Pandemic Influenza Modelling

- ‘Modelling’ can be used to describe many diverse activities
- Construct a simplified or idealised version, the ‘model’
- The model can then be analysed in detail, often using mathematical techniques

- Depending on the questions being asked different simplifications will be appropriate
- Many different models are usually required to capture the different aspects of a complicated problem
- Knowledge of how a model fails to capture all the aspects of the real situation is often as important as the model itself

- Two kinds of model are being studied in planning responses to a Flu Pandemic
  - Epidemiological models considering how the disease will spread and the effectiveness of countermeasures
  - 'Operational' models looking at the mechanics of how countermeasures can be implemented

- Modelling can only be as good as the data fed into the models and the assumptions made in the design
- In the case of dealing with a new pandemic flu virus there is little data and a wide range in the plausible assumptions

The role of modelling is thus:

to map out the range of possible risks and to suggest which responses are robust over the range of uncertainty

Groups

- Health Protection Agency
  - Centre for Infections
  - Centre for Emergency Preparedness and Response
- Department of Infectious Disease Epidemiology, Imperial College London
- SAT/ESOR
- Others (e.g. ICS)

Work areas

- Characteristics of a UK epidemic of pandemic flu without intervention (Health impact assessments)
- The possibilities of containment of a pandemic outside the UK and slowing/preventing subsequent arrival in the UK
- Antiviral use within the UK (both in treatment and possible containment)
- Other pre-vaccination public health measures
- Vaccination strategies in the UK
- NHS ‘surge’ capacity

Health Impact Assessment
Base scenario

- Cumulative clinical attack rate of 25% of the population over one or more waves, around 15 weeks each, weeks or months apart
- ‘Worst case’ of single wave with 25% attack rate
- Overall case fatality rate of 0.37% (based on inter-pandemic and 1957 experience)
- Hospitalisation rate of 0.55% (based on inter-pandemic experience)

Targeted antiviral prophylaxis and local travel restrictions might contain an outbreak in South East Asia.

- Antiviral prophylaxis combined with social distance measures is capable of containing the earliest stage of a pandemic providing:

  - The original cluster is identified rapidly.
  - Treatment can be delivered rapidly.
  - Enough courses of drug are available – 3m+.
  - Case detection is good once first cluster is identified.

Neil M. Ferguson, Derek A.T. Cummings, Simon Cauchemez, Christophe Fraser1, Steven Riley, Aronrag Meeyai1, Sopon Iamsirithaworn & Donald S. Burke – Nature 437(7056) pages 209-214

Travel restrictions (1)

Effect in delaying UK epidemic

- Restrictions into UK only
  - 90% effective ban — 1 to 2 weeks
  - 99% effective ban — 3 to 4 weeks
  - 99.9% effective ban — 1 to 2 months
- International restrictions from all countries with epidemics
  - 90% effective ban — 3 to 4 weeks
  - 99% effective ban — 7 to 8 weeks
  - 99.9% effective ban — 3 to 4 months

Travel restrictions (2)

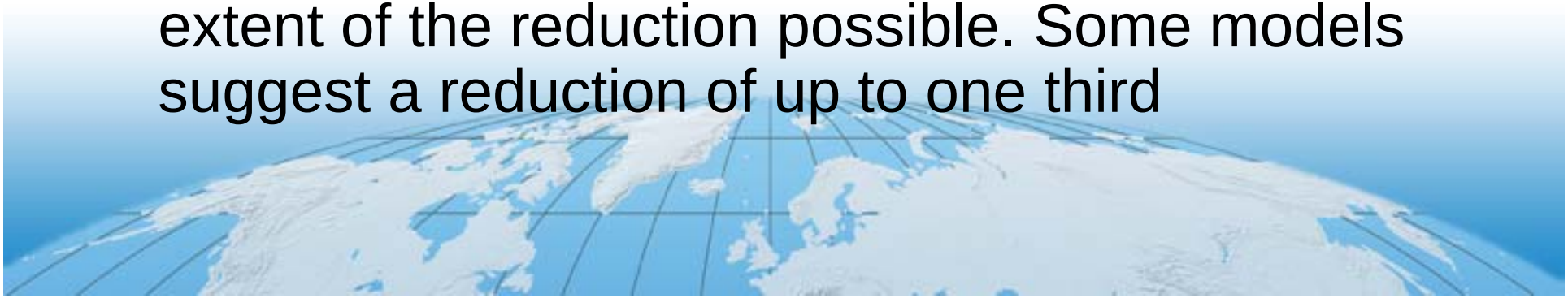
- Pandemic flu would probably take about a month to build up from a few to around a thousand cases and then perhaps only 2 to 4 weeks to spread from Asia to the UK
- Imposing a 90% restriction on air travel would delay the peak of a pandemic wave by only 1 to 2 weeks. On the other hand a 99.9% travel restriction might delay a pandemic wave by 2 months

Travel restrictions (3)

- If a substantial seasonal effect on the transmissibility of pandemic flu it might, theoretically, be possible to “buy” enough time to shift what would otherwise have been a winter outbreak to the spring (or a spring outbreak to the summer), when the lower transmissibility would result in a smaller outbreak
- Assuming passengers are screened before travel for clinical symptoms, there is little additional advantage in entry screening

Antiviral use within UK

- Antivirals are most efficiently used for treatment. If the available stock is less than the clinical attack rate it will be necessary to limit treatment to priority groups
- Although the main purpose of antiviral treatment is to reduce the severity of the disease, treating all clinical cases with antivirals might also decrease the overall attack rate
- There is considerable uncertainty as to the extent of the reduction possible. Some models suggest a reduction of up to one third



Pre-Vaccination Public Health Measures

- Even very substantial restrictions on travel within the UK (~60%) would delay the peak of an epidemic only by of the order of a week, make little difference to the total numbers of cases and reduce the peak incidence by at most 5-10%.

- Closing schools and other educational facilities would have a limited effect on the epidemic. There would be a major reduction in the numbers of students affected. On the other hand, there would be little reduction in the number of cases in the rest of the population.

- There is little evidence that cancelling large public events would have any significant impact on the course of the epidemic.

In progress

- Targeting of vaccination
  - Priority driven by at risk groups?
  - Interrupting transmission?

- Health care capacity
  - Surge capacity
  - Absenteeism
  - Delivery systems

Timetable

- Characteristics of a UK epidemic of pandemic flu without intervention (Health impact assessments)
- The possibilities of containment of a pandemic outside the UK and slowing/preventing subsequent arrival in UK
- Antiviral use within the UK (both in treatment and possible containment) Completed

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- Other pre-vaccination public health measures
  - Main results completed. Some refinement on school closures before end of year
- Vaccination strategies in the UK
- Health care capacity
  - Scoping work underway. Completed by end 2005

To be revisited

- Use of travel restrictions with seasonality to delay UK epidemic by a season (say 6 months)
- Use of antivirals to mitigate epidemic if it were known significant vaccine stocks would arrive in a timescale of 3 to 4 months