

Pandemic Influenza Planning: Addressing the Needs of Children

Children represent one quarter of the US population. Because of its enormous size and special needs, it is critically important to address this population group in pandemic influenza planning.

Here we describe the ways in which children are vulnerable in a pandemic, provide an overview of existing plans, summarize the resources available, and, given our experience with influenza A(H1N1), outline the evolving lessons we have learned with respect to planning for a severe influenza pandemic.

We focus on a number of issues affecting children—vaccinations, medication availability, hospital capacity, and mental health concerns—and emphasize strategies that will protect children from exposure to the influenza virus, including infection control practices and activities in schools and child care programs. (*Am J Public Health*. 2009;99:S255–S260. doi:10.2105/AJPH.2009.159970)

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APPROXIMATELY 74 MILLION residents of the United States (25% of the population) are younger than 18 years, and 20 million are younger than 5 years.¹ More than 55 million children are enrolled in schools,² and 11 million children younger than 5 years are in out-of-home child care.³ Children are a vulnerable segment of the population, dependent on others for providing their food, shelter, transportation, and medical care. Ensuring that the needs of children are met is essential to planning for a severe influenza pandemic. Although planners, program managers, and communities are beginning to recognize these needs and to address them as part of the ongoing influenza A(H1N1) outbreak, there are still gaps in plans designed to protect children in an influenza pandemic.

Here we discuss strategies for strengthening pandemic influenza planning. Our discussion is based on a pair of assumptions. First, lessons from the ongoing H1N1 pandemic in 2009 underscore the need for community-based plans that address children. Second, communities will suspend routine activities (e.g., school-based health screenings) in a severe pandemic and focus on priority needs. Given the large number of planning needs related to children, we touch on priority issues and build on a pandemic influenza report developed by the American Academy of Pediatrics and the Trust for America's Health.⁴ In doing so, we focus on the following critical prevention and

treatment topics: infectious disease (including influenza) prevention practices, vaccinations, medication availability, hospital capacity, and mental health concerns.

Community leaders should address children and adults separately because influenza affects children differently than adults, with children being more vulnerable in terms of infection, complication, and mortality rates. Seasonal influenza rates are higher among young children than among members of other age groups,^{5,6} and these children (as are the elderly) are at greater risk for complications than are older children, adolescents, and nonelderly adults.^{5,7,8}

Typically, the influenza mortality curve follows a U shape, with high mortality among very young children and the elderly. However, the 1918 pandemic strain killed a disproportionate number of healthy young adults, leading to a W-shaped age mortality curve in the United States, with high rates of mortality among very young children, those aged 15 to 45 years, and the elderly.^{9–11} During the 1957 pandemic, children appeared to have less residual immunity than adults, and infection rates were higher among children.¹² The current outbreak of H1N1, which began outside of the typical influenza season, has thus far resulted in only a limited numbers of deaths overall; however, the impact of subsequent waves of this virus on children is yet to be determined.

Children routinely spend time in crowded settings, such as

schools, after-school care, and childcare, increasing their risk of contracting influenza. Because of the amount of time they spend in these settings, children disproportionately contribute to disease transmission and amplification of an epidemic or pandemic. Children are more frequently responsible than adults for secondary transmission within households, and they usually shed more virus and do so for longer periods of time than adults.¹³

The Institute of Medicine¹⁴ and the American Academy of Pediatrics,⁴ as well as the Pandemic and All Hazards Preparedness Act (the aim of which is to improve public health and medical preparedness and response capabilities for emergencies),¹⁵ consider children a vulnerable population. According to these organizations and this legislation, the emergency care system is not prepared for disasters involving children, and the needs of this “at-risk” population in disasters are frequently overlooked. (Other determinants of vulnerability among children, including poverty, race/ethnicity, and special health care needs, are addressed in other articles in this supplement.)

INITIAL PANDEMIC PLANNING FOR CHILDREN

Given their unique vulnerabilities, planning specifically for children in an influenza pandemic is essential. In April 2007, the Centers for Disease Control and Prevention (CDC), as part of the National Strategy for Pandemic

Influenza Implementation Plan, completed a review of pandemic influenza operational plans from 60 of the 62 awardees funded under the Public Health Emergency Preparedness Cooperative Agreement, which includes 50 states, 3 cities, and US territories. Public Health Emergency Preparedness awardees were required to submit pandemic influenza operational plans that addressed, at a minimum, areas such as mass vaccination, continuity of health operations, antiviral distribution, surveillance and laboratory activities, communications, and community mitigation. This review indicated several examples of how states and communities have begun to address children's needs during an influenza pandemic.

Nearly all of the 60 plan submissions were in compliance with respect to tracking pediatric influenza deaths as nationally notifiable events. Seven of the 60 identified the necessity, during an emergency, to maintain state, county, and city agencies that address children's needs. The CDC review identified creative partnerships between public health departments and public and private agencies to support homebound children in isolation or quarantine, as well as children at home with parents or caregivers caring for other ill family members.

PREVENTIVE INTERVENTIONS

As is evident with the current H1N1 outbreak, all plans should address the prevention interventions most likely to be used immediately in a pandemic, including antiviral drugs, social distancing (e.g., through potential school dismissal and closure of child-care programs), and treatment

of secondary infections. Although the effectiveness of these interventions is not clear, they may be the best options available given the period necessary to develop and distribute a vaccine.¹⁶

Infectious Disease Prevention in Schools

Pandemic influenza plans should, in partnership with health departments and health care providers, support schools in implementing effective immunization, hygiene, and infection control policies and practices. In addition to infection control during an influenza pandemic, enforcing measures such as strict exclusion policies for ill students and staff would yield short-term benefits by limiting the transmission of seasonal influenza and other infectious diseases. At present, most infection control programs and policies in schools primarily focus on prevention and control of food- and blood-borne pathogens, with only a limited emphasis on immunization¹⁷; however, in the United States alone, infectious diseases such as colds and seasonal influenza account for millions of school days lost each year.¹⁸

Schools inherently foster transmission of infections as a result of shared supplies and equipment, enclosed environments, and insufficient hand, surface, and respiratory hygiene practices.¹⁹ Plans should support the ability of schools to engage in activities that will decrease the likelihood of transmission of infectious diseases on school property and in the larger community. Some states and local school districts are incorporating infectious disease prevention into their policies and practices. In 2006, 69.4% of states had in place model policies for schools on infectious disease prevention.¹⁷

Some schools use immunization policies and practices as a strategy for preventing and managing influenza; as an example, 4.5% of all schools in the United States offer influenza vaccinations. Pandemic influenza plans should involve education and public health partners in determining the feasibility of school-based vaccination programs. Beginning with the 2008–2009 influenza season, the Advisory Committee for Immunization Practices expanded its recommendations to include annual influenza vaccinations of all children aged 6 months to 18 years in addition to the groups previously included in the recommendations (children 6 to 59 months and their household contacts).²⁰ Many schools also collect and use student health information to prevent future illnesses; in 2006, 74.8% of US schools reported having reviewed student health records to identify possible outbreaks during the preceding 12 months, an increase from 61.9% in 2000.¹⁷

Community Mitigation

Schools. As the current H1N1 outbreak has shown, with vaccines unlikely to be available early in a pandemic, community mitigation is one of the few methods available to control disease spread. Experience and mathematical modeling from the 1918 influenza pandemic suggest that dismissing students from schools, in combination with other measures, may be an effective method to slow the spread of pandemic influenza.²¹

In 2006, roughly 1000 of the approximately 115 000 schools in the United States closed for short periods of time for health-related reasons ranging from seasonal influenza to school shootings (C. Otto, oral communication, October 2006).

Experience and knowledge gained in communities that had

large H1N1 outbreaks in spring 2009 indicate that the potential benefits of preemptively dismissing students from school are often outweighed by negative consequences, including students being left home alone, students missing meals, and interruption of students' education. Instead, for an outbreak similar to the one that occurred in spring 2009, schools should increase basic hygiene practices such as hand washing, keeping sick students and staff away from school, and helping families identify which children are at higher risk for influenza complications and would benefit from early evaluation from their physician if they become ill. If outbreaks become more severe, however, preemptive school dismissal could be considered. Theoretically, school dismissal, in combination with other community mitigation strategies such as canceling large events (e.g., football games), urging families to stay home, and supporting workers in telecommuting or alternative work schedules, could increase social distancing (i.e., it could prevent students from congregating outside of the school environment).

Because schools play important roles in the lives of children, pandemic influenza plans should address the significant implications of school dismissals for students, families, and communities. Local education and health officials should, in collaboration, carefully consider decisions as to whether to close schools. It is essential to build and strengthen such partnerships during the planning period rather than during attempts to respond to a pandemic. Twenty-nine million children in schools and childcare institutions participate daily in the US Department of Agriculture's National School

Lunch Program; approximately half of these children live in low-income households²² and may rely on school meals for a substantial portion of their diet. Public schools are also the nation's largest provider of mental health services to children.²³

The possible ramifications of dismissing schools are so great that planners must consider numerous issues, such as the legal authority to dismiss students, collaboration among state and local officials and with other partners to implement school dismissals, and triggers and processes for dismissing schools and resuming normal schedules. Other relevant issues include communicating school dismissal information; providing effective supervision and quality care for children during dismissal; maintaining the continuity of school funding, operations, and education during an extended dismissal; and minimizing the economic impact on families and communities.

Planning should take into account the substantial differences between short-term and long-term school dismissals. A primary concern during an extended school dismissal will be maintaining social distancing of students. Studies of school closures caused by seasonal influenza have shown that students visit a variety of public places or gather with others while their schools are closed. However, it is not clear from these studies whether the importance of social distancing was clearly articulated to the public.^{24,25} Initial pandemic influenza data from the spring of 2009 indicate that most students did stay home when explicitly told to do so, although anecdotal reports also show that students recongregated at shopping malls and other public locations.

Planning can also take advantage of school- and education-related

assets, including school buildings, buses, and staff, if students are dismissed. In addition, faculty may be able to provide lessons and other services to students via television, radio, mail, Internet, telephone, or other media. CDC and other federal agencies, along with their partners in the public health, education, business, and health care sectors, have developed guidance documents and tools to assist in planning for extended school closures.²⁶

Childcare programs. Out-of-home child care increases the prevalence of infections in families and communities. Children in childcare programs have a greater incidence of respiratory infections than those cared for at home^{27–30} and are typically the family members who introduce household respiratory infections.¹³

As is the case with schools, infectious disease prevention and control efforts in childcare programs involve a combination of immunization, exclusion of symptomatic individuals, and hygienic interventions. Federal guidance for severe influenza pandemics recommends possible closure of childcare programs, and planners should build on this federal guidance to support local planning. Depending on the geographic extent of the pandemic, closures potentially could affect at least 4.1 million preschool children³¹ and approximately 573 000 caregivers affiliated with the 118 947 regulated child-care programs in the United States.³

Similar to schools, closing childcare programs could have serious financial implications for these programs and their employees. Unlike publicly funded schools, most childcare programs are small businesses or are run by faith-based organizations and congregations,³² and closing them

during a pandemic could lead to long-term loss of services.³³

If childcare centers are closed, parents who work or volunteer for essential community services or who are involved in responding to a pandemic may need to find different sources of care for their children. These sources should provide safe, quality care.³⁴ Studies suggest that respiratory infection rates are lower in child-care groups with less than 6 children.³⁵ Planning should consider childcare options, including how families can form small, consistent groups with neighbors, friends, or coworkers to provide childcare when needed.

Planning for Large-Scale Vaccination

According to federal vaccine guidance, priority groups should receive pandemic influenza vaccine as it becomes available.³⁶ This guidance was largely based on the planning assumptions that disease would be caused by an influenza A(H5N1) virus, that disease would be severe, and that vaccine would initially be available only in limited quantities, necessitating prioritization. Pregnant women and children aged 6 to 35 months were placed in tier 1, the highest priority group. Children aged 3 to 18 years with high-risk conditions were placed in tier 2, the next highest priority group.

The epidemiology of the current 2009 H1N1 pandemic indicates that children and younger adults (those younger than 50 years) with health risks have been most severely affected, whereas the elderly (those 60 years or older) have been relatively spared.³⁷ School-aged children appear to be a likely primary target for vaccination when vaccine becomes available.³⁸

The US government is supporting the development and

manufacture of 2009 H1N1 vaccine.³⁹ Because of the urgency associated with administering this vaccine once it is available, data on the vaccine's immunological aspects, effectiveness, and safety in the case of both adults and children may be limited. Clinical trials involving both adult and pediatric populations, with and without adjuvants, are planned. Data from these trials will provide insight into the dosing requirements and safety profile of vaccines in children.

TREATMENT SERVICES

Although pandemic influenza plans should emphasize protecting children from exposure to the virus, in the case of a severe pandemic plans should also address the complexities of medication availability, medical interventions, infection control in hospitals and other settings, and provision of health, mental health, and other services.

Medication Efficacy and Availability

Specific to pandemic influenza, the Strategic National Stockpile (SNS) contains antiviral medications such as oseltamivir and zanamivir for treatment of symptomatic patients. Initially, oseltamivir was stockpiled in both pediatric suspensions and 75-mg capsules; it has been approved by the Food and Drug Administration (FDA) for treatment and prophylaxis of children at least 1 year of age. (As the characteristics of a pandemic emerge, planners should alert communities to review emerging guidance, for example, the approval by the FDA under an Emergency Use Authorization of oseltamivir use for treatment of children less than 1 year old during the beginning

phases of the ongoing H1N1 outbreak in 2009.⁴⁰⁾

Recently, oseltamivir became available in 30-mg and 45-mg pediatric strength capsules in addition to suspension. The capsule contents can be opened and mixed with sweetened liquids, such as chocolate syrup, for administration to children.⁴¹ The package insert provides compounding instructions for pharmacists to make an oral suspension from capsules, at a final concentration of 15 mg/mL, if the manufactured suspension is not available. Stockpiling recommendations for oseltamivir are based on population census data.

Zanamivir is available in the SNS as a capsule for inhalation with a special device; it has been approved by the FDA for use in the treatment of children 7 years or older and for prophylaxis in children 5 years or older.⁴² Similar to oseltamivir, stockpiling recommendations for zanamivir are based on population census data.

Intravenous antimicrobial medications are also included in the SNS; these medications can be used to treat secondary bacterial pneumonia in pandemic influenza patients. Weight-based dosing can be used to accommodate pediatric patients; the appropriate sizes of ancillary supplies for intravenous administration are included in the SNS but can also be found readily in the commercial marketplace and in health care facilities.

Planning for Pediatric Emergencies

Under current planning assumptions for severe pandemic influenza, an estimated 24 million children could become ill.⁴ These children would need health care from a system that routinely experiences surge capacity stress.

In 2003, 45% of emergency departments across the United States were on diversion status, meaning that they were temporarily incapable of providing optimal care to any additional patients at a given point in time.⁴³

When a general hospital is placed on diversion status, in many areas other general hospitals are nearby to help; however, given that there are only 50 to 55 free-standing pediatric hospitals nationwide, and approximately 80 to 90 pediatric units housed within general hospitals, often only one pediatric hospital exists within many miles of a family's home. This is in contrast to the proximity of the general hospital, usually situated within the town where people live. During influenza seasons in which pediatric populations are substantially affected, children's hospitals nationwide have experienced capacities as high as 120%, with their emergency departments running more than 130% to 150% of daily patient loads relative to the same point in the preceding year.^{44,45}

Only a small proportion of the more than 5700 general hospitals nationwide are prepared to address pandemic influenza cases among children. Fewer than 15% of the 4800 emergency departments nationwide are equipped to serve children on a routine basis as a result of a lack of specialized staff, training, equipment, or other resources. Only 10% of general hospitals have pediatric intensive care units, and only 14% possess all of the airway management supplies they need to treat pediatric patients.⁴⁶

The American Academy of Pediatrics has identified several issues related to managing and treating children who become ill during a pandemic influenza. These issues include limited bed

space in pediatric facilities and few mechanisms for expansion, expected staff shortages, delayed care because ill parents are not in attendance, and treatment of very sick children with physical and emotional needs caused by bereavement.⁴

Pandemic influenza planning should consider ways to address surges in numbers of pediatric patients, including developing regional coordination between pediatric hospitals and between pediatric hospitals and general hospitals; however, more research is needed to determine whether there is value in such approaches during a widespread pandemic. This coordination supports potential "just-in-time" models that provide hands-on training and possibly a dedicated resource professional to build the capacity of general hospitals to serve pediatric patients during an emergency.⁴⁷ Regional coordination may strengthen cooperation between pediatric hospital systems in a manner similar to that of the work done during Hurricanes Katrina and Rita. In those instances, children's hospitals in Texas, Alabama, and Georgia coordinated evacuations, provided dialysis services, and treated pediatric oncology patients. Regional coordination of pediatric care services is being modeled in Chicago, Los Angeles, and New York, and grants have been made available to stimulate regional preparedness.⁴⁸

Mental Health Needs

Few data exist on the mental health effects of disease outbreaks. However, data from the 2003 severe acute respiratory syndrome epidemic⁴⁹ suggest that high levels of stress can be anticipated in affected communities. During a severe pandemic, community

mitigation strategies are likely to cause stress and confusion among children, as well as parents and other family members. Closing of schools and other social distancing strategies will disrupt children's routines. Family stress levels are likely to increase when parents cannot work, children are at home, and loved ones are ill. Hospitalizations will lead to parent and child separations and can produce further stress among children who may fear for themselves or the lives of their parents.

Many children may experience the severe illness or loss of loved ones, including friends and family members. Cancellation of rituals, such as funerals or grief support groups that help children and families cope with death, can further complicate the recovery process. There is likely to be a high demand for community support services such as those provided by social service agencies and religious institutions (e.g., grief support and pastoral counseling, caregiver support, child abuse prevention).

Similar to other health systems, the mental health care system will, in all likelihood, be taxed by increased needs during a pandemic. Counseling services, traditionally delivered in face-to-face encounters, will need to be adapted to accommodate social distancing. Interventions delivered via telephone have been identified as a potential response⁴; however, as a result of its limitations, this approach is unlikely to address all of the psychosocial support needs of children and families.

A pandemic will require the innovative use of technology such as television, the Internet, and mobile stress management services.⁵⁰ State and local health departments should consider strengthening the infrastructure

and training necessary to support these services. National, state, and local plans should include an organized mental health response to children's needs during and after a pandemic. Such plans require collaborative efforts among organizations that represent traditional mental health service providers (e.g., child psychologists, social workers, psychiatrists, school psychologists, and marriage and family therapists), community pediatricians, and faith-based, educational, and community organizations.

CONCLUSIONS

Our experience with the ongoing H1N1 outbreak shows that children can be especially vulnerable to a new influenza virus. Communities should come together early and often to create plans for addressing the child-specific issues described here. To increase the likelihood of an effective response to any pandemic, public health agencies should work with educational agencies, clinicians, hospitals, childcare providers, and mental health service providers to develop and implement a coordinated approach. Pandemic influenza planners should not wait to strengthen plans, nor can they afford to wait for research gaps to be filled. Our current experience with H1N1, as well as practical experience from states and communities as they address seasonal influenza and other public health emergencies, is a critical information source for pandemic influenza planning among children. ■

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Contributors

E. Stevenson and L. Barrios coordinated the development of the article, wrote the overview sections, and reviewed and edited the article. R. Cordell wrote the section on childcare programs. D. DeLozier led the writing on school closure. S. Gorman wrote the section on the Strategic National Stockpile. L. J. Koenig wrote the section on mental health. E. Odom led the writing on infection control in schools. J. Polder reviewed drafts of the article and provided guidance in organization. J. Randolph wrote the section on hospital surge capacity. T. Shimabukuro wrote the section on vaccines. C. Singleton wrote the section on state planning efforts.

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