Conquering Pandemic Flu by Practical Measures

Over the past year, much public attention has focused on pandemic influenza, such as might arise from reassortment of the Type A (H5N1) avian flu that has been spreading from Southeast Asia, but expert consensus is stronger that a flu pandemic is likely than is the judgment that it will derive from H5N1. Even a recurrence or an image of the 1917-18 H1N1 "Spanish flu" that killed some 50 million people world wide would be a disaster in the modern age of specialization and globalization, and such a pandemic that occurred in the next few years could not be much eased by available stocks of vaccine or antiviral drugs. If the pandemic had the lethality (perhaps overestimated at 50%) of the present H5N1 for which there is no evidence of human-to-human transmission, it could kill a billion people or more, but there is no reason to believe that this lethality would be preserved in the transformed virus capable of such transmission and hence pandemic behavior.

Because there is a receptive audience to measures against pandemic flu, and because we have some novel and important perceptions to counter this serious and likely threat to health, life, and society, we present our analysis and recommendations for countering pandemic flu by nonpharmaceutical means. We speak of an epidemic in terms of a single reproductive actor R_0 ("R-naught") and a serial interval ν ("nu"). For the SARS epidemic, R_0 is about 3 and ν about 8 days. For smallpox, R_0 is about 3 and $\nu \approx 14$ days. And for influenza, $R_0 \approx 1.7$-2.4 and $\nu \approx 4$ days. In what follows we take for flu $R_0 = 2$, although we recognize that it will vary from society to society and in various groups within society. Unchecked, an epidemic that begins with N "index cases" would give rise $\nu \approx 4$ days later to 2N additional cases, ν days later to 4N more, 8N more, and so on, so that after M serial intervals there will be $N (1 + R_0 + R_0^2 + R_0^3 + ... + R_0^M)$ cases altogether, until the susceptible population is exhausted and a substantial fraction of the population is resistant or even dead.

On the other hand, if by the nature of the germ or of population density or other measures to reduce the transfer of germs to additional victims, R_0 can be reduced below 1.0 (i.e., $R_0 < 1.0$) the sum of successive generations is finite, even for M very large. Then the number of cases C totals $N (1/ (1-R_0))$. If we use an example a reduction of $R_0=2.0$ by a factor 3, so that $R_0 = 2/3$, $C = 3N$. We identify important measures that we believe may, if practiced, achieve this factor 3 reduction, so that a society in which 60 infective index cases enter per day would thus experience a total of 180 cases per day, or 65,700 flu cases per year—less than the normal seasonal flu that results in some 36,000 deaths each year from influenza in the United States alone. In the absence of such assumed effective measures, recent detailed modeling results[1] [T.C. Germann, et al, 04/11/06] show on the order of 50% of the 281 M people in the US infected with pandemic flu—2000 times as many.

Personal protective measures—PPM:

These personal protective measures—PPM-- that would appear to "protect" an individual by an assumed factor 3 would instead protect each individual in the society

[1] Germann TC, Kadau K, Longini IM Jr, Macken CA., Mitigation strategies for pandemic influenza in the United States. Proc Natl Acad Sci U S A. 2006 Apr 11;103(15):5935-40.

by a factor 2000. Under these circumstances, note that reducing or increasing the influx of infected persons (index cases) by a factor 3 would change C down or up by a factor 3 only—very different from the dramatic effect of a threefold reduction in the flu transmission factor R_0 within the society

Efforts to reduce the delay and to increase the rate of production of an effective vaccine are important, as are those to increase the production and protection from anti-viral drugs, but a pandemic in the next year or two would find inadequate vaccine and anti-virals for the population as a whole. This early pandemic would need to be met and might be vanquished by PPM in groups or societies which practiced such measures effectively in the face of contagion. . Simply put, without such effective PPM, antiviral drugs and vaccines will be exhausted and a pandemic would infect most people and kill many; the assumed effectiveness of PPM in a society would reduce the pandemic to the status of seasonal flu and allow the protection of hospital and health care workers by such pharmaceuticals, even if there were insufficient stocks for the general population

Influenza is transmitted primarily by the virus in droplets accompanying coughs and sneezes, by persistent aerosols (droplets too small to fall out of the air in a few minutes), and by virus transferred to the hand of the infected person and thence to doorknobs, support poles in public conveyances, hand shakes, or via other surfaces. The hand of a susceptible person acquires the virus, which then enters the body through contact of the hand with the mouth, nose, or eye.

Primary PPM:

1. Wash the hands after contact with potential contagion—e.g., when returning home, to the workplace, or frequently in space shared with others who may be symptomatic. If hand washing is inconvenient, use a 60+% alcohol-content hand sanitizing gel.

2. When in the presence of others, use a surgical mask or an N95 filter mask to protect against droplets or aerosols respectively. If masks are not available, improvise a mask such as a scarf over the eyes and mouth.

3. Don't shake hands; bump elbows in greeting.

4. Keep hands away from your face—especially eyes, nose, and mouth.

5. Don't infect others; use a tissue or piece of paper towel for sneezes and coughs and have a bag for used tissues.

6. Eliminate or reduce unnecessary trips, even local ones.

7. If you need to care for a person who might be sick with flu, use additional precautions such as diluted household bleach for bed clothes and for cleaning surfaces.

8. Practice these procedures at least one day every two weeks.

9. Clean and circulate air where people are in proximity, e.g., in transport, offices, assembly work.

Communicating the measures:

Communicating these measures should be considered an important part of training in public health. International, national, state, and local organizations (including businesses, schools, lodges, and faith-based organizations) should adopt and make available information and training, including check lists, bulletins, and web-based materials. Showing is superior to telling. Simulation games are likely to be made available on the web so that children and web-adept adults can see the effectiveness of PPM in vanquishing epidemics, as well as the impact of non-compliance by some.

Communications should be grounded in scientific evidence (or else identified as speculation). They should be empirically evaluated for effectiveness prior to dissemination. These evaluations will provide effectiveness estimates for the modeling. Communications need to be adapted to the culture and circumstances of their audience; they should be created well in advance of a pandemic, and then updated as needed. In some societies one must begin with mass education that the cause of this disease is germs—not evil magic or God.

Motivating individuals, families, and groups to practice and evaluate the measures:

Businesses and public-interest groups have an evident incentive to preserve the health and effectiveness of their members. Still, it will take staff, effort, and funds to adopt such programs, to reach the individuals through their various intersecting affiliations, and to ensure that PPM are practiced on schedule before any pandemic occurs. Examples might be: no access to public transportation on Thursdays without an improvised mask; posted public health rules requiring employers to have dispensers of hand sanitizing gel available in the workplace.

Validating the personal protective measures:

Large-scale and simplified computer models are an essential tool for understanding and communication. They should clearly identify assumptions made about human behavior. Results of research regarding that behavior should be reflected in the model, rather than relying on intuition. Where such research is lacking and the model is sensitive to the assumed specific value, then research to establish the correct value should be a priority. Research needs and results should be shared on the web. For a strategy that depends on masks and bleach, ensure that suppliers have planned for rapid transition to manufacture and distribution of such supplies on a timely basis

Real-time modeling of the emergence of pandemics in one's society and elsewhere:

WHO, aided by country teams and international business should make available on the web current and accurate information to guide action by individuals and groups everywhere. Measurements of R_0 in one society will need to be interpreted by a model to give characteristics of the virus that a similar model will translate into R_0 values for other societies and groups, thereby guiding the intensity of PPM required. Note that only a factor 3 reduction in R0 is required, but if 1 of 3 people don't comply, then even perfect compliance by the rest will not reach the goal. And universal noncompliance by a compact subgroup would allow a pandemic to rage in that subgroup.

Monitoring adherence to PPM:

Groups and public health officials should monitor training for PPM and the actual practice in the presence of flu in each group or country. Current and accurate data of case incidence should be made available on the web by responsible and credible groups for this purpose.

Beyond personal protective measures:

Prepare the population and groups for self reliance; prepare (and practice) the health care sector to do the greatest good in the face of overwhelming need.

Annexes (3):

Pandemic Mitigation Factors By Population Sectors

Mitigation Factors	By Governments	By Industry	By Individuals
Hand washing or sanitization	Population education	Employee education and stock extra soap, gel	Family education and implementation
Use of masks	Population education	Employee education and stock	Family education and implementation
Reduced contact, elbow bump, cough etiquette	Population education	Employee education and practice	Family education and implementation
Accurate information	CDC/WHO data	Company intranet	-internet or media -response dependent
Modeling	Predictive modeling		
Training/practice	Plan development and implementation	Employee education and practical exercises	Family education and exercises
Air exchange rate	Building codes	Cost versus benefit	Economics
Availability of utilities	-Public versus family issue for employees -Contingency plan in place and practiced -Electricity is critical	Plan is electricity dependent	Actions dependent on availability of electricity for receipt of information and guidance
Media education and factual materials	Public service announcements	Media editor training	Family training
Police and fire protection remains operational	Public versus family issue for officials		

20 May 2006 Pandemic Mitigation Factors Chart, 20 May 06.doc Provided by Alan Leigh Moore

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FAO Animal Health Manual, MANUAL ON PROCEDURES FOR DISEASE ERADICATION BY STAMPING OUT, Part 3: Decontamination procedures, Available from www.fao.org/docrep/004/y0660e/y0660e03.htm