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Surveillance for Pediatric Deaths Associated with 2009 Pandemic Influenza A (H1N1) Virus Infection — United States, April–August 2009

Children aged <5 years or with certain chronic medical conditions are at increased risk for complications and death from influenza (*1–3*). Because of this increased risk, the Advisory Committee on Immunization Practices (ACIP) has prioritized influenza prevention and treatment for children aged <5 years and for those with certain chronic medical and immunosuppressive conditions (*4,5*). CDC monitors child influenza deaths through its influenza-associated pediatric mortality reporting system. As of August 8, 2009, CDC had received reports of 477 deaths associated with 2009 pandemic influenza A (H1N1) in the United States, including 36 deaths among children aged <18 years. To characterize these cases, CDC analyzed data from April to August 2009. The results of that analysis indicated that, of 36 children who died, seven (19%) were aged <5 years, and 24 (67%) had one or more of the ACIP-recognized high-risk medical conditions. Twenty-two (92%) of the 24 children with high-risk medical conditions had neurodevelopmental conditions. Among 23 children with culture or pathology results reported, laboratory-confirmed bacterial coinfections were identified in 10 (43%), including all six children who 1) were aged ≥5 years, 2) had no recognized high-risk condition, and 3) had culture or pathology results reported. Early diagnosis of influenza can enable prompt initiation of antiviral therapy for children who are at greater risk or severely ill. Clinicians also should be aware of the potential for severe bacterial coinfections among children diagnosed with influenza and treat accordingly. All children aged ≥6 months and caregivers of children aged <6 months should receive 2009 pandemic influenza A (H1N1) monovalent vaccine when available (*6*).

Influenza-associated pediatric deaths have been nationally notifiable since October 2004. The CDC case reporting system defines an influenza-associated pediatric death as a death in a person aged <18 years with an illness clinically compatible with influenza and whose influenza is laboratory-confirmed. State and local health departments report influenza-associated pediatric deaths using a standardized case report form that collects information on demographics, dates of onset of illness and death, location of death, chronic medical conditions, influenza testing, bacteria or fungi cultured from sterile and nonsterile sites, and medical care received during the influenza illness. The case report form provides a list of chronic medical conditions that have been previously associated with an increased risk for complications from seasonal influenza and space to describe additional chronic medical conditions not listed on the form. Results of pathology testing conducted at CDC also are included. Medical records, medical examiner reports, or death certificates were not reviewed.

This case series included data reported to CDC on all deaths associated with 2009 pandemic influenza A (H1N1) virus infection occurring in persons aged <18 years through August 8, 2009. Laboratory confirmation was defined as a positive test for 2009 pandemic influenza A (H1N1) virus by reverse transcription–polymerase chain reaction (RT-PCR). CDC requested supplementary information from state and local health departments on antiviral treatment and chronic medical conditions for deaths associated with 2009 pandemic influenza A (H1N1) virus infection. For this case series, invasive bacterial coinfection was defined as laboratory detection of a bacterial pathogen in a specimen from a normally sterile

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site or a postmortem lung biopsy. Children were considered at high risk if they were aged <5 years or had one of the medical conditions recognized to increase the risk for influenza-related complications,* based on a review of the available medical data by a developmental pediatrician.

Thirty-six pediatric deaths associated with 2009 pandemic influenza A (H1N1) infection were reported from 15 state and local health authorities† through August 8 (Table 1).§ Illness onsets occurred during May 9–July 20, and deaths occurred during May 15–July 28. Six deaths occurred in May, 25 deaths in June, and five deaths in July. Median age of the patients was 9 years (range: 2 months–17 years); 50% were male, 42% were non-Hispanic white, and 33% were Hispanic (Table 2). Seven (19%) of the 36 children were aged <5 years (five were aged <2 years), and 24 (67%) had at least one high-risk medical condition, including three children aged <5 years. Among the 24 children with high-risk medical conditions, 22 (92%) had neurodevelopmental conditions (e.g., developmental delay or cerebral palsy). Of these 22 children, 13 (59%) had more than one neurodevelopmental diagnosis, and nine (41%) had neurodevelopmental and chronic pulmonary conditions. Eight (22%) of the 36 children were aged ≥5 years with no reported high-risk conditions. Two of these eight children were reported as obese; however, height and weight measurements were not reported.

Duration of illness before death in the 36 cases ranged from 1 to 28 days with a median of 6 days. Among 31 children for whom antiviral treatment data were available, 19 (61%) received antiviral treatment, and four of those received treatment within 2 days of illness onset. Of 25 children for whom information was available, 13 (52%) had received at least 1 dose of the 2008–09 seasonal influenza vaccine, including 11 children with high-risk medical conditions. Of the 23 children with culture or pathology results reported, 10 (43%) had a laboratory-confirmed bacterial coinfection, including *Staphylococcus aureus* (five, including three methicillin-resistant *Staphylococcus aureus*), *Streptococcus pneumoniae* (three), *Streptococcus pyogenes* (one), and *Streptococcus constellatus* (one). Among the eight children aged ≥5 years who did not have a high-risk medical condition, six had a laboratory-confirmed bacterial coinfection, including four with *S. aureus;* the other

* Additional information available at http://www.cdc.gov/h1n1flu/identifyingpatients.htm.

† Arizona (six cases), California (three), Connecticut (one), Florida (one) , Illinois (two), Massachusetts (one), Minnesota (two), New Jersey (three), New York (four), New York City (four), Oregon (one), Rhode Island (one), Texas (two), Utah (three), and Wisconsin (two).

§ A total of 33 cases were reported to CDC through August 8, 2009 and published online in FluView (http://www.cdc.gov/flu/weekly/fluactivity.htm). However, an additional three cases that were subject to reporting delays were added, bringing the total to 36.

TABLE 1. Selected characteristics of pediatric patients whose deaths were associated with 2009 pandemic influenza (H1N1) virus infection — Influenza-Associated Pediatric Mortality Case Reporting System, United States, April–August 2009*

Case no.	Age (yrs)	Sex	Race/ Ethnicity	Time from illness onset to influenza testing† (days)	Duration of illness (days)	Cardiac/ respiratory arrest occurred outside hospital	Location of death	Invasive bacterial coinfection (specimen)	Antiviral treatment (days from illness onset to treatment)	Chronic medical condition§
1	13	M	Hispanic	4	6	No	ICU¶	Negative (blood)	Oseltamivir, amantadine (4)	Cognitive dysfunction (global developmental delay); seizure disorder; cerebral palsy; spastic quadriplegia; scoliosis; left hip arthroplasty
2	10	F	Hispanic	5	5	Yes	ICU	Negative (blood)	None	Chronic lung disease; neurologic disease; cerebral palsy; developmental delay; heart disease, cardiac surgery
3	1	M	Black, non-Hispanic	21	28	No	ICU	Negative (blood)	Oseltamivir (23)	24 weeks premature; chronic lung disease; retinopathy of prematurity; gastrostomy tube; status/postpatent ductus arteriosus ligation; tracheal cyst; moderate to severe developmental delay
4	1	F	Asian	9	10	No	ICU	Negative (blood, bronchial wash)	Oseltamivir (9)	Developmental delay; Goldenhar syndrome; hydrocephalus, seizure disorder; prematurity; intraventricular hemorrhage grade 3; bronchospasm
5	12	F	Hispanic	4	8	No	ICU	Negative (blood)	None	Muscular dystrophy; severe scoliosis; restrictive lung disease
6	9	F	Hispanic	Postmortem	5	Yes	Outside hospital	*Streptococcus pyogenes* (blood, intracardiac blood)	None	None reported
7	2 mos	M	Hispanic	Postmortem	1	Yes	ED**	*Streptococcus pneumoniae (*lung tissue)	None	None reported
8	9	F	Hispanic	3	4	Yes	ICU	No specimens collected	Oseltamivir (Unknown)	Moderate to severe developmental delay; muscular dystrophy; chronic pulmonary disease; seizures
9	14	F	Black, non-Hispanic	5	19	No	ICU	MRSA†† (lung tissue)	Oseltamivir (5)	Obese§§
10	9	M	Hispanic	5	4	Unknown	ICU	*Streptococcus constellatus (*blood)	None	None reported
11	6	M	Asian	1	12	No	ICU	Negative (blood)	Oseltamivir (Unknown)	Pulmonary hypertension; chronic lung disease; idiopathic bronchiectasis of unknown etiology; on home bi-level positive airway pressure machine
12	13	M	White, non-Hispanic	2	5	No	ICU	*Staphylococcus aureus* (lung tissue), MRSA (endotracheal tube)	Oseltamivir (2)	None reported
13	8	M	Hispanic	Unknown	27	Unknown	Unknown	Unknown	Oseltamivir, rimantadine (6)	Acute lymphoblastic leukemia
14	11	F	Black, non-Hispanic	6	6	Yes	ED	No specimens collected	None	Obese
15	4 mos	F	White, non-Hispanic	Postmortem	4	Yes	Outside hospital	No specimens collected	None	None reported

TABLE 1. (*Continued*) Selected characteristics of pediatric patients whose deaths were associated with 2009 pandemic influenza (H1N1) virus infection — Influenza-Associated Pediatric Mortality Case Reporting System, United States, April–August 2009*

Case no.	Age (yrs)	Sex	Race/ Ethnicity	Time from illness onset to influenza testing† (days)	Duration of illness (days)	Cardiac/ respiratory arrest occurred outside hospital	Location of death	Invasive bacterial coinfection (specimen)	Antiviral treatment (days from illness onset to treatment)	Chronic medical condition§
16	5	F	White, non-Hispanic	5	6	No	ICU	Unknown	Oseltamivir (6)	Moderate to severe developmental delay; CHARGE/DiGeorge syndrome; prior tracheostomy; history of choanal atresia and repair; ventricular septal defect; fistula and esophageal atresia; hypoparathyroidism; immunodeficiency; seizure disorder; gastrostomy tube dependence
17	15	M	White, non-Hispanic	Postmortem	2	Yes	Home	*Staphylococcus aureus* (lung tissue)	None	Down syndrome; status/post atrioventricular canal repair
18	16	F	White, non-Hispanic	7	8	No	Inpatient ward	Negative (blood)	None	Moderate to severe developmental delay; hydrocephalus; seizure disorder; gastrostomy tube
19	9	M	Hispanic	Postmortem	1	Yes	ED	No specimens collected	None	Speech problems; reactive airway disease; bronchiolitis; moderate to severe developmental delay
20	9	M	White, non-Hispanic	6	11	No	ICU	Negative (blood)	Oseltamivir (6)	Constant care since near drowning at age 21 mos; spastic quadriplegia; static encephalopathy; seizure disorder; restrictive lung disease; scoliosis; moderate to severe developmental delay
21	12	F	White, non-Hispanic	2	6	No	ICU	Negative (blood)	Oseltamivir (2)	Chronic thickening of respiratory secretions; difficulty swallowing; mild autism; history of encephalitis; history of aspiration pneumonia
22	8	M	Black, non-Hispanic	5	2	No	ICU	Unknown	Unknown	None reported
23	10	M	White, non-Hispanic	2	5	No	ICU	No specimens collected	Oseltamivir (2)	Cerebral palsy; seizure disorder; developmental delay; scoliosis; reflux
24	9	F	Black, non-Hispanic	<1	15	No	ICU	MRSA (blood, endotracheal tube)	Oseltamivir (4)	None reported
25	1	F	Hispanic	Postmortem	2	Yes	Outside hospital	Negative (blood, cerebrospinal fluid)	None	None reported
26	15	M	Black, non-Hispanic	9	7	No	ICU	MRSA (blood, endotracheal tube)	Oseltamivir (5)	None reported
27	16	M	White, non-Hispanic	9	10	No	ICU	Negative (blood)	Type unknown (Unknown)	Cerebral palsy; spina bifida; paraplegia; hydrocephalus
28	14	F	Hispanic	Unknown	10	Unknown	Unknown	Unknown	Oseltamivir (3)	Chronic lung disease; asthma; mental retardation; Krabbe disease; seizure disorder
29	7	F	Hispanic	5	11	No	ICU	Negative (blood)	Oseltamivir (5)	Moderate to severe developmental delay; hydrocephalus status/post ventriculoperitoneal shunt; cerebral palsy; seizure disorder
30	17	M	White, non-Hispanic	5	9	Yes	ICU	*Streptococcus pneumoniae* (blood)	Unknown	Fragile X syndrome; autism; moderate to severe developmental delay
31	6	M	White, non-Hispanic	1	3	No	ICU	No specimens collected	Unknown	Cognitive delay; seizure disorder
32	13	F	White, non-Hispanic	5	11	No	ICU	No specimens collected	Oseltamivir (7)	Spina bifida; reactive airway disease

TABLE 1. (*Continued*) Selected characteristics of pediatric patients whose deaths were associated with 2009 pandemic influenza (H1N1) virus infection — Influenza-Associated Pediatric Mortality Case Reporting System, United States, April–August 2009*

Case no.	Age (yrs)	Sex	Race/ Ethnicity	Time from illness onset to influenza testing† (days)	Duration of illness (days)	Cardiac/ respiratory arrest occurred outside hospital	Location of death	Invasive bacterial coinfection (specimen)	Antiviral treatment (days from illness onset to treatment)	Chronic medical condition§
33	2	F	Asian	Postmortem	4	No	ED	*Streptococcus pneumoniae* (blood, cerebrospinal fluid, pleural fluid, spleen)	None	None reported
34	4	M	White, non-Hispanic	9	12	No	ICU	No specimens collected	Unknown	Cerebral palsy
35	13	M	White, non-Hispanic	1	4	No	ICU	Negative (blood)	Oseltamivir (1)	Severe developmental delay; cerebral palsy; seizure disorder
36	10	F	White, non-Hispanic	7	8	Unknown	Unknown	Unknown	Unknown	Moderate-severe developmental delay; chronic lung disease; cerebral palsy; scoliosis

* As of August 8, 2009, listed in order of illness onset.
† All testing was by reverse-transcription polymerase chain reaction.
§ Collected from responses to a checklist of associated medical conditions and additional comments from on CDC's influenza-associated pediatric mortality case report forms..
¶ Intensive care unit.
** Emergency department.
†† Methicillin-resistant *Staphylococcus aureus.*
§§ Height and weight not reported.

two children either had no specimens collected or information regarding bacterial coinfection was unavailable. Among the seven children aged <5 years who died, two had a laboratory-confirmed bacterial coinfection; neither child had a high-risk medical condition.

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Editorial Note: Twenty-eight (78%) of the 36 children whose deaths were associated with 2009 pandemic influenza A (H1N1) virus infection were in at least one of two groups previously found to be at increased risk for complications from seasonal influenza: children aged <5 years and those with a high-risk chronic medical condition (*1–3*). The percentage of children with high-risk medical conditions (67%) in this series is somewhat higher than the percentage reported in recent influenza seasons. During the 2003–04, 2004–05, 2005–06, and 2006–07 seasons, a total of 153, 47, 46, and 73 pediatric deaths were reported through the influenza-associated pediatric mortality reporting system, respectively. During those seasons, the percentages of children with ACIP-recognized high-risk medical conditions were 47%, 55%, 48%, and 35%, respectively (*1,7*). During the same seasons, among children who died, the percentages of children aged <5 years and aged <2 years among pediatric deaths was generally higher (<5 years, 42%–63%, <2 years, 26%–46%) than the 19% and 14%, respectively, reported for 2009 pandemic influenza A (H1N1). Continued surveillance is needed to determine whether these and other differences between pediatric deaths from seasonal influenza and deaths from 2009 pandemic influenza A (H1N1) are important.

Notably, among children with high-risk medical conditions, 92% had neurodevelopmental conditions (e.g., developmental delay or cerebral palsy), a finding consistent with the results from a study of influenza-associated mortality during the 2003–04 influenza season (*1*). In 2005, that finding helped lead to the addition of neurodevelopmental conditions to ACIP's list of conditions that should prompt seasonal influenza prevention and treatment (*8*). The findings from this report indicate that most of the children who died with neurodevelopmental conditions had multiple neurodevelopmental diagnoses and/or comorbid pulmonary conditions. Health-care providers should be aware of the potential for severe influenza illness, including death, in children with multiple neurodevelopmental conditions.

TABLE 2. Selected demographic characteristics and high-risk medical condition, antiviral treatment, and invasive bacterial coinfection status of pediatric patients whose deaths were associated with 2009 pandemic influenza (H1N1) virus infection — Influenza-Associated Pediatric Mortality Case Reporting System, United States, April–August 2009*

Characteristic/Status	No. of patients (N = 36)	(%)
Age group		
0–6 mos	2	(6)
6–23 mos	3	(8)
24–59 mos	2	(6)
5–8 yrs	5	(14)
9–12 yrs	13	(36)
13–17 yrs	11	(30)
Sex		
Male	18	(50)
Female	18	(50)
Race/Ethnicity		
White, Non-Hispanic	15	(42)
Black, Non-Hispanic	6	(17)
Hispanic	12	(33)
Asian	3	(8)
High-risk medical condition†		
Any high-risk medical condition	24	(67)
Neurodevelopmental condition§	22	(61)
Multiple neurodevelopmental diagnoses	13	(36)
Neurodevelopmental condition with chronic pulmonary condition	9	(25)
Chronic pulmonary condition	10	(28)
Congenital heart disease	3	(8)
Metabolic or endocrine condition	2	(6)
Immunosuppression	2	(6)
Antiviral treatment		
None	12	(39)
≤2 days after illness onset	4	(13)
>2 days after illness onset	12	(39)
Timing of treatment initiation unknown	3	(10)
Unknown	5	(14)
Invasive bacterial coinfection¶		
Yes	10	(28)
No	13	(36)
No specimens collected	8	(22)
Unknown	5	(14)

* As of August 8, 2009.
† As defined by the Advisory Committee on Immunization Practices. Conditions were not mutually exclusive; the majority of children had multiple conditions.
§ Neurodevelopmental conditions included cerebral palsy, developmental delay, autism, congenital neurologic disorders, and other chronic central nervous system disorders.
¶ Defined as laboratory detection of a bacterial pathogen in a specimen from a normally sterile site or a postmortem lung biopsy.

This report also highlights the prominence of laboratory-confirmed bacterial coinfections, which were identified in 10 (43%) of the 23 children who had culture or pathology results reported. All six children who were aged ≥5 years, did not have a high-risk medical condition, and had culture or pathology results reported had an invasive bacterial coinfection, suggesting that bacterial infection, in combination with 2009 pandemic influenza A (H1N1) virus infection, can result in severe disease in children who might be otherwise healthy. Clinicians should be aware of the potential for severe bacterial coinfections among children diagnosed with influenza and treat accordingly. As always, diagnostic testing and susceptibility testing of bacterial isolates are important to guide antibiotic therapy. Empiric antibacterial therapy, when indicated, should be directed at likely pathogens associated with influenza such as *Staphylococcus aureus, Streptococcus pneumoniae, and Streptococcus pyogenes* (*1,7*). In addition, all children should be current on recommended vaccinations, including 7-valent pneumococcal conjugate vaccine. Children aged ≥2 years with certain high-risk medical conditions are recommended to receive the 23-valent pneumococcal polysaccharide vaccine in accordance with guidance.¶

Although the majority of children in this case series received antiviral treatment, few received treatment within 2 days of illness onset. Influenza antiviral treatment is recommended for persons with suspected or laboratory-confirmed influenza who are hospitalized or who are at greater risk for influenza-related complications.** If a child is not in a high-risk group or is not hospitalized, health-care providers should use clinical judgment to guide treatment decisions. When evaluating children, clinicians should be aware that the risk for severe complications from seasonal influenza among children aged <5 years is highest among children aged <2 years. Antiviral treatment should be started as soon as possible after illness onset; evidence for benefits from antiviral treatment in studies of seasonal influenza is strongest when treatment is started within 48 hours of illness onset (*5*). However, treatment of any person with influenza who requires hospitalization is recommended, even if treatment is started ≥48 hours after illness onset. Health-care providers should be aware that although specificity is high, sensitivity of rapid influenza tests to detect 2009 pandemic influenza A (H1N1) virus infection is low (*9*); therefore, a negative test result does not exclude 2009 pandemic influenza A (H1N1) virus infection.

The findings in this report are subject to at least five limitations. First, influenza-associated pediatric deaths might be

¶ Additional information at http://www.cdc.gov/h1n1flu/guidance/ppsv_h1n1.htm.
** Additional information available at http://www.cdc.gov/h1n1flu/recommendations.htm.

underascertained because of a low level of influenza testing among children or underreporting of diagnosed cases. Second, differences in case ascertainment limit the direct comparability of the findings in this report with findings from reports fro seasonal influenza. All patients in this series were identified as having 2009 pandemic influenza A (H1N1) virus infection using RT-PCR, but surveillance for pediatric deaths associated with seasonal influenza includes cases ascertained by various diagnostic tests, some of which are less sensitive than RT-PCR. Third, some chronic medical conditions might be underreported in the case reporting system because they are not specifically listed on the case report form; however, the collection of supplementary data on chronic medical conditions from state and local health authorities might have helped to minimize this potential bias. Fourth, incomplete data on antiviral treatment and testing for invasive bacterial coinfections might have led to some children being misclassified. Finally, because medical records were not reviewed, the severity of neurodevelopmental conditions, including the degree of associated respiratory impairment, could not be characterized.

Vaccination is the primary strategy to prevent influenza and related complications. Persons aged 6 months–24 years and persons who live with or provide care for infants aged <6 months are recommended for vaccination against pandemic (H1N1) 2009 influenza virus infection (*6*). Initial doses of 2009 pandemic influenza A (H1N1) monovalent vaccine are expected to become available in mid-October. Guidance from CDC regarding administration of vaccine, antiviral treatment, management of influenza-associated bacterial complications, and other prevention and control measures for 2009 pandemic influenza A (H1N1) will be updated as needed. Health-care providers can find current recommendations online at http://www.cdc.gov/h1n1flu.

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Inadvertent Ingestion of Marijuana — Los Angeles, California, 2009

On April 8, 2009, the Los Angeles Police Department (LAPD) notified officials from the Los Angeles County Department of Public Health in California about a group of preschool teachers with nausea, dizziness, headache, and numbness and tingling of fingertips after consumption of brownies purchased 3 days before from a sidewalk vendor. To characterize the neurologic symptoms and determine whether these symptoms were associated with ingestion of the brownies, the police and health departments launched a collaborative investigation. This report summarizes the results of that investigation, which detected delta-9-tetrahydrocannabinol (THC) and cannabinol (substances found in marijuana) in a recovered sample of the brownies. Two patients sought medical treatment, and one patient's urine and serum tested positive for THC metabolites. The findings in this report demonstrate the utility of a collaborative investigation by public health and law enforcement. The findings also underscore the need to consider marijuana as a potential contaminant during foodborne illness investigations and the importance of timely testing of clinical specimens after symptom onset to identify drug metabolites.

On the morning of April 7, 2009, a preschool teacher put brownies, which she had purchased on April 5, on a table in