

# An Epidemiological Analysis of the 2009 H1N1 Swine Influenza “Pandemic”

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# The Faces of the 2009 H1N1 Swine Flu “Pandemic”



# The “Worst” Infectious Disease Pandemic?

- The **bubonic plague** pandemic in the mid-1300s killed an estimated 25 million persons in Europe over a five year period. At that time, 25 million represented a third of Europe’s total population.
- The “**Spanish Flu**” pandemic in 1918-1919 killed an estimated 20-40 million persons. At that time the global population was about 2 billion.
- From the initial recognition of **AIDS** in the early 1980s to 2010, AIDS has and can be expected to kill about 50 million persons globally, with the majority of deaths (> 70%) in sub-Saharan Africa (SSA).

**Using today’s world population of about 7 billion the mortality impact of these pandemics would be:**

**2 billion plague deaths in 5 years;  
100 million “Spanish Flu” deaths in 2 years; and  
50 million AIDS deaths in 30 years.**



***However, the tuberculosis (TB) pandemic which has been hyper-endemic in most human populations for many millennia, has killed more persons than any other infectious disease!***

# Origin of Human Influenza A Viruses

- Influenza A viruses are found in many different animals, including ducks, chickens, pigs, whales, horses, and seals.
- Wild birds are the primary natural reservoir for all subtypes of influenza A viruses and are thought to be the source of influenza A viruses to all other animals.
- Pigs can be infected with both human and avian influenza viruses in addition to swine influenza viruses.
- Because pigs are susceptible to avian, human and swine influenza viruses, they potentially may be infected with influenza viruses from different species (e.g., ducks and humans) at the same time. If this happens, it is possible for the genes of these viruses to mix and create a new virus.

# Origin of Human Influenza A Viruses

- While it is unusual for humans to get influenza virus infection directly from animals, sporadic human infection and limited outbreaks can be found in persons in close contact with sick animals.
- However, the emergence of a new influenza virus that “jumps” from animals to humans does not guarantee that a human pandemic will occur.
- The prime example of “emergence” of a non-pandemic influenza A type is the 1976 “**Swine flu**” outbreak!
- Over the past decade, there has been a marked increase in the detection of “new” influenza viruses infecting humans, but it is likely that hundreds may have emerged and then “vanished” or died out totally undetected.

# “New” Influenza Viruses Reported in the Past 100 Years

★ 1918 – “Spanish” flu (A/H1N1)	The “mother” of all influenza pandemics
1947 – Asian flu (A/H1N1)	A “mild” pandemic - low global death rate
★ 1957 – Asian flu (A/H2N2)	Human H1N1 and avian H2N2 virus strains
★ 1968 – Hong Kong flu (A/H2N3)	Human H2N2 and avian H3Nx virus strains
1976 - Swine flu (A/H1N1)	13 cases, 1 death at Fort Dix – hundreds infected
1986 – Dutch swine flu (A/H1N1)	1 adult with pneumonia
1988 – USA Swine flu (A/H1N1)	Swine virus – 1 death in a pregnant woman
1993 – Netherlands - (H3N2) - human H3N2 and avian H1N1	A father transmitted the virus to his 2 children after exposure to sick pigs.
1995 – UK duck virus (A/H7N7)	One adult with conjunctivitis
1997 - Russian flu (A/H1N1)	A “mild” pandemic – mostly in children
1997 – HK/Chicken flu (A/H5N1)	18 human cases in Hong Kong– 6 deaths.
1999 – HK/Avian flu (A/H9N2)	2 children in Hong Kong - few infections in China
2003 – Dutch/Avian flu (A/H7N7)	Up to 100 infections – mostly in poultry workers
2003 – China/Chicken flu (A/H5N1)	2 cases (1 death) in a Hong Kong family
● 2009 – Mexico/Swine flu (A/H1N1)	Mortality rate less than “seasonal” flu viruses

In addition, there have been numerous “new” or antigenic variant H1N1 viruses that have “emerged during the past few decades and have circulated globally as “seasonal” flu viruses.



# Different Influenza Death Rates

## Influenza Case Fatality Rate (CFR)

the percentage of persons diagnosed as an influenza case and who die as a result of that infection/illness within a given period.

$$\frac{\text{Influenza deaths}}{\text{Influenza cases}^*} = \text{Influenza CFR}$$

## Influenza Mortality Rate (MR)

The number of influenza deaths in a defined population – usually expressed as a number per 100,000.

$$\frac{\text{Influenza deaths}}{\text{Total population}} = \text{Influenza MR}$$

.....  
\*There is no standard definition of an influenza case – a case may be: (1) all influenza virus infections, with or without any illness; (2) all influenza-like illnesses - ILI, medically attended or not; (3) all hospitalized influenza cases.

**CDC has assumed that in all influenza pandemics, 30% of the total population have an ILI due to influenza and they are the denominator “cases” in CDC’s estimates of the influenza CFR.**

# Worldwide impact of the 1918 influenza pandemic

## Influenza mortality rates per 100,000 by region\*

500 in Europe and North America

900 in Central & South America

1,500 in Africa

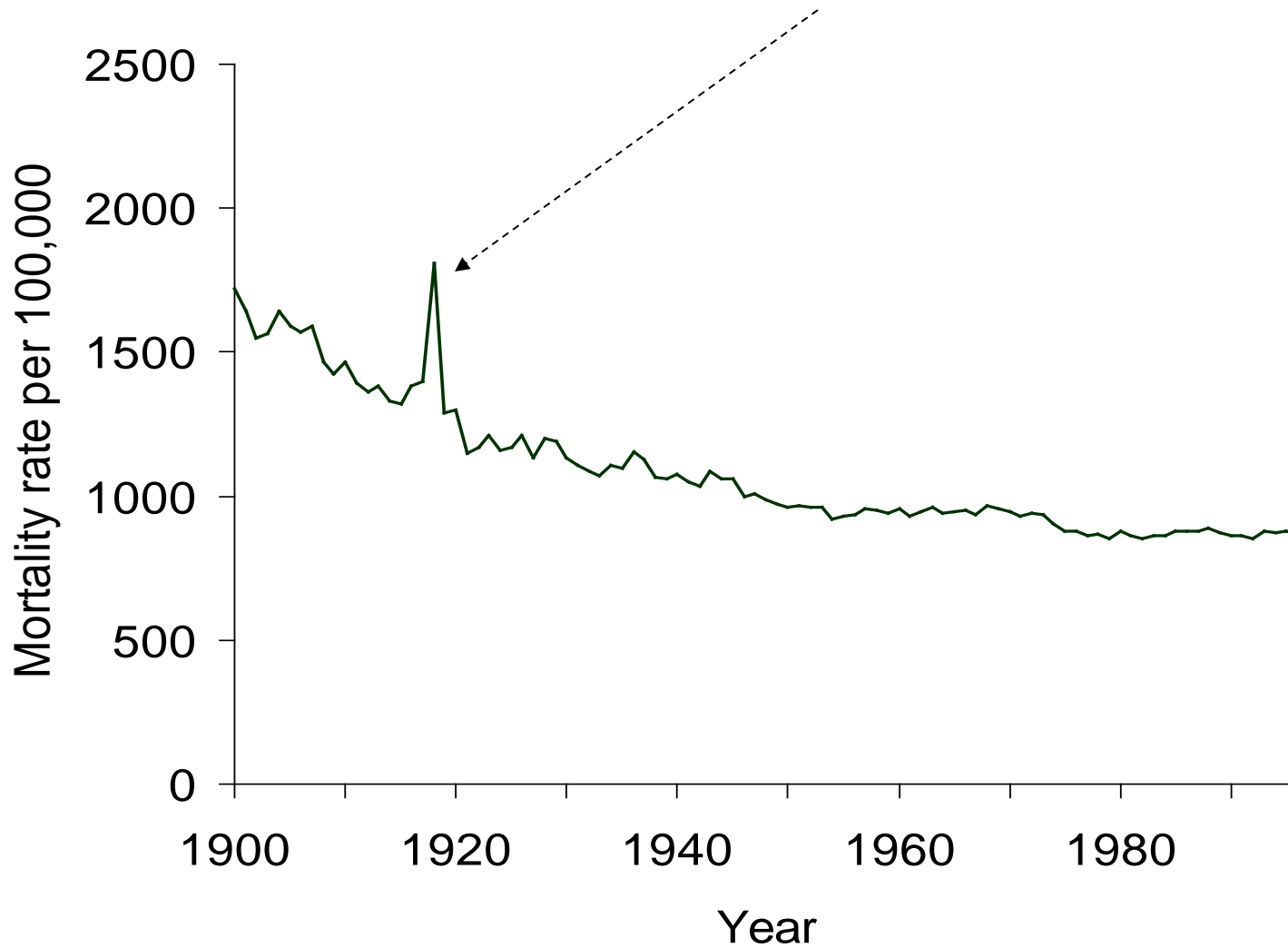
2,000-3,400 in Asia, with highest rates in India  
(estimated 12-17 million deaths in India)

\*\*\*\*\*

\* Estimation of influenza deaths is at best, an inexact science. Even if carefully and accurately carried out, the estimated influenza mortality rate (IMR) can vary by several folds within local areas and regions of any country. Globally, IMRs varied from lows of about 0.5% of the total population (500/100,000) up to 2-3% (2-3,000/100,000) for a global average of about 1.5% (1,500/100,000).



# 20<sup>th</sup> century mortality rates: USA, 1918-1919



# Estimated Global Influenza Mortality Rates (MR)

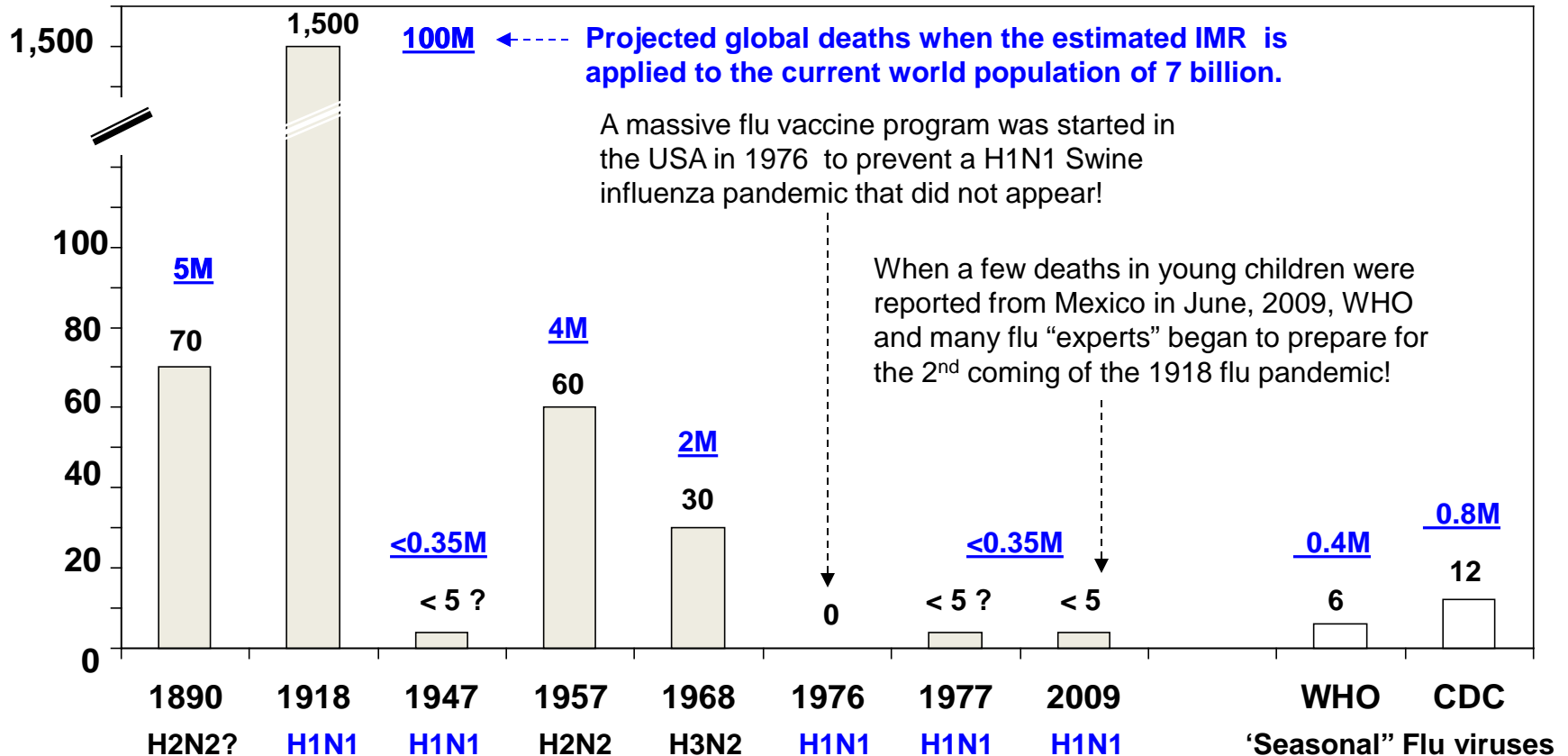
Influenza Viruses	Dates	Estimated flu deaths (millions)	World population (billions)	flu mortality rate (IMR) (100,000)	Influenza severity index*
Asiatic - H2N2?	1889-90	1	1.5	70	7
Spanish - H1N1	1918-20	25 [10-100]	1.8	1,500	150
A "prime" - H1N1	1947-48	"low"	2.4	<5?	<1?
Asian - H2N2	1957-58	1.75	2.9	60	6
Hong Kong - H3N2	1968-69	1	3.6	30	3
Russian - H1N1	1977-78	"mild"	4.3	<5?	<1?
"Swine" - H1N1	2009-10	<0.3 ?	6.8	<5 ?	<1?
Seasonal influenza viruses	recent years	USA: 0.36 World: 0.375	0.3 6.8	CDC -12 WHO - 6	IMR of 10 = 1^

\*Influenza case fatality rates (CFR) have been used to estimate the severity of influenza viruses, but since there is no uniform definition of an influenza case, the estimated influenza mortality rate (IMR) is a more reliable measurement. For past influenza pandemics, an "average" number of deaths were calculated from historical reviews. WHO's estimates of global deaths due to recent seasonal influenza viruses range from 250,000 to 500,000 for an average annual IMR of 6 per 100,000 population. CDC's estimates of deaths due to recent seasonal influenza viruses in the USA have ranged from 17,000 to 52,000 for an average of 36,000 or an average IMR of 12/100,000.

^An IMR of 10/100,000 may be considered as the average severity of recent seasonal influenza viruses and can be used as a yardstick to estimate the relative severity of past or new pandemic or seasonal influenza viruses.

# Estimated Influenza Mortality Rates (IMR) for Influenza “Pandemics” and Recent “Seasonal” Influenza

Influenza Mortality Rate (IMR) - deaths per 100,000 population



The estimated global IMR for the 1918 pandemic was about 1,500/100,000 - >25 million deaths in a population of 1.8 billion. However, the IMR can vary by several folds within regions and within countries since such variations may occur due to: (1) differences in the spread of influenza in different populations; (2) differences in the specific population immunity to influenza viruses; (3) differences in general levels of medical care; and (4) **estimation of influenza deaths is not an exact science!**

# WHO's 2005 Definition of an Influenza Pandemic

“An influenza pandemic occurs when a new influenza virus appears against which the human population has no immunity, resulting in several, simultaneous epidemics worldwide with enormous numbers of deaths and illness.”\*

\*[The last underlined phrase was deleted by WHO on May 4, 2009]

# In 2005 WHO also developed a phased alert system to prepare and respond to influenza pandemics

**Alert phases (AP) 1-3** monitors the emergence of new/novel influenza viruses that are capable of human-to-human (H-H) transmission. [[Reached in February-March, 2009](#)]

**AP-4** is reached when H-H transmission of a “new” animal or human-animal influenza virus, able to sustain community outbreaks, has been verified. [[April 27, 2009](#)]

**AP-5 (the pre-pandemic phase)** is reached when H-H spread of the virus is reported in two or more countries in one WHO region. [[April 29, 2009](#)] and the highest

**AP-6 (the pandemic phase)** is reached when in addition to AP-5, the same virus spreads from H-H in at least one other country in another WHO region [[June 11, 2009](#)].

# An Epidemiological Time Line for the 2009 H1N1 Swine Influenza “Pandemic”

A

When WHO officially declared the emergence of an influenza pandemic in June, 2009, its mortality rate was unknown, but the 2005 IHR revision considered the detection of a new influenza virus subtype that can spread in human communities as a global health emergency of international concern.

No excess influenza deaths were found in Australia and NZ during their 2009 flu season with the 2009 H1N1 pandemic virus **4**

**5** The 2009 H1N1 vaccine was initially available in Australia only after its 2009 flu season was over and in the USA when H1N1 infections were peaking

No evidence of a severe 2010 flu season with the 2009 H1N1 virus in Australia and NZ **9**

Mexico revises death estimates markedly lower, but WHO also revises its definition of an influenza pandemic by deleting the phrase “with enormous numbers of deaths and illnesses”

Influenza pandemic (alert level 6) declared by WHO and this triggered an unprecedented global response to an assumed global health emergency **3**

**5a** Estimated deaths in the USA due to the 2009 H1N1 virus peaked in Oct-Nov. Total deaths were about 15,000 and MR was low – 5/100,000

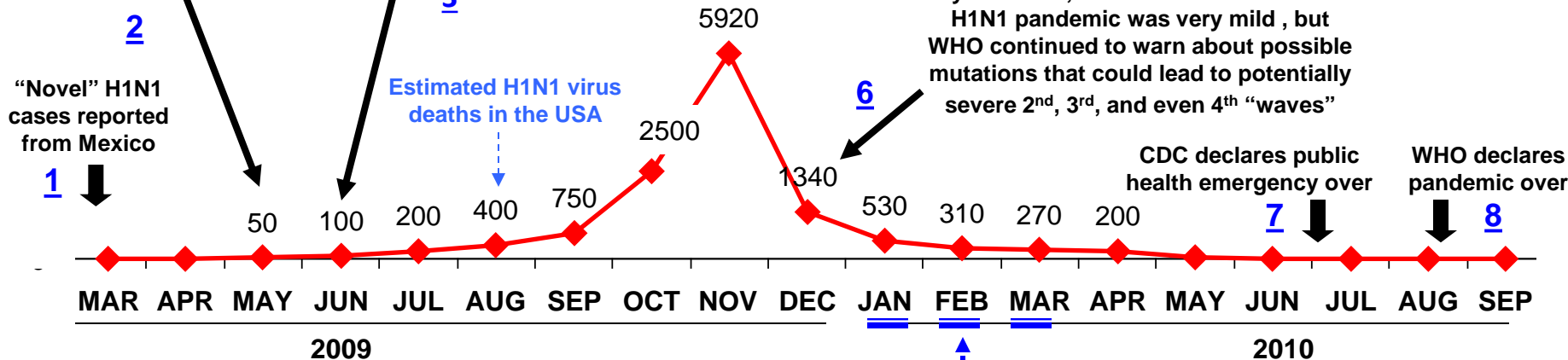
**B** All available data and estimates indicate that the 2009 H1N1 pandemic was not a global health emergency of international concern, and most of the expanded public health measures, i.e., routine hand washing, etc., had no measurable impact on the scope or severity of the pandemic!

**1** “Novel” H1N1 cases reported from Mexico

By late 2009, it was clear that the 2009 H1N1 pandemic was very mild, but WHO continued to warn about possible mutations that could lead to potentially severe 2<sup>nd</sup>, 3<sup>rd</sup>, and even 4<sup>th</sup> “waves”

CDC declares public health emergency over **7**

WHO declares pandemic over **8**



The usual peak months of influenza activity in the USA

# Influenza Prevention/Control Programs

Over the past few decades, annual influenza programs have provided influenza vaccines primarily to two priority groups:

1. persons who are at the ***highest risk of severe complications*** from influenza, particularly the elderly;
2. personnel who provide ***essential services***: health care workers, fire fighters, police, and the military.

The vaccine developed for the 2009 H1N1 “pandemic” was recommended for essentially the total population, but was not available until the influenza season was over in the Southern hemisphere and was peaking or had peaked in the Northern hemisphere.



# Influenza Prevention/Control Programs

*Public health measures for preventing community transmission of influenza are largely ineffectual* and therefore have not been major components of most annual influenza programs.

In recognition of this, WHO in April, 2009 advised against placing restrictions on international travel and urged increased surveillance and strengthening of infection control measures in health facilities.

As a result, routine hand washing, in and out of health facilities, was strongly promoted to the point that it became the cornerstone of public health prevention/control measures for preventing the community spread of influenza.

# Senior public health expert comments on hand washing to prevent the community spread of influenza

David Morens – “I can’t fully accept that contact/fomite transmission plays **NO** role (It may under certain circumstances play a role), I also **doubt that hand washing does much good other than as a reminder to be sanitary.**”

Edwin Kilbourne – “The pathogenesis of influenza is initiated by the inhalation of influenza virus – usually in the form of aerosols of small droplet nuclei... **Hand washing does nothing to curtail the spread of influenza but it may be a good substitute for hand wringing.**”

# Senior public health expert comments on hand washing to prevent the community spread of influenza

**Michael Osterholm** – “hands and fomites play a role in the transmission of some respiratory viruses [but] the case for this as a major mode of transmission for influenza cannot be supported ... **responsible hand washing can never be a bad thing, [but] we’ve oversold it for preventing influenza transmission.**”

**Donald A Henderson** – “Will hand washing be effective in altering the course of the pandemic (dream on!) and what in heavens name could "disinfecting" health facilities do?... **The CDC responses that we have had have generally been: One simply can't stand by; we have to advise something...**”

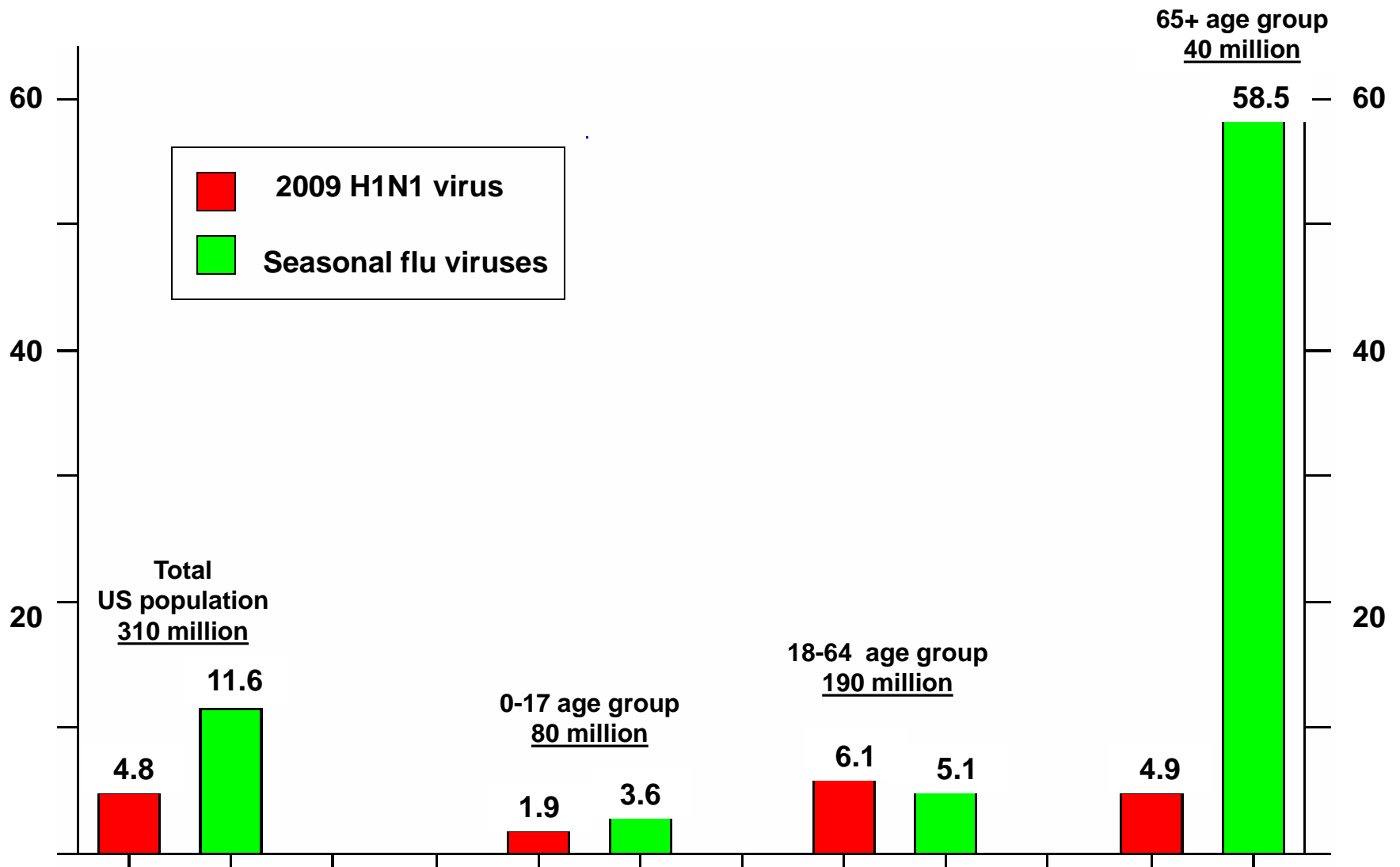
# Influenza Deaths in USA Based on Estimated Influenza Mortality Rates

Influenza mortality rate similar to:	Estimated Influenza deaths in 2009-10
1918 “Spanish” H1N1	4-5 million*
1957 “Asian” H2N2	190,000
1968 “Hong Kong” H3N2	95,000
2009 “Swine” H1N1	?<20,000?**)
<b>Recent “Seasonal” Influenza viruses</b>	
WHO model	>15,000
CDC model	>30,000

\* Based on the global average of 1,500/100,000 for the IMR in the 1918 pandemic – if the estimated IMR for the USA of about 600/100,000 is used the toll of influenza deaths would be about 2 million!

\*\* As of early 2010, CDC estimated based on death data and viral surveillance data that there may have been about 15,000 deaths due to the 2009 H1N1 virus.

# Estimated Influenza Mortality Rates\* by Age Groups - USA



\* Influenza mortality rate (IMR) per 100,000 population

# Conclusions

- ***Conflict of interest charges*** against WHO influenza advisors, and an evaluation of WHO's handling of the 2009 "pandemic" as ***proportionate and effective*** were both wrong!
- The problem with WHO's response to the 2009 H1N1 "Swine" influenza virus were **assuming**: the "new" influenza virus would be very severe; and that there are effective public health measures to limit the spread and impact of a "new" influenza virus.  
**Both assumptions were wrong!**

# Conclusions

- Use of case fatality rates (**CFR**) for estimating the relative severity of influenza viruses is not reliable since there is no standard definition of what an influenza “case” may be and the numbers of reported “cases” can be greatly increased due to news media hype!

A more objective rate for estimating the severity of influenza viruses is the mortality rate (**IMR**) i.e., number of specific influenza deaths per 100,000 population.

- The severity of the 2009 “pandemic” in children has been overestimated due to intense media coverage of deaths in children, which have led to: more children seeking medical care for influenza-like-illness [**ILI**]; more children hospitalized with moderately severe **ILI**; and increased reporting of **ILI** in children rather than under reporting!



# Conclusions

- The estimated mortality rate (**MR**) of the 2009 H1N1 “pandemic” in the USA was very low (5/100,000) - less than half of the **MR** in an “average” influenza season, primarily because the **MR** in the 65+ population was more than an order of magnitude less than in recent influenza seasons. Similar low influenza **MR** were reported from countries with well developed influenza surveillance systems.
- The unprecedented global response to the 2009 influenza “pandemic” had very **little impact on the scope and severity of the “pandemic”** since the 2009 H1N1 vaccine was generally not available until the “pandemic” peaked and measures for limiting the community spread of influenza, including routine hand washing, may have, at best, only slowed the spread of the H1N1 virus in some populations.

# Conclusions

- The primary reason for the relative “mildness” of the 2009 influenza “pandemic” was that most persons over the age of 10, especially the elderly (65+), had some immunity to H1N1 influenza viruses.
- *Without pre-existing population immunity, the 2009 flu “pandemic” might have been very severe, but the unprecedented global response would still have been ineffective!*

# Recommendations

- International Health Regulations (IHR) shouldn't consider the spread of a **new** influenza virus subtype as a ***global health emergency*** without some indication of the severity of the **new** virus.
- WHO needs to clarify ***what constitutes a new pandemic virus***, since there was ample population immunity to the 2009 H1N1 virus.
- WHO should also clearly acknowledge the ***major limitations*** of public health programs for the prevention and control of influenza and ***critically evaluate the cost effectiveness*** of recommended measures to limit the community spread of influenza viruses.

# Recommendations

Development of a ***graded response to an influenza pandemic*** based on its estimated mortality rate (MR) seems reasonable, but the MR can't be well estimated until a pandemic has peaked! - therefore, future global response to any new influenza pandemic ***should be similar to that developed for seasonal influenza*** - with some increased vaccine coverage, when possible or warranted.

WHO should ***advocate for increased global support*** for the timely provision of updated influenza vaccines to resource poor countries.