mainly by 61 microbiology laboratories in the public and private sector, in all regions of Cyprus.

The Sexually Transmitted Diseases Network

This is a voluntary system for reporting a number of sexually transmitted diseases. Reporting is done mainly by 26 gynaecologists and 14 dermatologists (from both the public and private sector), in all regions of Cyprus.
All data are entered into an EPIInfo 2000 database which provides statistical analysis and information on geographical distribution.

The system will provide feedback through a six monthly newsletter and will inform countries in the European Union of communicable disease developments in Cyprus.
Priorities in tackling infectious diseases (based on 2003 reporting) currently include viral meningitis, sexually transmitted diseases including HIV, endemic typhus, tuberculosis, hepatitis and various bacterial enteric/foodborne infections. All the above infectious diseases occur sporadically. Rarely, foodborne infections such as salmonellosis cause limited outbreaks. In addition, problems are also encountered with methicillin resistant *Staphylococcus aureus* and other healthcare-acquired infections.
The recently introduced Network together with the upgrading of microbiology laboratories, is expected to increase the sensitivity as well as the specificity of the surveillance of communicable diseases in Cyprus.

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Scenario analysis - estimating the effect of different interventions during an influenza pandemic

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Three influenza pandemics occurred during the twentieth century: "Spanish flu" in 1918-1920, "Asian flu" in 1957-1958 and "Hong Kong flu" in 1968-1969. Avian influenza in Hong Kong in 1997, (18 proved human cases, of which 6 were fatal) and the outbreak in the Netherlands in 2003 (74 confirmed human cases, of which 1 was fatal) have shown that the threat of a new influenza epidemic must be taken seriously. A pandemic is expected to affect a considerable proportion, possibly more than half of the world population, if it is a new virus that no one has immunity to. Within the framework of pandemic planning, estimates of expected hospitalisations and deaths are required. Because the outcome of an estimate depends on assumptions concerning the virus, a form of a scenario analysis must be constructed, in which the calculation is repeated for a range of several, but plausible combinations of assumptions. The most important assumptions concern the contagiousness of the virus and the morbidity and mortality due to infection in several parts of the population.

An earlier scenario analysis calculated the total number of infections, hospital admissions and mortality over the course of a pandemic [1]. Antiviral drugs (neuraminidase inhibitors) are an important intervention tool in an influenza pandemic, because of the high probability that it will not be possible to produce a vaccine against the new virus quickly. To judge the impact of possible interventions during a pandemic more accurately, this earlier scenario analysis can be extended with a description of the transmission dynamics of the influenza virus in the population. Accounting for transmission is essential, because interventions generally interrupt transmission and derive their effectiveness from this interruption. A simple example of this is the impact of vaccination on transmission. Because successfully vaccinated individuals do not contribute to the transmission, the force of infection is reduced. Non-vaccinated individuals also benefit from the intervention by means of a smaller chance of catching the disease

A direct protective effect is when an individual's chance of getting ill is reduced because that individual himself is immunised. An indirect protective effect is when the chance of a non-immunised individual getting ill is reduced because the intervention reduces the force of infection. Herd immunity to measles is an example whereby susceptible children are protected by the indirect impact of vaccination of classmates. Use of antivirals provides indirect protection, both successfully by prophylaxis (by means of the same mechanism as vaccination) and as a therapy (shortens the infectious period).

Expected indirect protective effect depends on contagiousness of the influenza virus. Contagiousness is quantified by the basic reproduction number R_0, defined as the expected number of secondary cases of infection caused by one primary infection in an entirely susceptible population. The bigger the value of R_0, the larger the extent of the epidemic without intervention, and the greater the effort necessary to curb it. An indirect protective effect is largest if the intervention succeeds in arousing group immunity (i.e. the net reproduction number is reduced to below the threshold value of 1), whereupon the outbreak finishes and newly introduced infections can no longer cause a large outbreak. Because historic data indicate that influenza pandemics in the previous century had a rather low R_0 (an approximate value of 2), interventions during similar future pandemics are expected to have a relatively large indirect protective effect.

Interventions aimed at age groups

School children can drive the transmission of influenza infections (which are transferred by means of contagious droplets) because of their large number of contacts. For this reason, interventions aimed at school children will be relatively more efficient in reducing the force of infection and creating an indirect protective effect. This contrasts with the elderly who have an increased risk of hospitalisation and death as a result of influenza. Interventions aimed at people over 65 would be efficient in obtaining a direct protective effect in terms of the number of hospitalisations and death rates. A comparison between interventions aimed at alternative age groups is possible with a transmission model which assumes particular contact structures between the different age groups.

Modelling the indirect protection of antivirals can indicate which age group can most beneficially be vaccinated. We examined the estimated impact of four possible interventions during pandemic that would affect 50% of the population in absence of any intervention. In intervention scenario 1 and 2, a vaccine is available only 150 days after the pandemic reaches the Netherlands (Figure). In scenario 3 and 4, antiviral therapy is offered to everyone with influenza-like syndrome, from the onset of illness. In scenario 1 and 3, after 150 days, all groups at risk of complications and all people over 65 are vaccinated against influenza. In scenario 2 and 4 the same number of vaccine doses are used to vaccinate a part (49%) of the 5-20 age group who do not belong to the risk groups. A vaccine effectiveness of 80% was adopted in individuals younger than 65 years, and 56% in individuals over 65. Hospital admission and mortality probabilities were calculated using data from previous inter-pandemic influenza.

Figure. Effect of four possible interventions for an influenza pandemic on the total number of hospital admissions
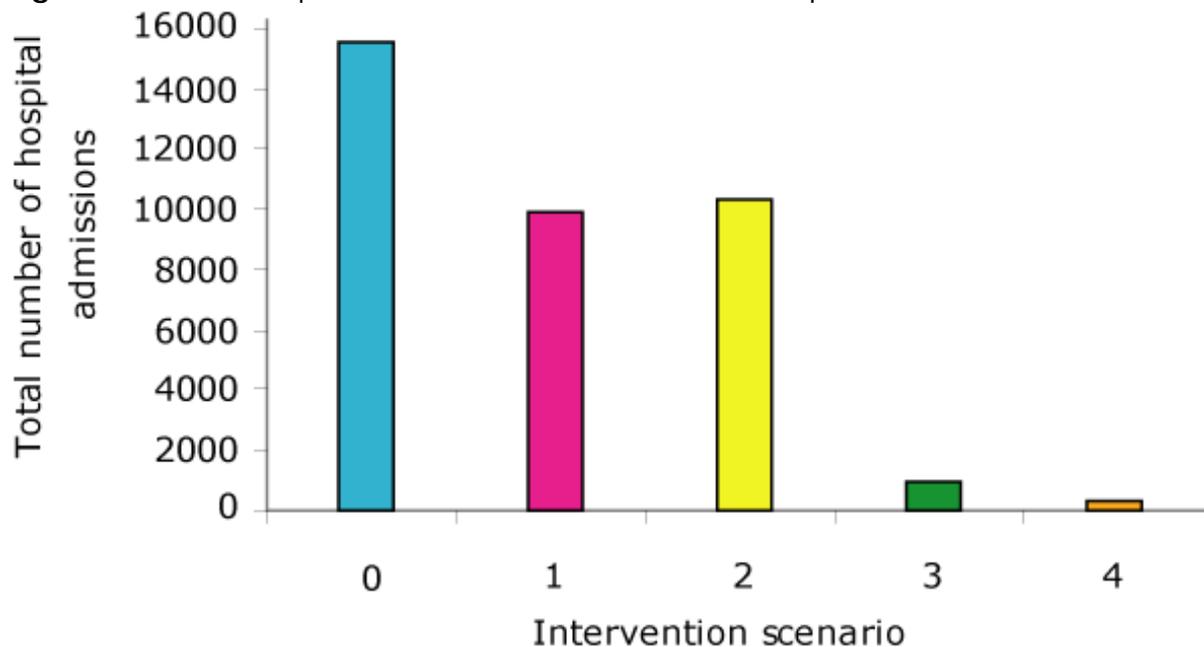
The example shows that use of antivirals will affect the best choice of the target group for influenza vaccination. In the presence of the antiviral therapy, it could make sense to aim vaccination mainly at the best transmitters (people aged between 5-20) and in this way give indirect protection. Without commitment of antiviral resources it is, on the other hand, a good idea to aim vaccination at elderly people and risk groups to provide direct protection.

The effectiveness of possible interventions during an influenza pandemic is determined by both direct and indirect protection. The indirect protection impact can be decisive in determining the best intervention strategy. Using a pandemic influenza model, the impact of intervention on transmission of influenza can be accounted for. Scenario

analyses can be an important tool in estimating the sometimes counterintuitive impact of intervention measures against influenza and thus can help in drafting prevention policies for future pandemics.

This article was translated and adapted from reference 2 by Jacco Wallinga and the Eurosurveillance Weekly editorial team.

References:

1. van Genugten ML, Heijen M-L, Jager JC. Pandemic influenza and healthcare demand in the Netherlands: scenario analysis. *Emerg Infect Dis* 2003; **9**(5):531-8 (http://www.cdc.gov/ncidod/EID/vol9no5/02-0321.htm) [accessed 6 May 2004]
2. Hagenaars TJ, van Genugten MLL, Wallinga J. Het effect van verschillende interventies bij een influenzapandemie. *Infektieziekten Bulletin* 2004; **15**(1): 4-6 (http://www.rivm.nl/infectieziektenbulletin/) [accessed 6 May 2004]

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Influenza pandemic scenario analysis report: could a pandemic be contained using antiviral agents?

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If a new pandemic strain of influenza emerges in the near future, there will almost certainly be, at best, only a limited supply of vaccine [1] and initial control efforts will have to depend on other measures. Using a stochastic (i.e. probabilistic) influenza transmission model similar to one developed in the 1970s [2], Longini and co-workers investigated whether targeted antiviral prophylaxis could contain an epidemic in a small closed community [3]. This work extends previous models of antiviral prophylaxis for influenza by accounting for mixing patterns associated with households, schools and pre-schools, and neighbourhoods [4]. The authors concluded that, assuming high antiviral coverage of exposed groups and short delays between exposure and treatment, prophylactic antiviral treatment could be highly effective at reducing the chance of a major epidemic.

The authors used estimates of the efficacies of influenza antiviral agents for the prevention of infection and disease, and for reducing infectiousness, obtained from studies of both classes of antiviral agent: adamantanes and neuraminidase inhibitors. A population structure that the authors claim is typical for an American community was adopted, and transmission probabilities were assumed to be highest within households, lower in day-care centres, playgroups and schools, and lowest within neighbourhoods and the population at large. Age-specific illness attack rates were taken from the 1957-58 influenza pandemic. The authors further assumed that one third of untreated cases were asymptomatic, and that these people were 50% as infectious as symptomatic cases. Control policies consisted of the treatment (with antivirals) of detected index cases in each mixing group (school, pre-school or household), and prophylactic treatment of contacts in the same mixing group one day after symptoms appearing in the index case for that group.

Assuming that 80% of index cases were detected, and that 80% of school, and 100% of pre-school or household contacts received prophylaxis, the authors found that one week courses of prophylaxis prevented, on average, just over a third of cases compared to the no-intervention scenario. Increasing treatment duration from one to six weeks prevented 90% of cases, a policy about as effective as vaccinating 80% of children.

Reduced targeted prophylaxis regimes (targeting just families or schools or pre-schools) were found to have limited effectiveness, as were policies targeting much less than 80% of exposed groups. Effectiveness fell considerably if the time from index case symptoms to prophylactic treatment was delayed from one to five days (from preventing 93% of cases with eight weeks of therapy to preventing only 45%).

These results suggest that an extensive targeted antiviral prophylaxis strategy has, under some circumstances, the potential to save many lives. As with all such simulation studies, there are important limitations. First, because the virus itself changes and incidence in different age groups varies from year to year, assumptions applicable for one pandemic year may not easily generalise to another. Second, in this study, transmissibility was assumed to be towards the low end of plausible values (a basic reproduction number, R_0, of 1.7 was implicitly assumed). With a