Pandemic influenza: impact on morbidity and health care resource use

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Background

The Dutch Ministry on Health, Welfare and Sports has designed a national plan in order to minimise the effects of pandemic influenza. Within the scope of this pandemic plan, we were asked to provide estimates of the number of hospitalisations and deaths.

Objective

To estimate the potential impact of the next pandemic in terms of hospitalisations and deaths, and the effect of various intervention options. The development of an influenza vaccine is time-consuming. Therefore, it is almost inevitable that in the early stages of a pandemic no vaccine will be available or that there will be a major shortage. Alternative interventions are pneumococcal vaccination (protection against one complication of influenza) or the therapeutic use of neuraminidase (NA) inhibitors within 48 hours after the first symptoms. The potential impact of the interventions has been calculated in terms of avoided hospitalisations and deaths and the number of vaccine doses or prescriptions required.

Method

No one can predict when the next pandemic will occur, nor can it be forecasted how its course will be. As we are dealing with so many uncertainties, we have carried out a scenario-analysis including modelling and expert consultation. Experts were asked to give their opinion on the model and assumptions and on possible scenarios.

Model and assumptions

The model calculates the number of hospitalisations and deaths. Data on high risk groups in the population were drawn from Dutch GP-registries. Influenza and pneumococcal vaccine efficacy were derived from the literature. Efficacy of neuraminidase inhibitors was assumed to be 50%. Influenza-specific hospitalisation rates are based on rates reported for earlier epidemics. Pandemic influenza care (including prescription of antibiotics) was assumed to be as usual. Gross attack rates (percentage of influenza cases per population) were assumed to be 30%. As the age distribution of patients in the next pandemic is unknown, we assumed the distribution among three age groups (0 to 19 years, 20 to 64 years, and 65 years and older) to be equal to the distribution in earlier epidemics. We have conducted sensitivity analysis in which the age-specific hospitalisation rates and the attack rates were varied.

Scenarios

The model is used to compare the following scenarios:

1. Non intervention scenario (care as usual and no vaccine).
2. Influenza vaccination of medical risk groups (including persons aged 65 and older) and health care workers.
3. Influenza vaccination of the total population.
4. Pneumococcal vaccination of medical risk groups for influenza (including persons aged 65 and older).
5. Therapeutic use of neuraminidase inhibitors for each person with influenza-like illness.

Results

An influenza epidemic, with a gross attack rate of 10% and under current Dutch vaccination policy, is calculated to result in on average 1900 influenza-related hospitalisations and 800 deaths. The same gross attack rate but without a vaccine would lead to 3400 influenza-related hospitalisations and 1350 deaths. A gross attack rate of 30%, could lead to as many as 10.000 influenza-related hospitalisations and 4000 deaths.

Avoided number of hospitalisations and deaths (pandemic 30%)

	Required doses / presriptions (millions)	Avoided number (percentage) of hospitalisations	Avoided number (percentage) of deaths
Pneumococcal vaccination medical risk groups	2,78 (17.8%)	3179 (31.2%)	137 (3.4%)
Therapeutic use of NA inhibitors	4,69 (30%)	5093 (50%)	2020 (50%)
Influenza vaccination medical risk groups and health care workers	3,59 (23.0%)	6218 (61.0%)	2251 (55.7%)
Influenza vaccination total population	15,62 (100%)	6339 (62.2%)	2302 (57.0%)

Assuming a gross attack rate of 30%, age-specific hospitalisation, deaths and attack rates as in earlier epidemics and influenza care as usual, influenza vaccination could prevent 62% of influenza-related hospitalisations and 57% deaths. Vaccination of the total population requires about 16 million doses of vaccine, vaccination of the medical risk groups and health care workers requires 3,6 million doses. The difference in the numbers of avoided hospitalisations between these two scenarios is minimal because vaccination of the total population adds the group of healthy people aged 0-64 to the vaccination strategy (for whom hospitalisation and death rates are low). Therapeutic use of neuraminidase inhibitors could prevent 50% of influenza-related hospitalisations and 50% of deaths, requiring 4,7 million prescriptions. Pneumocococal vaccination of the medical risk groups (including persons aged 65 and older) could prevent 31% of the influenza-related hospitalisations and 3.4% deaths, requiring 1,4 million doses of vaccines.

Conclusions

Our analysis is helpful in making policy decisions and designing a pandemic plan on national and on a local level because it provides insight into:

1. the impact of the pandemic in terms of the numbers of people who will become ill or will be hospitalised or die;
2. the impact of the various intervention options in terms of avoided influenza-related hospitalisations and deaths;
3. the crucial model parameters: age-specific hospitalisation, death and attack rates.

When there is an acute pandemic threat, the availability of the underlying decision support model provides the opportunity to update estimates of hospitalisations and mortality based on surveil-lance data from the pandemic source region. The model can also be used for other countries, using country-specific data.

Reference

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Pandemic influenza: scenario's on health care resource use.
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