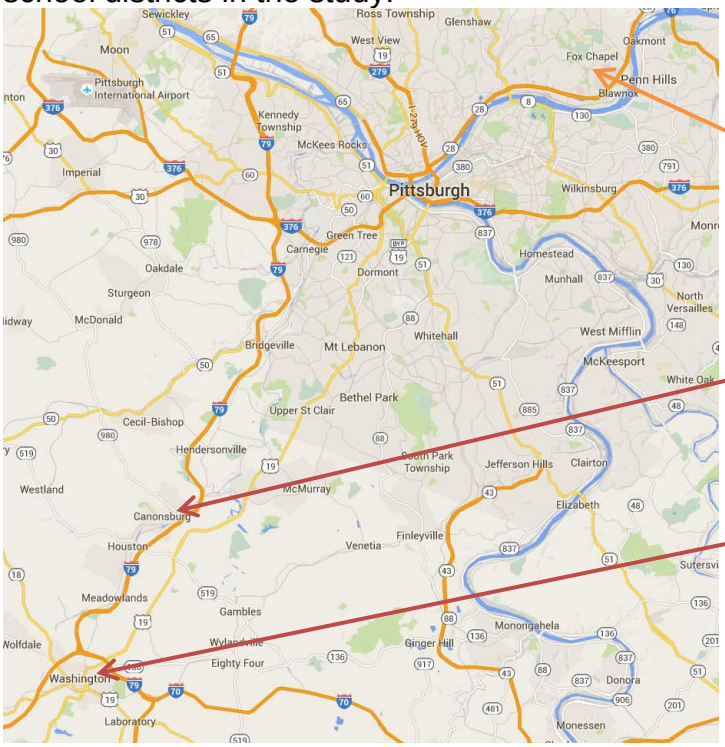


Figure 1:
SMART^2 Participating Schools and School Districts

Fox Chapel Area:
Fox Chapel Area HS
O'Hara Elementary

Canon-McMillan:
Cecil Elementary
Borland Manor Elementary
Hills Hendersonville Elem

Washington:
Park Elementary
Park Intermediate
Washington JHS
Washington SHS

There are ten schools in the Canon-McMillan School District (~4700 students), 4 schools in Washington School District (~1500 students), and 6 schools in Fox Chapel Area School District (~4600 students). SMART^2 worked with students from nine schools (Table 1).

Table 1: **SCHOOLS PARTICIPATING IN YEAR 1 OF THE SMART^2 STUDY**

District	School	Grades	Number of Students	% of students participating	Surveillance Period
Canon-McMillan	Borland Manor Elementary	K-3	680	87%	10/12/2015 – 5/13/2016
	Cecil Elementary	K-3			
	Hills Hendersonville Elementary	K-3			
Fox Chapel	O'Hara Elementary	K-5	1999	95%	1/19/2016 – 5/13/16
	Fox Chapel High School	9-12			11/5/2015 – 5/13/2016
Washington	Park Elementary	K-3	1489	98%	10/14/2015 – 5/12/2016
	Park Intermediate	4-6			
	Washington Jr High School	7-8			
	Washington Sr High School	9-12			

SIGNIFICANCE OF SMART^2

The primary goal of this project is to improve prediction and tracking of influenza activity in entire communities. This will be done by conducting surveillance of influenza and other respiratory illnesses in school-based populations and comparing this to surveillance conducted by public health authorities in the general community. Researchers will use this data to develop statistical methods that may improve prediction of influenza activity in communities and could be generalized for wide use across the country. Early warning of the timing and extent of an influenza epidemic or pandemic can substantially improve the preparation and response of healthcare services. This could allow community education in advance of the flu, gearing up to accommodate patient surge, and postponing or rescheduling routine non-essential activities.

METHODS

SMART^2 monitored absenteeism in target schools, covering all grades from Kindergarten to 12. Study staff determined the reason for absence and looked for a specific set of symptoms commonly associated with influenza, called Influenza-like Illness (ILI). Students with ILI were then tested for a range of respiratory illnesses.

SMART^2 has begun to use the data collected to compare measures of incidence of influenza and other pathogens in the schools under surveillance with data available from national, state and county level public health systems and the major healthcare

provider in Pittsburgh. The comparison will determine which systems and what output of existing surveillance systems are most predictive of influenza incidence.

This was done using the following actions:

1. Contact parents to determine the specific cause of absence, focusing on a specific set of symptoms which are typical of viral respiratory infections. This focused on ILI – influenza like illness - which is defined by the US Centers for Disease Control and Prevention as fever $\geq 100^{o}F$ coupled with cough or sore throat. Parents were contacted primarily through telephone, but also by email as preferred by each parent.
2. Obtain nasal swabs from students who have ILI and send these swabs for laboratory analysis using multiplex RT-PCR to determine the presence/absence of influenza and a panel of additional respiratory viruses. Students to be tested include:
    a. Students being sent home from school with ILI, who were swabbed before departure, if possible.
    b. Students who are reported as absent from school with ILI. These students were tested upon their return to school.
3. Enroll a cohort of families from the target schools to be contacted weekly for 8 weeks to determine if any respiratory illness has occurred in any family member in the past week.
4. Obtain and process surveillance data on laboratory confirmed influenza outcomes from the University of Pittsburgh Medical Center, Allegheny County Health Department, Pennsylvania Department of Health and US Centers for Disease Control.

Informed consent/assent was obtained in all cases using Institutional Review Board approved methods.

RESULTS

SMART^2 was able to identify 16,033 absence events during our study.

Table 2: SMART2 ABSENCE EVENTS

Grade	BME	CE	HH	OH	FCAHS	PE	PI	WJH	WSH	TOTAL
K	93	60	28	185		797				1163
1	128	139	119	207		488				1081
2	166	111	109	237		510				1133
3	196	124	106	292		493				1211
4	148	137	157	211			464			1117
5				224			480			704
6							422			422
7								466		466
8								513		513
9					1306				633	1939
10					1212				489	1701
11					1367				532	1899
12					1985				699	2684
TOTAL	731	571	519	1356	5870	2288	1366	979	2353	16033

We were able to determine the reason for absence in 7,065 cases (44%). We identified 687 students with ILI (9.7% of resolved absences).

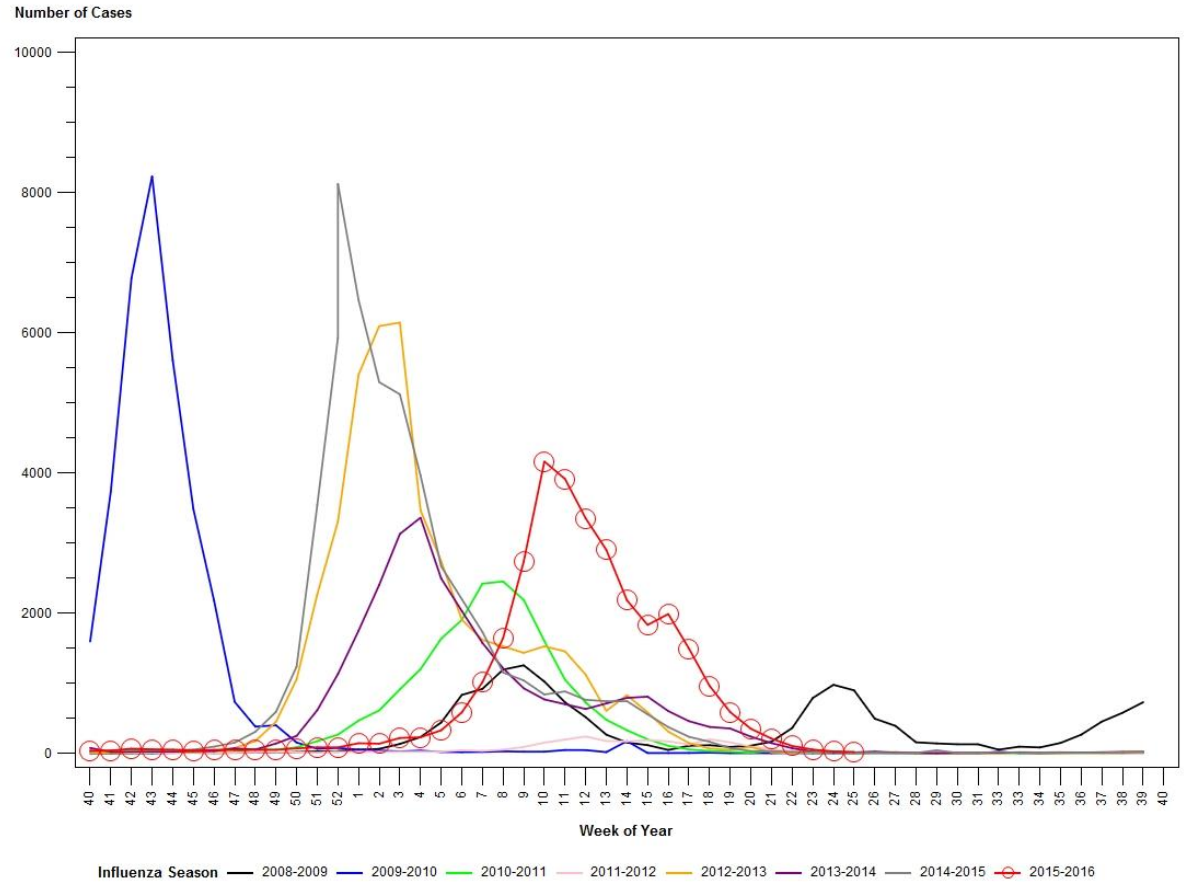
Table 3: SMART2 Influenza Like Illness (ILI)

Grade	BME	CE	HH	OH	FCAHS	PEP	PEI	WJH	WSH	TOTAL
K	17	11	5	25		40				98
1	18	25	27	31		18				119
2	20	10	23	16		17				86
3	25	18	18	20		16				97
4	16	15	28	17			12			88
5				21			17			38
6							9			9
7								20		20
8								14		14
9					29				9	38
10					21				7	28
11					18				4	22
12					24				6	30
Total	96	79	101	130	92	91	38	34	26	687

We were able to obtain 255 swabs from Canon-McMillan, 192 from FCASD and 139 from Washington, for 586 total swabs (85.3% of the students with ILI). The reason that students were not swabbed was primarily refusal and students returning too late to be swabbed by protocol.

The 2015-16 flu season was moderate, and late, relative to recent years. (See figure 2: 2015-16 is the red line with the circles. Data courtesy of PA Department of Health). Across the Commonwealth, Influenza A was prevalent with 67% of the cases. Influenza B accounted for 33% of cases.

Figure 2: PA INFLUENZA CASES 2008- 2016



SMART^2 also conducted a cohort study, where we asked families to report each week if any families members had a series of symptoms (fever, cough, sore throat, runny nose or congestion, headache, muscle or joint pain, nausea, diarrhea or vomiting). We were able to enroll 165 families into the cohort study, and obtained data for the equivalent of 293 8-week study periods. Families responded to our weekly survey at a rate of 95.5%.

Table 4: Cohort Family Study Results

ILI Individuals	ILI Families	Swabs Sent	Swabs returned	Swabs processed
200	150	652	553	536

There were 135 cases of influenza found in our study population from our school districts. There were 104 cases found through our school surveillance and 31 found through our Family Cohort Study.

Table 5: Laboratory Confirmed Influenza

	Students	ILI	% ILI**	Flu A	Flu B	Total Flu	% Flu**
Fox Chapel							
O'Hara Elem	702	130	19%	19	23	42	6.0%
FCA High School	1360	92	7%	2	3	5	0.4%
Dorseyville Middle*				1	0	1	
Total**	2062	222	11%	22	26	48	2.3%
Canon-McMillan							
Hills Hendersonville Elem	202	101	50%	11	13	24	11.9%
Cecil Elem	205	79	39%	3	8	11	5.4%
Borland Manor Elem	260	96	37%	2	2	4	1.5%
N Strabane Int*				0	2	2	
Total**	667	276	41%	16	25	41	5.8%
Washington							
Park Elementary	502	91	18%	5	8	13	2.6%
Park Intermediate	351	38	11%	1	2	3	0.9%
W Junior High	335	34	10%	0	0	0	0.0%
W Senior High	293	26	9%	0	2	2	0.7%
Total	1481	189	13%	6	12	18	1.2%
Samples from Cohort Families				4	24	28	
GRAND TOTAL				48	87	135	

* Found through our Cohort Study
** %-age does not include students from N Strabane or Dorseyville

Influenza B predominated in our school population (64%). As expected, confirmed influenza cases were found predominantly in the elementary school population. SMART^2 tested for 14 additional respiratory viruses, such as those that cause the common cold, and found 434 additional infections.

SMART^2 was able to obtain absence data from 31 other school districts, which spanned a range of 1 to 10 years. Most districts provided 5 years of data. SMART^2 was also able to obtain community flu data from the Allegheny County Health Department and the PA Department of Health.

We have found that school absenteeism can be used to predict community-level virologically-confirmed influenza when included in statistical models that account for yearly time and weather variations. Using kindergarten absences contributed to the most accurate influenza predictions, indicating an age-structure in school absences that reflect the underlying age-specific differences in influenza infections. We've previously demonstrated that younger students experience higher attack rates of respiratory pathogens compared to older students. Younger students experience non-illness-related absences with reduced frequency compared to older students, which may explain the increased performance using younger student absence data compared to older students.

Our findings suggest that models including younger student absences improve predictions virologically-confirmed influenza, suggesting that that increases in all-cause absences from specific grades are able to predict increases in community-level influenza cases. We had data in some instances which identified ILI-specific absences, but these performed similarly to all-cause absences in their predictive power. Identification of elementary schools and specifically kindergarten absences that better predict influenza has implications for prevention strategies like targeted vaccinations.

DISCUSSION

SMART^2 has taken the first steps in creating a predictive model for influenza based on surveillance of school absenteeism. This can have applications in school health planning and in response to seasonal and pandemic influenza. Recent examination of targeted school vaccination programs have shown a reduction in laboratory-confirmed influenza cases and reduced rates of school absenteeism in elementary schools. Early detection of increased absenteeism in elementary schools or specific grades may reflect early increases influenza circulation, and could initiate school-based vaccination programs to reduce school and community-level influenza transmission.

A preliminary look at data from the Family Cohort Study suggests that there may be statistically verifiable connections between influenza at home and absences at school. Review of this data will continue over the next year.

RECOMMENDATIONS

The data from SMART^2 supports the findings of SMART, and so we continue the following recommendations for influenza control and surveillance:

1. The US Centers for Disease Control and Prevention recommend that “Everyone 6 months of age and older should get a flu vaccine every season.” This would include all school children, teachers and staff. SMART supports this recommendation. Schools should support and promote this recommendation.
2. Schools should support vaccination and surveillance efforts. This could include: requirements of flu vaccination for school attendance; requiring reporting to student flu vaccination; provision of school based clinics; education to parents and students.
3. A particular focus of vaccination and educations efforts should be on younger school-age children, especially in grades K-4, or grades K-6 where these are found in a single school building.
4. Schools should support hygiene methods which have been shown to reduce influenza, including hand hygiene (washing and hand sanitizer), education to cover coughs and sneezes, etc., especially in elementary schools.
5. In the case of serious seasonal influenza, or pandemic conditions, schools should consider actions to reduce contact between students. This may include isolation of students within the school, or the use of half-day sessions. This may be an effective way to reduce influenza infection in school children, and a possible alternative to full-day school closures, which were ineffective in the 2009-2010 H1N1 pandemic.