Interim Pre-pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States—

Early, Targeted, Layered Use of Nonpharmaceutical Interventions

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I

Executive Summary

Purpose

This document provides interim planning guidance for State, territorial, tribal, and local communities that focuses on several measures other than vaccination and drug treatment that might be useful during an influenza pandemic to reduce its harm. Communities, individuals and families, employers, schools, and other organizations will be asked to plan for the use of these interventions to help limit the spread of a pandemic, prevent disease and death, lessen the impact on the economy, and keep society functioning. This interim guidance introduces a Pandemic Severity Index to characterize the severity of a pandemic, provides planning recommendations for specific interventions that communities may use for a given level of pandemic severity, and suggests when these measures should be started and how long they should be used. The interim guidance will be updated when significant new information about the usefulness and feasibility of these approaches emerges.

Introduction

The Centers for Disease Control and Prevention, U.S. Department of Health and Human Services in collaboration with other Federal agencies and partners in the public health, education, business, healthcare, and private sectors, has developed this interim planning guidance on the use of nonpharmaceutical interventions to mitigate an influenza pandemic. These measures may serve as one component of a comprehensive community mitigation strategy that includes both pharmaceutical and nonpharmaceutical measures, and this interim guidance includes initial discussion of a potential strategy for combining the use of antiviral medications with these interventions. This guidance will be updated as new information becomes available that better defines the epidemiology of influenza transmission, the effectiveness of control measures, and the social, ethical, economic, and logistical costs of mitigation strategies. Over time, exercises at the local, State, regional, and Federal level will help define the feasibility of these recommendations and ways to overcome barriers to successful implementation.

The goals of the Federal Government's response to pandemic influenza are to limit the spread of a pandemic; mitigate disease, suffering, and death; and sustain infrastructure and lessen the impact on the economy and the functioning of society. Without mitigating interventions, even a less severe pandemic would likely result in dramatic increases in the number of hospitalizations and deaths. In addition, an unmitigated severe pandemic would likely overwhelm our nation's critical healthcare services and impose significant stress on our nation's critical infrastructure. This guidance introduces, for the first time, a Pandemic Severity Index in which the case fatality ratio (the proportion of deaths among clinically ill persons) serves as the critical driver for categorizing the severity of a pandemic. The severity index is designed to enable better prediction of the impact of a pandemic and to provide local decision-makers with recommendations that are matched to the severity of future influenza pandemics.

It is highly unlikely that the most effective tool for mitigating a pandemic (i.e., a well-matched pandemic strain vaccine) will be available when a pandemic begins. This means that we must be prepared to face the first wave of the next pandemic without vaccine and potentially without sufficient quantities of influenza antiviral medications. In addition, it is not known if influenza antiviral medications will be effective against a future pandemic strain. During a pandemic, decisions about how to protect the public before an effective vaccine is available need to be based on scientific data, ethical considerations, consideration of the public's perspective of the protective measures and their impact on society, and common sense. Evidence to determine the best strategies for protecting people during a pandemic is very limited. Retrospective data from past influenza pandemics and the conclusions drawn from those data need to be examined and analyzed within the context of modern society. Few of those conclusions may be completely generalizable; however, they can inform contemporary planning assumptions. When these assumptions are integrated into the current mathematical models, the limitations need to be recognized, as they were in a recent Institute of Medicine report (Institute of Medicine. Modeling Community Containment for Pandemic Influenza. A Letter Report. Washington, DC.: The National Academies Press; 2006).

The pandemic mitigation framework that is proposed is based upon an early, targeted, layered application of multiple partially effective nonpharmaceutical measures. It is recommended that the measures be initiated early before explosive growth of the epidemic and, in the case of severe pandemics, that they be maintained consistently during an epidemic wave in a community. The pandemic mitigation interventions described in this document include:

1. Isolation and treatment (as appropriate) with influenza antiviral medications of all persons with confirmed or probable pandemic influenza. Isolation may occur in the home or healthcare setting, depending on the severity of an individual's illness and /or the current capacity of the healthcare infrastructure.

2. Voluntary home quarantine of members of households with confirmed or probable influenza case(s) and consideration of combining this intervention with the prophylactic use of antiviral medications, providing sufficient quantities of effective medications exist and that a feasible means of distributing them is in place.

3. Dismissal of students from school (including public and private schools as well as colleges and universities) and school-based activities and closure of childcare programs, coupled with protecting children and teenagers through social distancing in the community to achieve reductions of out-of-school social contacts and community mixing.

4. Use of social distancing measures to reduce contact between adults in the community and workplace, including, for example, cancellation of large public gatherings and alteration of workplace environments and schedules to decrease social density and preserve a healthy workplace to the greatest extent possible without disrupting essential services. Enable institution of workplace leave policies that align incentives and facilitate adherence with the nonpharmaceutical interventions (NPIs) outlined above.

All such community-based strategies should be used in combination with individual infection control measures, such as hand washing and cough etiquette.

Implementing these interventions in a timely and coordinated fashion will require advance planning. Communities must be prepared for the cascading second- and third-order consequences of the interventions, such as increased workplace absenteeism related to child-minding responsibilities if schools dismiss students and childcare programs close.

Decisions about what tools should be used during a pandemic should be based on the observed severity of the event, its impact on specific subpopulations, the expected benefit of the interventions, the feasibility of success in modern society, the direct and indirect costs, and the consequences on critical infrastructure, healthcare delivery, and society. The most controversial elements (e.g., prolonged dismissal of students from schools and closure of childcare programs) are not likely to be needed in less severe pandemics, but these steps may save lives during severe pandemics. Just as communities plan and prepare for mitigating the effect of severe natural disasters (e.g., hurricanes), they should plan and prepare for mitigating the effect of a severe pandemic.

Rationale for Proposed Nonpharmaceutical Interventions

The use of NPIs for mitigating a community-wide epidemic has three major goals: 1) delay the exponential growth in incident cases and shift the epidemic curve to the right in order to "buy time" for production and distribution of a well-matched pandemic strain vaccine, 2) decrease the epidemic peak, and 3) reduce the total number of incident cases, thus reducing community morbidity and mortality. Ultimately, reducing the number of persons infected is a primary goal of pandemic planning. NPIs may help reduce influenza transmission by reducing contact between sick and uninfected persons, thereby reducing the number of infected persons. Reducing the number of persons infected will, in turn, lessen the need for healthcare services and minimize the impact of a pandemic on the economy and society. The surge of need for medical care that would occur following a poorly mitigated severe pandemic can be addressed only partially by increasing capacity within hospitals and other care settings. Reshaping the demand for healthcare services by using NPIs is an important component of the overall mitigation strategy. In practice, this means reducing the burdens on the medical and public health infrastructure by decreasing demand for medical services at the peak of the epidemic and throughout the epidemic wave; by spreading the aggregate demand over a longer time; and, to the extent possible, by reducing net demand through reduction in patient numbers and case severity.

No intervention short of mass vaccination of the public will dramatically reduce transmission when used in isolation. Mathematical modeling of pandemic influenza scenarios in the United States, however, suggests that pandemic mitigation strategies utilizing multiple NPIs may decrease transmission substantially and that even greater reductions may be achieved when such measures are combined with the targeted use of antiviral medications for treatment and prophylaxis. Recent preliminary analyses of cities affected by the 1918 pandemic show a highly significant association between the early use of multiple NPIs and reductions in peak and overall death rates. The rational targeting and layering of interventions, especially if these can be implemented before local epidemics have demonstrated exponential growth, provide hope that the effects of a severe pandemic can be mitigated. It will be critical to *target* those at the nexus of transmission and to *layer* multiple interventions together to reduce transmission to the greatest extent possible.

Pre-Pandemic Planning: the Pandemic Severity Index

This guidance introduces, for the first time, a Pandemic Severity Index, which uses case fatality ratio as the critical driver for categorizing the severity of a pandemic (Figure A, abstracted and reprinted here from Figure 4 in the main text). The index is designed to enable estimation of the severity of a pandemic on a population level to allow better forecasting of the impact of a pandemic and to enable recommendations to be made on the use of mitigation interventions that are matched to the severity of future influenza pandemics.

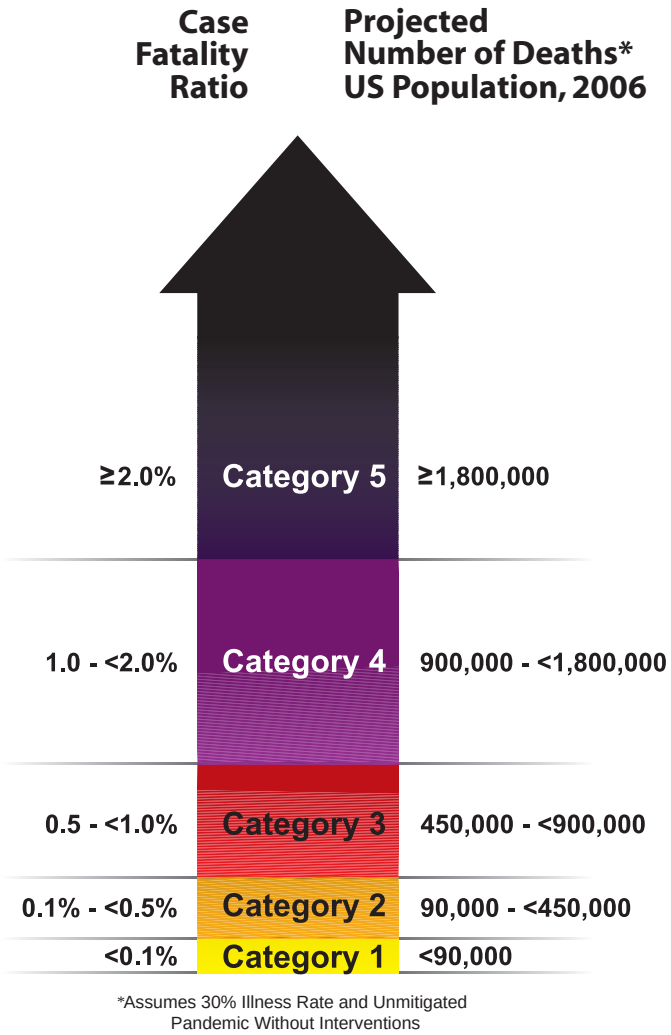
Future pandemics will be assigned to one of five discrete categories of increasing severity (Category 1 to Category 5). The Pandemic Severity Index provides communities a tool for scenario-based contingency planning to guide local pre-pandemic preparedness efforts. Accordingly, communities facing the imminent arrival of pandemic disease will be able to use the pandemic severity assessment to define which pandemic mitigation interventions are indicated for implementation.

Use of Nonpharmaceutical Interventions by Severity Category

This interim guidance proposes a community mitigation strategy that matches recommendations on planning for use of selected NPIs to categories of severity of an influenza pandemic. These planning recommendations are made on the basis of an assessment of the possible benefit to be derived from implementation of these measures weighed against the cascading second- and third-order consequences that may arise from their use. Cascading second- and third-order consequences are chains of effects that may arise because of the intervention and may require additional planning and intervention to mitigate. The term generally refers to foreseeable unintended consequences of intervention. For example, dismissal of students from school may lead to the second-order effect of workplace absenteeism for child minding. Subsequent workplace absenteeism and loss of household income could be especially problematic for individuals and families living at or near subsistence levels. Workplace absenteeism could also lead to disruption of the delivery of goods and services essential to the viability of the community.

For Category 4 or Category 5 pandemics, a planning recommendation is made for use of all listed NPIs (Table A, abstracted and reprinted here from Table 2. in the main text). In addition, planning for dismissal of students from schools and school-based activities and closure of childcare programs, in combination with means to reduce out-of-school social contacts and community mixing for these children, should encompass up to 12 weeks of intervention in the most severe scenarios. This approach to pre-pandemic planning will provide a baseline of readiness for community response. Recommendations for use of these measures for pandemics of lesser severity may include a subset of these same interventions and potentially for shorter durations, as in the case of social distancing measures for children.

Figure A. Pandemic Severity Index



For Category 2 and Category 3 pandemics, planning for voluntary isolation of ill persons is recommended; however, other mitigation measures (e.g., voluntary quarantine of household members and social distancing measures for children and adults) should be implemented only if local decision-makers determine their use is warranted due to characteristics of the pandemic within their community. Pre-pandemic planning for the use of mitigation strategies within these two Pandemic Severity Index categories should be done with a focus on a duration of 4 weeks or less, distinct from the longer timeframe recommended for the more severe Category 4 and Category 5 pandemics. For Category 1 pandemics, voluntary isolation of ill persons is generally the only community-wide recommendation, although local communities may choose to tailor their response to Category 1-3 pandemics by applying NPIs on the basis of local epidemiologic parameters, risk assessment, availability of countermeasures, and consideration of local healthcare surge capacity. Thus, from a pre-pandemic planning perspective for Category 1, 2, and 3 pandemics, capabilities for both assessing local public health capacity and healthcare surge, delivering countermeasures, and implementing these measures in full and in combination should be assessed.

Triggers for Initiating Use of Nonpharmaceutical Interventions

The timing of initiation of various NPIs will influence their effectiveness. Implementing these measures prior to the pandemic may result in economic and social hardship without public health benefit and over time, may result in "intervention fatigue" and erosion of public adherence. Conversely, implementing these interventions after extensive spread of pandemic influenza illness in a community may limit the public health benefits of employing these measures. Identifying the optimal time for initiation of these interventions will be challenging because implementation needs to be early enough to preclude the initial steep upslope in case numbers and long enough to cover the peak of the anticipated epidemic curve while avoiding intervention fatigue.

This guidance suggests that the primary activation trigger for initiating interventions be the arrival and transmission of pandemic virus. This trigger is best defined by a laboratory-confirmed cluster of infection with a novel influenza virus and evidence of community transmission (i.e., epidemiologically linked cases from more than one household).

Defining the proper geospatial-temporal boundary for this cluster is complex and should recognize that our connectedness as communities goes beyond spatial proximity and includes ease, speed, and volume of travel between geopolitical jurisdictions (e.g., despite the physical distance, Hong Kong, London, and New York City may be more epidemiologically linked to each other than they are to their proximate rural provinces/areas). In order to balance connectedness and optimal timing, it is proposed that the geopolitical trigger be defined as the cluster of cases occurring within a U.S. State or proximate epidemiological region (e.g., a metropolitan area that spans more than one State's boundary). It is acknowledged that this definition of "region" is open to interpretation; however, it offers flexibility to State and local decision-makers while underscoring the need for regional coordination in pre-pandemic planning.

From a pre-pandemic planning perspective, the steps between recognition of a pandemic threat and the decision to activate a response are critical to successful implementation. Thus, a key component is the development of scenario-specific contingency plans for pandemic response that identify key personnel, critical resources, and processes. To emphasize the importance of this concept, the guidance section on triggers introduces the terminology of *Alert*,

Table A. Summary of the Community Mitigation Strategy by Pandemic Severity

	Pandemic Severity Index		
Interventions* by Setting	**1**	**2 and 3**	**4 and 5**
Home **Voluntary isolation** of ill at home (adults and children); combine with use of antiviral treatment as available and indicated	**Recommend†§**	**Recommend†§**	**Recommend†§**
Voluntary quarantine of household members in homes with ill persons¶ (adults and children); consider combining with antiviral prophylaxis if effective, feasible, and quantities sufficient	**Generally not recommended**	**Consider****	**Recommend****
School **Child social distancing**			
-dismissal of students from schools and school based activities, and closure of child care programs	**Generally not recommended**	**Consider: ≤4 weeks††**	**Recommend: ≤12 weeks§§**
-reduce out-of-school social contacts and community mixing	**Generally not recommended**	**Consider: ≤4 weeks††**	**Recommend: ≤12 weeks§§**
Workplace / Community **Adult social distancing**			
-decrease number of social contacts (e.g., encourage teleconferences, alternatives to face-to-face meetings)	**Generally not recommended**	**Consider**	**Recommend**
-increase distance between persons (e.g., reduce density in public transit, workplace)	**Generally not recommended**	**Consider**	**Recommend**
-modify postpone, or cancel selected public gatherings to promote social distance (e.g., postpone indoor stadium events, theatre performances)	**Generally not recommended**	**Consider**	**Recommend**
-modify work place schedules and practices (e.g., telework, staggered shifts)	**Generally not recommended**	**Consider**	**Recommend**

Generally Not Recommended = Unless there is a compelling rationale for specific populations or jurisdictions, measures are generally not recommended for entire populations as the consequences may outweigh the benefits.
Consider = Important to consider these alternatives as part of a prudent planning strategy, considering characteristics of the pandemic, such as age-specific illness rate, geographic distribution, and the magnitude of adverse consequences. These factors may vary globally, nationally, and locally.
Recommended = Generally recommended as an important component of the planning strategy.
*All these interventions should be used in combination with other infection control measures, including hand hygiene, cough etiquette, and personal protective equipment such as face masks. Additional information on infection control measures is available at www.pandemicflu.gov.
†This intervention may be combined with the treatment of sick individuals using antiviral medications and with vaccine campaigns, if supplies are available.
§Many sick individuals who are not critically ill may be managed safely at home.
¶The contribution made by contact with asymptomatically infected individuals to disease transmission is unclear. Household members in homes with ill persons may be at increased risk of contracting pandemic disease from an ill household member. These household members may have asymptomatic illness and may be able to shed influenza virus that promotes community disease transmission. Therefore, household members of homes with sick individuals would be advised to stay home.
**To facilitate compliance and decrease risk of household transmission, this intervention may be combined with provision of antiviral medications to household contacts, depending on drug availability, feasibility of distribution, and effectiveness; policy recommendations for antiviral prophylaxis are addressed in a separate guidance document.
††Consider short-term implementation of this measure—that is, less than 4 weeks.
§§Plan for prolonged implementation of this measure—that is, 1 to 3 months; actual duration may vary depending on transmission in the community as the pandemic wave is expected to last 6-8 weeks.

Standby, and *Activate*, which reflect key steps in escalation of response action. *Alert* includes notification of critical systems and personnel of their impending activation, *Standby* includes initiation of decision-making processes for imminent activation, including mobilization of resources and personnel, and *Activate* refers to implementation of the specified pandemic mitigation measures. Pre-pandemic planning for use of these interventions should be directed to lessening the transition time between *Alert*, *Standby*, and *Activate*. The speed of transmission may drive the amount of time decision-makers are allotted in each mode, as does the amount of time it takes to fully implement the intervention once a decision is made to *Activate.*
For the most severe pandemics (Categories 4 and 5), *Alert* is implemented during WHO Phase 5/U.S. Government Stage 2 (confirmed human outbreak overseas), and *Standby* is initiated during WHO Phase 6/ U.S. Government Stage 3 (widespread human outbreaks in multiple locations overseas). *Standby* is maintained through Stage 4 (first human case in North America), with the exception of the State or region in which a cluster of laboratory-confirmed human pandemic influenza cases with evidence of community transmission is identified. The recommendation for that State or region is to *Activate* the appropriate NPIs when identification of a cluster with community transmission is made. Other States or regions *Activate* appropriate interventions when they identify laboratory-confirmed human pandemic influenza case clusters with evidence of community transmission in their jurisdictions.

For Category 1, 2, and 3 pandemics, *Alert* is declared during U.S. Government Stage 3, with step-wise progression by States and regions to *Standby* based on U.S. Government declaration of Stage 4 and the identification of the first human pandemic influenza case(s) in the United States. Progression to *Activate* by a given State or region occurs when that State or region identifies a cluster of laboratory-confirmed human pandemic influenza cases, with evidence of community transmission in their jurisdiction.

Duration of Implementation of Nonpharmaceutical Interventions

It is important to emphasize that as long as susceptible individuals are present in large numbers, disease spread may continue. Immunity to infection with a pandemic strain can only occur after natural infection or immunization with an effective vaccine. Preliminary analysis of historical data from selected U.S. cities during the 1918 pandemic suggests that duration of implementation is significantly associated with overall mortality rates. Stopping or limiting the intensity of interventions while pandemic virus was still circulating within the community was temporally associated with increases in mortality due to pneumonia and influenza in many communities. It is recommended for planning purposes that communities be prepared to maintain interventions for up to 12 weeks, especially in the case of Category 4 or Category 5 pandemics, where recrudescent epidemics may have significant impact. However, for less severe pandemics (Category 2 or 3), a shorter period of implementation may be adequate for achieving public health benefit. This planning recommendation acknowledges the uncertainty around duration of circulation of pandemic virus in a given community and the potential for recrudescent disease when use of NPIs is limited or stopped, unless population immunity is achieved.

Critical Issues for the Use of Nonpharmaceutical Interventions

A number of outstanding issues should be addressed to optimize the planning for use of these measures. These issues include the establishment of sensitive and timely surveillance, the planning and conducting of multi-level exercises to evaluate the feasibility of implementation, and the identification and establishment of appropriate monitoring

and evaluation systems. Policy guidance in development regarding the use of antiviral medications for prophylaxis, community and workplace-specific use of personal protective equipment, and safe home management of ill persons must be prioritized as part of future components of the overall community mitigation strategy. In addition, generating appropriate risk communication content/materials and an effective means for delivery, soliciting active community support and involvement in strategic planning decisions, and assisting individuals and families in addressing their own preparedness needs are critical factors in achieving success.

Assessment of the Public on Feasibility of Implementation and Compliance

A Harvard School of Public Health public opinion poll on community mitigation interventions, conducted with a nationally representative sample of adults over the age of 18 years in the United States in September and October 2006, indicated that most respondents were willing to follow public health recommendations for the use of NPIs, but it also uncovered financial and other concerns. More information on "Pandemic Influenza and the Public: Survey Findings" is available at www.keystone.org/Public_Policy/Pandemic_control.html.

The Public Engagement Project on Community Control Measures for Pandemic Influenza (see link at www.keystone.org/Public_Policy/Pandemic_control.html), carried out in October and November 2006, found that approximately two-thirds of both citizens and stakeholders supported all the nonpharmaceutical measures. Nearly half of the citizens and stakeholders supported implementation when pandemic influenza first strikes the United States, and approximately one-third of the public supported implementation when influenza first strikes in their State.

Although the findings from the poll and public engagement project reported high levels of willingness to follow pandemic mitigation recommendations, it is uncertain how the public might react when a pandemic occurs. These results need to be interpreted with caution in advance of a severe pandemic that could cause prolonged disruption of daily life and widespread illness in a community. Issues such as the ability to stay home if ill, job security, and income protection were repeatedly cited as factors critical to ensuring compliance with these NPI measures.

Planning to Minimize Consequences of Community Mitigation Strategy

It is recognized that implementing certain NPIs will have an impact on the daily activities and lives of individuals and society. For example, some individuals will need to stay home to mind children or because of exposure to ill family members, and for some children, there will be an interruption in their education or their access to school meal programs. These impacts will arise in addition to the direct impacts of the pandemic itself. Communities should undertake appropriate planning to address both the consequences of these interventions and direct effects of the pandemic. In addition, communities should pre-identify those for whom these measures may be most difficult to implement, such as vulnerable populations and persons at risk (e.g., people who live alone or are poor/working poor, elderly [particularly those who are homebound], homeless, recent immigrants, disabled, institutionalized, or incarcerated). To facilitate preparedness and to reduce untoward consequences from these interventions, Pandemic Influenza Community Mitigation Interim Planning Guides have been included (see Appendices 4-9) to provide broad planning guidance tailored for businesses and other employers, childcare programs, elementary and secondary schools, colleges and universities, faith-based and community organizations, and individuals and families. It is also critical

for communities to begin planning their risk communication strategies. This includes public engagement and messages to help individuals, families, employers, and many other stakeholders to prepare.

The U.S. Government recognizes the significant challenges and social costs that would be imposed by the coordinated application of the measures described above. It is important to bear in mind, however, that if the experience of the 1918 pandemic is relevant, social distancing and other NPI strategies would, in all likelihood, be implemented in most communities at some point during a pandemic. The potential exists for such interventions to be implemented in an uncoordinated, untimely, and inconsistent manner that would impose economic and social costs similar to those imposed by strategically implemented interventions but with dramatically reduced effectiveness. The development of clear interim pre-pandemic guidance for planning that outlines a coordinated strategy, based upon the best scientific evidence available, offers communities the best chance to secure the benefits that such strategies may provide. As States and local communities exercise the potential tools for responding to a pandemic, more will be learned about the practical realities of their implementation. Interim recommendations will be updated accordingly.

Testing and Exercising Community Mitigation Interventions

Since few communities have experienced disasters on the scale of a severe pandemic, drills and exercises are critical in testing the efficacy of plans. A severe pandemic would challenge all facets of governmental and community functions. Advance planning is necessary to ensure a coordinated communications strategy and the continuity of essential services. Realistic exercises considering the effect of these proposed interventions and the cascading second- and third-order consequences will identify planning and resource shortfalls.

Research Needs

It is recognized that additional research is needed to validate the proposed interventions, assess their effectiveness, and identify adverse consequences. This research will be conducted as soon as practicable and will be used in providing updated guidance as required. A proposed research agenda is outlined within this document.

Conclusions

Planning and preparedness for implementing mitigation strategies during a pandemic are complex tasks requiring participation by all levels of government and all segments of society. Community-level intervention strategies will call for specific actions by individuals, families, employers, schools, and other organizations. Building a foundation of community and individual and family preparedness and developing and delivering effective risk communication for the public in advance of a pandemic are critical. If embraced earnestly, these efforts will result in enhanced ability to respond not only to pandemic influenza but also to multiple other hazards and threats. While the challenge is formidable, the consequences of facing a severe pandemic unprepared will be intolerable. This interim pre-pandemic planning guidance is put forth as a step in our commitment to address the challenge of mitigating a pandemic by building and enhancing community resiliency.

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II

Introduction

A severe pandemic in a fully susceptible population, such as the 1918 pandemic or one of even greater severity, with limited quantities of antiviral medications and pre-pandemic vaccine represents a worst-case scenario for pandemic planning and preparedness.[1] However, because pandemics are unpredictable in terms of timing, onset, and severity, communities must plan and prepare for the spectrum of pandemic severity that could occur. The purpose of this document is to provide interim planning guidance for what are believed currently to be the most effective combinations of pharmaceutical and nonpharmaceutical interventions (NPIs) for mitigating the impact of an influenza pandemic across a wide range of severity scenarios.

The community strategy for pandemic influenza mitigation supports the goals of the Federal Government's response to pandemic influenza to limit the spread of a pandemic; mitigate disease, suffering, and death; and sustain infrastructure and lessen the impact to the economy and the functioning of society.[2] In a pandemic, the overarching public health imperative must be to reduce morbidity and mortality. From a public health perspective, if we fail to protect human health we are likely to fail in our goals of preserving societal function and mitigating the social and economic consequences of a severe pandemic.[3-8]

A severe pandemic could overwhelm acute care services in the United States and challenge our nation's healthcare system.[9-11] To preserve as many lives as possible, it is essential to keep the healthcare system functioning and to deliver the best care possible.[12] The projected peak demand for healthcare services, including intensive care unit (ICU) admissions and the number of individuals requiring mechanical ventilation, would vastly exceed current inventories of physical assets (emergency services capacity, inpatient beds, ICU beds, and ventilators) and numbers of healthcare professionals (nurses and physicians). The most prudent approach, therefore, would appear to be to expand medical surge capacity as much as possible while reducing the anticipated demand for services by limiting disease transmission. Delaying a rapid upswing of cases and lowering the epidemic peak to the extent possible would allow a better match between the number of ill persons requiring hospitalization and the nation's capacity to provide medical care for such people (see Figure 1).

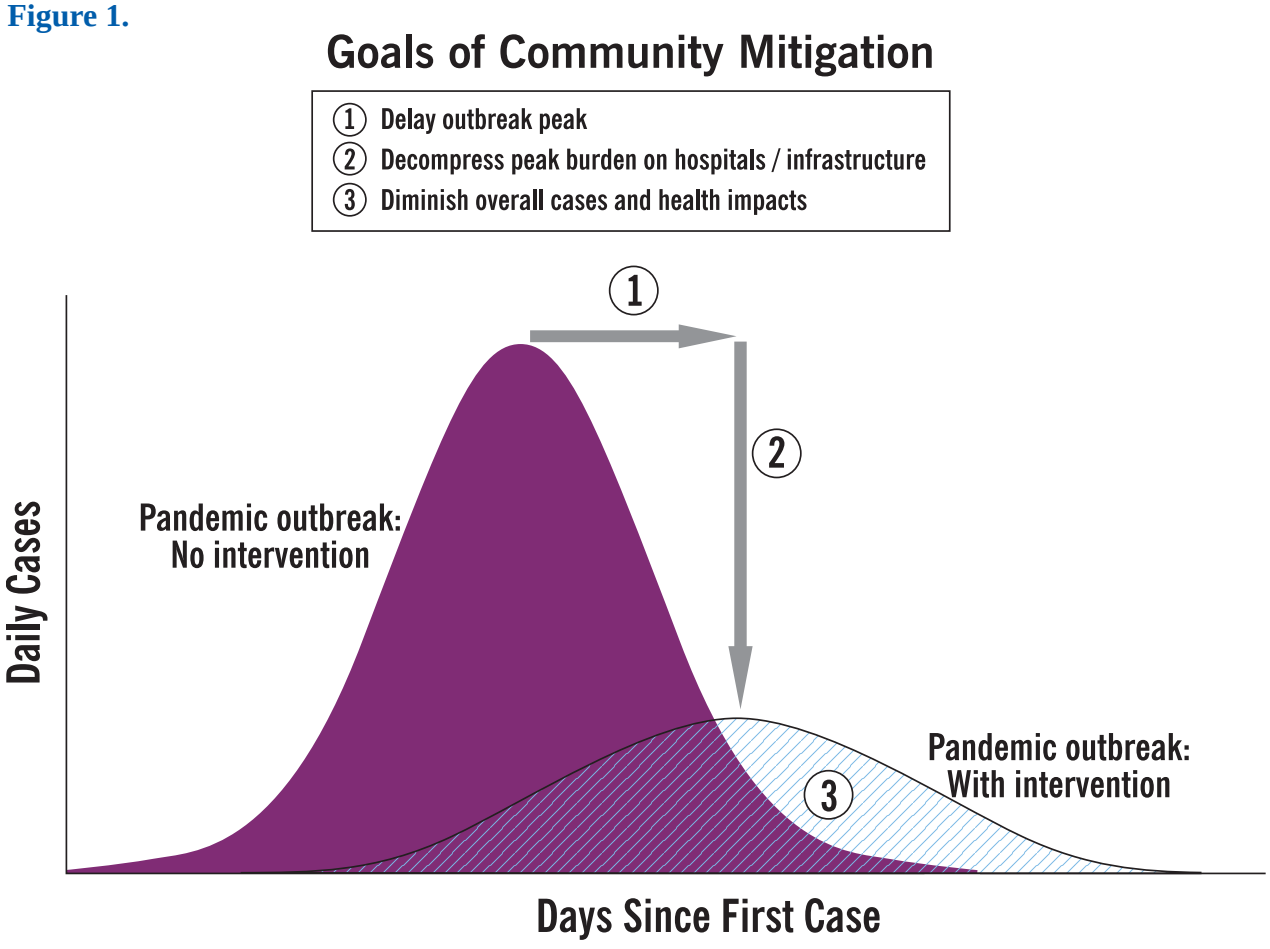
The primary strategies for combating influenza are 1) vaccination, 2) treatment of infected individuals and prophylaxis of exposed individuals with influenza antiviral medications, and 3) implementation of infection control and social distancing measures.[5, 7, 8, 13, 14] The single most effective intervention will be vaccination. However, it is highly unlikely that a well-matched vaccine will be available when a pandemic begins unless a vaccine with broad cross-protection is developed.[15-18] With current vaccine technology, pandemic strain vaccine would not become available for at least 4 to 6 months after the start of a pandemic, although this lag time may be reduced in the future. Furthermore, once an effective pandemic vaccine is developed and being produced, it is likely that amounts will be limited due to the production process and will not be sufficient to cover the

entire population. Pre-pandemic vaccine may be available at the onset of a pandemic, but there is no guarantee that it will be effective against the emerging pandemic strain. Even if a pre-pandemic vaccine did prove to be effective, projected stockpiles of such a vaccine would be sufficient for only a fraction of the U.S. population.

These realities mean that we must be prepared to face the first wave of the next pandemic without vaccine—the best countermeasure—and potentially without sufficient quantities of influenza antiviral medications.[19] In addition, it is not known if influenza antiviral medications will be effective against a future pandemic strain. During a pandemic, decisions about how to protect the public before an effective vaccine is available need to be based on scientific data, ethical considerations, consideration of the public's perspective of the protective measures and their impact on society, and common sense. Evidence to determine the best strategies for protecting people during a pandemic is very limited. Retrospective data from past epidemics and the conclusions drawn from those data need to be examined and analyzed within the context of modern society. Few of those conclusions may be completely generalizable; however, they can inform contemporary planning assumptions. When these assumptions are integrated into the current mathematical models, the limitations need to be recognized, as they were in a recent Institute of Medicine report.[20]

This document provides interim pre-pandemic planning guidance for the selection and timing of selected NPIs and recommendations for their use matched to the severity of a future influenza pandemic. While it is not possible, prior to

Figure 1.



emergence, to predict with certainty the severity of a pandemic, early and rapid characterization of the pandemic virus and initial clusters of human cases may give insight into its potential severity and determine the initial public health response. The main determinant of a pandemic's severity is its associated mortality.[21-27] This may be defined by case fatality ratio or excess mortality rate—key epidemiological parameters that may be available shortly after the emergence of a pandemic strain from investigations of initial outbreaks or from more routine surveillance data. Other factors, such as efficiency of transmission, are important for consideration as well.

The Centers for Disease Control and Prevention (CDC) developed this guidance with input from other Federal agencies, key stakeholders, and partners, including a working group of public health officials and other stakeholders (see Appendix 2, Interim Guidance Development Process). A community mitigation framework is proposed that is based upon an early, targeted, layered mitigation strategy involving the directed application of multiple partially effective nonpharmaceutical measures initiated early and maintained consistently during an epidemic wave.[20, 28-33] These interventions include the following:

1. Isolation and treatment (as appropriate) with influenza antiviral medications of all persons with confirmed or probable pandemic influenza. Isolation may occur in the home or healthcare setting, depending on the severity of an individual's illness and /or the current capacity of the healthcare infrastructure.

2. Voluntary home quarantine of members of households with confirmed or probable influenza case(s) and consideration of combining this intervention with the prophylactic use of antiviral medications, providing sufficient quantities of effective medications exist and that a feasible means of distributing them is in place.

3. Dismissal of students from school (including public and private schools as well as colleges and universities) and school-based activities and closure of childcare programs, coupled with protecting children and teenagers through social distancing in the community to achieve reductions of out-of-school social contacts and community mixing.

4. Use of social distancing measures to reduce contact among adults in the community and workplace, including, for example, cancellation of large public gatherings and alteration of workplace environments and schedules to decrease social density and preserve a healthy workplace to the greatest extent possible without disrupting essential services. Enable institution of workplace leave policies that align incentives and facilitate adherence with the nonpharmaceutical interventions (NPIs) outlined above.

The effectiveness of individual infection control measures (e.g., cough etiquette, hand hygiene) and the role of surgical masks or respirators in preventing the transmission of influenza are currently unknown. However, cough etiquette and hand hygiene will be recommended universally, and the use of surgical masks and respirators may be appropriate in certain settings (specific community face mask and respirator use guidance is forthcoming as is guidance for workplaces and will be available on www.pandemicflu.gov).

Decisions about what tools should be used during a pandemic should be based on the observed severity of the event, its impact on specific subpopulations, the expected benefit of the interventions, the feasibility of success in modern society, the direct and indirect costs, and the consequences on critical infrastructure, healthcare delivery, and society. The most controversial elements (e.g., prolonged dismissal of students from schools and closure of childcare programs) are not likely to be needed in less severe pandemics, but these steps may save lives

during severe pandemics. Just as communities plan and prepare for mitigating the effect of severe natural disasters (e.g., hurricanes), they should plan and prepare for mitigating the effect of a severe pandemic.

The U.S. Government recognizes the significant challenges and social costs that would be imposed by the coordinated application of the measures described above. [2, 10, 34] It is important to bear in mind, however, that if the experience of the 1918 pandemic is relevant, social distancing and other NPI strategies would, in all likelihood, be implemented in most communities at some point during a pandemic. The potential exists for such interventions to be implemented in an uncoordinated, untimely, and inconsistent manner that would impose economic and social costs similar to those imposed by strategically implemented interventions but with dramatically reduced effectiveness. The development of clear interim pre-pandemic guidance for planning that outlines a coordinated strategy, based upon the best scientific evidence available, offers communities the best chance to secure the benefits that such strategies may provide. As States and local communities exercise the potential tools for responding to a pandemic, more will be learned about the practical realities of their implementation. Interim recommendations will be updated accordingly.

This document serves as interim public health planning guidance for State, local, territorial, and tribal jurisdictions developing plans for using community mitigation interventions in response to a potential influenza pandemic in the United States. Given the paucity of evidence for the effectiveness of some of the interventions and the potential socioeconomic implications, some interventions may draw considerable disagreement and criticism.[20] Some interventions that may be highly useful tools in the framework of a disease control strategy will need to be applied judiciously to balance socioeconomic realities of community functioning. CDC will regularly review this document and, as appropriate, issue updates based on the results from various ongoing historical, epidemiological, and field studies. Response guidance will need to remain flexible and likely will require modification during a pandemic as information becomes available and it can be determined if ongoing pandemic mitigation measures are useful for mitigating the impact of the pandemic. Pandemic planners need to develop requirements for community-level data collection during a pandemic and develop and test a tool or process for accurate real-time and post-wave evaluation of pandemic mitigation measures, with guidelines for modifications.

Communities will need to prepare in advance if they are to accomplish the rapid and coordinated introduction of the measures described while mitigating the potentially significant cascading second- and third-order consequences of the interventions themselves. Cascading second- and third-order consequences are chains of effects that may arise because of the intervention and may require additional planning and intervention to mitigate. The terms generally refer to foreseeable unintended consequences of intervention. For example, dismissal of students from school classrooms may lead to the second-order effect of workplace absenteeism for child minding. Subsequent workplace absenteeism and loss of household income could be especially problematic for individuals and families living at or near subsistence levels. Workplace absenteeism could also lead to disruption of the delivery of goods and services essential to the viability of the community. If communities are not prepared for these untoward effects, the ability of the public to comply with the proposed measures and, thus, the ability of the measures to reduce suffering and death may be compromised.

Federal, State, local, territorial, and tribal governments and the private sector all have important and interdependent roles in preparing for, responding to, and recovering from a pandemic. To maintain public confidence and to enlist the support of private citizens in disease

mitigation efforts, public officials at all levels of government must provide unambiguous and consistent guidance that is useful for planning and can assist all segments of society to recognize and understand the degree to which their collective actions will shape the course of a pandemic. The potential success of community mitigation interventions is dependent upon building a foundation of community and individual and family preparedness. To facilitate preparedness, Pandemic Influenza Community Mitigation Interim Planning Guides have been included as appendices to provide broad but tailored planning guidance for businesses and other employers, childcare programs, elementary and secondary schools, colleges and universities, faith-based and community organizations, and individuals and families (see Appendices 4-9). See also the Department of Homeland Security's *Pandemic Influenza Preparedness, Response and Recovery Guide for Critical Infrastructure and Key Resources* (available at www.pandemicflu.gov/plan/pdf/cikrpandemicinfluenzaguide.pdf).

U.S. and Global Preparedness Planning

The suggested strategies contained in this document are aligned with the World Health Organization (WHO) phases of a pandemic.[35] WHO has defined six phases, occurring before and during a pandemic, that are linked to the characteristics of a new influenza virus and its spread through the population (see Appendix 2. WHO Phases of a Pandemic/U.S. Government Stages of a Pandemic). This document specifically provides pre-pandemic planning guidance for the use of NPIs in WHO Phase 6. These phases are described below:

Inter-Pandemic Period

Phase 1: No new influenza virus subtypes have been detected in humans. An influenza virus subtype that has caused human infection may be present in animals. If present in animals, the risk of human disease is considered to be low.
Phase 2: No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza virus subtype poses a substantial risk of human disease.

Pandemic Alert Period

Phase 3: Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to a close contact.

Phase 4: Small cluster(s) with limited human-to-human transmission but spread is highly localized, suggesting that the virus is not well adapted to humans.

Phase 5: Larger cluster(s) but human-to-human spread still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk).

Pandemic Period

Phase 6: Pandemic phase: increased and sustained transmission in general population.

The WHO phases provide succinct statements about the global risk for a pandemic and provide benchmarks against which to measure global response capabilities. However, to describe the U.S. Government's approach to the pandemic response, it is more useful to characterize the stages of an outbreak in terms of the immediate and specific threat a pandemic virus poses to the U.S. population.[2] The following stages provide a framework for Federal Government actions:

Stage 0: New Domestic Animal Outbreak in At-Risk Country
Stage 1: Suspected Human Outbreak Overseas
Stage 2: Confirmed Human Outbreak Overseas
Stage 3: Widespread Human Outbreaks in Multiple Locations Overseas
Stage 4: First Human Case in North America
Stage 5: Spread throughout United States
Stage 6: Recovery and Preparation for Subsequent Waves

Using the Federal Government's approach, this document provides pre-pandemic planning guidance from Stages 3 through 5 for step-wise escalation of activity, from pre-implementation preparedness, through active preparation for initiation of NPIs, to actual use.

III

Rationale for Proposed Nonpharmaceutical Interventions

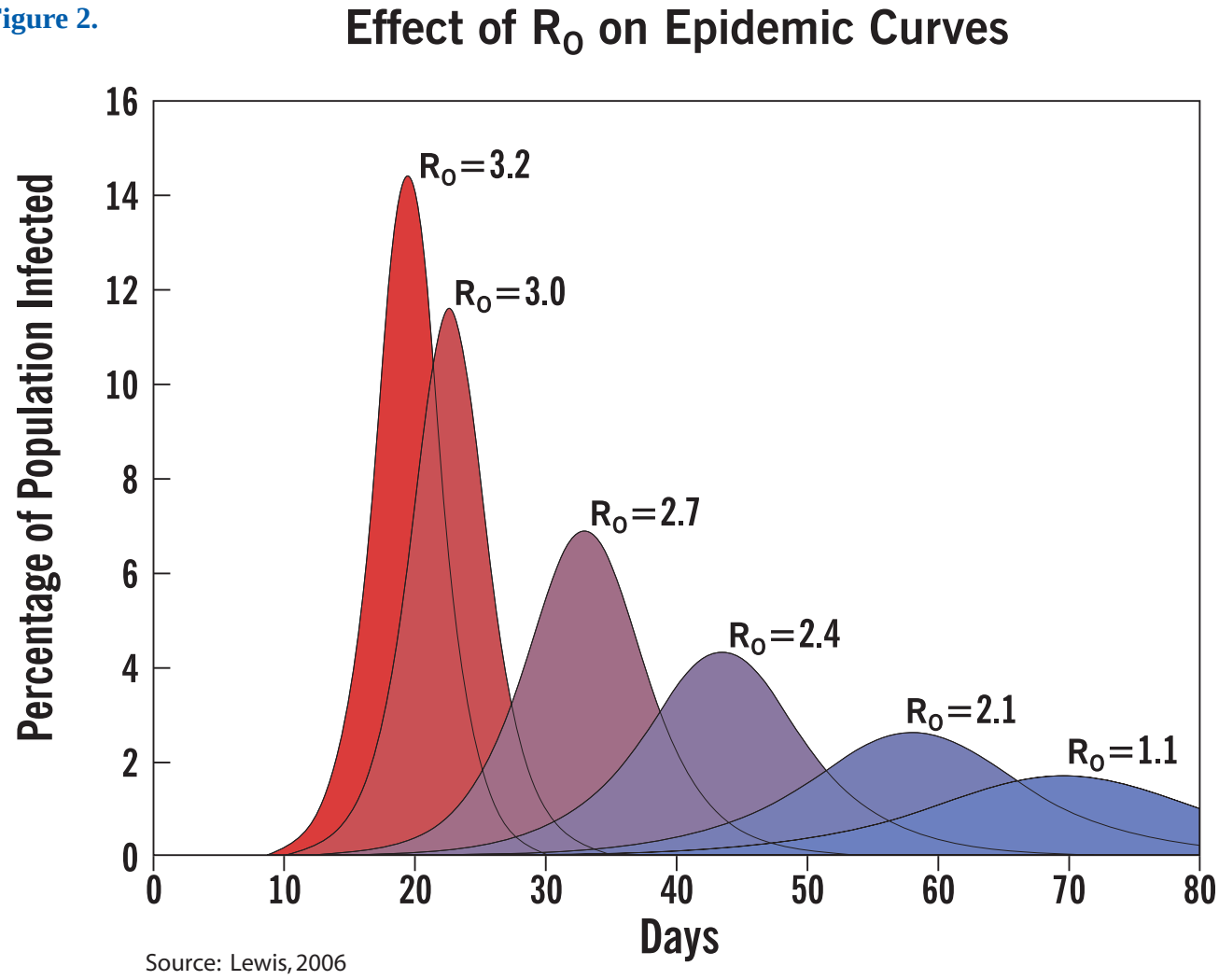
The three major goals of mitigating a community-wide epidemic through NPIs are 1) delay the exponential increase in incident cases and shift the epidemic curve to the right in order to "buy time" for production and distribution of a well-matched pandemic strain vaccine, 2) decrease the epidemic peak, and 3) reduce the total number of incident cases and, thus, reduce morbidity and mortality in the community (Figure 1). These three major goals of epidemic mitigation may all be accomplished by focusing on the single goal of saving lives by reducing transmission. NPIs may help reduce influenza transmission by reducing contact between sick persons and uninfected persons, thereby reducing the number of infected persons. Reducing the number of persons infected will also lessen the need for healthcare services and minimize the impact of a pandemic on the economy and society. The surge of need for medical care associated with a poorly mitigated severe pandemic can be only partially addressed by increasing capacity within hospitals and other care settings. Thus, reshaping the demand for healthcare services by using NPIs is an important component of the overall strategy for mitigating a severe pandemic

Principles of Disease Transmission

Decreasing the Basic Reproductive number, R_0

The basic reproductive number, R_0, is the average number of new infections that a typical infectious person will produce during the course of his/her infection in a fully susceptible population in the absence of interventions.[36-38] R_0 is not an intrinsic property of the infectious agent but is rather an epidemic characteristic of the agent acting within a specific host within a given milieu. For any given duration of infection and contact structure, R_0 provides a measure of the transmissibility of an infectious agent. Alterations in the pathogen, the host, or the contact networks can result in changes in R_0 and thus in the shape of the epidemic curve. Generally speaking, as R_0 increases, epidemics have a sharper rise in the case curve, a higher peak illness rate (clinical attack rate), a shorter duration, and a higher percentage of the population infected before the effects of herd immunity begin to exert an influence (in homogeneous contact networks, herd immunity effects should dominate when the percentage of the population infected or otherwise rendered immune is equivalent to $1 - 1/ R_0$). R_t is the change in the reproductive number at a given point in time. Thus, as shown in Figure 2, decreasing R_t by decreasing host susceptibility (through vaccination or the implementation of individual infection control measures) or reducing transmission by diminishing the number of opportunities for exposure and transmission (through the implementation of community-wide NPIs) will achieve the three major goals of epidemic mitigation.[39] Mathematical modeling of pandemic influenza scenarios in the United States suggests that pandemic mitigation strategies utilizing NPIs separately and in combination with medical countermeasures may decrease the R_t.[20, 28-31, 40] This potential to reduce R_t is the rationale for employing early, targeted, and layered community-level NPIs as key components of the public health response.

Figure 2.



Source: Lewis, 2006

Influenza: Infectiousness and Transmissibility

Assuming the pandemic influenza strain will have transmission dynamics comparable to those for seasonal influenza and recent pandemic influenza strains, the infection control challenges posed will be considerable. Factors responsible for these challenges include 1) a short incubation period (average of 2 days, range 1-4 days); 2) the onset of viral shedding (and presumably of infectiousness) prior to the onset of symptoms; and 3) the lack of specific clinical signs and symptoms that can reliably discriminate influenza infections from other causes of respiratory illness.[41, 42] Although the hallmarks of a pandemic strain will not be known until emergence, patients with influenza may shed virus prior to the onset of clinical symptoms and may be infectious on the day before illness onset. Most people infected with influenza develop symptomatic illness (temperature of 100.4° F or greater, plus cough or sore throat), and the amount of virus they shed correlates with their temperature; however, as many as one-third to one-half of those who are infected may either have very mild or asymptomatic infection. This possibility is important because even seemingly healthy individuals with influenza infection as well as those with mild symptoms who are not recognized as having influenza could be infectious to others.

Early, Targeted Implementation of Interventions

The potential for significant transmission of pandemic influenza by asymptomatic or minimally symptomatic individuals to their contacts suggests that efforts to limit community transmission that rely on targeting only symptomatic individuals would result in diminished ability to mitigate the effects of a pandemic. Additionally, the short intergeneration time of influenza disease suggests that household members living with an ill individual (who are thus at increased risk of infection with pandemic virus) would need to be identified rapidly and targeted for appropriate intervention to limit community spread.[20, 28-31, 40] Recent estimates have suggested that while the reproductive number for most strains of influenza is less than 2, the intergeneration time may be as little as 2.6 days. These parameters predict that in the absence of disease mitigation measures, the number of cases of epidemic influenza will double about every 3 days, or about a tenfold increase every 1-2 weeks. Given the potential for exponential growth of a pandemic, it is reasonable to expect that the timing of interventions will be critical. Planning for community response that is predicated on reactive implementation of these measures may limit overall effectiveness. Measures instituted earlier in a pandemic would be expected to be more effective than the same measures instituted after a pandemic is well established. Although subject to many limitations, mathematical models that explored potential source mitigation strategies that make use of vaccine, antiviral medications, and other infection control and social distancing measures for use in an influenza outbreak identified critical time thresholds for success.[20, 28, 31] These results suggest that the effectiveness of pandemic mitigation strategies will erode rapidly as the cumulative illness rate prior to implementation climbs above 1 percent of the population in an affected area. Thus, pre-pandemic, scenario-based contingency planning for the early, targeted use of NPIs likely provides the greatest potential for an effective public health response.

To summarize, isolation of ill individuals will reduce the onward transmission of disease after such individuals are identified. However, influenza is a disease in which infected persons may shed virus prior to onset of symptoms and thus are potentially infectious for approximately 1 day before becoming symptomatic. In addition, not all infected individuals will be identified because mild or asymptomatic cases may be relatively common. Isolation strategies are thus, at best, a partial solution. Similarly, voluntary quarantine of members of households with ill persons will facilitate the termination of transmission chains, but quarantine strategies are limited to the extent that they can be implemented only after cases are identified. Consequently, only a percentage of transmission chains will be interrupted in this fashion. Given the very short generation times (time between a primary and secondary case) observed with influenza and the fact that peak infectiousness occurs around the time of symptom onset, the identification of cases and simultaneous implementation of isolation and quarantine must occur very rapidly or the efficacy of these strategies will erode significantly.

Antiviral Therapy/Prophylaxis

Four approved influenza antiviral agents are available in the United States: amantadine, rimantadine, zanamivir, and oseltamivir. The role of influenza antiviral medications as therapy for symptomatic individuals is primarily to improve individual outcomes not to limit the further transmission of disease; although, recent clinical trials have demonstrated that prophylaxis of household contacts of symptomatic individuals with neuraminidase inhibitors can reduce household transmission. [43-48]

Current antiviral medication stockpiles are thought to be inadequate to support antiviral prophylaxis of members of households with ill individuals.[49, 50] Moreover, the feasibility

of rapidly (within 48 hours after exposure) providing these medications to ill individuals and those who live in household with ill individuals has not been tested and mechanisms to support such distribution need to be developed. As with the use of antiviral medications for treatment, concerns exist regarding the emergence of resistance if the use of antiviral medications for prophylaxis is widespread.[51, 52] Although mathematical models illustrate the additive effects that antiviral prophylaxis offers in reducing disease transmission, these challenges must be addressed to make this a realistic measure for implementation during a pandemic.[20] Future updates of this guidance will address feasibility concerns and incorporate any new recommendations regarding use of antiviral prophylaxis for members of households with ill individuals.

Targeting Interventions by Exploiting Heterogeneities in Disease Transmission

Our social connectedness provides a disease transmission network for a pandemic to spread.[50, 53-58] Variation exists with respect to individual social connectedness and contribution to disease transmission. Such a distribution is characteristic of a "scale-free" network. A scale-free network is one in which connectivity between nodes follows a distribution in which there are a few highly connected nodes among a larger number of less connected nodes. Air travel provides an example of this concept. In this example, a relatively small number of large hub airports are highly connected with large numbers of originating and connecting flights from a much larger number of small regional airports with a limited number of flights and far lesser degree of connectedness to other airports. Because of the differences in connectivity, the closure of a major hub airport, compared with closure of a small regional airport, would have a disproportionately greater effect on air travel. Given the variation of social connectedness and its contribution to the formation of disease transmission networks, it is useful to identify the nodes of high connectivity since eliminating transmission at these nodes could most effectively reduce disease transmission.

Social Density

One measure for decreasing transmission of an influenza virus is by increasing the distances among people in work, community, and school settings.[31, 50, 59] Schools and pre-schools represent the most socially dense of these environments. Social density is greatest in pre-school classrooms, with guidelines for occupancy density specifying 35-50 square feet per child.[60, 61] Published criteria for classroom size based upon the number of students and one teacher recommend an elementary school and high school classroom density of 49 and 64 square feet per person, respectively.[62] There is more space per person in work and healthcare settings, with high variability from one setting to another; for example, occupancy density in hospitals is about 190 square feet per person.[63] Office buildings and large retail buildings have an average occupational density of 390-470 square feet per person.[64, 65] Homes represent the least socially dense environment (median occupancy density of 734 square feet per person in single-family homes).[66]

Public transportation, including subways and transit buses, represents another socially dense environment. There were on average 32.8 million unlinked passenger trips each weekday for all public transportation across the United States in 2004—nearly 20 million of which were by bus.[67] More than half these 32.8 million passenger trips are work related (54 percent) and about 15 percent of these trips are school related.[68] Each day, 144,000 public transit vehicles, including 81,000 buses, are in use.

More than half the children attending school (K-12) in the United States travel on a school bus—that equates to an estimated 58 million person trips daily (to school and back home).[69] The number of schoolchildren traveling via school bus and via public transportation during a school day is twice the number of people

taking all public transportation in the United States in terms of number of trips and number of individuals during a weekday.

Targeting Schools, Childcare, and Children

Biological, social, and maturational factors make children especially important in the transmission of influenza. Children without pre-existing immunity to circulating influenza viruses are more susceptible than adults to infection and, compared with adults, are responsible for more secondary transmission within households.[70, 71] Compared with adults, children usually shed more influenza virus, and they shed virus for a longer period. They also are not skilled in handling their secretions, and they are in close proximity with many other children for most of the day at school. Schools, in particular, clearly serve as amplification points of seasonal community influenza epidemics, and children are thought to play a significant role in introducing and transmitting influenza virus within their households.[20, 27, 70-76, 78] A recent clinical trial demonstrated that removing a comparatively modest number of school children from the transmission pool through vaccination (vaccinating 47 percent of students with a live attenuated vaccine whose efficacy was found in a separate trial to be no greater than 57 percent) resulted in significant reductions in influenza-related outcomes in households of children (whether vaccinated or unvaccinated) attending intervention schools. [77]

Therefore, given the disproportionate contribution of children to disease transmission and epidemic amplification, targeting their social networks both within and outside of schools would be expected to disproportionately disrupt influenza spread. Given that children and teens are together at school for a significant portion of the day, dismissal of students from school could effectively disrupt a significant portion of influenza transmission within these age groups. There is evidence to suggest that school closure can in fact interrupt influenza spread. While the applicability to a U.S. pandemic experience is not clear, nationwide school closure in Israel during an influenza epidemic resulted in significant decreases in the diagnoses of respiratory infections (42 percent), visits to physicians (28 percent) and emergency departments (28 percent), and medication purchases (35 percent).[56] The New York City Department of Health and Mental Hygiene recently examined the impact of routine school breaks (e.g., winter break) on emergency department visits for influenza-like illness from 2001 to 2006. Emergency department visits for complaints of febrile illness among school-age children (aged 5 to 17 years) typically declined starting 2-3 days after a school break began, remained static during the school break, and then increased within several days after school recommenced. A similar pattern was not seen in the adult age group.[78]

Dismissal of students from schools could eliminate a potential amplifier of transmission. However, re-congregation and social mixing of children at alternate settings could offset gains associated with disruption of their social networks in schools. For this reason, dismissal of students from schools and, to the extent possible, protecting children and teenagers through social distancing in the community, to include reductions of out-of-school social contacts and community mixing, are proposed as a bundled strategy for disrupting their social networks and, thus, the associated disease transmission pathways for this age group.[79]

Targeting Adults—Social Distancing at Work and in the Community

Eliminating schools as a focus of epidemic amplification and reducing the social contacts for children and teens outside the home will change the locations and dynamics of influenza virus transmission. The social compartments within which the majority of disease transmission will likely take place will be the home and workplace, and adults will play a more important role in sustaining transmission chains.[20, 53, 73] Disrupting adult-to-adult transmission will offer additional

opportunities to suppress epidemic spread. The adoption by individuals of infection control measures, such as hand hygiene and cough etiquette, in the community and workplace will be strongly encouraged.

In addition, adults may further decrease their risk of infection by practicing social distancing and minimizing their non-essential social contacts and exposure to socially dense environments. Low-cost and sustainable social distancing strategies can be adopted by individuals within their community (e.g., going to the grocery store once a week rather than every other day, avoiding large public gatherings) and at their workplace (e.g., spacing people farther apart in the workplace, teleworking when feasible, substituting teleconferences for meetings) for the duration of a community outbreak. Employers will be encouraged to establish liberal/unscheduled leave policies, under which employees may use available paid or unpaid leave without receiving prior supervisory approval so that workers who are ill or have ill family members are excused from their responsibilities until their or their family members' symptoms have resolved. In this way, the amount of disease transmission that occurs in the workplace can be minimized, making the workplace a safer environment for other workers.

Healthcare workers may be prime candidates for targeted antiviral prophylaxis once supplies of the drugs are adequate to support this use. Moreover, beyond the healthcare arena, employers who operate or contract for occupational medical services could consider a cache of antiviral drugs in anticipation of a pandemic and provide prophylactic regimens to employees who work in critical infrastructure businesses, occupy business-critical roles, or hold jobs that put them at repeated high risk of exposure to the pandemic virus. This use of antiviral drugs may be considered for inclusion in a comprehensive pandemic influenza response and may be coupled with NPIs. Strategies ensuring workplace safety will increase worker confidence and may discourage unnecessary absenteeism.

Value of Partially Effective Layered Interventions

Pandemic mitigation strategies generally include 1) case containment measures, such as voluntary case isolation, voluntary quarantine of members of households with ill persons, and antiviral treatment/prophylaxis; 2) social distancing measures, such as dismissal of students from classrooms and social distancing of adults in the community and at work; and 3) infection control measures, including hand hygiene and cough etiquette. Each of these interventions may be only partially effective in limiting transmission when implemented alone.

To determine the usefulness of these partially effective measures alone and in combination, mathematical models were developed to assess these types of interventions within the context of contemporary social networks. The "Models of Infectious Disease Agents Study" (MIDAS), funded by the National Institutes of Health, has been developing agent-based computer simulations of pandemic influenza outbreaks with various epidemic parameters, strategies for using medical countermeasures, and patterns of implementation of community-based interventions (case isolation, household quarantine, child and adult social distancing through school or workplace closure or restrictions, and restrictions ontravel).[20, 28-30, 32, 39, 40]

Mathematical modeling conducted by MIDAS participants demonstrates general consistency in outcome for NPIs and suggests the following within the context of the model assumptions:

- Interventions implemented in combination, even with less than complete levels of public adherence, are effective in reducing transmission of pandemic influenza virus, particularly for lower values of R_0.
- School closure and generic social distancing are important components of a community

mitigation strategy because schools and workplaces are significant compartments for transmission.
- Simultaneous implementation of multiple tools that target different compartments for transmission is important in limiting transmission because removing one source of transmission may simply make other sources relatively more important.
- Timely intervention may reduce the total number of persons infected with pandemic influenza.

Each of the models generally suggest that a combination of targeted antiviral medications and NPIs can delay and flatten the epidemic peak, but the degree to which they reduce the overall size of the epidemic varies. Delay of the epidemic peak is critically important because it allows additional time for vaccine development and antiviral production. However, these models are not validated with empiric data and are subject to many limitations.[20]

Supporting evidence for the role of combinations of NPIs in limiting transmission can also be found in the preliminary results from several historical analyses.[20] One statistical model being developed based on analysis of historical data for the use of various combinations of selected NPIs in U.S. cities during the 1918 pandemic demonstrates a significant association between early implementation of these measures by cities and reductions in peak death rate.[80, 81]

Taken together, these strands of evidence are consistent with the hypothesis that there may be benefit in limiting or slowing the community transmission of a pandemic virus by the use of combinations of partially effective NPIs. At the present time, this hypothesis remains unproven, and more work is needed before its validity can be established.

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IV

Pre-pandemic Planning: The Pandemic Severity Index

Appropriate matching of the intensity of intervention to the severity of a pandemic is important to maximize the available public health benefit that may result from using an early, targeted, and layered strategy while minimizing untoward secondary effects. To assist pre-pandemic planning, this interim guidance introduces the concept of a Pandemic Severity Index based primarily on case fatality ratio [23-27], a measurement that is useful in estimating the severity of a pandemic on a population level and which may be available early in a pandemic for small clusters and outbreaks. Excess mortality rate may also be available early and may supplement and inform the determination of the Pandemic Severity Index.[82] Pandemic severity is described within five discrete categories of increasing severity (Category 1 to Category 5). Other epidemiologic features that are relevant in overall analysis of mitigation plans include total illness rate, age-specific illness and mortality rates, the reproductive number, intergeneration time, and incubation period. However, it is unlikely that estimates will be available for most of these parameters during the early stages of a pandemic; thus, they are not as useful from a planning perspective.

The Pandemic Severity Index provides U.S. communities a tool for scenario-based contingency planning to guide pre-pandemic planning efforts. Upon declaration by WHO of having entered the Pandemic Period (Phase 6) and further determination of U.S. Government Stage 3, 4, or 5, the CDC's Director shall designate the category of the emerging pandemic based on the Pandemic Severity Index and consideration of other available information. Pending this announcement, communities facing the imminent arrival of pandemic disease will be able to define which pandemic mitigation interventions are most indicated for implementation based on the level of pandemic severity.

Multiple parameters may ultimately provide a more complete characterization of a pandemic. The age-specific and total illness and mortality rates, reproductive number, intergeneration time, and incubation period as well as population structure and healthcare infrastructure are important factors in determining pandemic impact. Although many factors may influence the outcome of an event, it is reasonable to maintain a single criterion for classification of severity for the purposes of guiding contingency planning. If additional epidemiologic characteristics become well established during the course of the next pandemic through collection and analysis of surveillance data, then local jurisdictions may develop a subset of scenarios, depending upon, for example, age-specific mortality rates.

Table 1 provides a categorization of pandemic severity by case fatality ratio—the key measurement in determining the Pandemic Severity Index—and excess mortality rate. In addition, Table 1 displays ranges of illness rates with potential numbers of U.S. deaths per category, with recent U.S. pandemic experience and U.S. seasonal influenza to provide historical context. Figure 3a plots prior U.S. pandemics from the last century and a severe annual

Table 1. Pandemic Severity Index by Epidemiological Characteristics

Characteristics	Pandemic Severity Index				
	Category 1	Category 2	Category 3	Category 4	Category 5
Case Fatality Ratio (percentage)	<0.1	0.1-<0.5	0.5-<1.0	1.0-<2.0	≥2.0
Excess Death Rate (per 100,000)	<30	30-<150	150-<300	300-<600	≥600
Illness Rate (percentage of the population)	20-40	20-40	20-40	20-40	20-40
Potential Number of Deaths (based on 2006 U.S. population)	<90,000	90,000-<450,000	450,000-<900,000	900,000-<1.8 million	≥1.8 million
20th Century U.S.Experience	Seasonal Influenza (illness rate 5-20%)	1957,1968 Pandemic	None	None	1918 Pandemic

influenza season based on case fatality ratio and illness rate and demonstrates the great variability in pandemics based on these parameters (and the clear distinctiveness of pandemics from even a severe annual influenza season). Figure 3b demonstrates that the primary factor determining pandemic severity is case fatality ratio. Incremental increases in case fatality ratio result in proportionally greater mortality in comparison to increasing illness rates, which result in proportionally much smaller increases in mortality. Figure 4 provides a graphic depiction of the U.S. Pandemic Severity Index by case fatality ratio, with ranges of projected U.S. deaths at a constant 30 percent illness rate and without mitigation by any intervention.

Data on case fatality ratio and excess mortality in the early course of the next pandemic will be collected during outbreak investigations of initial clusters of human cases, and public health officials may make use of existing influenza surveillance systems once widespread transmission starts. However, it is possible that at the onset of an emerging pandemic, very limited information about cases and deaths will be known. Efforts now to develop decision algorithms based on partial data and efforts to improve global surveillance systems for influenza are needed.

Figure 3A. Projected Mortality* of a Modern Influenza Pandemic Compared with that of 20th Century Pandemics (1918, 1957, 1968)

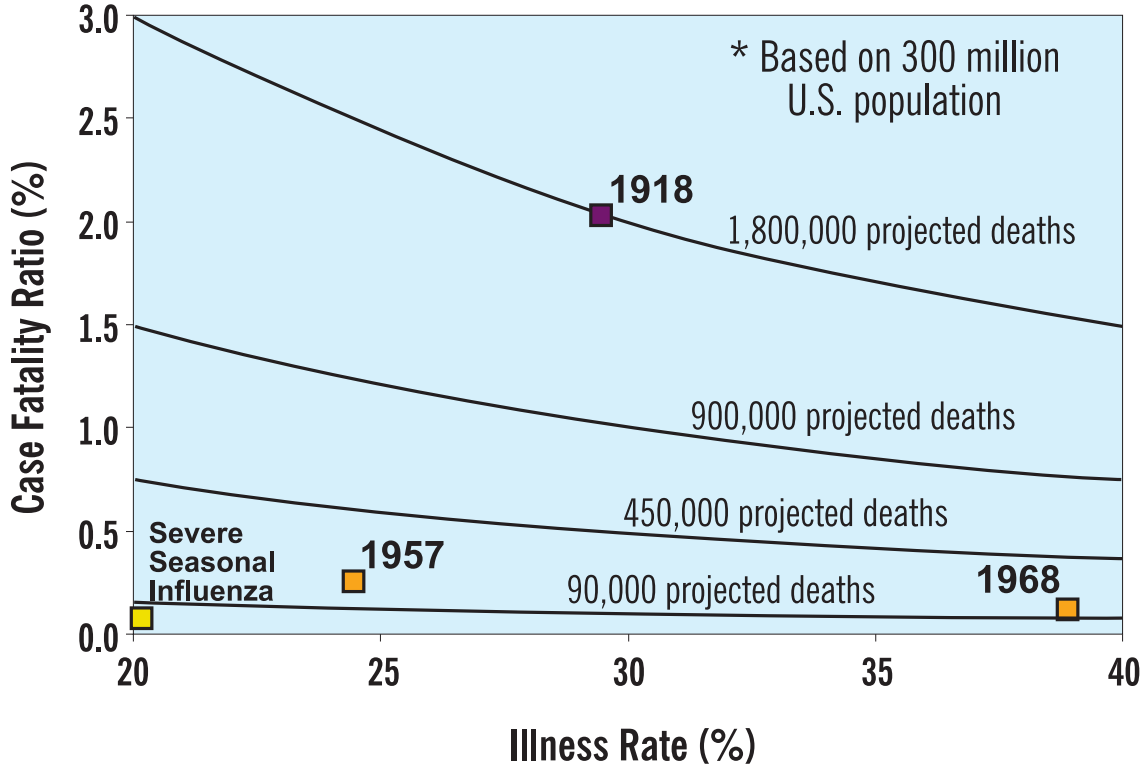


Figure 3B. Pandemic Severity Categories as Determined by Differences in Case Fatality Ratio

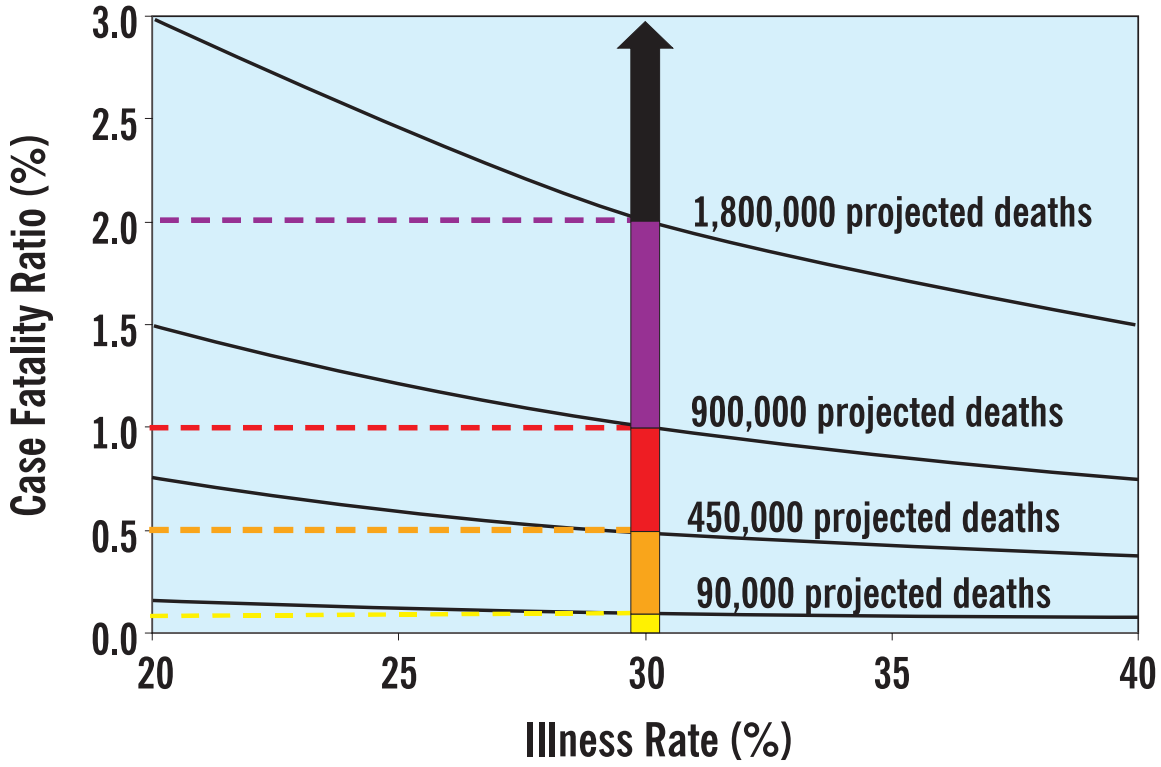
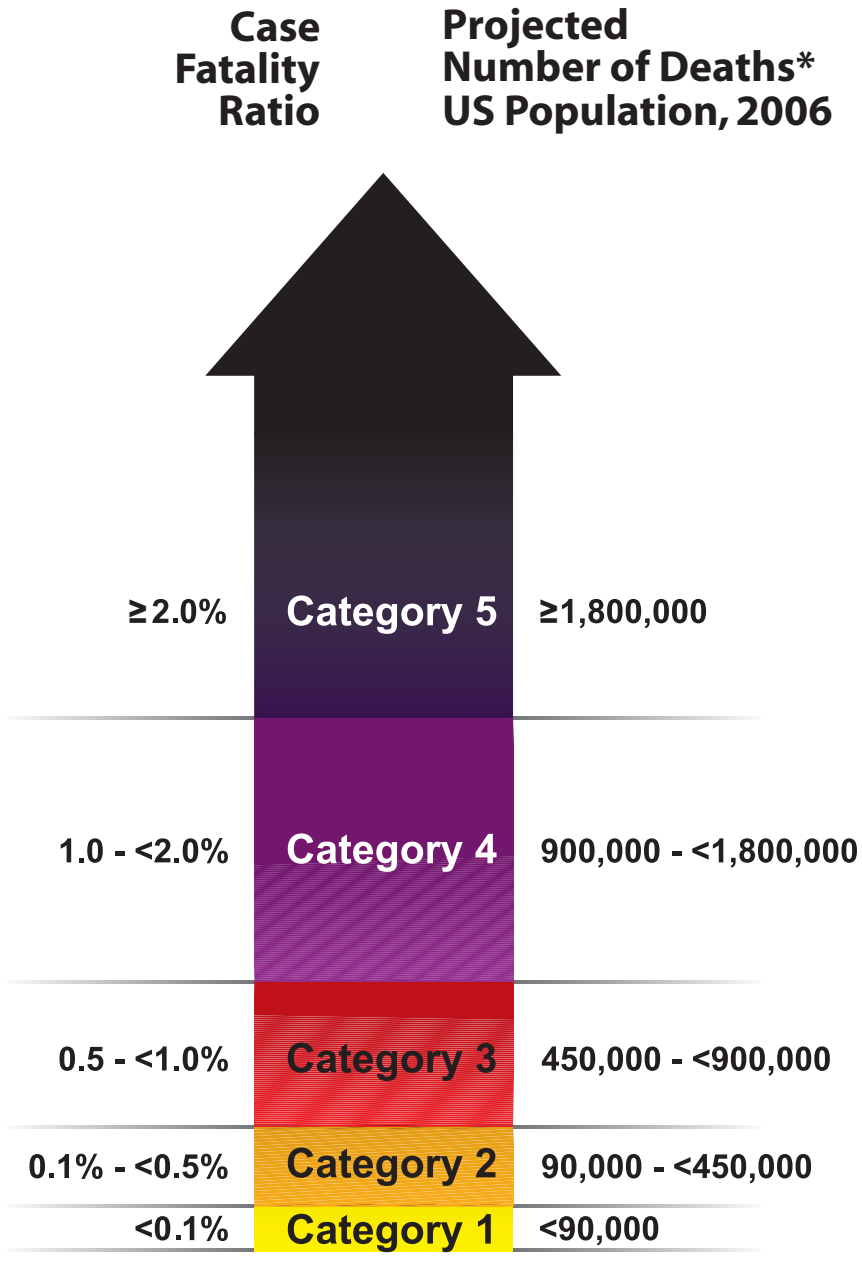


Figure 4. Pandemic Severity Index



*Assumes 30% Illness Rate and Unmitigated Pandemic Without Interventions

V

Use of Nonpharmaceutical Interventions by Pandemic Severity Category

This section provides interim pre-pandemic planning recommendations for use of pandemic mitigation interventions to limit community transmission. These planning recommendations are likely to evolve as more information about their effectiveness and feasibility becomes available. To minimize economic and social costs, it will be important to judiciously match interventions to the pandemic severity level. However, at the time of an emerging pandemic, depending on the location of the first detected cases, there may be scant information about the number of cases and deaths resulting from infection with the virus. Although surveillance efforts may initially only detect the "herald" cases, public health officials may choose to err on the side of caution and implement interventions based on currently available data and iteratively adjust as more accurate and complete data become available. These pandemic mitigation measures include the following:

1. Isolation and treatment (as appropriate) with influenza antiviral medications of all persons with confirmed or probable pandemic influenza. Isolation may occur in the home or healthcare setting, depending on the severity of an individual's illness and /or the current capacity of the healthcare infrastructure.

2. Voluntary home quarantine of members of households with confirmed or probable influenza case(s) and consideration of combining this intervention with the prophylactic use of antiviral medications, providing sufficient quantities of effective medications exist and that a feasible means of distributing them is in place.

3. Dismissal of students from school (including public and private schools as well as colleges and universities) and school-based activities and closure of childcare programs, coupled with protecting children and teenagers through social distancing in the community to achieve reductions of out-of-school social contacts and community mixing.

4. Use of social distancing measures to reduce contact between adults in the community and workplace, including, for example, cancellation of large public gatherings and alteration of workplace environments and schedules to decrease social density and preserve a healthy workplace to the greatest extent possible without disrupting essential services. Enable institution of workplace leave policies that align incentives and facilitate adherence with the nonpharmaceutical interventions (NPIs) outlined above.

Planning for use of these NPIs is based on the Pandemic Severity Index, which may allow more appropriate matching of the interventions to the magnitude of the pandemic. These recommendations are summarized in Table 2. All interventions should be combined with infection control practices, such as good hand hygiene and cough etiquette. In addition, the use of personal protective equipment, such as surgical masks or respirators, may be appropriate in some cases, and guidance on community face mask and respirator use will be forthcoming. Guidance on infection control measures, including those for workplaces, may be accessed at www.pandemicflu.gov.

Table 2. Summary of the Community Mitigation Strategy by Pandemic Severity

	Pandemic Severity Index		
Interventions* by Setting	**1**	**2 and 3**	**4 and 5**
Home **Voluntary isolation** of ill at home (adults and children); combine with use of antiviral treatment as available and indicated	**Recommend†§**	**Recommend†§**	**Recommend†§**
Voluntary quarantine of household members in homes with ill persons¶ (adults and children); consider combining with antiviral prophylaxis if effective, feasible, and quantities sufficient	**Generally not recommended**	**Consider****	**Recommend****
School **Child social distancing**			
-dismissal of students from schools and school based activities, and closure of child care programs	**Generally not recommended**	**Consider: ≤4 weeks††**	**Recommend: ≤12 weeks§§**
-reduce out-of-school social contacts and community mixing	**Generally not recommended**	**Consider: ≤4 weeks††**	**Recommend: ≤12 weeks§§**
Workplace / Community **Adult social distancing**			
-decrease number of social contacts (e.g., encourage teleconferences, alternatives to face-to-face meetings)	**Generally not recommended**	**Consider**	**Recommend**
-increase distance between persons (e.g., reduce density in public transit, workplace)	**Generally not recommended**	**Consider**	**Recommend**
-modify postpone, or cancel selected public gatherings to promote social distance (e.g., postpone indoor stadium events, theatre performances)	**Generally not recommended**	**Consider**	**Recommend**
-modify work place schedules and practices (e.g., telework, staggered shifts)	**Generally not recommended**	**Consider**	**Recommend**

Generally Not Recommended = Unless there is a compelling rationale for specific populations or jurisdictions, measures are generally not recommended for entire populations as the consequences may outweigh the benefits.
Consider = Important to consider these alternatives as part of a prudent planning strategy, considering characteristics of the pandemic, such as age-specific illness rate, geographic distribution, and the magnitude of adverse consequences. These factors may vary globally, nationally, and locally.
Recommended = Generally recommended as an important component of the planning strategy.
*All these interventions should be used in combination with other infection control measures, including hand hygiene, cough etiquette, and personal protective equipment such as face masks. Additional information on infection control measures is available at www.pandemicflu.gov.
†This intervention may be combined with the treatment of sick individuals using antiviral medications and with vaccine campaigns, if supplies are available
§Many sick individuals who are not critically ill may be managed safely at home
¶The contribution made by contact with asymptomatically infected individuals to disease transmission is unclear. Household members in homes with ill persons may be at increased risk of contracting pandemic disease from an ill household member. These household members may have asymptomatic illness and may be able to shed influenza virus that promotes community disease transmission. Therefore, household members of homes with sick individuals would be advised to stay home.
**To facilitate compliance and decrease risk of household transmission, this intervention may be combined with provision of antiviral medications to household contacts, depending on drug availability, feasibility of distribution, and effectiveness; policy recommendations for antiviral prophylaxis are addressed in a separate guidance document.
††Consider short-term implementation of this measure—that is, less than 4 weeks.
§§Plan for prolonged implementation of this measure—that is, 1 to 3 months; actual duration may vary depending on transmission in the community as the pandemic wave is expected to last 6-8 weeks.

For Category 4 or Category 5 pandemics, a planning recommendation is made for use of all listed NPIs (Table 2). In addition, planning for dismissal of students from schools and school-based activities and closure of childcare programs, in combination with means to reduce out-of-school social contacts and community mixing for these children, should encompass up to 12 weeks of intervention in the most severe scenarios. This approach to pre-pandemic planning will provide a baseline of readiness for community response even if the actual response is shorter. Recommendations for use of these measures for pandemics of lesser severity may include a subset of these same interventions and, possibly, suggestions that they be used for shorter durations, as in the case of the social distancing measures for children.

For Category 2 or Category 3 pandemics, planning for voluntary isolation of ill persons is recommended, whereas other measures (voluntary quarantine of household contacts, social distancing measures for children and adults) are to be implemented only if local decision-makers have determined that characteristics of the pandemic in their community warrant these additional mitigation measures. However, within these categories, pre-pandemic planning for social distancing measures for children should be undertaken with a focus on a duration of 4 weeks or less, distinct from the longer timeframe recommended for pandemics with a greater Pandemic Severity Index. For Category 1 pandemics, only voluntary isolation of ill persons is recommended on a community-wide basis, although local communities may still choose to tailor their response to Category 1-3 pandemics differently by applying NPIs on the basis of local epidemiologic parameters, risk assessment, availability of countermeasures, and consideration of local healthcare surge capacity. Thus, from a pre-pandemic planning perspective for Category 1, 2, and 3 pandemics, capabilities for both assessing local public health capacity and healthcare surge, delivering countermeasures, and implementing these measures in full and in combination should be assessed.

Nonpharmaceutical Interventions

Voluntary Isolation of Ill Persons

The goal of this intervention is to reduce transmission by reducing contact between persons who are ill and those who are not. Ill individuals not requiring hospitalization would be requested to remain at home voluntarily for the infectious period, approximately 7-10 days after symptom onset. This would usually be in their homes, but could be in a home of a friend or relative. Voluntary isolation of ill children and adults at home is predicated on the assumption that many ill individuals who are not critically ill can, and will need to be cared for in the home. In addition, this intervention may be combined with the use of influenza antiviral medications for treatment (as appropriate), as long as such medications are effective and sufficient in quantity and that feasible plans and protocols for distribution are in place.

Requirements for success include prompt recognition of illness, appropriate use of hygiene and infection control practices in the home setting (specific guidance is forthcoming and will be available on www.pandemicflu.gov); measures to promote voluntary compliance (e.g., timely and effective risk communications); commitment of employers to support the recommendation that ill employees stay home; and support for the financial, social, physical, and mental health needs of patients and caregivers. In addition, ill individuals and their household members need clear, concise information about how to care for an ill individual in the home and when and where to seek medical care. Special consideration should be made for persons who live alone, as many of these individuals may be unable to care for themselves if ill.

Voluntary Quarantine of Household Members of Ill Persons

The goal of this intervention is to reduce community transmission from members of households in which there is a person ill with pandemic influenza. Members of households in which there is an ill person may be at increased risk of becoming infected with a pandemic influenza virus. As determined on the basis of known characteristics of influenza, a significant proportion of these persons may shed virus and present a risk of infecting others in the community despite having asymptomatic or only minimally symptomatic illness that is not recognized as pandemic influenza disease. Thus, members of households with ill individuals may be recommended to stay home for an incubation period, 7 days (voluntary quarantine) following the time of symptom onset in the household member. If other family members become ill during this period, the recommendation is to extend the time of voluntary home quarantine for another incubation period, 7 days from the time that the last family member becomes ill. In addition, consideration may be given to combining this intervention with provision of influenza antiviral medication to persons in quarantine if such medications are effective and sufficient in quantity and if a feasible means of distributing them is in place.

Requirements for success of this intervention include the prompt and accurate identification of an ill person in the household, voluntary compliance with quarantine by household members, commitment of employers to support the recommendation that employees living in a household with an ill individual stay home, the ability to provide needed support to households that are under voluntary quarantine, and guidance for infection control in the home. Additionally, adherence to ethical principals in use of quarantine during pandemics, along with proactive anti-stigma measures should be assured.[83, 84]

Child Social Distancing

The goal of these interventions is to protect children and to decrease transmission among children in dense classroom and non-school settings and, thus, to decrease introduction into households and the community at large. Social distancing interventions for children include dismissal of students from classrooms and closure of childcare programs, coupled with protecting children and teenagers through social distancing in the community to achieve reductions of out-of-school social contacts and community mixing. Childcare facilities and schools represent an important point of epidemic amplification, while the children themselves, for reasons cited above, are thought to be efficient transmitters of disease in any setting. The common sense desire of parents to protect their children by limiting their contacts with others during a severe pandemic is congruent with public health priorities, and parents should be advised that they could protect their children by reducing their social contacts as much as possible.

However, it is acknowledged that maintaining the strict confinement of children during a pandemic would raise significant problems for many families and may cause psychosocial stress to children and adolescents. These considerations must be weighed against the severity of a given pandemic virus to the community at large and to children in particular. Risk of introduction of an infection into a group and subsequent transmission among group members is directly related to the functional number of individuals in the group. Although the available evidence currently does not permit the specification of a “safe” group size, activities that recreate the typical density and numbers of children in school classrooms are clearly to be avoided. Gatherings of children that are comparable to family-size units may be acceptable and could be important in facilitating social interaction and play behaviors for children and promoting emotional and psychosocial stability.

A recent study of children between the ages of 25 and 36 months found that children in group care with six or more children were 2.2 times as likely to have an upper respiratory tract illness as children reared at home or in small-group care (defined as fewer than six children).[85] If a recommendation for social distancing of children is advised during a pandemic and families must nevertheless group their children for pragmatic reasons, it is recommended that group sizes be held to a minimum and that mixing between such groups be minimized (e.g., children should not move from group to group or have extended social contacts outside the designated group).

Requirements for success of these interventions include consistent implementation among all schools in a region being affected by an outbreak of pandemic influenza, community and parental commitment to keeping children from congregating out of school, alternative options for the education and social interaction of the children, clear legal authorities for decisions to dismiss students from classes and identification of the decision-makers, and support for parents and adolescents who need to stay home from work. Interim recommendations for pre-pandemic planning for this intervention include a three-tiered strategy: 1) no dismissal of students from schools or closure of childcare facilities in a Category 1 pandemic, 2) short-term (up to 4 weeks) dismissal of students and closure of childcare facilities during a Category 2 or Category 3 pandemic, and 3) prolonged (up to 12 weeks) dismissal of students and closure of childcare facilities during a severe influenza pandemic (Category 4 or Category 5). The conceptual thinking behind this recommendation is developed more fully in Section VII, *Duration of Implementation of Nonpharmaceutical Interventions*.

Colleges and universities present unique challenges in terms of pre-pandemic planning because many aspects of student life and activity encompass factors that are common to both the child school environment (e.g., classroom/dormitory density) and the adult sphere (e.g., commuting longer distances for university attendance and participating in activities and behaviors associated with an older student population). Questions remain with regard to the optimal strategy for managing this population during the early stages of an influenza pandemic.

The number of college students in the United States is significant. There are approximately 17 million college students attending both 2- and 4-year universities [86], a large number of whom live away from home.[87] Of the 8.3 million students attending public or private 4-year colleges and universities, less than 20 percent live at home with their parents.

At the onset of a pandemic, many parents may want their children who are attending college or university to return home from school. Immediately following the announcement of an outbreak, colleges and universities should prepare to manage or assist large numbers of students departing school and returning home within a short time span. Where possible, policies should be explored that are aligned with the travel of large numbers of students to reunite with family and the significant motivations behind this behavior. Pre-pandemic planning to identify those students likely to return home and those who may require assistance for imminent travel may allow more effective management of the situation. In addition, planning should be considered for those students who may be unable to return home during a pandemic.

Adult Social Distancing

Social distancing measures for adults include provisions for both workplaces and the community and may play an important role in slowing or limiting community transmission pressure. The goals of workplace measures are to reduce transmission within the workplace and thus into the community at large, to ensure a safe working environment and promote confidence

in the workplace, and to maintain business continuity, especially for critical infrastructure. Workplace measures such as encouragement of telework and other alternatives to in-person meetings may be important in reducing social contacts and the accompanying increased risk of transmission. Similarly, modifications to work schedules, such as staggered shifts, may also reduce transmission risk.

Within the community, the goals of these interventions are to reduce community transmission pressures and thus slow or limit transmission. Cancellation or postponement of large gatherings, such as concerts or theatre showings, may reduce transmission risk. Modifications to mass transit policies/ridership to decrease passenger density may also reduce transmission risk, but such changes may require running additional trains and buses, which may be challenging due to transit employee absenteeism, equipment availability, and the transit authority's financial ability to operate nearly empty train cars or buses.

Requirements for success of these various measures include the commitment of employers to providing options and making changes in work environments to reduce contacts while maintaining operations; whereas, within communities, the support of political and business leaders as well as public support is critical.

VI

Triggers for Initiating Use of Nonpharmaceutical Interventions

The timing of initiation of various NPIs will influence their effectiveness. Implementing these measures prior to the pandemic may result in economic and social hardship without public health benefit and may result in compliance fatigue. Conversely, implementing these interventions after extensive spread of a pandemic influenza strain may limit the public health benefits of an early, targeted, and layered mitigation strategy. Identifying the optimal time for initiation of these interventions will be challenging, as implementation likely needs to be early enough to preclude the initial steep upslope in case numbers and long enough to cover the peak of the anticipated epidemic curve while avoiding intervention fatigue. In this document, the use of these measures is aligned with declaration by WHO of having entered the Pandemic Period Phase 6 and a U.S. Government declaration of Stage 3, 4, or 5.

Case fatality ratio and excess mortality rates may be used as a measure of the potential severity of a pandemic and, thus, suggest the appropriate nonpharmaceutical tools; however, mortality estimates alone are not suitable trigger points for action. This guidance suggests the primary activation trigger for initiating interventions be the arrival and transmission of pandemic virus. This trigger is best defined by a laboratory-confirmed cluster of infection with a novel influenza virus and evidence of community transmission (i.e., epidemiologically linked cases from more than one household). Other factors that will inform decision-making by public health officials include the average number of new infections that a typical infectious person will produce during the course of his/her infection (R_0) and the illness rate. For the recommendations in this interim guidance, trigger points for action assume an R_0 of 1.5-2.0 and an illness rate of 20 percent for adults and 40 percent for children. In this context, in all categories of pandemic severity, it is recommended that State health authorities activate appropriate interventions (as described in Table 2) when a laboratory-confirmed human pandemic influenza case cluster is reported in their State or region (as appropriate) and there is evidence of community transmission.

Defining the proper geospatial-temporal boundary for this cluster is complex and should recognize that our connectedness as communities goes beyond spatial proximity and includes ease, speed, and volume of travel between geopolitical jurisdictions (e.g., despite the physical distance, Hong Kong, London, and New York City may be more epidemiologically linked to each other than they are to their proximate rural provinces/areas). In this document in order to balance connectedness and the optimal timing referenced above, it is proposed that the geopolitical trigger be defined as the cluster of cases occurring within a U.S. State or proximate epidemiological region (e.g., a metropolitan area that spans more than one State's boundary). It is acknowledged this definition of region is open to interpretation; however, it offers flexibility to State and local decision-makers while underscoring the need for regional coordination in pre-pandemic planning.

From a pre-pandemic planning perspective, the steps between recognition of pandemic threat and the decision to activate a response are critical to successful implementation. Thus, a

key component is the development of scenario-specific contingency plans for pandemic response that identify key personnel, critical resources, and processes. To emphasize the importance of this concept, this guidance section on triggers introduces the terminology of *Alert, Standby,* and *Activate,* which reflect key steps in escalation of response action. *Alert* includes notification of critical systems and personnel of their impending activation, *Standby* includes initiation of decision-making processes for imminent activation, including mobilization of resources and personnel, and *Activate* refers to implementation of the specified pandemic mitigation measures. Pre-pandemic planning for use of these interventions should be directed to lessening the transition time between *Alert, Standby,* and *Activate*. The speed of transmission may drive the amount of time decision-makers are allotted in each mode, as does the amount of time it takes to truly implement the intervention once a decision is made to activate.

These triggers for implementation of NPIs will be most useful early in a pandemic and are summarized in Table 3. This table provides recommendations arrayed by Pandemic Severity Index and U.S. Government Stage for step-wise escalation of action from *Alert,* to *Standby*, to *Activate*.

Table 3. Triggers for Implementation of Mitigation Strategy by Pandemic Severity Index and U.S. Government Stages

Pandemic Severity Index	WHO Phase 6, U.S. Government stage 3*	WHO Phase 6, U.S. Government Stage 4† and First human case in the United States	WHO Phase 6, U.S. Government Stage 5§ and First laboratory confirmed cluster in state or region¶
1	Alert	Standby	Activate
2 and 3	Alert	Standby	Activate
4 and 5	Standby**	Standby/Activate††	Activate

Alert: Notification of critical systems and personnel of their impending activation.
Standby: Initiate decision-making processes for imminent activation, including mobilization of resources and personnel.
Activate: Implementation of the community mitigation strategy.
*Widespread human outbreaks in multiple locations overseas.
†First human case in North America.
§Spread throughout the United States.
¶Recommendations for regional planning acknowledge the tight linkages that may exist between cities and metropolitan areas that are not encompassed within state boundaries.
**Standby applies. However, Alert actions for Category 4 and 5 should occur during WHO Phase 5, which corresponds to U.S. Government Stage 2.
††Standby/Activate Standby applies unless the laboratory-confirmed case cluster and community transmission occurs within a given jurisdiction, in which case that jurisdiction should proceed directly to Activate community interventions defined in Table 2.

For the most severe pandemics (Categories 4 and 5), *Alert* is implemented during WHO Phase 5/U.S. Government Stage 2 (confirmed human outbreak overseas), and *Standby* is initiated during WHO Phase 6/U.S. Government Stage 3 (widespread human outbreaks in multiple locations overseas). *Standby* is maintained through Stage 4 (first human case in North America), with the exception of the State or region in which a laboratory-confirmed human pandemic influenza case cluster with evidence of community transmission is identified. The recommendation for that State or region is to *Activate* the appropriate NPIs as defined in Table 2 when identification of a cluster and community transmission is made. Other States or regions *Activate* appropriate interventions when they identify laboratory-confirmed human pandemic influenza case clusters with evidence of community transmission in their jurisdictions.

For Category 1, 2, and 3 pandemics, *Alert* is declared during U.S. Government Stage 3, with step-wise progression by States and regions to *Standby* based on U.S. Government declaration of Stage 4 and the identification of the first human pandemic influenza case(s) in the United States. Progression to *Activate* by a given State or region occurs when that State or region identifies a laboratory-confirmed human pandemic influenza case cluster with evidence of community transmission.

Determining the likely time frames for progression through *Alert*, *Standby*, and *Activate* postures is difficult. Predicting this progression would involve knowing 1) the speed at which the pandemic is progressing and 2) the segments of the population most likely to have severe illness. These two factors are dependent on a complex interaction of multiple factors, including but not limited to the novelty of the virus, efficiency of transmission, seasonal effects, and the use of countermeasures. Thus it is not possible to use these two factors to forecast progression prior to recognition and characterization of a pandemic outbreak, and predictions within the context of an initial outbreak investigation are subject to significant limitations. Therefore, from a pre-pandemic planning perspective and given the potential for exponential spread of pandemic disease, it is prudent to plan for a process of rapid implementation of the recommended measures.

Once the pandemic strain is established in the United States, it may not be necessary for States to wait for documented pandemic strain infections in their jurisdictions to guide their implementation of interventions, especially for a strain that is associated with a high case fatality ratio or excess mortality rate. When a pandemic has demonstrated spread to several regions within the United States, less direct measures of influenza circulation (e.g., increases in influenza-like illness, hospitalization rates, or other locally available data demonstrating an increase above expected rates of respiratory illness) may be used to trigger implementation; however, such indirect measures may play a more prominent role in pandemics within the lower Pandemic Severity Index categories.

Once WHO has declared that the world has entered Pandemic Phase 5 (substantial pandemic risk), CDC will frequently provide guidance on the Pandemic Severity Index. These assessments of pandemic severity will be based on the most recent data available, whether obtained from the United States or from other countries, and may use case fatality ratio data, excess mortality data, or other data, whether available from outbreak investigations or from existing surveillance.

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VII

Duration of Implementation of Nonpharmaceutical Interventions

Preliminary analysis of historical data from selected U.S. cities during the 1918 pandemic suggests that duration of implementation of NPI's is significantly associated with overall mortality rates. Stopping or limiting the intensity of interventions while pandemic virus was still circulating within the community was temporally associated with recrudescent increases in mortality due to pneumonia and influenza in some communities.[20, 81] Total duration of implementation for the measures specified in this guidance will depend on the severity of the pandemic and the total duration of the pandemic wave in the community, which may average about 6-8 weeks in individual communities. However, because early implementation of pandemic mitigation interventions may reduce the virus's basic reproductive number, a *mitigated* pandemic wave may have lower amplitude but longer wavelength than an unmitigated pandemic wave (see Figure 2). Communities should therefore be prepared to maintain these measures for up to 12 weeks in a Category 4 or 5 pandemic.

It is important to emphasize that as long as susceptible individuals are present in large numbers, spread may continue. Immunity to infection with a pandemic strain can only occur after natural infection or immunization with an effective vaccine. The significant determinants for movement of a pandemic wave through a community are immunity and herd effect, and there is likely to be a residual pool of susceptible individuals in the community at all times. Thus, while NPIs may limit or slow community transmission, persisting pandemic virus circulating in a community with a susceptible population is a risk factor for re-emergence of the pandemic. Monitoring of excess mortality, case fatality ratios, or other surrogate markers over time will be important for determining both the optimal duration of implementation and the need for resumption of these measures.

While the decisions to stop or limit the intensity of implementation are crucial factors in pandemic response, this document is primarily oriented to providing pre-pandemic planning guidance. It is recommended for planning purposes that a total duration of 12 weeks for implementation of these measures be considered, particularly with regard to severe pandemics of Category 4 or 5 in which recrudescent disease may have significant impact. However, for less severe pandemics, a shorter period of implementation may be adequate to achieving public health benefit.

This guidance recommends a three-tiered strategy for planning with respect to the duration of dismissal of children from schools, colleges and universities, and childcare programs (Table 2):

- No dismissal of students from schools or closure of childcare facilities in a Category 1 pandemic
- Short-term (up to 4 weeks) dismissal of students and closure of childcare facilities during a Category 2 or Category 3 pandemic
- Prolonged (up to 12 weeks) dismissal of students and closure of childcare facilities during a severe influenza pandemic (Category 4 or Category 5 pandemic)

This planning recommendation acknowledges the uncertainty around the length of time a pandemic virus will circulate in a given community and around the potential for recrudescent disease when use of NPIs is limited or stopped. When dismissals and closures are indicated for the most severe pandemics, thoughtful pre-planning for their prolonged duration may allow continued use of this intervention.

VIII

Critical Issues for the Use of Nonpharmaceutical Interventions

A number of outstanding issues should be addressed to optimize the planning for use of these measures. These issues include the establishment of sensitive and timely surveillance, the planning and conducting of multi-level exercises to evaluate the feasibility of implementation, and the identification and establishment of appropriate monitoring and evaluation systems. Policy guidance in development regarding the use of antiviral medications for prophylaxis, community and workplace-specific use of personal protective equipment, and safe home management of ill persons must be fast-tracked and prioritized as part of future versions of the overall community mitigation strategy. As well, developing appropriate and effective risk communication content and a means for its effective delivery, soliciting active community support and involvement in strategic planning decisions, and assisting individuals and families in identifying their own preparedness needs are critical community factors in achieving success.

Establishing and maintaining sensitive and timely surveillance at national, State, and local levels is critical. Achieving this goal will require enhancing the capability of local physicians and public health authorities to rapidly identify suspect cases of pandemic influenza. This increased capability may be facilitated by the development of point-of-care testing and the appropriate laboratory capacity and ability to transmit specimens and data to reference laboratories.

In addition, establishing protocols for notification of Federal authorities and establishing effective reporting and feedback systems to ensure information is shared appropriately with State and local decision-makers is a key requirement. Within this framework, focused support of established systems, such as the 121 Cities Mortality Reporting System [88], and the establishment of electronic mortality records may facilitate the rapid robust reporting of data elements to support the timely and appropriate implementation of NPIs. Similarly, establishing surveillance systems to monitor trends in disease in a community and to provide guidance on adjusting implementation of interventions and determining appropriate durations for intervention are critical components for implementation and will provide valuable data for decision-making around lifting interventions.

Critical issues remain with regard to ensuring both timely implementation and appropriate layering of interventions. Preliminary analysis of historical data and mathematical modeling suggest that the early, coordinated application of multiple interventions may be more effective in reducing transmission than the use of a single intervention. Multi-level exercises to evaluate the feasibility of implementation and identify critical enablers for use of these measures are required. In addition, early planning for appropriate monitoring and evaluation systems to provide assessment of the effectiveness of all proposed pandemic influenza interventions is needed. Policies and plans are required to ensure the availability of rapid diagnostic testing to distinguish influenza-like illness due to seasonal influenza strains and other respiratory pathogens from illnesses due to pandemic influenza strains. Accurate ascertainment of pandemic influenza

cases is needed early during the course of a pandemic to minimize unnecessary application of mitigation interventions and in later stages of the pandemic to ascertain persisting community transmission.

Policies and planning for distribution of antiviral medications for treatment (and prophylaxis) needs to account for local capabilities, availability of the antiviral medications, and systems for distribution that could leverage the combined capabilities of public health organizations, the private sector, community organizations, and local governments. As well, guidance for community- and workplace-specific use of personal protective equipment is required, as are policies and planning to support their use.

Clear and consistent guidance is required for planning for home care of ill individuals, such as when and where to seek medical care, how to safely care for an ill individual at home, and how to minimize disease transmission in the household. In addition, guidance is required for appropriate use of community resources, such as home healthcare services, telephone care, the 9-1-1 emergency telephone system, emergency medical services, and triage services (nurse-advice lines, self-care guidance, and at-home monitoring systems) that could be deployed to provide resources for home care.

Community engagement is another critical issue for successful implementation and includes building a foundation of community preparedness to ensure compliance with pandemic mitigation measures. Community planners should use media and trusted sources in communities to 1) explain the concepts of pandemic preparedness, 2) explain what individuals and families can do to be better prepared, and 3) disseminate clear information about what the public may be asked to do in the case of a pandemic. In addition, developing and delivering effective risk communications in advance of and during a pandemic to guide the public in following official recommendations and to minimize fear and panic will be crucial to maintaining public trust.