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Cost-effectiveness of seasonal influenza vaccination in pregnant women, health care workers and persons with underlying illnesses in Belgium

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ABSTRACT

Risk groups with increased vulnerability for influenza complications such as pregnant women, persons with underlying illnesses as well as persons who come into contact with them, such as health care workers, are currently given priority (along with other classic target groups) to receive seasonal influenza vaccination in Belgium. We aimed to evaluate this policy from a health care payer perspective by cost-effectiveness analysis in the three specific target groups above, while accounting for effects beyond the target group. Increasing the coverage of influenza vaccination is likely to be cost-effective for pregnant women (median €6589 per quality-adjusted life-year (QALY) gained [€4073–€10,249]) and health care workers (median €24,096/QALY gained [€16,442–€36,342]), if this can be achieved without incurring additional administration costs. Assuming an additional physician's consult is charged to administer each additional vaccine dose, the cost-effectiveness of vaccinating pregnant women depends strongly on the extent of its impact on the neonate's health. For health care workers, the assumed number of preventable secondary infections has a strong influence on the cost-effectiveness. Vaccinating people with underlying illnesses is likely highly cost-effective above 50 years of age and borderline cost-effective for younger persons, depending on relative life expectancy and vaccine efficacy in this risk group compared to the general population. The case-fatality ratios of the target group, of the secondary affected groups and vaccine efficacy are key sources of uncertainty.

1. Introduction

Seasonal influenza causes a substantial number of symptomatic infections, hospitalizations and fatalities, especially in young children, the elderly and people with underlying illnesses [1]. The Superior Health Council of Belgium recommends giving priority to immunizing people at increased risk of influenza complications, namely people living in institutions, people with underlying illnesses and the elderly (>65 years). Furthermore, health care workers (HCWs), pregnant women in the 2nd and 3rd trimester of pregnancy, the general population between 50 and 64, and poultry and pig farmers and their household members, have priority over the general population [2]. Prioritization is important, because the demand for influenza vaccines has surpassed supply in recent years [3]. Although these recommendations were based on the medical literature, their potential cost-effectiveness was largely unknown. Also, doubts have been expressed about the usefulness of influenza vaccination in view of uncertainties related to season-specific effectiveness in at-risk groups [4]. Therefore, up to date information on the cost-effectiveness of vaccinating these risk groups, may improve the prioritization and acceptability of seasonal influenza vaccines. In this paper, we evaluate the cost-effectiveness of increasing seasonal influenza vaccine uptake in (1) pregnant women in their 2nd and 3rd trimester, (2) HCWs and (3) people with underlying illnesses. Currently these groups have relatively low vaccine uptake (≤35% in 2008 [1]), despite the

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above recommendations. Cost-effectiveness analyses of influenza vaccination of the elderly are presented elsewhere [3]. We did not consider here the specific risk group of poultry and pig farmers, because the rationale for their vaccination (recombination of viruses in their work environment with potential risk to the general population) requires a different modelling approach.

The cost-effectiveness of vaccinating pregnant women [5–7], HCWs [8–11] and people with underlying illnesses [12–16] has been evaluated before in other countries, but the results depended strongly on assumed vaccine efficacy. In this study, we use the most up to date estimates [17], and consider the potential impact of influenza vaccination beyond the target group. Vaccination during pregnancy has the potential to reduce foetal death through avoided maternal mortality, and confers vaccine-induced immunity to the neonate [18]. In previous cost-effectiveness analyses, these potential effects were not [5,7] or only partially [6] accounted for. Vaccinating HCWs was also shown to have an effect on the patients they contact [19,20]. This could be of particular importance for institutionalized or hospitalized patients and the elderly in general, and is therefore also considered in our analyses.

2. Material and methods

2.1. Decision analytic model

Since the groups of pregnant women, HCWs and people with underlying illness are relatively small in Belgium and are not core transmitter groups for the influenza virus, the cost-effectiveness of their vaccination can be analysed using a static model [21,22]. For each risk group, a decision tree model was developed in the R software (R Development Core Team, 2012, http://www.R-project.org). The model script can be obtained from the authors upon request. The general structure is displayed in Fig. 1 and model parameters are listed in Table 1. The model assumes that susceptible individuals (unvaccinated or vaccinated without being protected) experience an age dependent rate of acquiring a symptomatic influenza infection for which they seek medical care. This rate is based on estimates from a dynamic model for influenza like illness (ILI) fitted to ILI surveillance data [3], combined with laboratory confirmed influenza proportions on these ILI data. We obtained the total number of symptomatic cases and thence the age-specific number of cases who do and do not seek medical care (i.e. do not consult a physician). Thus we obtained the number of cases not receiving medical care, ambulatory cases, hospitalizations and fatalities.

Direct medical costs and QALY losses associated with these outcome categories were included in order to compare the costs and QALYs of current with increased vaccine uptake scenarios (up to 50% (40% for persons with underlying illnesses)) [1]. In accordance with Belgian guidelines [23], a health care payer perspective was used under which morbidity and mortality-associated productivity losses to society were excluded. We did not make an exception for the target group of HCWs despite the fact that reductions in HCWs' productivity due to illness or death represent specific opportunity costs to the health care sector. However, we show in scenario analysis the potential impact of including such costs under a health care payer perspective. Costs and non-fatal health outcomes were not discounted because of the short analytical time horizon (1 year). Future life-years lost due to influenza-attributable mortality were discounted at an annual rate of 1.5%, in accordance with Belgian guidelines [23].

We assumed the vaccine is offered to pregnant women, on average in calendar week 47 (i.e. mid-November). We assumed also a 4-week delay before vaccines benefit from vaccine protection. Hence, costs and QALY losses were included for infections occurring between calendar weeks 51 and 25 (assumed end of the influenza season), by using a partial attack rate in the model (84% of the yearly ILI cases occur in that time window). According to the Belgian guidelines, pregnant women should receive an influenza vaccine during the second or third trimester of their pregnancy, implying the average delivery date of pregnant vaccine recipients is in calendar week 7 (assuming uniformly distributed deliveries over the year and vaccination in calendar week 47). It is assumed that when the pregnant mother dies due to influenza, so does the foetus. Therefore, to account for fatalities in the period leading up to calendar week 7, the discounted expected life-years lost of both the mother and her unborn child are summed to calculate the associated cost-effectiveness ratios. From calendar week 7 until week 25, infants can be assumed to be exposed to an autonomous risk of acquiring an influenza infection (one third of the annual attack rate in the infant (<1 year) age category). Within that period we foresee potential transferred vaccine-induced immunity from mother to child. Since the extent to which an immune response may translate into clinical protection is not yet demonstrated for our setting [24], we vary the factor by which vaccine efficacy is transferred from mother to child from 0% over 50% to 100% in sensitivity analysis. We ignore any separate health or cost consequences for the infants due to influenza-related deaths in mothers in the period after birth. Finally the occurrence of multiple pregnancies has not been accounted for, since they only make up a small part of the total number of pregnancies.

The health outcomes for secondary symptomatic influenza infections amongst elderly in contact with health care workers are calculated in the same manner as those for primary infections.

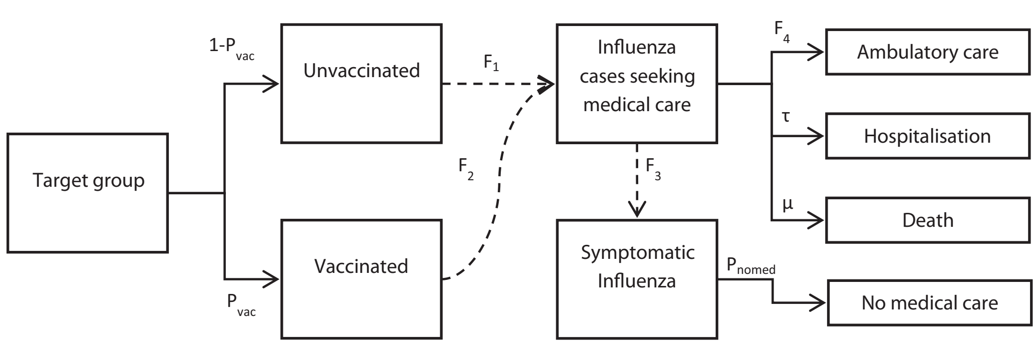

Fig. 1. Basic structure of the static model.
Full arrows indicate the causal structure of the model. Dashed arrows indicate how the group sizes were calculated, when it is different from the causal structure, and how the sizes of the different groups were calculated using the input data available in Table 1. $F_1 = \lambda_{ILI} \times P_{influ}$; $F_2 = F_1 \times (1-\varepsilon)$; $F_3 = 1/(1-P_{nomed})$; $F_4 = 1 - \mu - \tau$; P_{vac} is the vaccination coverage of the target group; λ_{ILI} is the yearly attack rate of influenza like illness (ILI) for which medical care is sought; P_{influ} is the proportion of influenza relative to the ILI cases seeking medical care; ε is the vaccine efficacy against influenza; τ is the influenza hospitalization rate, μ the influenza death rate and P_{nomed} is the proportion of symptomatic influenza cases not seeking medical care (see also Table 1).