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Control of Pandemic Influenza at Ports of Entry and in the Community
-Non-Pharmaceutical Interventions (NPIs)

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Overview

- Definitions
- Background & Assumptions
- Ports of Entry Strategy
- Community Mitigation Strategy
  - Pandemic Severity Index
  - Rationale for Community Mitigation
  - Community-based Interventions
  - Initiation of Interventions (Triggers)

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Definitions

- ***Isolation***
  - Separation of ill persons with contagious diseases
  - Often in a hospital setting, could be at home
- ***Quarantine***
  - Restriction of persons who are not ill but presumed exposed, usually in the home or a designated facility
- ***Social Distancing***
  - *"social measures to decrease the frequency of contact among people in order to diminish the risk of spread from communicable diseases"*
- ***Infection Control***
  - "hygienic measures to decrease spread of infectious pathogens"

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Background & Assumptions

- **Pandemic Influenza**
  - Novel virus, fully susceptible population, efficient and sustained human to human spread
  - Epidemic over a large geographic area affecting a large proportion of the population
    - "1918-like" pandemic would result in 2 million deaths in US
  - Vaccine (pandemic strain) likely delayed
  - Antivirals may be insufficient quantity, ineffective, and/or difficult to distribute in a timely way

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Ports of Entry

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Impact of Interventions at Ports of Entry

- Delay entry into US
  - 90% effectiveness = 1 week delay
  - 99% effectiveness= 3 to 4 week delay

Balance of benefit vs. disruption of commerce & society

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Border Interventions

- Complete Border Closure
  - Stop people & cargo
- Partial Border Closure
  - Stop people
  - Allow cargo
- Risk-based approach
  - Allow people & cargo
  - Limit entry of people based on risk

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Risk Based Border Strategy, Pandemic Influenza

- Objectives
  - identification, isolation and treatment of persons ill with infectious pandemic influenza
  - Quarantine and prophylaxis of travel contacts (in situ or home, depending on risk)
  - Ensure open ports and smooth entry into US of non-affected travelers

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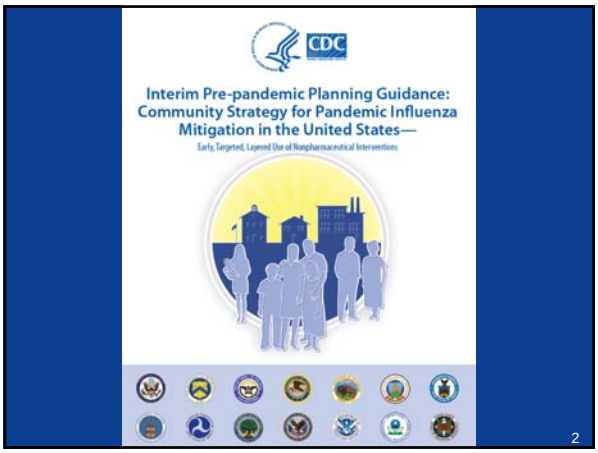

Pandemic Severity Index

- Designed to enable the estimation of the severity of a pandemic on a population
- Needed *early* in pandemic
- Mitigation interventions can be matched to the severity of the pandemic

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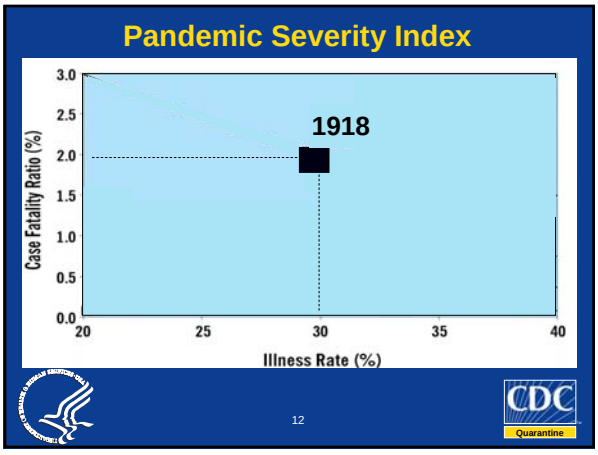

Pandemic Severity Index

- **Excess Mortality (Projected)**
  - Illness Rate (IR) 30%
  - Case Fatality Ratio (CFR) 2%
  - Mortality Rate: IR X CFR = 0.6%
  - Excess Mortality = MR X Population
    0.6% X 300,000,000 = 1,800,000

To be determined <u>early</u> during pandemic

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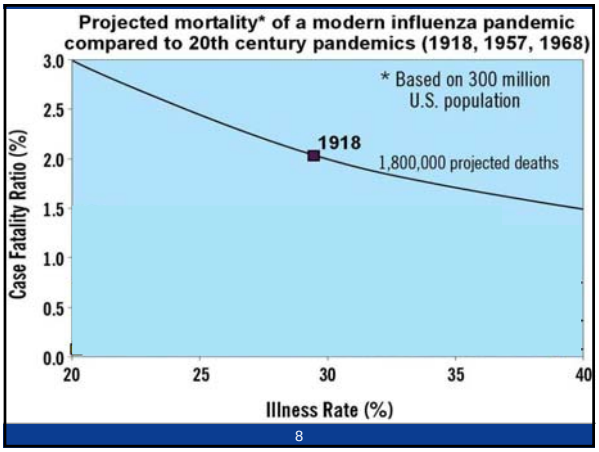

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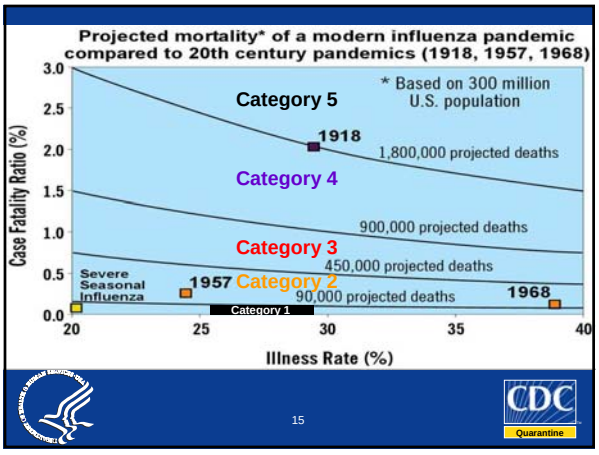

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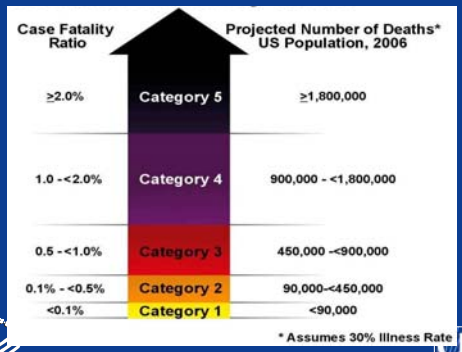
Pandemic Severity Index



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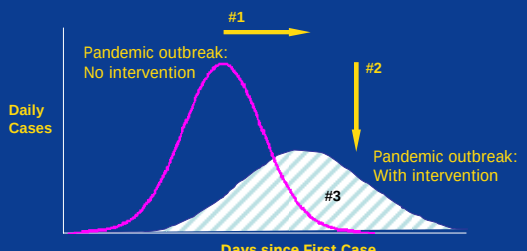
Estimates of the Impact of an Influenza Pandemic by Severity

	Category 2 (Similar to a 1957 pandemic)	Category 4/5 (Similar to a 1918 pandemic)
Illness	90 million (30%)	90 million (30%)
Outpatient medical care	45 million (50%)	45 million (50%)
Hospitalization	865,000	9, 900,000
ICU care	128,750	1,485,000
Mechanical ventilation	64,875	745,500
Deaths	209,000	1,903,000

Community-Based Interventions

1. **Delay disease transmission and outbreak peak**
2. **Decompress peak burden on healthcare infrastructure**
3. **Diminish overall cases and health impacts**



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Factors that Impact Transmission and Reproductive Rate (Ro)*

- Infectiousness of the infected
- Susceptibility of uninfected
- Contact rates (behaviors) in the population- ***target of interventions***

** R(o): avg number of persons each infected individual transmits to; Goal is Ro < 1, results in decreasing epi curve and end of outbreak/epidemic*

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Basis for Use of Non-Pharmaceutical Interventions (NPIs)

- Evidence from 1918 pandemic
- Epidemiologic studies
- Modeling
- Common Sense

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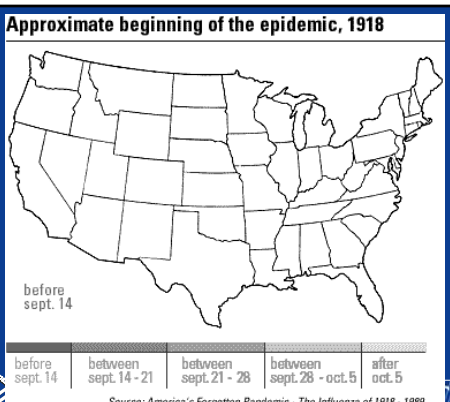
Approximate beginning of the epidemic, 1918



Source: America's Forgotten Pandemic - The Influenza of 1918 - 1989

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Source: http://www.pbs.org/wgbh/amex/influenza/maps/index.html

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Menu of NPIs circa 1918

- Making influenza a reportable disease
- Isolating sick individuals
- Quarantine of households with sick individuals
- School closure
- Protective sequestration of children or adults
- Cancellation of worship services
- Closure of public gathering places [e.g., saloons, theatres, etc.]
- Staggered business hours to decrease congestion on trams, etc.

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Menu of NPIs circa 1918

- Mandatory or recommended the use of masks in public
- Closing or discouraging the use of public transit systems
- Restrictions on funerals, parties, and weddings
- Restrictions on door-to-door sales
- Community-wide curfew measures and business closures
- Social distancing strategies for those encountering others
- Public health risk communication measures
- Declaration of public health emergency.

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Historical Data

- Review of 17 US cities, 1918 pandemic, US
- Cities that implemented ***multiple*** NPIs ***early*** in the pandemic, lower death rates
  - 50% lower peak death rate
  - 20% lower cumulative death
- Releasing NPIs early resulted in increased death rates

Richard J. Hatchett *, Carter E. Mecher , and Marc Lipsitch. Public health interventions and epidemic intensity during the 1918 influenza pandemic, PNAS, April 2007

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JAMA
Nonpharmaceutical Interventions Implemented by US Cities During the 1918-1919 Influenza Pandemic
Markel, H. et. al. JAMA 2007
Supplementary tables, data and bibliography can be accessed at: www.cdc.gov/ncidod/dq/index.htm
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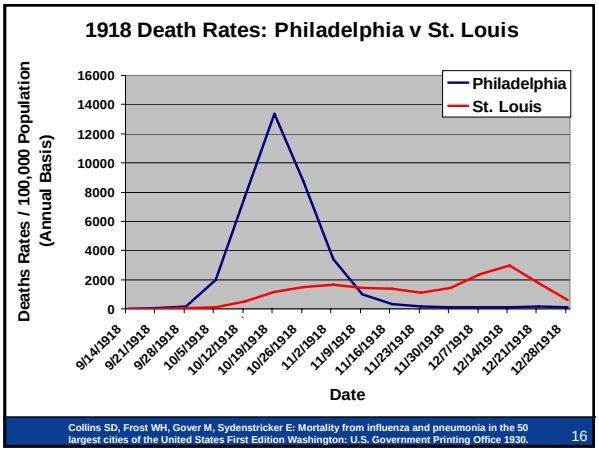
1918 Death Rates: Philadelphia v St. Louis
Deaths Rates / 100,000 Population (Annual Basis)
16000
14000
12000
10000
8000
6000
4000
2000
0
Philadelphia
St. Louis
9/14/1918
9/21/1918
9/28/1918
10/5/1918
10/12/1918
10/19/1918
10/26/1918
11/2/1918
11/9/1918
11/16/1918
11/23/1918
11/30/1918
12/7/1918
12/14/1918
12/21/1918
12/28/1918
Date
Collins SD, Frost WH, Gover M, Sydenstricker E: Mortality from influenza and pneumonia in the 50 largest cities of the United States First Edition Washington: U.S. Government Printing Office 1930.
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Liberty Loan Parade
September 28, 1918
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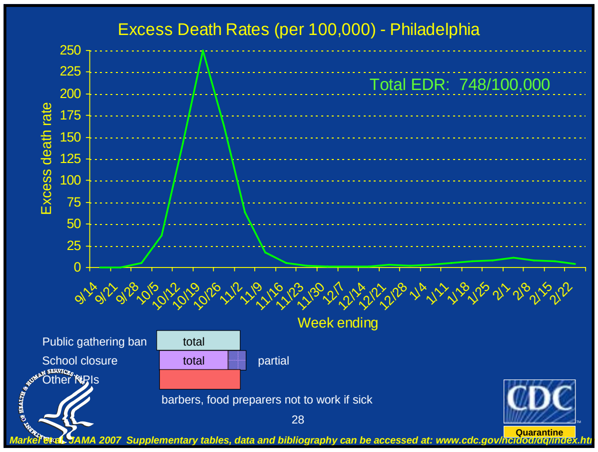
Excess Death Rates (per 100,000) - Philadelphia
Total EDR: 748/100,000
Excess death rate
Week ending
Public gathering ban
total
School closure
total
partial
Other NPIs
barbers, food preparers not to work if sick
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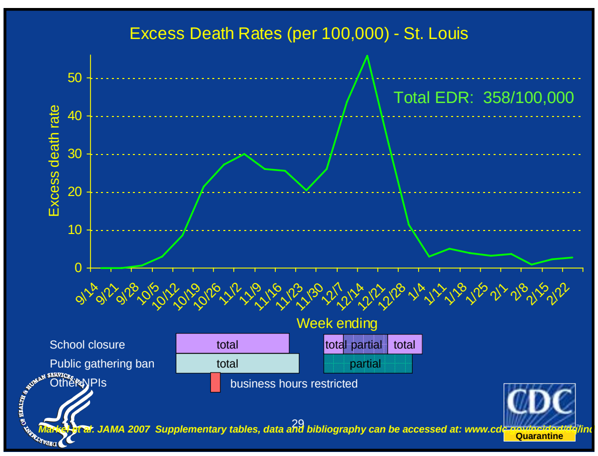
Markel et al. JAMA 2007 Supplementary tables, data and bibliography can be accessed at: www.cdc.gov/ncidod/dq/index.htm


Excess Death Rates (per 100,000) - St. Louis
Total EDR: 358/100,000
Excess death rate
Week ending
School closure
total
total
partial
total
Public gathering ban
total
partial
Other NPIs
business hours restricted
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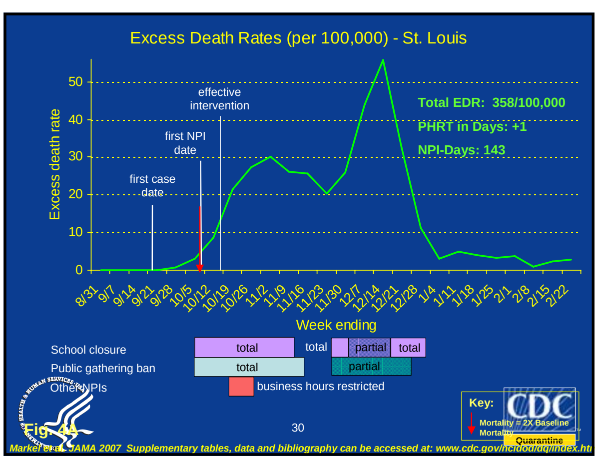
Excess Death Rates (per 100,000) - St. Louis
effective intervention
first NPI date
first case date
Total EDR: 358/100,000
PHRT in Days: +1
NPI-Days: 143
Excess death rate
Week ending
School closure
total
total
partial
total
Public gathering ban
total
partial
Other NPIs
business hours restricted
Key:
Mortality = 2X Baseline Mortality
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Markel et al. JAMA 2007 Supplementary tables, data and bibliography can be accessed at: www.cdc.gov/ncidod/dq/index.htm

Historical Data: Markel et al, 2007*

- Review of 43 US cities, 1918 pandemic
  - Cities that implemented ***multiple*** NPIs, ***early*** in the pandemic, ***longer duration,*** resulted lower death rates
- Early, Sustained, Layered applications of NPIs resulted in decreased

•Markel, et al; Nonpharmaceutical Interventions Implemented by US Cities During the 1918-1919 Influenza Pandemic,JAMA, August 2007

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EPI Data: Role of Children & Schools

- Prevention of influenza in children results in decreased influenza among all age groups in the community (1).
- School closure results in decreased viral respiratory infections among children (2).
- Influenza prevention in daycare results in decreased influenza among household contacts (3)

1. Monto et al. Bull WHO, 1969, 41,537-42.
2. Heyman et al. PIDJ. 2004,23, 675-9.
3. Hurwitz et al. JAMA. 2000, 284 (13),1677-82.

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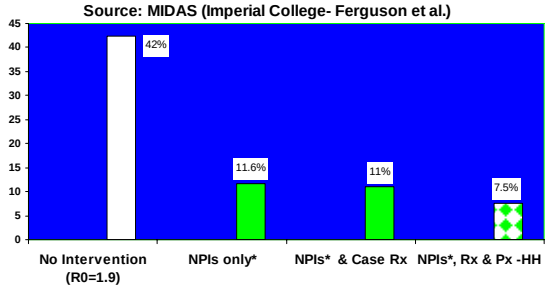
Pandemic Influenza Illness Rates With and Without TLC Interventions
Source: MIDAS (Imperial College- Ferguson et al.)



*All identified cases isolated, full school closure, 50% adult social contact reduction, 30% compliance HH Quarantine, 60% case identification

NPI=Nonpharmaceutical intervention
Rx= antiviral treatment, Px= antiviral prophylaxis for household (HH) contacts

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Who Infects Who?

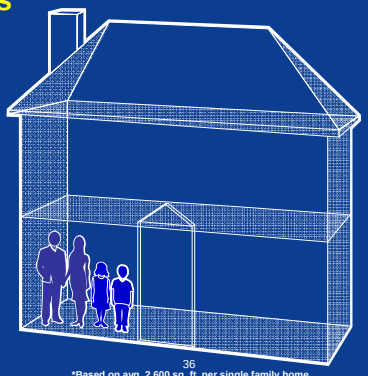
	To Children	To Teenagers	To Adults	To Seniors	Total From
From Children	21.4	3.0	17.4	1.6	43.4
From Teenagers	2.4	10.4	8.5	0.7	21.9
From Adults	4.6	3.1	22.4	1.8	31.8
From Seniors	0.2	0.1	0.8	1.7	2.8
Total To	28.6	16.6	49.0	5.7	

Likely sites of transmission
- School
- Household
- Workplace

Demographics
- Children/Teenagers 29%
- Adults 59%
- Seniors 12%

Glass, RJ, et al. Local mitigation strategies for pandemic influenza. NISAC, SAND Number: 2005-7955J

Spacing of people: If homes were like schools



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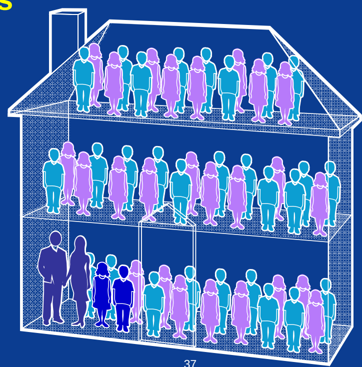
*Based on avg. 2,600 sq. ft. per single family home

Quarantine

Spacing of people: If homes were like schools



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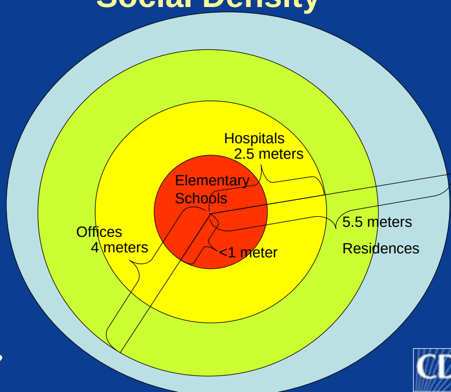
*Based on avg. 2,600 sq. ft. per single family home

Koonin, Mecher, Hatchett, Cetron

Social Density



http://buildingsdatabook.eren.doe.gov/docs/7.4.4.xls

Community Strategy

- **Isolation and treatment of ill persons**
- **Voluntary home quarantine of household contacts**
- **Dismissal of students from school and social distancing and daycare closure**
- **Workplace/community social distancing**

Targeted Layered Containment (TLC):
The sum likely to be greater than the parts…

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Other Infection Control Measures

- **All 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*.**

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Community Strategies by Pandemic Flu Severity (1)

	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 contacts and community mixing	Generally not recommended	Consider: ≤ 4 weeks	Recommend: ≤ 12 weeks

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Community Strategies by Pandemic Flu Severity (2)

	Pandemic Severity Index		
Interventions by Setting	1	2 and 3	4 and 5
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., stadium events, theater performances)	Generally not recommended	Consider	Recommend
–modify workplace schedules and practices (e.g., telework, staggered shifts)	Generally not recommended	Consider	Recommend

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Triggers

- **Timing of initiating interventions influences effectiveness**
  - **Historical evidence from 1918 pandemic**
  - **Models**
  - **Common sense**

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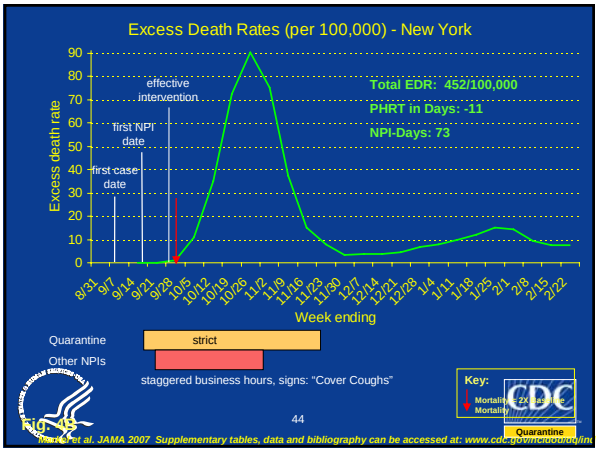

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Fig 45

Markel et al. JAMA 2007 Supplementary tables, data and bibliography can be accessed at: www.cdc.gov/nczved/dsm/flin

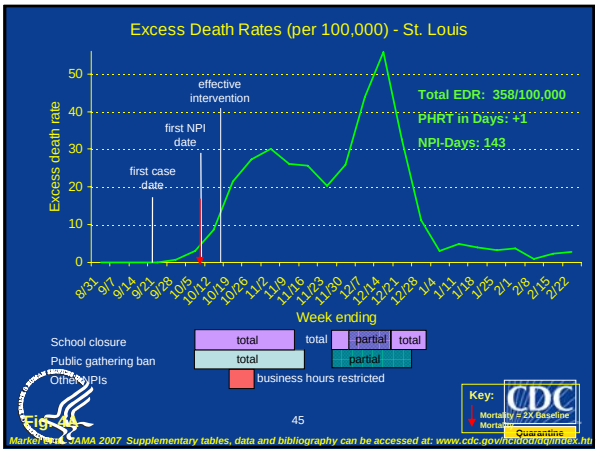

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Fig 46

Markel et al. JAMA 2007 Supplementary tables, data and bibliography can be accessed at: www.cdc.gov/ncezid/dsm/index.ht

Triggers for Implementation of Mitigation Strategies by Pandemic Severity Index and U.S. Government Pandemic 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 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

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Community Mitigation: Consequences

- **Economic impact and potential disruption of services due to absenteeism**
- **Issues associated with sequestration of children**
- **Disproportionate impact on certain populations**
- **Shifts medical care from community to home**

These and other consequences may occur in the absence of community-wide interventions, as a result of spontaneous action by the public.

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Summary

- **Risk Based Border Strategy may be effective in delaying introduction of pandemic influenza**
- **Community Nonpharmaceutical interventions (NPIs) likely to be effective in mitigating influenza pandemic**
  - **Effectiveness unknown, will depend on compliance with interventions**
  - **Multiple, early interventions (targeted, layered containment) likely more effective than single intervention**
  - **Consequences of interventions need to be considered**
  - **May be the only interventions available for resource poor countries**
  - **Additional research needed**

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"You make policy based on the data you have, not the data you wish you had…"

- Adapted from a former Secretary of Defense

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