Increasing Influenza Vaccine Uptake
A Comprehensive Approach

Ingrid Looijmans – van den Akker

Increasing Influenza Vaccine Uptake. A Comprehensive Approach

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A Comprehensive Approach

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Chapter 2
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Chapter 3
Looijmans –van den Akker I, van den Heuvel PM, Verheij ThJM, van Delden JJM, van Essen GA, Hak E. No intention to comply with influenza and pneumococcal vaccination: behavioural determinants among smokers and non-smokers. *Preventive Medicine.* 2007; 45(5):380-385.

Chapter 4.1
Looijmans –van den Akker I, van Delden JJM, Hak E. Uptake of influenza vaccination in Dutch nursing home personnel following national recommendations. *Journal of the American Geriatrics Society*. 2007;55(9):1486-1487.

Chapter 4.2
Looijmans -van den Akker I, van Delden JJM, Verheij ThJM, van Essen GA, van der Sande MAB, Hulscher ME, Hak E. Which determinants should be targeted to increase influenza vaccine uptake among health care workers in nursing homes? *Accepted for publication inVaccine.*

Chapter 4.3
Looijmans -van den Akker I, Hulscher ME, Groen E, Verheij ThJM, Hak E, and van Delden JJM. How to develop a program to increase influenza vaccine uptake among workers in health care settings? *Submitted.*

Chapter 4.4
Looijmans -van den Akker I, van Delden JJM, Verheij ThJM, van der Sande MAB, van Essen GA, Hulscher ME, Hak E. Effects of a multi-faceted program to increase influenza vaccine uptake among health care workers in nursing homes: a cluster randomised controlled trial. *Submitted.*

Chapter 4.5
Looijmans -van den Akker I, Marsaoui B, Hak E, van Delden JJM. Appreciation of mandatory influenza vaccination of health care workers in nursing homes: a questionnaire study from The Netherlands. *Submitted.*

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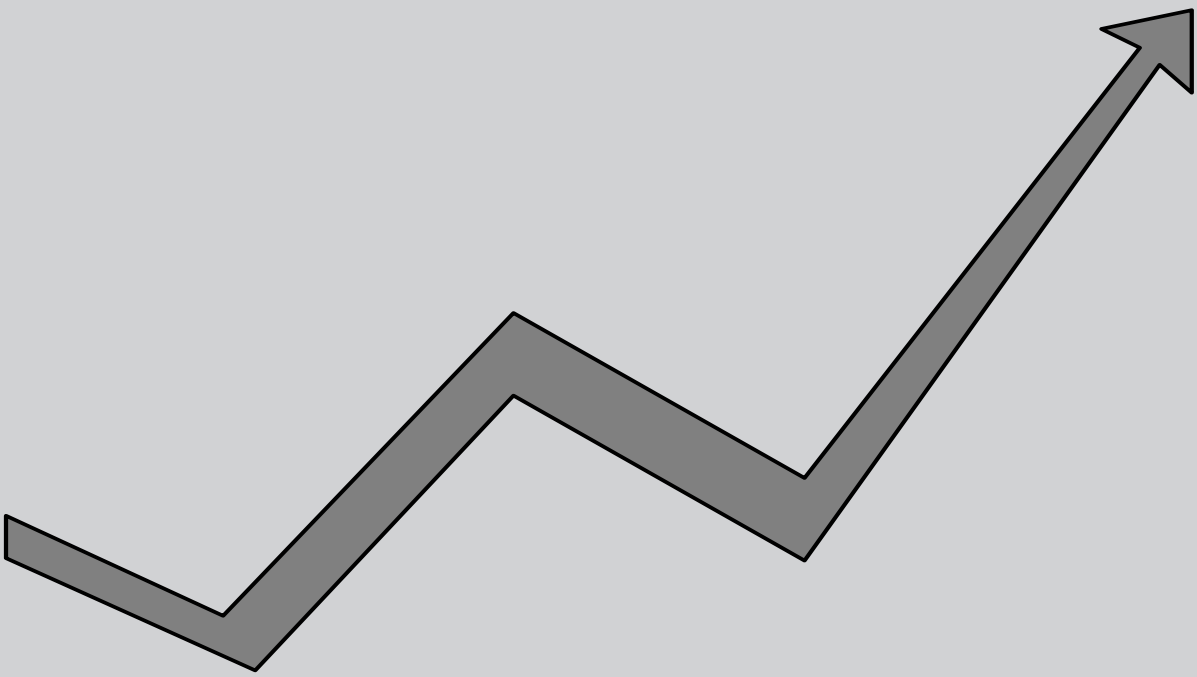
Chapter 1



General Introduction

Introduction

Influenza is an acute infectious disease of the respiratory system caused by an influenza virus. During annual influenza outbreaks, on average 5 to 10 percent of the population is infected with influenza. Although in approximately half of these infections the disease remains sub-clinical[1], influenza can pose a substantial threat to elderly individuals or other, younger, high-risk groups.[2-4] In these individuals, influenza can lead to serious secondary complications such as pneumonia, may exacerbate underlying disease or may even be fatal.

To prevent influenza virus infection, immunization against influenza has been recommended for individuals with increased risk of complications. These groups comprise individuals of 60 years and older, individuals with risk-elevating co-morbid conditions, residents of nursing homes and other chronic care facilities in The Netherlands and, only recently, health care workers.[5] In 2007, approximately 25 percent of the Dutch population qualified for an annual influenza vaccination as part of the national vaccination program. More than half of the target population is aged over 60 years. Almost 75 percent of those who qualify for such vaccination are being vaccinated each year, more than 3 million individuals or 20 percent of the total Dutch population. Vaccine uptake was highest in individuals of 65 years and older; more than 80 percent. In those younger than 65 years uptake was approximately 65 percent.[6] Although these uptake rates are reasonable there is still room for improvement in The Netherlands. Internationally, vaccine uptake rates need even more improvement considering that the uptake among high risk-groups in The Netherlands is the highest in Europe.[7]

Patients with diabetes

Independent of their age, patients with diabetes are among those at high risk for developing a complicated course from influenza infections such as pneumonia or diabetes dysregulation. Hence annual influenza vaccination has been recommended for decades in these individuals.[8-10] Despite these long-term recommendations, vaccination coverage in The Netherlands is around 60 percent in younger patients with diabetes. In other countries uptake is even lower. In the United states, for example, uptake in the 2004-2005 influenza season was only 26 percent in high-risk adults (18 to 64 years of age) including patients with diabetes and 63 percent in all individuals over 65 years of age.[11] These vaccination levels in the United States still remain much lower than the 2010 national health objectives (> 90 percent in all individuals of 65 years and older and >60 percent in individuals from high-risk groups between 18 and 64 years). Vaccine uptake is, among others, associated with patients' and health care providers' belief in the usefulness of such vaccination. Therefore, one of the major reasons for the disappointing vaccine uptake in patients with diabetes might be that evidence regarding the clinical benefits of influenza vaccination in these patients with diabetes is conflicting and protection has been questioned because of a potential decreased T-cell mediated immune response in patients with diabetes.[12]

Research question 1
What is the clinical effectiveness of first and repeat influenza vaccination in adult and elderly diabetic patients?

Change of vaccination behaviour

The role vaccination should play in specific health problems has been described in detail in various guidelines.[5;13;14] There are, however, many indications that these guidelines are not being followed closely enough. Systematic analyses of strategies for improving the behaviour of health care providers and implementing guidelines found that there is no superior method to tackle all

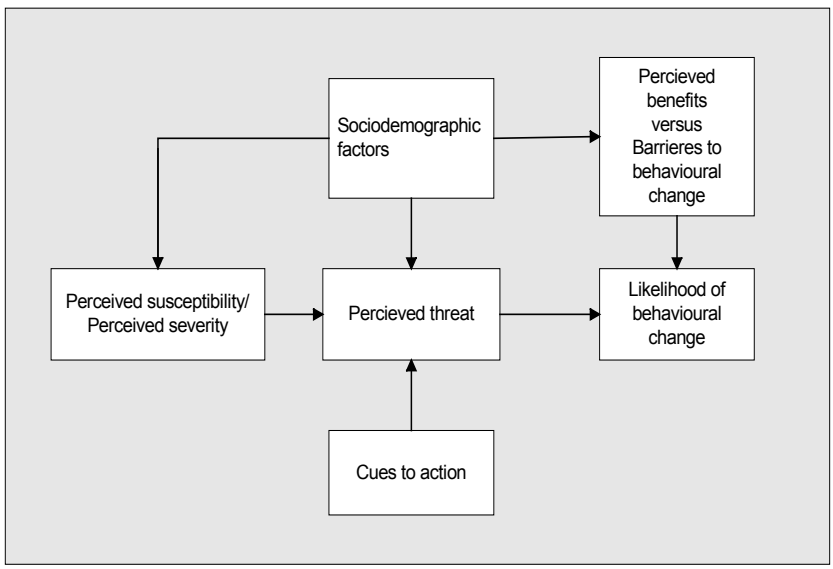
the problems effectively.[15] It is very difficult to change clinical behaviour and most measures or programs result in only modest improvements (5 to 10 percent).[16] Educating health care providers or patients, giving them feedback, financial incentives or sanctions, organisational or logistical measures, etc. can all result in an improvement of medical behaviour if they are well tailored to the specific problems, the target group and the setting in which the change should take place.[15] A proper analysis of relevant determinants is therefore fundamental for an effective improvement program.[17]

So, to obtain a high influenza vaccine uptake, epidemiological evidence on the effectiveness of the vaccine in the specific target group alone is not enough to convince patients and health care providers. To reach high levels of vaccine uptake, a comprehensive approach towards behavioural change among those who qualify for such vaccination is needed. In order to invoke behavioural change in a specific group it is necessary to identify relevant determinants of vaccination behaviour at different levels from a behavioural, organisational and ethical perspective. Theories of health behaviour like the "Health Belief Model"[18] and the "Behavioural Intention Model"[19] (also called theory of planned behaviour) can provide a background to understand and select these relevant determinants of behaviour.

Health Belief Model

The health belief model (figure 1) was originally developed to explain and predict patients' participation in preventive health activities.[20-22] The model assumes that an individual's decision about undertaking a recommended health action is a function of an individual's beliefs on subjective dimensions. Action to avoid disease will be taken if the individual believes (1) that he/she is susceptible, (2) that occurrence of disease will have at least moderate severity on some component of life, (3) that taking the recommended health action will be beneficial and (4) that the health action does not entail overcoming important barriers. In addition, a cue to action appears to be essential.[21;23;24]

Figure 1 The Health Belief Model

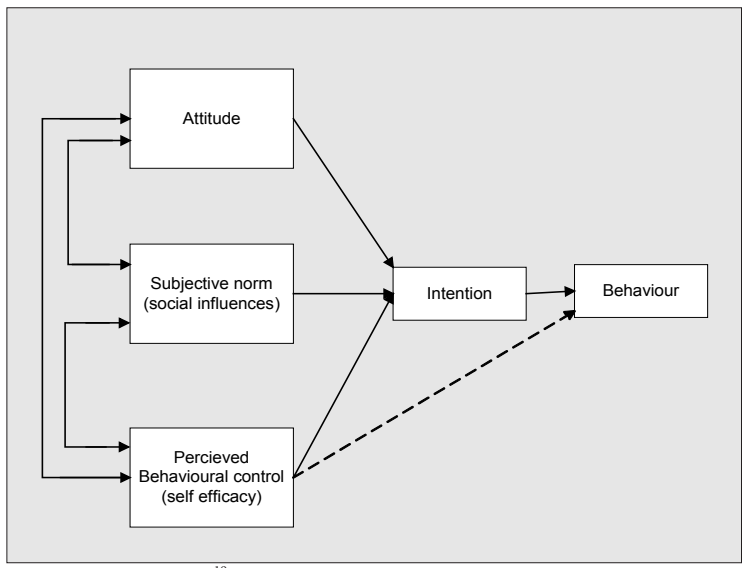


Adapted from: Rosenstock IM, 1974[18]

Behavioural Intention Model

The Behavioural Intention model, also called Theory of Planned Behaviour, (figure 2) was developed in the field of psychology to help understand how behaviour of people can be changed. It is the successor of the Theory of Reasoned Action. According to the Theory of Reasoned Action, if people evaluate the suggested behaviour as positive (attitude), and if they think their significant others wanted them to perform the behaviour (subjective norm or social influences), this results in a higher intention (motivation) and they are more likely to do so. According to the developer of the Behavioural Intention Model (Icek Azjen) the succession resulted from the discovery that behaviour appeared not to be completely voluntary and under control. This discovery resulted in the addition of perceived behavioural control (self efficacy) to the model.

Figure 2 The Behavioural Intention model



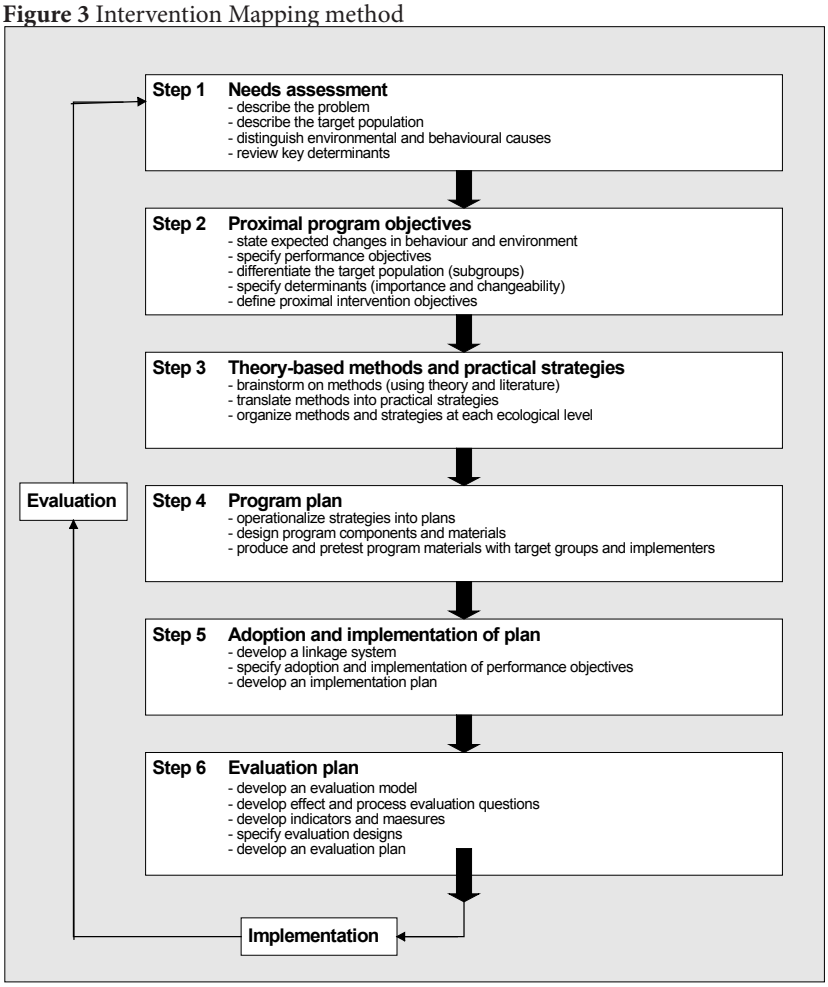
Adapted from Azjen I, 1991[19]

After using behavioural theories to identify relevant determinants of behaviour the next step is the development of an intervention to invoke a change in this behaviour. To be most effective, such interventions should be built upon a coherent theoretical base incorporating also the organisational and ethical context.17;25-27 One of the possible suitable methods to accomplish this is the Intervention Mapping (IM) method.

The Intervention Mapping method

The IM method is a framework developed in the field of health education and promotion to systematically design theory and evidence-based health promotion programs.28 It was originally developed for interventions aimed at high-risk behaviours (e.g. HIV prevention29), and has also been used for other types of interventions (e.g. quality improvement interventions30). The IM method follows several consecutive steps giving planners a systematic method for decision making in each phase of intervention development.28 The process of intervention design can be divided into six steps: (1) a needs assessment, (2) specification of proximal program objectives, (3) selection of theory-based methods and practical strategies for inducing change, (4) planning the program, (5) planning of program adoption and implementation and (6) planning for evaluation. The steps of the IM method and their components are shown in figure 3.

Figure 3 Intervention Mapping method



(adapted from Bartholomew et al.)[31]

Two groups for which the earlier mentioned health behaviour theories can help provide insight in the relevant determinants of influenza vaccination behaviour are the untargeted high-risk group of healthy smokers and the only recently targeted group of health care workers.

Untargeted high-risk group for influenza vaccination: Healthy smokers

Smokers have a substantially higher risk of developing influenza and pneumococcal diseases than non-smokers,[32-34] but smokers have so far not been included in national immunization recommendations. Some, however, believe it may be reasonable to incorporate vaccination into smoking-cessation programs and even consider vaccinating those who continue smoking.[32;33] Whether such a vaccination program would be accepted by this target population is unknown. Although there have been studies that showed that cigarette smoking was associated with failure to be immunized against influenza,[35-37] it is unclear if reasons for not complying with influenza vaccination, the behavioural determinants, among smokers are different from those among non-smokers. Although there are no official recommendations to offer smokers influenza or pneumococcal vaccination yet, it might be implemented in the future. If implemented it is of

importance to first assess determinants of influenza and pneumococcal vaccination behaviour before influenza or pneumococcal vaccination behaviour in this group can be changed.

Research question 2
What are reasons for not complying with influenza and pneumococcal vaccination programs in smokers and non-smokers?

Recently targeted group for influenza vaccination: Health care workers
Despite the high vaccination rate achieved by the Dutch influenza vaccination program, elderly and especially frail elderly in nursing homes are often not fully protected against influenza. The main reason for this is that vaccination only gives an adequate immune response in around 50 percent of the elderly compared to 70 to 90 percent of healthy adults.[38;39] In addition these patients are in close contact with their group members, a situation that facilitates the rapid spread of influenza. Consequently, outbreaks of influenza still occur in care facilities.[40]

Studies have demonstrated that influenza vaccination of health care workers (HCWs) reduces mortality and morbidity among nursing home patients.[41-43] In addition, it reduces the medical and non-health care costs related to influenza outbreaks and influenza-associated absenteeism of HCWs.[44;45] In 2003, the WHO officially welcomed the initiatives of countries to also offer influenza vaccination to HCWs in contact with high-risk individuals.[46] In response the Dutch association of nursing home physicians (NVVA) developed a guideline for influenza vaccination in nursing homes in 2004.[13] In this guideline it was strongly recommended to immunize HCWs against influenza. Since uptake among HCWs in Dutch nursing homes in 2004 was estimated to be 5 to 8 percent, increase of vaccine uptake is clearly needed. But the uptake and its demographical, behavioural, and organisational determinants after introduction of these recommendations remain unclear. Information on these determinants can support the development of an implementation program to increase influenza vaccine uptake.

Research question 3
Did introduction of the NVVA guideline result in a substantial improvement of influenza vaccine uptake among HCWs in Dutch nursing homes and what organisational determinants on management level are associated with higher vaccine uptake among HCWs in Dutch nursing homes?

Research question 4
Which demographical, behavioural and organisational determinants on HCW level are associated with influenza vaccine uptake among HCWs?

Many studies have shown that publication of guidelines alone is not enough to change behaviour of health care professionals. Carefully planned implementation programs are needed to reach acceptable levels of compliance to guidelines. Previous studies showed that promoting uptake of influenza vaccination among HCWs is not an easy task, despite the fact that vaccines are reimbursed and the active vaccination campaigns.[47;48] Therefore, an effective implementation strategy needs to be established in order to change influenza vaccination behaviour among HCWs. As mentioned before, such an implementation program to change behaviour should be developed in a comprehensive, systematic and transparent manner, for example by using the IM method.

Research question 5
What elements should a program to increase influenza vaccine uptake among HCWs in Dutch nursing homes contain?

The final step (step 6) of the IM method is the development of an evaluation plan for the newly developed program. Such an evaluation plan should not only comprise the evaluation of the effectiveness of the implementation program but also a process evaluation. This process evaluation can help to understand the programs' effectiveness and can be used to adapt the program.

Research question 6
What is the effectiveness of a systematically developed intervention program to increase influenza vaccine uptake among HCWs in nursing homes and does compliance to certain elements of the intervention program influence the outcome?

Mandatory vaccination
Considering the results of previous European studies it can however be debated whether voluntary influenza vaccination programs will be sufficient to reach their health objectives. If voluntary programs indeed fail to reach sufficiently high levels of vaccine uptake as an alternative it has been suggested to implement mandatory influenza vaccination programs. Implementing such mandatory influenza vaccination to achieve higher uptake among HCWs might be ethically acceptable.[49-51] Different arguments have been used in favour of this measure. One of these is the professional responsibility of HCWs which justifies some infringement of personal autonomy. Another argument is the duty of HCWs not to frustrate the collective efforts of the institution at which they work.[49;50;52] It is however unclear to what extent the management of the nursing homes agrees with these arguments.

Research question 7
To what extent does the management of Dutch nursing homes agree with the argument used to justify the implementation of mandatory influenza vaccination for HCWs?

Outline of this thesis

In **chapter 2** our primary objective is to determine the clinical effectiveness of first and repeat influenza vaccination in adult and elderly diabetic patients *(research question 1)*. **chapter 3** describes reasons for not complying with influenza and pneumococcal vaccination in smokers and non-smokers *(research question 2)*. In **chapter 4** we focus on influenza vaccination of health care workers (HCWs). First, in **chapter 4.1** we will assess whether introduction of the NVVA guideline resulted in a substantial improvement of influenza vaccine uptake and what organisational determinants on management level are associated with higher vaccine uptake among HCWs in Dutch nursing homes *(research question 3)*. In **chapter 4.2** we describe which determinants on HCW level are associated with uptake of influenza vaccination among HCWs *(research question 4)*. **Chapter 4.3** describes the development of an intervention program to increase influenza vaccine uptake among HCWs in Dutch nursing homes *(research question 5)*. Next, in **chapter 4.4** we assess the effectiveness of this intervention program and if compliance to certain elements of the program influences the outcome *(research question 6)*. **Chapter 4.5** describes to what extent the management of Dutch nursing homes agree with the argument used to justify the implementation of mandatory influenza vaccination for HCWs *(research question 7)*. Finally, in **chapter 5** we discuss the main findings of this thesis and provide recommendations for clinical practise and further research.

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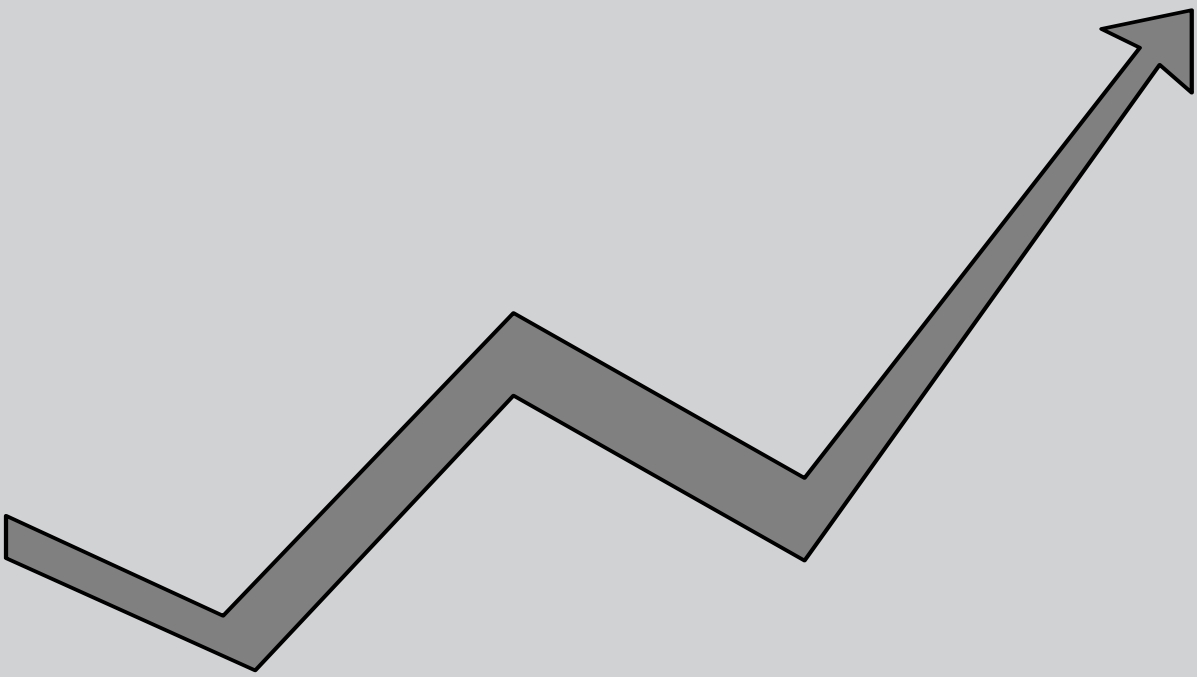
Chapter 2



Clinical Effectiveness of First and Repeat Influenza Vaccination in Adult and Elderly Diabetic Patients

Abstract

Background
In the US, influenza vaccine uptake remains low among the high-risk group of patients with diabetes, partly because of conflicting evidence regarding its potential benefits. In this study, we assessed the clinical effectiveness of influenza vaccination in adults with diabetes and specifically examined potential modification of effect by age and prior influenza vaccine uptake.

Methods
The study was part of the Prevention of Influenza, Surveillance and Management (PRISMA) study, a nested case-control study conducted during the 1999-2000 influenza A epidemic, among 75,235 patients from primary care of any age recommended for vaccination. Among 9,238 adult patients with diabetes, 131 cases arose who were either hospitalized for diabetes dysregulation, acute respiratory or cardiovascular disease and 61 cases who died, and we compared them with 1,561 control subjects. We evaluated the effect of (prior) influenza vaccination by means of logistic regression analysis controlling for age, sex, health insurance coverage, prior health care use, medication use and co-morbid conditions.

Results
Vaccination was associated with a 56% reduction in any complication (95% confidence interval [95% CI] 36-70%), a 54% reduction in hospitalizations (95% CI 26-71%) and 58% reduction in deaths (95% CI 13-80%). Among study subjects aged 18-64 years, we observed somewhat higher reductions in the occurrence of any complication than among those aged over 65 years (72% versus 39%). In first-time vaccinated subjects, the primary endpoint was reduced by 47% (95% CI 0.2%-72%) and in those who received vaccination in the year before, the reduction was 58% (95% CI 4-81%).

Conclusion
Adults with type 2 diabetes, like other individuals from recognized risk groups, benefit considerably from influenza vaccination, and no difference in vaccine effectiveness was observed between first-time and repeat vaccination.

Introduction

Patients with diabetes are at high risk for developing a complicated course from lower-respiratory tract infections[1]; hence, annual influenza vaccination has been recommended for decades in these individuals.[2,3] Despite these long-term recommendations, in the 2004-2005 influenza season, vaccination levels still remained much lower than the 2010 health objectives in the United States (only 25.5% in the high-risk adult group [18 to 64 years of age] and 62.7% in all individuals over 65 years of age).[4] One of the major reasons might be that evidence regarding the clinical benefits of such vaccination is conflicting and protection has been questioned because of a potential decreased T-cell-mediated immune response.[5]

Several experimental studies did not observe differences in serological protection against influenza infection by vaccination between patients with diabetes and healthy controls (table 1).[6-9] However, only few studies aimed to establish effectiveness of influenza vaccination against serious morbidity and mortality in diabetic patients, and results of these studies are inconsistent. Colquhoun et al.[10], for example, observed that influenza vaccination reduced hospital admissions of diabetic patients during an influenza epidemic by 79%. Hak et al.[11] also found significant vaccine effectiveness among the subgroup of elderly individuals with diabetes with reductions in hospitalization for influenza or pneumonia or death from any cause ranging from 50% in one influenza season to 21% in the second season. In contrast, Heymann et al.[12] did not find clinical effects of such vaccination in the subgroup of elderly individuals with diabetes.

Table 1 Characteristics of in the text mentioned influenza effectiveness studies in people with diabetes

authors	Study type	Influenza season	End points	Conclusion
Serological studies				
Pozilli et al.	Case-control	'84-'85	Postvaccination antibody titer and cell-mediated immune response in adults with type 1 or type 2 diabetes compared with healthy control subjects	**No significant difference**
Diepersloot et al.	Case-control	'87-'88	Postvaccination antibody titer in adults with type 1 diabetes compared with healthy control subjects	**No significant difference**
McElhaney et al.	Case-control	'93-'94	Pre- and postvaccination in vitro challenge of peripheral blood mononuclear cells with live influenza virus; measuring interleukin-2 activity in elderly (60 years or older) with type 2 diabetes compared with healthy control subjects	Increased postvaccination interleukin-2 production in diabetic patients due to vaccination history. **No difference due to diabetes**
Feery et al.	Case-control	'80-'81	Postvaccination antibody titer in adults with type 1 or type 2 diabetes compared with healthy control subjects	**No significant difference** and influenza vaccination is safe
Clinical studies				
Colquhoun et al.	Case-control	'89-'90 and '93	Hospitalization for influenza, pneumonia, bronchitis, diabetic ketoacidosis, coma or diabetes in people of all age-groups with type 1 or type 2 diabetes compared with control subjects with type 1 or type 2 diabetes	**79% reduction** in hospitalization
Heymann et al.	Case-control	'00-'01	Hospitalization in internal medicine and geriatric wards for any reason or death in elderly (65 years or older) with type 1 or type 2 diabetes compared with healthy control subjects	23% reduction in hospitalization and death among elderly patients, **no additional benefit for diabetics**
Hak et al.	Case-control	'96-'97 and '97-'98	Hospitalization for pneumonia/influenza or death in people aged 65 years or older with type 1 or type 2 diabetes compared with healthy control subjects	31%-48% reduction in hospitalization and death in high-risk elderly and **21%-50% reduction** in people with diabetes

The primary objective of our study was to determine the effectiveness of influenza vaccination in reducing the occurrence of hospitalization and death from any cause in adults with diabetes during an influenza epidemic.

Methods

Source population

The design of the primary care-based *Prevention of Influenza, Surveillance and Management* (PRISMA) nested case-control study has been described elsewhere.[13] Previously, we have demonstrated that a nested case-control approach is an efficient alternative to full-cohort analysis for the study of influenza vaccination.[14] The PRISMA study was conducted in 91 general practices during the 1999-2000 influenza A epidemic and during two consecutive seasons in which the influenza activity appeared virtually absent (the 2000-2001 season) or mild (the 2001-2002 season). For the purpose of our study, we therefore choose to analyze the data of case and control subjects ascertained from the primary care-based cohort of 75,235 study patients of any age followed up during the 1999-2000 influenza A(H3N1) epidemic for the original and present study. Among the original cohort of patients who were all eligible for annual influenza vaccination according to guidelines of the Dutch Health council, 9,238 adult patients had a primary care diagnosis of diabetes (44% aged 18 to 64 years and 56% aged 65 years or older). Influenza vaccine uptake among this subcohort was high (81%). Since study data were supplied anonymously to the data-management centres, we did not obtain individual patient consent.

Identification of case and control subjects

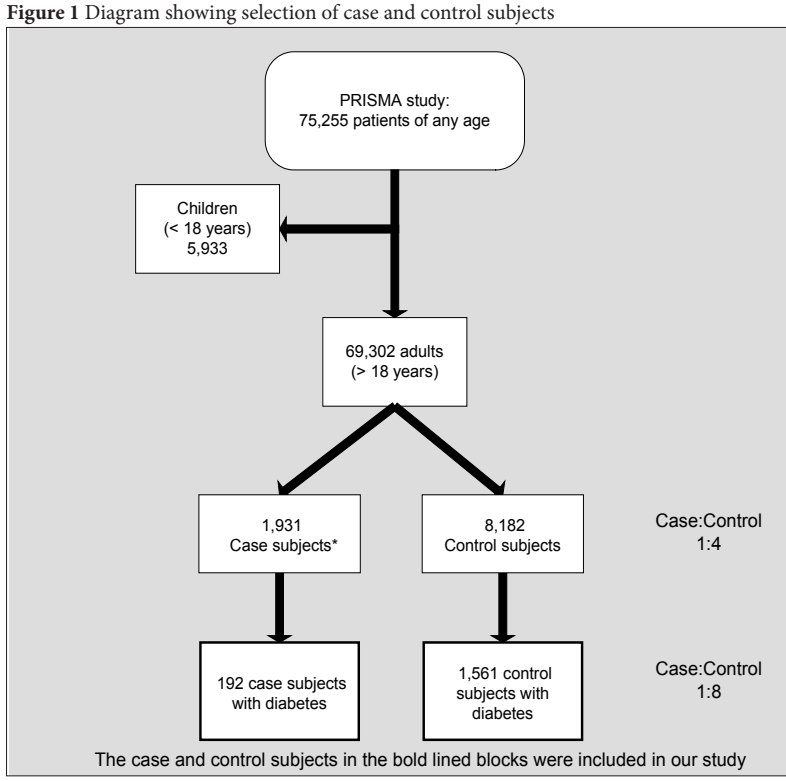
Patients with diabetes were defined as an incident case when a person-period of physician-diagnosed influenza (International Classification of Primary Care [ICPC] code [R80]), pneumonia (R81), other acute respiratory disease defined as acute bronchitis (R78), prednisolone-treated chronic bronchitis (R91), emphysema (R95) or asthma [R96), myocardial infarction (K75), congesti¬ve heart failure (K77), stroke (K90), diabetes dysregulation (T90) requiring hospitalization or death from any cause was present. According to the ICPC coding classification, coding for influenza requires a positive test for the presence of influenza. Coding for pneumonia requires either a positive X-ray or at least three of six clinical criteria suggestive of pneumonia (reduced breathing frequency, dull percussion, local crepitations, bronchophony, temperature >38^{o}C and thorax pain). The coding of heart failure requires confirmation by a cardiologist or at least three of five symptoms suggestive of heart failure (oedema, increased central venous pressure, pleural signs, enlarged heart and dyspnoea). The diagnosis of stroke is made by a specialist. For exacerbations of chronic pulmonary disease, no coding is available. As in a previous study from our group, we only selected those patients who were coded for their pulmonary disease in combination with a treatment with oral prednisolone. Serious diabetes dysregulation requiring hospitalization is defined in Dutch primary care guidelines as hyperglycemia exceeding 20 mmol/l. Because of a high diagnostic uncertainty in primary care, we only included patients diagnosed in hospital and those who died from any cause. Control patients with diabetes did not have an end point and were randomly selected from the remainder of the base-line cohort.[15] Since, we studied a sub-group of the original study in which the case-control ratio was approximately 1:4, we had more control subjects available per case in the present analysis (see also figure 1).

Clinical influenza activity during the 1999-2000 season was highly epidemic from week 50 in 1999 to week 10 in 2000 and predominantly associated with influenza A(H3N2) Sydney type.[16]

Assessment of first and repeat influenza vaccination

In The Netherlands, influenza vaccination is administered free of charge by the general practitioner (GP) to most individuals recommended for influenza vaccination through the national influenza vaccination program. GPs receive a fee for each registered vaccination. We assumed that an individual had been vaccinated for the present study season if the code for influenza vaccination (R44.1) was recorded in the period from October 1st to December 7th of 1999. We also recorded whether the patient had received the vaccine in the same period in the year before (1998). Those who did not receive the vaccine that year were designated 'first vaccinated subject' and others as 'repeat vaccinated subject'. An earlier study during the same season confirmed that exposure/nonexposure to influenza vaccination before the epidemic was in high agreement with the absence/presence of the ICPC-code for vaccination R44.1 (kappa 93 percent).[17] The trivalent subunit influenza vaccine matched well with circulating influenza A and B strains in the 1999-2000 season.[16]

Figure 1 Diagram showing selection of case and control subjects



* patients with a general practitioner attended complication were also included as case subjects in the original PRISMA study

Covariates and adjustment for confounding by indication

We obtained prognostic information from each study subject to be able to adjust for differences in prognosis between vaccinated and unvaccinated subjects.[17-19,20] Information was collected on a number of covariates while accounting for age and sex. Presence of relevant medically attended episodes of asthma or chronic obstructive pulmonary disease (R91, R95 and R96), lung cancer (R84 and R85), myocardial infarction (K75), congestive heart failure (K77) or other cardiovascular disease (K74, K76, K78, K79, K82, K83 and K84), chronic renal disease (U88 and U99) or

immune-related disease (B73, B74 and B90) was documented. Prior health care use was recorded as the number of GP consultations, number of medications, referral to a specialist and prior hospitalization for one of the possible complications in the 12 months preceding the epidemic. Furthermore, health insurance coverage was registered. In The Netherlands, this was either a private party insurance or National Health Insurance. The latter is an indicator of a lower social economic status (uninsured status is virtually absent in The Netherlands).

Data analysis

An individual was counted only once as a case for the first occurring hospitalization. Patients who were hospitalized and died afterwards were counted once for the combined outcome measure and counted for both hospitalized cases and deaths. Bivariate comparisons for vaccinated and unvaccinated subjects were conducted using χ^2-test and Student's t-test for categorical and continuous variables, respectively. In accordance with other reports,[9,10,17] univariate and multivariable logistic regression models were used to obtain crude and adjusted odds ratios (ORs) and their 95 percent confidence intervals (95% CI) of the association between vaccination and case status. The OR was used as an approximation of the relative risk. The adjusted vaccine effectiveness was calculated as: (1-adjusted OR)*100 percent.[11,21] The following potential confounders were added to the regression equation to adjust the vaccine effectiveness (VE) estimates: age, sex, health care insurance, presence of heart or lung disease or other high-risk disease, as well as the number of medications and the number of GP visits during the 12 months before the start of the epidemic. The same approach was applied to obtain adjusted ORs in each of the relevant subgroups according to age (18-64 years versus 65 years and older) and first versus repeat vaccination. A two-sided *p*-value less than 0.05 was considered to indicate statistical significance.

Results

Baseline characteristics

In all, 192 case and 1,561 control subjects were included in the analysis. To gain more insights into differences between vaccinated and unvaccinated individuals, we recorded baseline characteristics among the 1,561 control subjects (table 2a). Overall, vaccinated control subjects were older, more likely to have chronic hart or lung disease, and took a higher number of medication in the 12 month preceding the epidemic. Apart from health care insurance status, cases differed from control subjects for most characteristics (table 2b).

Incidence of complications during the influenza epidemic

Among the 9,238 individuals with diabetes, 61 deaths (9 in the age-group 18 to 64 years and 52 in the elderly) and 131 hospitalizations (61 in the age-group 18 to 64 years and 70 in the elderly) occurred. To explore potential differences in incidence rates of outcomes between vaccinated and unvaccinated individuals during the 1999-2000 influenza A epidemic, we calculated the incidence rates per 1,000 person-periods in both groups using the figures of the total baseline cohort of 9,238 diabetes patients (table 3). The incidence rate of any complication among the age-group 18 to 64 years was two times higher in unvaccinated (28.3 per 1,000) individuals than in vaccinated (14.0 per 1,000) individuals. Among the elderly, incidence rates of hospitalization did not substantially differ between unvaccinated (11.2 per 1,000) and vaccinated (13.9 per 1,000) individuals. In this age-group, mortality rates were most noticeably different between the two groups.

Table 2a Baseline characteristics of control subjects in our study

Characteristic	18-64 years of age			Elderly ≥65 years of age		
	Unvaccinated n=75 (20%)	Vaccinated n=294 (80%)	*p* value[a]	Unvaccinated n=147 (12%)	Vaccinated n=1,045 (88%)	*p* value[a]
Mean age (SD)	49.4 (10.7)	52.3 (9.8)	0.025	75.2 (6.8)	75.5 (6.7)	0.675
Female sex	34 (45.3)	149 (50.7)	0.408	100 (68.0)	680 (65.1)	0.481
NHI	52 (69.3)	213 (72.4)	0.592	114 (77.6)	807 (77.3)	0.945
Lung disease	10 (13.3)	35 (11.9)	0.736	11 (7.5)	180 (17.2)	0.003
Heart disease	6 (8.0)	46 (15.6)	0.089	53 (36.1)	440 (42.1)	0.163
Other disease[b]	1 (1.3)	3 (1.0)	0.815	2 (1.4)	26 (2.5)	0.398
Mean no. of GP visits (SD)[c]	1.17 (3.42)	1.31 (2.52)	0.693	2.20 (3.17)	2.26 (3.43)	0.841
Mean no. of prescriptions (SD)[c]	0.96 (1.36)	1.11 (1.40)	0.409	1.52 (1.97)	1.90 (2.23)	0.050
Specialist care[c]	14 (18.7)	80 (27.2)	0.130	35 (23.8)	300 (28.7)	0.216
Hospitalization[c]	0 (0)	4 (1.4)	0.310	7 (4.8)	50 (4.8)	0.990

Note: data are given as number (percentage) of patients unless otherwise specified.
[a] *p*-values compare vaccinated and unvaccinated subjects.
[b] Other disease includes renal disease and immune-related disease
[c] no. in previous 12 months
NHI: National Health Insurance
GP: general practitioner

Table 2b Baseline characteristics of case and control subjects in our study

Characteristic	18-64 years of age			Elderly ≥65 years of age			All adults ≥18 years of age		
	Cases n=70	Controls n=369	*p* value[a]	Cases n=122	Controls n=1,192	*p* value[a]	Cases n=192	Controls n=1,561	*p* value[a]
Vaccination	43 (61.4)	294 (79.7)	0.001	98 (80.3)	1,045 (87.7)	0.022	141 (73.4)	1,339 (85.8)	<0.001
Mean age (SD)	53.1 (7.57)	51.7 (10.0)	0.257	76.7 (7.56)	75.4 (6.69)	0.045	68.1 (13.7)	69.8 (12.6)	0.081
Female sex	31 (44.3)	183 (49.6)	0.415	62 (50.8)	780 (65.4)	0.001	93 (48.4)	963 (61.7)	<0.001
NHI	51 (72.9)	265 (71.8)	0.859	101 (83.5)	921 (77.3)	0.121	152 (79.6)	1,186 (76.0)	0.275
Lung disease	13 (18.6)	45 (12.2)	0.149	37 (30.3)	191 (16.0)	<0.001	50 (26.0)	236 (15.1)	<0.001
Heart disease	12 (17.1)	52 (14.1)	0.507	65 (53.3)	493 (41.4)	0.011	77 (40.1)	545 (34.9)	0.156
Other disease[b]	2 (2.9)	4 (1.1)	0.241	7 (5.7)	28 (2.3)	0.027	9 (4.7)	32 (2.0)	0.022
Mean no. of GP visits (SD)[c]	1.54 (4.46)	1.38 (2.84)	0.696	4.49 (7.73)	2.47 (3.53)	<0.001	3.42 (6.86)	2.21 (3.41)	<0.001
Mean no. of prescriptions (SD)[c]	1.67 (1.76)	1.08 (1.39)	0.002	3.26 (2.43)	1.86 (2.20)	<0.001	2.68 (2.34)	1.67 (2.07)	<0.001
Specialist care[c]	8 (11.4)	94 (25.5)	0.011	45 (36.9)	335 (28.1)	0.042	53 (27.6)	429 (27.5)	0.972
Hospitalization[c]	4 (5.7)	4 (1.1)	0.008	20 (16.4)	57 (4.8)	<0.001	24 (12.5)	61 (3.9)	<0.001

Note: data are given as number (percentage) of patients unless otherwise specified.
[a] p-values compare case with control subjects
[b] Other disease includes renal disease and immune-related disease
[c] no. in previous 12 months
NHI: National Health Insurance
GP: general practitioner

Table 3 Incidence rates* of end points per 1,000 person-periods during the 1999-2000 Influenza A epidemic

	Aged 18-64 years		Aged ≥65 years	
	Unvaccinated	Vaccinated	Unvaccinated	Vaccinated
Deaths	3.1	2.0	18.7	8.4
Hospitalizations	25.2	12.0	11.2	13.9
Total	28.3	14.0	29.9	22.3

*Incidence rates were calculated as the number of case-periods within an age subgroup divided by the number of individuals at baseline from the same group, multiplied by 1,000.

Vaccine effectiveness

In the age-group 18 to 64 years, hospitalizations for influenza, pneumonia, other acute respiratory disease, myocardial infarction, congesti¬ve heart failure, stroke or diabetes event were prevented by 70% (95% CI 39-85%, table 4). Most hospitalizations were due to diabetes dysregulation (59 of 61 outcomes). Point estimate for the separate outcome hospitalization for diabetes dysregulation was slightly lower (60%, 95% CI 22-80 %). The power of the study was inadequate to establish statistically significant difference in mortality rates in this younger age-group. Among individuals aged 65 years or older, vaccination prevented 56% of deaths (95% CI 4-80%) after adjustments. In this age-group, hospitalization was prevented by 14% (95% CI -88 to 60%), but this was not statistically significant. Among all individuals with diabetes, regardless of age, 56% (95% CI 36-70%) of any complication was prevented. Hospitalizations were prevented by 54% (95% CI 26-71%) and deaths by 58% (95% CI 13-80%). In first-vaccinated subjects, the primary endpoint was reduced by 47% (95% CI 0.2%-72%) and in those who received vaccination in the year before, the reduction was 58% (95% CI 4-81%).

Table 4 Influenza vaccine effectiveness (VE) in reducing morbidity and mortality during the 1999-2000 influenza A epidemic in individuals with diabetes

Subgroups	Hospitalization	Death from any cause	Hospitalization or death
All adults aged ≥18 years			
Vaccinated cases, No (%)	98/131 (75)	43/61 (71)	141/192 (73)
Vaccinated controls, No (%)	1,339/1,561 (86)	1,437/1,692 (85)	1,339/1,561 (86)
Unadjusted VE (95% CI)	51 (25-68)	60 (30-78)	54 (35-68)
Adjusted VE (95% CI)	54 (26-71)	58 (13-80)	56 (36-70)
Adjusted *p*-value	0.002	0.019	<0.001
Aged 18-64 years			
Vaccinated cases, No (%)	37/61 (61)	6/9 (67)	43/70 (61)
Vaccinated controls, No (%)	294/369 (80)	331/430 (77)	294/369 (78)
Unadjusted VE (95% CI)	65 (36-80)	54 (-89 to 89)	63 (36-79)
Adjusted VE (95% CI)	70 (39-85)	24 (-706 to 93)	72 (46-85)
Adjusted *p*-value	0.001	0.819	<0.001
Elderly aged ≥65 years			
Vaccinated cases, No (%)	61/70 (87)	37/52 (71)	98/122 (80)
Vaccinated controls, No (%)	1,045/1,192 (88)	1,106/1,262 (88)	1,045/1,192 (88)
Unadjusted VE (95% CI)	0 (-107 to 51)	64 (32-81)	40 (2-63)
Adjusted VE (95% CI)	14 (-88 to 60)	56 (4-80)	39 (-5 to 65)
Adjusted *p*-value	0.706	0.039	0.076

Discussion

Our study clearly demonstrates substantial clinical benefits from influenza vaccination among adult individuals with diabetes, most with type 2, independent of age or prior vaccine uptake. However, some potential limitations need to be considered before accepting these results. Since immunization guidelines recommend vaccination for patients with high-risk conditions regardless of age[3], it is unethical to conduct a placebo-controlled trial.[20,21] However, the nested case-control approach permits the assessment of vaccine effects, notably on infrequent severe end points such as hospitalization or death.[17] Vaccination rates in control subjects were similar and comparable with estimates from other large Dutch cohorts.[13,15,19] Further, the distribution of some important risk factors were not substantially different in vaccinated and unvaccinated control subjects and were similar to those observed in earlier studies.[11,15] Furthermore, the potential for recall bias was minimized through the complete review of prospectively collected data in routine medical care from computerized medical records.

Although the GPs were informed about the vaccination status of their patients, we find it unlikely that this could have influenced the GPs diagnostic process and, by doing so, caused overestimation of vaccine effectiveness. Because this study was performed in a Dutch routine-care setting, the GPs were not actively involved in recruiting patients and assessing the outcomes. When there was such a bias, we would expect a much higher reduction in the more specific end points, hospitalization for pneumonia or influenza, than in the less specific end points such as hospitalization for diabetes dysregulation. Obviously, the association of mortality and vaccination status can not be influenced by such bias.

The outcome used in this study was hospitalization for influenza, pneumonia, other acute respiratory disease, myocardial infarction, congesti¬ve heart failure, stroke, or diabetes dysregulation or death from any cause. By far, most of the hospitalizations were due to diabetes dysregulation. The fact that, in proportion, diabetes events were most common is not surprising considering the fact that diabetic ketoacidosis is an important complication of influenza infection in patients with diabetes.[22] We did not, however, perform virological analysis of our cases to confirm actual influenza infection. Therefore, it is still possible that part of these hospitalizations were not actually caused by the influenza virus. The effect of such a misclassification bias, if anything, would be an underestimation of true vaccine effectiveness.

An important issue in clinical vaccine effectiveness studies is that, by definition, unselected vaccinated and unvaccinated patients tend to differ in their prognosis.[20] In previous studies, it has been shown that risk factors such as higher age and presence of comorbidity are more common in vaccinated than unvaccinated individuals, which can influence observed associations.[10,16] When we compare the death rate of 18.7 per 1,000 in the unvaccinated subjects of 65 years or older in our study (table 3) with the incidence rate of 6.7 per 1,000 in the original study,[15] the clear indication is that in our study, all subjects are already at higher risk at baseline because they all have diabetes. This may also most probably have resulted in fewer differences in baseline characteristics between vaccinated and unvaccinated control subjects. We only found more comorbidity in the vaccinated elderly, and this was solely with respect to chronic lung disease. In the 18 to 64 years of age group, those vaccinated were not substantially different from unvaccinated subjects.

We further minimized the possibility of 'confounding by indication' by sampling into age subgroups and controlling for the confounding effect in the analyses. Furthermore, we had data on a number of other potentially confounding characteristics and adjusted for all of these by using

logistic regression analysis (table 5). However, we did not have information on some diabetes-specific factors, which may have confounded the association. Absence of confounding can only be guaranteed in adequately large randomized controlled trials, but it is very unlikely that the vaccine effectiveness estimates observed in this study, were influenced by residual confounding. If anything, observed estimations would be underestimations because vaccinated people in general are at higher risk for developing an end point.

Table 5 Results of adjustments for confounding using multivariable logistic regression analysis

	Hospitalization or death	
	VE (95% CI)	*p* value
All adults aged ≥18 years		
Unadjusted VE	54 (35-68)	<0.001
VE Adjusted for age, sex and NHI	51 (39-65)	<0.001
VE Adjusted for the above plus lung, hart and other comorbid diseases	55 (34-69)	<0.001
VE Adjusted for the above plus mean no of GP visits, mean no of prescriptions, specialist care and hospitalization	56 (36-70)	<0.001
Aged 18-64 years		
Unadjusted VE	63 (36-79)	0.001
VE Adjusted for age, sex and NHI	65 (38-80)	<0.001
VE Adjusted for the above plus lung, hart and other comorbid diseases	71 (44-85)	<0.001
VE Adjusted for the above plus mean no of GP visits, mean no of prescriptions, specialist care and hospitalization	72 (46-85)	<0.001
Elderly aged ≥65 years		
Unadjusted VE	40 (2-63)	0.041
VE Adjusted for age, sex and NHI	35 (-6 to 61)	0.083
VE Adjusted for the above plus lung, hart and other comorbid diseases	36 (-9 to 62)	0.105
VE Adjusted for the above plus mean no of GP visits, mean no of prescriptions, specialist care and hospitalization	39 (-5 to 65)	0.076

NHI: National Health Insurance
VE: vaccine effectiveness

Colquhoun et al.[10] observed a 79% reduction of hospitalizations in patients with diabetes of all ages, but in this study, 83% of case subjects were under 65 years of age. The effectiveness estimate compares with the 70%, as observed among the 18 to 64 year age-group in our study. In an earlier study from the US, Hak et al.[11] found a 50% reduction in hospitalizations and death in elderly patients with diabetes in the first season in which the predominating influenza strains matched well with the vaccine. In the present study, with good matching of the vaccine, a vaccine effectiveness estimate of 39% (though not significant) compares with the US study. Heymann et al.[12] did not find an additional benefit in patients with diabetes, but the study could be discussed because of the low influenza activity during the study season.

In our study, we only had information on the diagnosis of diabetes in general and could not distinguish between type 1 and type 2 diabetes. Since a decreased T-cell immune response has been found in type 1, but not type 2, diabetes[4] and most patients have type 2 diabetes (>90%), it remains unclear whether patients with type 1 diabetes can benefit from such vaccination. We also were unable to record ethnicity of all study subjects since such data are not routinely available in Dutch general practice. Data from the Dutch National Survey of General Practice also showed that only a minority of primary care patients is not of Dutch origin, making it difficult to draw conclusions about this specific group.

Regarding studies into annual revaccination, previous studies have reported conflicting results. Hoskins et al.[23], who performed a trial of inactivated influenza vaccine in an English boarding school for boys, only observed significant protection in boys who were vaccinated for the first time, while Beyer et al.[24] did not observe differences in serological protection in those receiving the vaccine for the first time or repeatedly. Voordouw et al.[19], on the other hand, reported that annual influenza vaccination is associated with a reduction in all-cause mortality risk, particularly in older individuals in 2005 and first vaccination reduced mortality only marginally. In our study, we did not find a significant difference between those vaccinated for the first time and those who received a repeat vaccination.

In conclusion, the results of our study lend strong support to the view that patients with type 2 diabetes, like other high-risk individuals[15], benefit from annual influenza vaccination regardless of age, and efforts should be renewed to increase vaccination rates among this high-risk group. Results from a recent study[25] show that shortfall in the delivery of such routine preventive services is not only explained by patient characteristics but also by structure and revenue sources of physician practices. Influencing these factors might further increase vaccination rates among diabetes patients.

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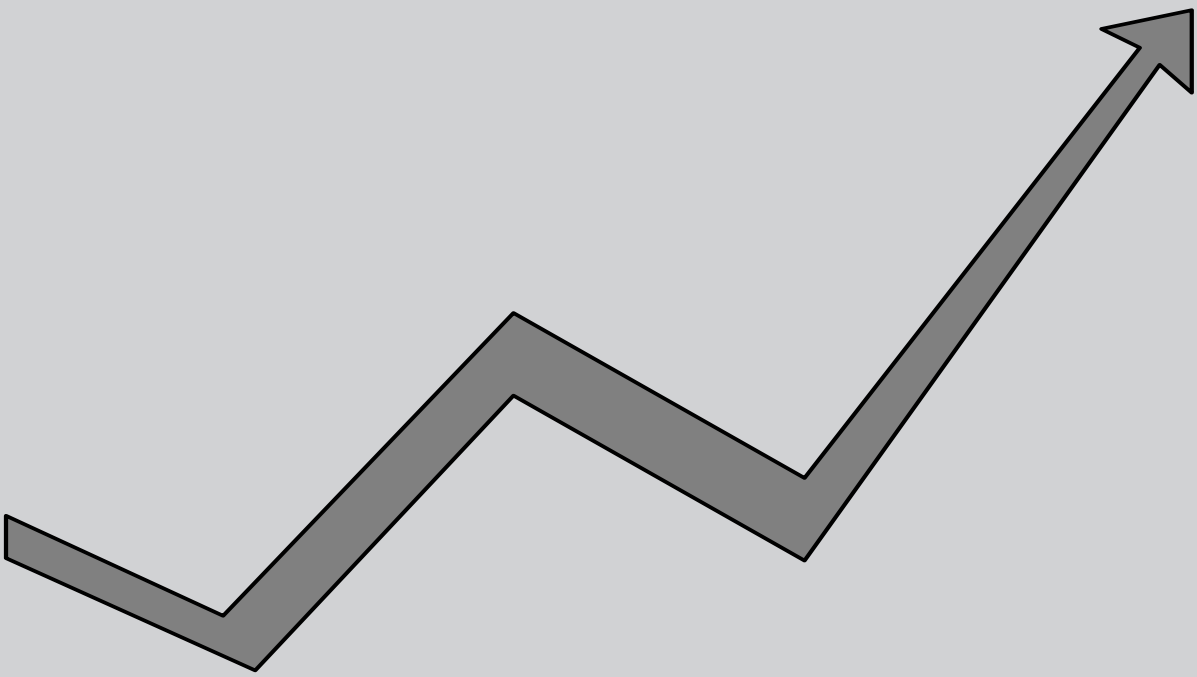
Chapter 3



No Intention to Comply with Influenza and Pneumococcal Vaccination: Behavioural Determinants among Smokers and Non-smokers

Abstract

Background
Smoking increases the risk for influenza and pneumococcal disease, but vaccination uptake is lower among smokers than non-smokers. We therefore aimed to determine reasons for not complying with vaccination among smokers and non-smokers.

Methods
In 2005 a self-administered questionnaire was sent to a random sample of Dutch patients (n=4,000) assessing medical, social and behavioural determinants. Independent factors associated with not complying with influenza and pneumococcal vaccination among smokers and non-smokers were assessed by multivariate logistic regression analysis.

Results
In all, 1,725 of 4,000 patients returned the questionnaire (response rate: 43%), 426 (25%) were smokers. Among smokers self-reported influenza vaccine uptake was 42% and among non-smokers 52% among both only 0,2% received both vaccines. Most important predictors of not complying in smokers and non-smokers were patient's beliefs not to be susceptible to disease (odds Ratio [OR] 4.0, 95% confidence interval [95% CI] 2.0-8.0 and OR 2.8, 95% CI 2.0-3.9), finding it difficult to go to the GP for vaccination (OR 2.5, 95% CI 1.3-4.8 and OR 1.8, 95% CI 1.3-2.6) and being against vaccination (OR 2.4, 95% CI 1.3-4.4 and OR 1.8, 95% CI 1.3-2.6), respectively.

Conclusion
There are no substantial differences in determinants associated with not complying with influenza and pneumococcal vaccination between smokers and non-smokers but there is a trend towards stronger associations in smokers.

Introduction

Smokers have a substantially higher risk for both influenza and pneumococcal diseases than non-smokers.[1-3] Not only do cigarette smokers have higher rates of influenza infection than non-smokers, they also have more severe infections.[4] Importantly, cigarette smoking is the strongest independent risk factor for invasive pneumococcal disease.[2] Prevention of secondary bacterial complications from influenza and primary pneumococcal disease is therefore highly important in this large group of individuals.

Currently, pneumonia is one of the 10 leading causes of death in many countries including the United States and The Netherlands.[5;6] Recent studies[7;8] have also shown an increase in hospitalization and mortality due to pneumonia over the last decade. The leading cause for pneumonias is *Streptococcus pneumonia* and therefore prevention of pneumococcal disease is very important. In The Netherlands, pneumococcal vaccination with the 23-valent polysaccharide pneumococcocal vaccine is only recommended for a small group of patients with high pneumoccocal-associated mortality risks.[9] In the United States, such vaccination has been recommended for a large group of individuals with increased risks such as elderly individuals aged over 65 years as well as individuals with certain risk-elevating co-morbid conditions.[10]

In The Netherlands, influenza vaccination is recommended for individuals with increased risk of complications such as the elderly and individuals with co-morbid conditions. In the United States, vaccination is further recommended for children aged 6 months to 18 years, pregnant women, individuals aged 50 to 65 years and individuals living with or caring for persons at high risk (health care workers and household contacts).[11]
Current recommendations on influenza and pneumococcal vaccination focus on high-risk groups because of high age or underlying diseases, but smokers are so far not included in these recommendations, Some, however, believe it may be reasonable to incorporate pneumococcal vaccination into smoking cessation programs and even consider vaccinating those who continue smoking.[1;2] If such a vaccination program would be accepted by this target population is unknown. Three studies showed that cigarette smoking was associated with failure to be immunized for influenza.[12-14]

The purpose of this questionnaire study was to determine the reasons for not complying with influenza and pneumococcal vaccination in smokers and non-smokers. Such knowledge is indispensable to develop tailored educational strategies to promote vaccination in smokers.

Methods

Setting

Data for this population-based questionnaire study were obtained from the computerized medical database of the University Medical Center Utrecht Primary Care Research network that includes information on a cumulative population of approximately 60,000 patients over the years 1989 to 2004. Main characteristics of this patient population are similar to the Dutch population as a whole.[15] From 1995 onwards medical data of all patients enlisted in the six participating primary care centers have been recorded using a uniform, structured, contact registration format in the computerized general practitioner information system ELIASâ (ISoft, Nieuwegein, The Netherlands). ELIAS is one of the most commonly used general practitioner information systems in The Netherlands.[16] According to the Dutch guidelines on research with humans, for this questionnaire study ethical approval was not required by the Medical Ethical Committee.

Study population
From the database, we randomly selected 4,000 patients over 50 years of age recorded by the general practitioner (GP) as a current smoker or non-smoker. Eligible patients had to have sufficient knowledge of the Dutch language and were able to fill in the questionnaire.

Questionnaire
In 2005, an anonymous self-administered questionnaire (in Dutch) was sent by mail to the selected patients and non-responders were reminded after two weeks by sending them a reminder letter. The development of the questionnaire was based on a review of the literature and two previously developed questionnaires by our research group.[17;18] The questionnaire contained questions about the presence of co-morbid conditions, attitudes towards vaccination, and additional questions about lifestyle and socio-demographic factors. Questions about co-morbid conditions were used to classify patients into high-risk or low-risk groups according to the ACIP guidelines for influenza vaccination. Patients suffering from chronic heart or lung disease or other chronic disease (e.g. immune compromising diseases such as diabetes mellitus) were classified as belonging to the high-risk group and therefore more susceptible to complications of influenza and pneumococcal disease. All others were classified in the low-risk group.[19] Questions about attitude towards vaccination were based on the Health Belief Model.[18-21] Similar to previous studies, patients were asked to answer questions on a five-point Likert scale ranging from 'strongly agree' to 'strongly disagree'.[17;18] For the shortened English translation of the questionnaire, with only the questions relevant to the main outcomes of this study, see appendix A.

Health Belief Model
The Health Belief Model was originally developed to explain and predict patients' participation in preventive health activities.[22-24] The model argued that an individual's decision about undertaking a recommended health action was a function of the individual's beliefs on subjective dimensions. Action to avoid disease will be taken if the individual believes (1) that he/she is susceptible, (2) that occurrence of disease will have at least moderate severity on some component of life, (3) that taking the recommended health action will be beneficial and (4) that the health action does not entail overcoming important barriers. In addition, a cue to action appears to be essential.[19;20;23]

Outcome measure
The outcome variable for the current study was determined by self-reported compliance with or intention to comply with influenza and pneumococcal vaccination. The questions to divide study subjects into a positive or negative category were the following: 'did you receive the flu and pneumococcal vaccine in the past five years?' and 'are you willing to be immunized against flu and pneumococcal disease in the future?' Those who responded positive to either of these questions were regarded as having the intent to comply with influenza and pneumococcal vaccinations.

Statistical analysis
Data were analyzed using SPSS for Windows (Version 12.0; SPSS, Inc., Chicago, Illinois). Several continuous variables were dichotomized: age (>65 [all individuals recommended for vaccination] or ≤65 [only high-risk individuals recommended for vaccination]), co-morbid condition (present or absent), education (high [university preparatory and higher] or low [non-university preparatory]), smoking status (smoker or non-smoker) and the questions on the five-point likert scale (agree [1-2] or uncertain and disagree [3-5]).

Subgroup analysis was applied to clearly determine differences between smokers and non-smokers. First univariate associations of potential determinants with not complying were assessed. Next, all determinants with a *p*-value less than 0.1 in one or both univariate models were used to

assess multivariate associations. Odds ratios (OR) and 95% confidence intervals (95% CI) were determined. The Hosmer-Lemeshow goodness-of-fit test was used to assess the fit of the final model with the observed data.[18]

Results

In all, 1,725 of 4,000 patients completed the questionnaire (response rate: 43%). Baseline characteristics of the respondents are shown in table 1. Mean age was 64.1 years (range 50–95 years), 920 (53%) were women, most patients did not have a co-morbid condition (72%) and 426 patients (25%) were smokers. No substantial differences were found between smokers and non-smokers in terms of sex (56% versus 57% females) and co-morbid conditions (29% versus 28%). They differed in mean age (Mean [SD]: 61.2 versus 65.0 [10.3]). According to the ACIP recommendations, nearly 909 (53%) of patients were at high risk and therefore targeted for both influenza and pneumococcal vaccinations. Since pneumococcal vaccination has only been recommended for a few very uncommon high-risk conditions as immune deficiency or renal disease, figures for pneumococcal vaccination in this group were very low. Among smokers self reported influenza vaccine uptake was 42% and among non-smokers 52% among both only 0,2% received both vaccines.

Table 1 Baseline characteristics of study population (2005, The Netherlands)

	Total (n=1,725)	
Characteristic	**N**	**%**
Smoker	426	25
Cigarette	337	20
Cigars	65	4
Tobacco	16	1
Age (Mean (SD))	64.1 (10.0)	
Age < 65 years	1,004	58
Female gender	920	53
Health care worker	199	12
No comorbid condition	1,234	72
Cardiovascular disease	230	13
Pulmonary disease	162	9
Renal disease	16	1
Cerebrovascular disease	29	2
Diabetes mellitus	148	9
Cancer	51	3
Living on their own	389	23
Living with partner	1,236	72
Living with others	69	4
High education	632	37
Having no pulmonary infections	1,319	77
Influenza infection	312	18
Acute bronchitis	125	7
Pneumonia	62	4
No GP* visit for infection	1,419	82
No antibiotics for infection	1,533	89

*GP: general practitioner

Smoking as a predictor of not complying with vaccinations

Overall, intention not to comply with both vaccinations did not significantly differ between smokers and non-smokers, respectively, 47.2% and 50.5% (OR 0.88, 95% CI 0.70-1.09, *p* value 0.24). Independent of other factors, such as age, comorbid conditions and household situation, smoking did not significantly contribute to not complying (OR 0.84, 95% CI 0.66-1.05, *p* value 0.12).

Predictors of not complying with vaccinations in smokers and non-smokers

In univariate analysis according to subgroup, the following factors were significant predictors of not complying in non-smokers: young age (≤ 65 years), absence of co-morbid condition, being a health care worker, absence of pulmonary infections, GP consultation or antibiotic prescription(s), patient's beliefs that they are not susceptible to the diseases, that the diseases are not dangerous and that vaccination is not effective and causes side effects, serious illness or weakens the natural defences, being against vaccination, finding it difficult to go to the GP for vaccination and perceived lack of recommendation by the GP (table 2). In univariate analysis according to subgroup similar factors were significant in smokers, except being a health care worker, absence of pulmonary infections, GP consultation or antibiotic prescription(s) and patient's beliefs that vaccination causes serious illness or weakens the natural defenses. Additional significant predictors in smokers were high level of education and unwillingness to comply with the GP's advice.

Table 2 Factors associated with not complying with influenza and pneumococcal vaccination*

	SMOKERS (n=426)		NON-SMOKERS (n=1,299)	
Variable	OR	95% CI	OR	95% CI
Age ≤ 65 years	1.54	1.01-2.35	1.67	1.34-2.08
Female gender	1.33	0.94-2.04	1.00	0.99-1.00
Absence of comorbid condition	2.94	1.88-4.61	1.98	1.55-2.53
Living without a partner	1.15	0.75-1.78	1.19	0.91-1.55
High level of education	1.72	1.15-2.59	1.20	0.96-1.51
Being a health care worker	1.60	0.87-2.96	1.66	1.17-2.34
Absence of pulmonary infections	1.50	0.97-2.32	1.56	1.20-2.03
Absence of GP consultation	1.42	0.87-2.31	1.66	1.24-2.22
Absence of antibiotic prescription(s)	1.67	0.93-3.00	2.44	1.67-3.57
Influenza is not dangerous	2.02	1.33-3.06	2.75	2.19-3.47
Pneumonia is not dangerous	2.61	1.75-3.87	2.25	1.80-2.82
Influenza vaccine is not effective	2.69	1.72-4.21	1.92	1.46-2.52
Pneumococcal vaccine is not effective	2.42	1.55-3.77	1.78	1.39-2.28
I am not susceptible to influenza and pneumonia	4.61	2.71-7.84	3.01	2.27-3.98
Vaccination weakens the natural defences	1.13	0.76-1.68	1.26	1.00-1.58
Vaccination will cause side effects	2.16	1.45-3.20	1.53	1.22-1.91
Vaccination will cause serious illness	0.92	0.60-1.42	1.37	1.05-1.79
I am against vaccination	2.73	1.69-4.39	2.68	2.05-3.49
It is difficult to go to the GP for vaccination	2.33	1.47-3.71	2.48	1.90-3.25
My GP does not recommend the vaccination	3.08	2.04-4.64	1.94	1.54-2.43
It is not important to comply with GP's advice	1.99	1.08-3.66	1.20	0.86-1.67

* results of univariate logistic regression analysis
OR: odds ratio
95% CI: 95% confidence interval
GP: general practitioner

In multivariate analysis according to subgroup the following factors were independent significant predictors of not complying in non-smokers; young age (≤ 65 years), being a health care worker, patient's beliefs that they are not susceptible to influenza and pneumonia, that these diseases are not dangerous, that pneumococcal vaccination is not effective, being against vaccination, and finding it difficult to go to the GP for vaccination (table 3). In multivariate analysis according to subgroup similar factors were independent predictors in smokers, except for young age (≤ 65 years), being a health care worker and patient's beliefs that influenza is not dangerous. Additional independent significant predictors in smokers were high level of education, patient's belief that influenza vaccine is not effective and perceived lack of recommendation by the GP. Overall, there was a trend of associations given by odds ratio's of almost all significant predictors to be stronger in smokers than non-smokers. The calibration of the models, tested by the Hosmer-Lemeshow goodness-of-fit test, was good (*p* value 0.86 in smokers and *p* value 0.60 in non-smokers). The discriminative values of both models was moderate to good with an area under the receiver operating characteristic curve (AUC) of 0.78 (95% CI 0.73-0.82) and AUC 0.74 (95% CI 0.71-0.77) in smokers and non-smokers, respectively.

Table 3 Independent predictors of not complying with influenza and pneumococcal vaccination*

	SMOKERS		NON-SMOKERS	
Variable	OR	95% CI	OR	95% CI
Age ≤ 65 years	-	-	1.36	1.04-1.79
High level of education	1.95	1.18-3.23	-	-
Being a health care worker	-	-	1.67	1.12-2.49
Lack of perceived severity (influenza)	-	-	1.80	1.35-2.40
Lack of perceived severity (pneumonia)	1.84	1.13-2.99	1.33	1.00-1.77
Belief of vaccine ineffectiveness (influenza)	1.87	1.06-3.32	-	-
Belief of vaccine ineffectiveness (pneumonia)	1.75	1.02-3.01	1.77	1.33-2.36
Lack of perceived susceptibility	3.96	1.95-8.04	2.78	1.97-3.91
"I am against vaccination"	2.38	1.27-4.44	1.83	1.30-2.58
"It is difficult to go to GP for vaccination"	2.54	1.34-4.81	1.84	1.29-2.60
Lack of GP recommendation	1.77	1.07-2.91	-	-

* results from multiple logistic regression analysis
OR: odds ratio
95% CI: 95% confidence interval
GP: general practitioner

Discussion

This study among 1,725 patients aged 50 years and older showed that smoking is not a significant predictor of not complying with influenza and pneumococcal vaccination, but associations appeared stronger in smokers than non-smokers.

However, some potential limitations need to be considered before accepting these results. First, the response rate on the questionnaires was 43% and response bias may have influenced our results. However, we believe that such bias is unlikely given the fact that the percentage smokers in the study population (25%) is similar to the Dutch population (28%).[25] Moreover, the study population of smokers consisted of 79% cigarette smokers, 15% cigar smokers and 4% tobacco smokers which is more or less similar to rates for the general Dutch smoking population (62%, 16% and 1%,

respectively). Second, smoking habits were self-reported. However, the agreement between the GP records and self-reported smoking status was high (kappa as measure of agreement of 0.80). Third, we devided our study population into two groups (smoker and non-smoker). It could possibly have been more accurate to devide into three or more categories. We ,however, explored whether there were differences in intent to comply among heavy and light smokers and the self-reported uptake of influenza vaccination over the last five years among those who smoked 1-10, 11-20 en >20 cigarettes per day turned out to be similar: 43%, 40% and 44%. Fourth, since this was a questionnaire study evaluating only few items of the dimensions of the Health Belief Model that have been shown to be important in vaccination behaviour in previous studies, we chose not to determine construct validity of our questionnaire. The final model appeared however to discriminate well between those who did and did not intent to comply with the vaccines; hence we assume that the questions were valid. Fifth, we did not record actual behaviour towards vaccinations, but measured intention to comply with influenza and pneumococcal vaccination as outcome measure. It is, however, well known that intention is a strong predictor of behaviour as summarized in the Health Belief Model.

In an earlier study, smoking was not related to non-compliance with influenza and pneumococcal vaccination (OR 0.9, 95% CI 0.6-1.5) in patients aged 65 years or older.[18] On the other hand, some studies have found smoking to be associated with a failure to receive influenza vaccination.[12-14] Our study, investigating intention to comply with vaccination instead of vaccination behaviour, could not confirm these findings. No substantial differences in intention to comply with influenza and pneumococcal vaccination were found between smokers and non-smokers and smoking was not significantly associated with not complying with vaccination (OR 0.88, 95% CI 0.70-1.09). But the main result is that most predictors were more strongly associated with the intention not to comply with vaccinations among smokers than non-smokers. Despite of the fact that this measure is not that difficult to comply with compared with many other preventive measures.

Separate behavioural determinants associated with not complying with vaccination in smokers have not been investigated before. Our data showed significant independent predictors of not complying with influenza and pneumococcal vaccination among this large group. Nichol et al.[12] found similar factors independently associated with influenza and pneumococcal vaccination in another study group of high-risk patients and Opstelten et al.[18] found similar predictors of not undergoing influenza and pneumococcal vaccination in elderly subjects. In the latter most important predictors of not undergoing both vaccinations were perceived lack of recommendation of pneumococcal vaccination (OR 8.2, 95% CI 4.3-15.5) and patient's unwillingness to comply with the physician's advice (OR 6.1, 95% CI 2.4-15.4). Hak et al. found similar factors in predicting a negative attitude towards future vaccinations in the Dutch childhood vaccination program in parents.[17] Some independent significant factors were high level of education (OR 3.3, 95% CI 1.3-8.6), being a health care worker (OR 4.2, 95% CI 1.4-12.6) and perception of vaccine ineffectiveness (OR 6.9, 95% CI 2.5-18.9).

Prevention of influenza and pneumococcal disease in high-risk groups is an issue in current medical practice and will only become more important in the future since morbidity and mortality are increasing. Physicians should therefore inform smoking patients about their increased risk of pulmonary infections and emphasize the importance of smoking cessation.

This study also shows some important points meriting attention that should be considered in current and future vaccination programs. Patient's beliefs that influenza and pneumonia are not dangerous, that influenza and pneumococcal vaccines are not effective and that they are not susceptible to disease emphasizes the neccesity of informing patients. Special attention needs to be

addressed to patients younger than 65 years of age and with high level of education. In this study a health care workers' lack of recommendation predicted patients not complying with vaccination and being a health care worker was an independent predictor of not complying with vaccination. Therefore another specific target group, in efforts to optimize results of vaccination programs, should be health care workers.

Our study showed that, if smokers are considered as a high-risk group and therefore targeted for vaccination, the above mentioned points need to be taken into account. Since lower vaccination rates in smokers have been shown in previous studies, vaccination behaviour in smokers needs to be studied further in the future.

Conclusion

In this study, we examined the medical, social and behavioural determinants associated with not complying with influenza and pneumococcal vaccination. In a representative sample of the smoking and non-smoking population similar factors are associated with not complying with vaccinations, but associations are stronger in smokers.

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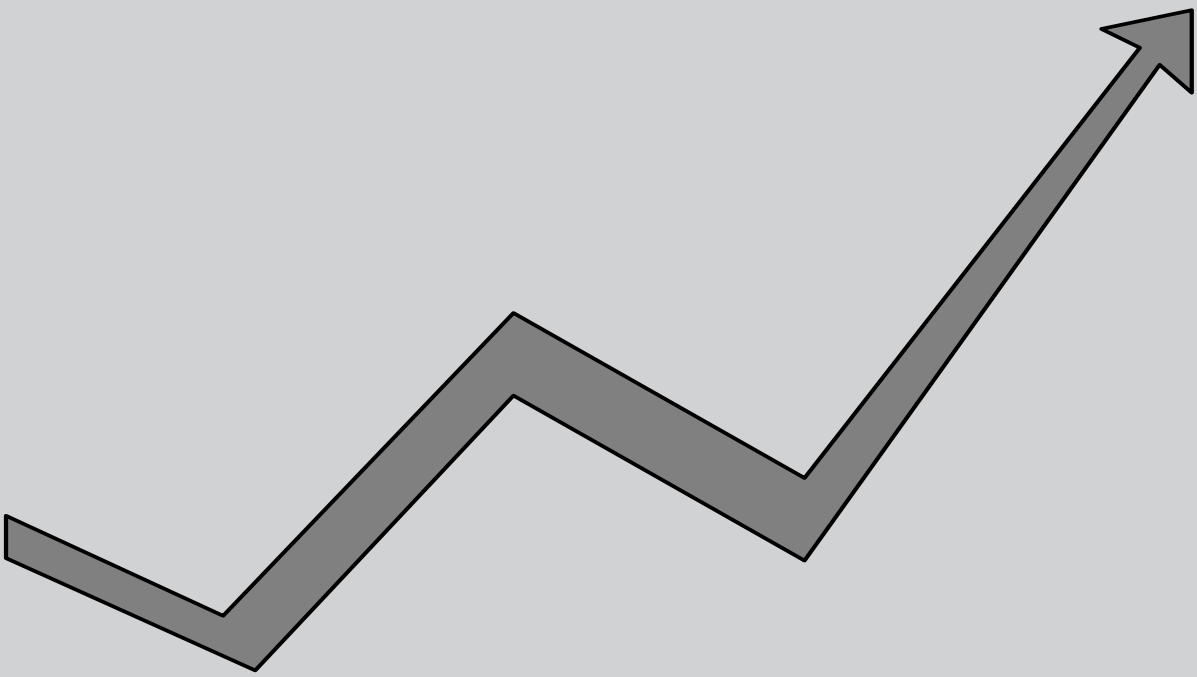
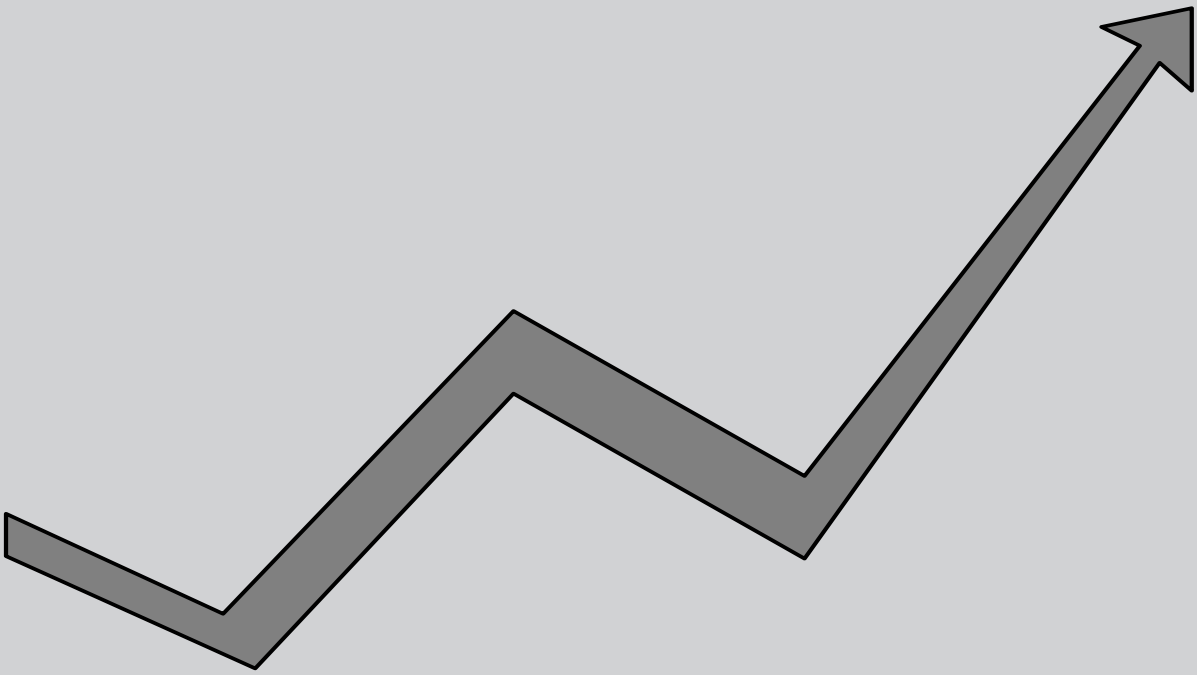
Chapter 4



Influenza Vaccination of Health Care Workers

Chapter 4.1



Uptake of Influenza Vaccination in Dutch Nursing Home Personnel following National Recommendations

Introduction

Because recent studies have demonstrated substantial benefits from routine influenza vaccination in health care workers (HCWs) of long-term care institutions, the Dutch association of nursing home physicians (NVVA) issued a guideline on influenza vaccination in nursing homes in 2004.[1] The disrupting effect of influenza on nursing home care has been acknowledged, and vaccinating health care workers against influenza reduces the occurrence of influenza infections and associated productivity loss.[2-4] Even more important, frail patients who may benefit less from immunization against influenza are indirectly protected by reduction of influenza virus transmission.[4-6] Before the guideline, vaccine uptake in HCWs of Dutch nursing homes was 5 to 8%.[1] Considering the fact that influenza vaccination rates among recommended patient groups in The Netherlands are among the highest in the world, such an uptake is extremely low. We therefore hypothesized that introducing a national guideline might result in substantial improvement.

Methods

In October 2005, a self administered questionnaire was sent to the management of all Dutch nursing homes (n=335). Participants reported on uptake of influenza vaccination in patients and HCWs in the preceding season (2004-2005 season), whether the institution had a written policy on influenza vaccination for HCWs, what the current offering policy was (active request, HCWs initiative or none) and whether HCWs were currently offered information on influenza vaccination. For the English translation of the questionnaire see appendix B.

Results

In all, 149 of the 335 questionnaires were completed and returned (response rate 45%). The average vaccination rate was 10.5% in HCWs (95% confidence interval of mean [95% CI] 8.7-12.3%) and 90.5% in patients (95% CI 88.3-92.8%). Only 67 (45%) homes had a written policy. In all, 107 (72%) homes actively requested their HCWs to be vaccinated. Of homes with a written policy (n=67), 65 (97%) actively requested their HCWs to be vaccinated. Of homes in which there was no written policy (n=72), influenza vaccination was not offered in 27 (37%) and in seven (10%) was offered if an HCW asked for vaccination. Having a written policy, actively requesting HCWs to get vaccinated and informing HCWs about influenza vaccination resulted in significantly higher mean vaccination rates in HCWs (table 1).

Table 1 Effects of policy determinants on mean influenza vaccination rates among HCWs in nursing homes (n=149)

	Yes		No			
Policy determinants	N[a]	%[b]	N[a]	%[b]	MD (95% CI)	*p* value[c]
Having a written policy	67	12.4	72	7.8	4.6 (1.1 to 8.1)	0.011
Actively requesting HCWs to get vaccinated	107	12.1	37	5.3	6.8 (2.6 to 10.9)	0.002
Offering information to HCWs in any way	111	11.9	22	3.6	8.3 (3.6 to 12.9)	0.001

[a] N: number of homes
[b] %: mean vaccination rate of HCWs in nursing homes
[c] Differences in mean vaccination rates were considered significant if p<0.05

Discussion

Compared with data from a similar questionnaire study from 2000,[7] only a 5% absolute increase was observed in having a written policy (40% versus 45%). Although in homes with a written policy, the proportion with an active request rose substantially, from 22% to 97%. Despite these organisational improvements, the uptake of influenza vaccination among HCWs did not improve substantially (from 5 to 8% before to 11% in the year after the introduction of the guideline). The response rate of the previous questionnaire study was higher (73% versus 45%), but similar vaccination rates were found in patients (86% versus 90%). Also, the method used was similar, and bias is therefore highly unlikely. After all, awareness of a newly issued guideline should be most prominent in the first year. Even so, having a written policy, actively requesting HCWs to get vaccinated and informing HCWs about influenza vaccination resulted in only slightly higher mean vaccination rates (12%). To implement the guideline successfully, more strategies are clearly needed. International research has shown a number of behavioural and organisational determinants to be of importance in raising vaccination levels among HCWs in general such as perceived influenza risk and severity, perceived vaccine effectiveness and easy access to free vaccination.[8-10] Further research is needed to asses which behavioural, organisational and ethical determinants of vaccine uptake among HCWs in Dutch nursing homes should be focused on when developing an effective influenza vaccination campaign.

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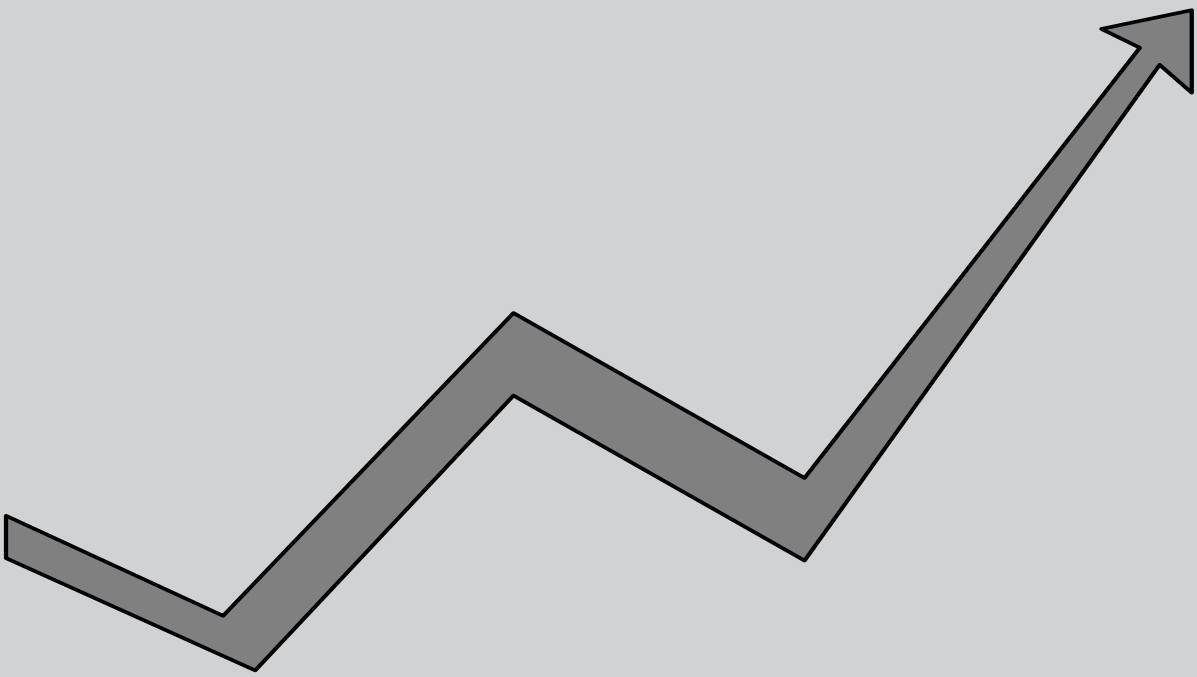
Chapter 4.2



Which Determinants Should be Targeted to Increase Influenza Vaccine Uptake among Health Care Workers in Nursing Homes?

Abstract

Background

Although health care workers (HCWs) have been recommended to be immunized against influenza, vaccine uptake remains low. So far, research on determinants of influenza vaccination among HCWs has been limited by design, population or theoretical framework. Therefore we aimed to assess which determinants were associated with influenza vaccine uptake among HCWs.

Methods

In 2005 1,889 anonymous self-administered questionnaires were distributed among HCWs of 32 Dutch nursing homes assessing demographical, behavioural and organisational determinants.

Results

A total of 1,125 questionnaires was returned (response rate 60%). Self reported influenza vaccine uptake in HCWs was 33%. In all, the multivariate analysis resulted in a 13- item logistic regression model with two demographical, nine behavioural and two organisational determinants that were independently associated with influenza vaccine uptake. The area under the receiving operating characteristic curve of this model was 0.95.

Conclusion

We were able to accurately predict influenza vaccine uptake in HCWs in Dutch nursing homes based on a 13-item prediction model. We plan to develop an implementation programs that targets the determinants of this model.

Introduction

Annually, influenza remains a major cause of morbidity and mortality, especially in the elderly.[1;2] Influenza outbreaks in long-term care institutions such as nursing homes can therefore have large consequences.[2;3] Health care workers (HCWs) can introduce influenza in these health care settings since a significant number of HCWs (10 to 30%) are infected with influenza each winter[3-5] and most of them continue to work despite of infection (approximately 50 to 80% of those infected).[6-9] Thus, HCWs increase the risk of influenza transmission to patients as well as colleagues. Immunizing HCWs against influenza reduces the occurrence of influenza infections and associated productivity loss among HCWs.[7;10;11] Even more important, it might also enhance indirect protection of frail patients by reduction of influenza virus transmission.[12] This indirect protection has been debated in the past[13] but more recent studies lend support to indirect benefits of vaccination.[14;15]
Following guidelines by the WHO, in 2004 the Dutch association of nursing home physicians (NVVA) recommended influenza vaccination of HCWs in nursing homes.[16] In spite of this guideline, we showed that vaccine uptake among HCWs in this high-risk setting remained low and concluded that more targeted implementation strategies, which take into account the factors that influence vaccine uptake, are clearly needed.[17;18] So far, research on determinants of influenza vaccination among HCWs has been limited by design, population or theoretical framework. Study populations have been small (less than 500 respondents)[19-22] or limited to subgroups of HCWs (e.g. only physicians [23]). Or determinants studied were limited (e.g. only asked for the primary reason for accepting or refusing vaccination[24] or only short questionnaires used[8;25]) and not covering all relevant dimensions for effective implementation (demographical, behavioural and organisational determinants).[8;24;26-30]

As part of a series of studies on vaccine uptake[31-33], we conducted a questionnaire study in Dutch nursing homes to assess which demographical, behavioural and organisational determinants were associated with influenza vaccine uptake in HCWs.

Methods

Study design and population

We designed a questionnaire study among HCWs of Dutch nursing homes. In October 2005, all Dutch nursing homes (n=335) were sent an invitation letter to participate in the study. Among the nursing homes that responded positively (n=76, 23%) we randomly selected 32 nursing homes to participate in this study by computer. In December 2005, after the influenza vaccination campaign, questionnaires were distributed in these participating nursing homes among all HCWs (mostly physicians, nurses and nursing assistants) at work on the days of distribution. Participating nursing homes were free to choose a day of distribution within a fixed period of two weeks. According to

the Dutch guidelines on research with humans, for this questionnaire study ethical approval was not required by the Medical Ethical Committee.

Outcome measure

The primary outcome measure was self-reported uptake of influenza vaccination after the influenza vaccination campaign of 2005. The question was posed as follows: 'Did you receive influenza vaccination this year (autumn 2005)?'.

Determinants of influenza vaccine uptake

Determinants of influenza vaccine uptake were assessed by an anonymous, self-administered questionnaire with a total of 59 questions. Questions were based on a review of the literature[19-21;34-38] and two previously developed questionnaires by our research group.[31;33] Respondents were asked to answer most propositions on a five-point Likert scale ranging from 'strongly agree' to 'strongly disagree'. For the English translation of the questionnaire see appendix C.

Demographical determinants

The questionnaire contained 12 questions on demographical determinants (see table 2) most of which have been identified in previous studies.[19;21;22;26-29;34;36;37;39;40] Respondents were asked to report their sex, age, educational level, if they shared a home with children and if they had a chronic illness for which influenza vaccination is indicated. Professional data collected consisted of individual level data (profession, number of years working in health care, working hours a week and type of shifts worked) and nursing home data (number of beds per nursing home and occurrence of an influenza outbreak in the last three years). Finally, type of ward(s) respondents worked at was asked.

Behavioural determinants

Questions on behavioural determinants were based on the 'Health Belief Model'[41] and the 'Behavioural Intention Model'.[42] A total of 39 questions (see table 3) assessed the following five Health Belief Model domains: perceived susceptibility (four questions), perceived severity (two questions), perceived benefits (seven questions), perceived barriers (12 questions) and cues to action (one question). The former were complemented with the two Behavioural Intention Model domains: attitude (eight questions, most of these were questions with an ethical perspective) and social influences (five questions). Most of these behavioural determinants were identified through previous studies.[8;19-24;29;34;36-38;40]

Organisational determinants

Organisational determinants (see table 4) were assessed using six questions in accordance with previous studies.[23;24;34;40] These consisted of the current situation concerning organisation of information on influenza vaccination (information received or not, route of information and whether information has been sufficient or not) and opinion towards various routes of receiving

information. Finally we asked for the current situation concerning the organisation of vaccine provision (if and how provision is organised and if this has been adequate). We decided not to incorporate a question on costs, because influenza vaccination is offered free of charge in Dutch nursing homes and this item would therefore not be predictive for vaccine uptake.

Statistical analysis

Data were analyzed using SPSS for Windows (Version 14.0) and SAS for Windows (version 9.1). Continuous determinants (age, years working in health care, working hours a week and number of beds in the nursing home) were dichotomized with the median as cut-off point, as was confirmed by preliminary analysis. Questions on the five-point Likert scale were dichotomized (agree [numbers 1 and 2 of the scale] versus do not agree/do not disagree and disagree [numbers 3 to 5 of the scale]) in accordance with previous reports on determinants of pneumococcal vaccination compliance in elderly[31] and determinants of compliance of parents with possible future vaccinations for their children.[33]

To determine which determinants among HCWs were associated with influenza vaccine uptake, univariate associations of potential determinants were assessed. Next, all determinants with a *p*-value less than 0.1 in the univariate analysis were used to assess multivariate associations. All determinants with a *p*-value of 0.05 or lower were used in the final multivariate logistic regression model and the area under the receiver operating characteristic curve (AUC) with its corresponding 95% confidence interval (95% CI) was calculated as a measure of discriminative value of the model. Odds ratios (OR) and their 95% CI were reported as measures of associations. Because clustering effects at the nursing home level could be present, we verified our analyses using Generalised Estimation Equation analysis with nursing homes as the clustering variable in SAS for Windows. The results of these analyses were comparable indicating that clustering did not affect our results.

Results

Study population

Participating nursing homes

The 32 participating nursing homes had a mean capacity of 161 beds per nursing home (standard deviation [SD] 81) and a mean number of 210 HCWs per nursing home (SD 139) compared to a mean capacity of all Dutch nursing homes in 2005 of 178 beds per nursing home[43] and a mean number of HCWs per nursing home in 2003 of 232.[44] Since information on all Dutch nursing homes has not been centralized, it was impossible to make further comparisons.

Two percent of HCWs of participating nursing homes were employed as physician, 9% as nurse, 50% as nursing assistant National Vocational Qualification (NVQ) level 3 and 20% as nursing assistant NVQ level 2 (level 3 being higher educated than level 2). The remaining 20% consisted of a variety of professions (e.g. feeding assistants, physiotherapists, occupational therapists).

Participating HCWs

Of all 1,889 distributed questionnaires 1,125 were returned (response rate 60%). Baseline characteristics of respondents are shown in table 1. Mean age of respondents was 39 years (range 17-64 years, SD 11) and 88% were female. For comparisons, in all Dutch nursing homes in 2005 89% of HCWs were female and mean age of HCWs was 40,8 years.[45] Of the 1,125 respondents 5% were nursing home physicians, 15% were nurses, 54% were nursing assistants level 3 and 4% nursing assistants level 2. In total 242 of the 1,125 reported a variety of other professions (e.g. 32 [3%] feeding assistants, 19 [2%] physiotherapists, 15 [1%] occupational therapists). Comparing this distribution of jobs among responders to that of all HCWs working in the participating nursing homes, response seemed to be higher among physicians, nurses and nursing assistants level 3 than nursing assistants level 2.

Table 1 Baseline characteristics of study subjects (n= 1,125)

Characteristics	Number (%)
Personal data	
Female gender	986 (87.6)
Mean age [years (SD)]	38.8 (11.0)
Children living at home	534 (47.5)
Educational level > NVQ[a] level 3	334 (29.7)
Chronic illness	110 (9.8)
Professional data	
Years working in health care [years (SD)]	15.0 (9.9)
Working hours a week [h (SD)]	28.8 (7.5)
No evening or night shifts	381 (33.9)
Mean number of beds in nursing home [number (SD)]	160.8 (81.5)
Influenza outbreak in nursing home in the last 3 years	640 (56.9)
Profession	
Physician	58 (5.2)
Nurse	172 (15.3)
Nursing assistant (NVQ[a] level 3)[b]	612 (54.4)
Nursing assistant (NVQ[a] level 2)[b]	41 (3.6)
Other	242 (21.5)
Type of ward [c]	
Somatic	728 (64.7)
Psycho geriatric	886 (78.8)
Revalidation [d]	520 (46.2)

[a] NVQ: National vocational qualification
[b] Level 3 being higher educated than level 2
[c] More than 1 type of ward possible
[d] The revalidation ward mainly consists of temporary patients

Outcome measure

Of all respondents, 32.6% (n=367) were vaccinated against influenza during the study season. Influenza vaccine uptake was 81% among physicians, 38% among nurses, 26% among nursing assistants level 3, 18% among nursing assistants level 2 and 24% among those with other professions. In the preceding 2004-2005 influenza season 25% of respondents (n=287) received influenza vaccination (respectively 50%, 28%, 24%, 10% and 25%).

Determinants univariately associated with influenza vaccine uptake

Demographical determinants

Results from the univariate analysis to assess the association of demographical determinants with influenza vaccine uptake are shown in table 2. Older age (odds ratio [OR] 2.22, 95% confidence interval [95% CI] 1.71-2.87, higher education (OR 1.88, 95% CI 1.44-2.46) and more years working in health care (OR 2.04, 95% CI 1.58-2.63) were among demographical determinants univariately associated with influenza vaccine uptake among HCWs. Nurses and physicians were more likely to be vaccinated compared to the reference category of nursing assistants (OR 1.72, 95% CI 1.20-2.46 and OR 11.97, 95% CI 6.06-23.64, respectively).

Table 2 Univariate analysis: demographic determinants associated with influenza vaccine uptake among HCWs

Factors	Vaccinated (n=367) Number (%)	Unvaccinated (n=757) Number (%)	Odds ratio (95% CI)	p-value
Demographic				
Male gender	50/361 (13.9)	67/741 (9.0)	1.62 (1.10-2.39)	0.015
Over 40 years of age	221/358 (61.7)	311/738 (42.1)	2.22 (1.71-2.87)	<0.001
Children living at home	177/361 (49.0)	356/741 (48.0)	1.04 (0.81-1.34)	0.758
Higher education (> NVQ[a] level 3)	141/348 (40.5)	193/726 (26.6)	1.88 (1.44-2.46)	<0.001
Chronic illness	85/365 (23.3)	24/755 (3.2)	9.25 (5.76-14.85)	<0.001
Professional data				
Years working in health care >15	197/367 (55.0)	274/730 (37.5)	2.04 (1.58-2.63)	<0.001
Working hours a week > 28	215/354 (60.7)	430/728 (59.1)	1.07 (0.83-1.39)	0.600
No evening or night shifts	167/367 (45.5)	214/757 (28.3)	2.12 (1.64-2.75)	<0.001
Number of beds in nursing home >150	173/334 (51.8)	309/651 (47.5)	1.19 (0.91-1.55)	0.198
Influenza outbreak in the last 3 years	218/364 (59.9)	422/747(56.5)	1.15 (0.89-1.48)	0.282
Profession[b]				
Nurse vs. nursing assistant	65/226 (28.8)	106/557 (19.0)	1.72 (1.20-2.46)	0.003
Physician vs. nursing assistant	47/208 (22.6)	11/462 (2.4)	11.97 (6.06-23.64)	<0.001
Type of ward				
Somatic	244/367 (66.5)	483/757 (63.8)	1.13 (0.87-1.46)	0.378
Psycho geriatric	302/367 (82.3)	584/757 (77.1)	1.38 (1.00-1.89)	0.048
Revalidation	181/367 (49.3)	339/757 (44.8)	1.20 (0.94-1.54)	0.153

[a] NVQ: National vocational qualification
[b] professions of nurse respectively physician compared to the reference category of nursing assistants
95% CI: 95% confidence interval

Behavioural determinants

Behavioural determinants univariately associated with influenza vaccine uptake are shown in table 3. In the domain perceived susceptibility, 'a high personal risk for influenza infection' (OR 6.37, 95% CI 4.62-8.77) and 'awareness of the risk to infect patients' (OR 4.72, 95% CI 3.32-6.70) were among associated determinants. Perceived benefits were strongly associated with influenza vaccination; most strongly associated benefit was the reduction of work pressure due to vaccination (OR 16.87, 95% CI 12.14-23.43). In the domain perceived barriers, vaccinated respondents more

Table 3 Univariate analysis: behavioural determinants associated with influenza vaccine uptake among HCWs

Factors	Vaccinated (n= 367) Number (%)	Unvaccinated (n=757) Number (%)	Odds ratio (95% CI)	p-value
Perceived susceptibility				
High personal risk for influenza infection	148/366 (40.4)	72/747 (9.6)	6.37 (4.62-8.77)	<0.001
Awareness of the risk to infect patients	322/365 (88.2)	459/748 (61.4)	4.72 (3.32-6.70)	<0.001
Awareness of higher effectiveness in those under 65 years of age	200/363 (55.1)	172/744 (23.1)	4.08 (3.12-5.34)	<0.001
During an epidemic HCWs are more likely to get an influenza infection	328/364 (90.1)	558/746 (74.8)	3.07 (2.10-4.50)	<0.001
Perceived severity				
Influenza is dangerous for me	158/366 (43.2)	142/747 (19.0)	3.24 (2.46-4.27)	<0.001
Influenza is dangerous for the patients	328/365 (89.9)	577/749 (77.0)	2.64 (1.81-3.87)	<0.001
Perceived benefits				
Vaccination reduces the personal risk of influenza illness	180/364 (49.5)	45/749 (6.0)	15.30 (10.63-22.04)	<0.001
Vaccination reduces the risk to infect patients	232/363 (63.9)	87/750 (11.6)	13.50 (9.90-18.39)	<0.001
Vaccination reduces the risk to infect family members	199/364 (54.7)	80/749 (10.7)	10.09 (7.39-13.76)	<0.001
Vaccination can reduce work pressure	227/364 (62.4)	67/749 (8.9)	16.87 (12.14-23.43)	<0.001
Knowing there is a guideline by the Dutch association of nursing home physicians	110/365 (30.1)	81/746 (10.9)	3.54 (2.57-4.88)	<0.001
Having knowledge on the contents of the guideline	251/364 (69.0)	412/742 (55.5)	1.78 (1.37-2.32)	<0.001
Agreeing with the contents of the guideline	288/349 (82.5)	199/692 (28.8)	11.70 (8.48-16.13)	<0.001
Perceived barriers				
Vaccination is useful in spite of the constant flow of visitors	189/359 (52.6)	99/735 (13.5)	7.14 (5.31-9.61)	<0.001
Not against vaccinations in general	304/361 (84.2)	434/739 (58.7)	3.75 (2.73-5.15)	<0.001
Not against vaccination of HCWs in nursing homes	312/363 (86.0)	365/740 (49.3)	6.29 (4.52-8.74)	<0.001
Vaccination is not just offered to reduce costs	203/363 (55.9)	265/741 (35.8)	2.28 (1.76-2.94)	<0.001
Vaccination is not just offered to reduce sick-leave	180/364 (49.5)	206/743 (27.7)	2.55 (1.97-3.31)	<0.001
Never experienced side effects in the past	334/362 (92.3)	670/751 (89.2)	1.44 (0.92-2.26)	0.110
Side effects in the past are no reason for not being vaccinated in the future	359/362 (99.2)	693/748 (92.6)	9.50 (2.95-30.57)	<0.001
Not expecting side effect after vaccination	160/364 (44.0)	211/742 (28.4)	1.97 (1.52-2.56)	<0.001
Not expecting allergic reaction or autoimmune disease after vaccination	267/364 (73.4)	386/746 (51.7)	2.57 (1.95-3.37)	<0.001
After getting vaccinated once you're not obligated to get vaccinated every year	339/363 (93.4)	675/748 (90.2)	1.53 (0.95-2.47)	0.081
Vaccinations don't reduce resistance	237/362 (65.5)	203/744 (27.3)	5.05 (3.86-6.62)	<0.001
Vaccination can't cause influenza infection	217/360 (60.3)	230/746 (30.8)	3.40 (2.62-4.43)	<0.001
Cues to action				
Media attention for avian influenza influenced my ideas	65/364 (17.9)	52/738 (7.0)	2.87 (1.94-4.23)	<0.001
Attitudes				
Finding it important that HCWs don't infect patients	336/364 (92.3)	540/748 (72.2)	4.62 (3.05-7.02)	<0.001
HCWs should get vaccinated to ensure continuity of care	234/364 (64.3)	96/746 (12.9)	12.19 (9.00-16.50)	<0.001
All HCWs should be vaccinated	247/364 (67.9)	60/746 (8.0)	24.14 (17.12-34.03)	<0.001
Finding it not important that HCWs have freedom of choice concerning influenza vaccination	18/361 (5.0)	12/741 (1.6)	3.19 (1.52-6.69)	0.001
In case of influenza outbreak unvaccinated HCWs should be banned from work	18/361 (5.0)	22/743 (3.0)	1.72 (0.91-3.25)	0.091
In case of influenza outbreak unvaccinated HCWs should be banned from work without payment	10/362 (2.8)	6/744 (0.8)	3.49 (1.26-9.69)	0.011
HCWs should get vaccinated because of their duty not to harm	215/361 (59.6)	57/738 (7.7)	17.59 (12.49-24.78)	<0.001
Influenza vaccination should become mandatory for HCWs in nursing homes	81/362 (22.4)	26/746 (3.5)	7.98 (5.03-12.68)	<0.001
Social influences				
People close to me think it's important for me to get vaccinated	86/361 (23.8)	18/743 (2.4)	12.60 (7.44-21.33)	<0.001
Finding it important to do what people close to me think is important	74/361 (20.5)	55/746 (7.4)	3.24 (2.23-4.71)	<0.001
My colleagues think it's important for me to get vaccinated	75/360 (20.8)	27/744 (3.6)	6.99 (4.41-11.08)	<0.001
Finding it important to do what my colleagues think is important	67/361 (18.6)	44/745 (5.9)	3.63 (2.42-5.44)	<0.001
Feeling support concerning influenza vaccination decision	225/314 (71.7)	382/670 (57.0)	1.91 (1.43-2.55)	<0.001

often reported that side effects in the past were no reason for not being vaccinated in the future (OR 9.50, 95% CI 2.95-30.57). Most strongly associated attitudes were the ethical perspectives that all HCWs should be vaccinated (OR 24.14, 95% CI 17.12-34.03) and that HCWs should get vaccinated because of their duty not to harm (OR 17.59, 95% CI 12.49-24.78). But also the ethical perspectives that HCWs should get vaccinated to ensure continuity of care (OR 12.19, 95% CI 9.00-16.50) and that influenza vaccination should become mandatory for HCWs in nursing homes (OR 7.98, 95% CI 5.03-12.68) were associated with influenza vaccine uptake. Finally, social influences were associated with influenza vaccine uptake, with people close to the respondents such as spouse, family and friends (OR 12.60, 95% CI 7.44-21.33) having the most influence.

Organisational determinants

Organisational determinants univariately associated with influenza vaccine uptake are shown in table 4. More vaccinated respondents remembered receiving information on influenza vaccination during the study season (OR 2.03, 95% CI 1.24-3.33) but unvaccinated respondents did not think that they were insufficiently informed about influenza vaccination (OR 0.78, 95% CI 0.79-2.94).

Table 4 Univariate analysis: organisational determinants associated with influenza vaccine uptake among HCWs

Factors	Vaccinated (n=367) Number (%)	Unvaccinated (n=757) Number (%)	Odds ratio (95%CI)	p-value
Information				
Information received	346/367 (94.3)	674/757 (89.0)	2.03 (1.24-3.33)	0.004
Receiving information by letter	227/367 (61.9)	499/757 (65.9)	0.84 (0.65-1.09)	0.181
Receiving information by poster/leaflet	89/367 (24.3)	137/757 (18.1)	1.45 (1.07-1.96)	0.016
Receiving information from a nursing home physician	88/367 (24.0)	105/757 (13.9)	1.96 (1.43-2.69)	<0.001
Receiving information through an information meeting	43/367 (11.7)	37/757 (4.9)	2.58 (1.63-4.09)	<0.001
Receiving information through the media	55/367 (15.0)	92/757 (12.2)	1.27 (0.89-1.83)	0.186
Receiving information by internet	16/367 (4.4)	22/757 (2.9)	1.52 (0.79-2.94)	0.206
Received information is sufficient	278/364 (76.4)	598/742 (80.6)	0.78 (0.58-1.05)	0.104
Important to receive information by letter	330/347 (95.1)	619/729 (84.9)	3.45 (2.04-5.85)	<0.001
Important to receive information by poster or leaflet	248/324 (76.5)	392/679 (57.7)	2.39 (1.77-3.22)	<0.001
Important to receive information from nursing home physician	167/320 (52.2)	279/688 (40.6)	1.60 (1.23-2.09)	0.001
Important to receive information by information meeting	17/307 (38.1)	186/677 (27.5)	1.63 (1.22-2.16)	0.001
Important to receive information through the media	202/323 (62.5)	302/679 (44.5)	2.08 (1.59-2.73)	<0.001
Important to receive information by internet	93/306 (30.4)	123/650 (18.9)	1.87 (1.37-2.56)	<0.001
Provision				
Provision of vaccination is organised	355/367 (96.7)	713/757 (94.2)	1.83 (0.95-3.50)	0.066
Vaccination at a fixed day and time	155/367 (42.2)	295/757 (39.0)	1.15 (0.89-1.48)	0.295
Vaccination at a fixed day but flexible time	54/367 (14.7)	84/757 (11.1)	1.38 (0.96-2.00)	0.083
Vaccination at a flexible day and time	110/367 (30.0)	170/757 (22.5)	1.48 (1.12-1.96)	0.006
Provision is at an adequate number of moments	274/358 (76.5)	505/712 (70.9)	1.34 (1.00-1.79)	0.052

95% CI: 95% confidence interval

Other organisational determinants associated with influenza vaccine uptake were remembering receiving information from a nursing home physician (OR 1.96, 95% CI 1.43-2.69) and through an information meeting (OR 2.58, 95% CI 1.63-4.09). Vaccinated respondents found all routes of receiving information more important than unvaccinated respondents.
Provision of influenza vaccination was organised in some way in most nursing homes and 72.2% of all respondents found the organisation adequate. Only 'provision at a flexible day and time' was associated with influenza vaccine uptake (OR 1.45, 95% CI 1.10-1.91).

Determinants multivariately associated with influenza vaccine uptake

The multivariate analysis resulted in a 13-item final logistic regression model (table 5) with two demographical, nine behavioural and two organisational determinants that were independently associated with influenza vaccine uptake. Having a chronic illness for which influenza vaccination is indicated (OR 8.50, 95% CI 4.29-16.83) and working in health care for more than 15 years (OR 2.32, 95% CI 1.50-3.61) were the demographical determinants significantly associated with influenza vaccine uptake.

Table 5 Multivariate logistic regression analysis: determinants associated with influenza vaccine uptake among HCWs (n=980)[a]

Factors	Vaccinated (n=333) Number (%)	Unvaccinated (n=647) Number (%)	Odds ratio (95% CI)	p-value
Demographical determinants				
Chronic illness	74/333 (22.2)	24/647 (3.7)	8.50 (4.29-16.83)	<0.001
Years working in health care > 15	185/333 (55.6)	243/647 (37.6)	2.32 (1.50-3.61)	<0.001
Behavioural determinants				
High personal risk for influenza infection	136/333 (40.8)	60/647 (9.3)	2.80 (1.64-4.77)	<0.001
Vaccination reduces the personal risk of influenza illness	163/333 (48.9)	34/647 (5.3)	2.56 (1.34-4.89)	0.005
Vaccination reduces the risk to infect patients	212/333 (63.7)	70/647 (10.8)	3.29 (1.92-5.63)	<0.001
Knowing there is a guideline	106/333 (31.8)	74/647 (11.4)	1.86 (1.07-3.24)	0.028
Agreeing with the guideline	274/333 (82.3)	183/647 (28.3)	2.75 (1.68-4.50)	<0.001
Media attention for avian influenza influenced my ideas	55/333 (16.5)	40/647 (6.2)	2.24 (1.12-4.50)	0.023
All HCWs should be vaccinated	227/333 (68.2)	49/647 (7.6)	2.25 (1.26-4.02)	0.006
HCWs should get vaccinated because of their duty not to harm	200/333 (60.1)	47/647 (7.3)	4.71 (2.68-8.29)	<0.001
People close to me think it's important for me to get vaccinated	77/333 (23.1)	13/647 (2.0)	5.33 (2.18-13.06)	<0.001
Organisational determinants				
This year I received information through an information meeting	39/333 (11.7)	30/647 (4.6)	3.40 (1.59-7.30)	0.002
This year I received information from a nursing home physician	82/333 (24.6)	92/647 (14.2)	2.11 (1.21-3.69)	0.008

[a] AUC of multivariate model: 0.95
95% CI: 95% confidence interval

Associated behavioural determinants were a perceived high personal risk for influenza infection (OR 2.80, 95% CI 1.64-4.77), perceived reduction of this personal risk (OR 2.56, 95% CI 1.34-4.89) and of the risk to infect patients (OR 3.29, 95% CI 1.92-5.63). Knowing that there is a guideline of the Dutch association of nursing home physicians (OR 1.86, 95% CI 1.07-3.24) and agreement with this guideline (OR 2.75, 95% CI 1.68-4.50) were also associated with influenza vaccine uptake. Other associated behavioural determinants were the social influence of people close to the respondents (OR 5.33, 95% CI 2.18-13.06), the influence of the media attention for avian influenza (OR 2.24, 95% CI 1.12-4.50) and the ethical perspective that all HCWs should get vaccinated (OR 2.25, 95% CI 1.26-4.02) as well as that HCWs should get vaccinated because of their duty not to harm (OR 4.71, 95% CI 2.68-8.29).
Finally, organisational determinants associated with influenza vaccine uptake were receiving information through an information meeting (OR 3.21, 95% CI 1.50-6.87) and from a nursing home physician (OR 2.00, 95% CI 1.15-3.47). The area under the receiver operating characteristic curve (AUC) for only the two demographical determinants was 0.66 (95% CI 0.62-0.70), adding the nine behavioural determinants increased it to 0.94 (95% CI 0.92-0.95) and finally adding the two organisational determinants brought the AUC for the final model to 0.95 (95% CI 0.93-0.96).

Discussion

This study showed that a multivariate model consisting of a combination of two demographical, nine behavioural and two organisational determinants was highly associated with influenza vaccine uptake among HCWs in Dutch nursing homes. The strength of this study is the thorough combined assessment of demographical, behavioural and organisational determinants associated with influenza vaccine uptake among HCWs, and finally combining them into a multivariate model with high predictive capacities. On the basis of these determinants, in more than 90% of HCWs vaccine behaviour can be correctly predicted.

To appreciate the results of our study, some potential limitations need to be addressed. The response rate on the questionnaire was 60% and not all Dutch nursing homes participated in our study. We did randomly select 32 nursing homes out of the 76 that responded positively to the single invitation to participate in the study, sent to all 335 Dutch nursing homes. Despite that the 60% response rate is reasonable, certainly in comparison with previous studies,[31-33] response bias can not be completely ruled out. The primary outcome used was self-reported influenza vaccination rate and there were no records of influenza vaccination of HCWs in the participating nursing homes available for validation. However, in a Dutch study among primary care patients the agreement between the general practioners' records and self-reported absence or presence of previous influenza vaccination was high (kappa as measure of agreement 0.54).[46] But since the self-reported influenza vaccination rate among respondents in the previous year (2004) was 25% which was higher than reported in the previous study on policy (11%)[17], we might have overestimated the vaccine uptake in the current study. How this may have affected the development of a predictive

model which was our primary aim is uncertain. The sample of nursing homes in our study was reasonably similar to all Dutch nursing homes. However, when comparing responding HCWs to all HCWs working in the participating nursing homes, the response rates seemed to be a little lower among nursing assistants level 2. In general, these professionals have a somewhat lower economic status and it is well known that high response rates among these persons are challenging to obtain. Since our study was a questionnaire study among Dutch HCWs it is uncertain to what extent results are generalizable to HCWs in other countries.

Our results confirm those of other studies that have evaluated part of the relevant determinants associated with influenza vaccine uptake. Our data are in accordance with studies that found that chronic illness[19;27], more working years[34], strong worksite recommendation[21;23;35], high personal risk for influenza infection[19;21;32] and belief in vaccine effectiveness[8;19;21;32;35] are associated with influenza vaccine uptake among HCWs. In previous studies both effectiveness on reduction of the personal risk for infection and, less often, reduction of the risk to infect patients were repeatedly found to be associated with a positive attitude towards vaccination.[8;21;22;29;32;35] The use of a multivariate model in our study offered the advantage to demonstrate that both determinants are strongly associated with influenza vaccine uptake. This shows the importance of HCWs being aware of their potential contribution to influenza transmission to patients to increase influenza vaccine uptake.

In conclusion, this study shows the demographical, behavioural and organisational determinants that influence influenza vaccine uptake among HCWs in Dutch nursing homes. We plan to use these determinants to develop an influenza vaccination implementation program to increase influenza vaccine uptake among HCWs in nursing homes. The intervention mapping method will be applied and importance and changeability of the determinants will be derived from this model.[47]

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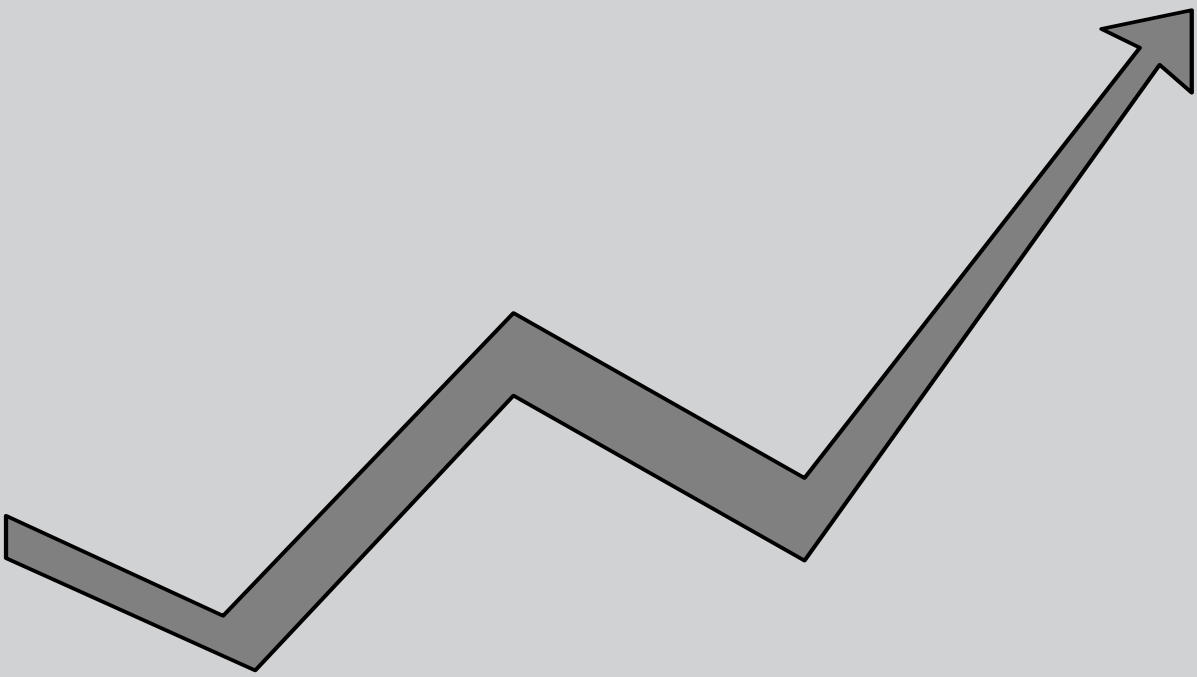
Chapter 4.3



How to Develop a Program to Increase Influenza Vaccine Uptake among Workers in Health Care Settings?

Abstract

Background

Apart from direct protection and reduced productivity loss during epidemics, the main reason to immunize health care workers (HCWs) against influenza is to provide indirect protection of frail patients through reduced transmission in health care settings. Since the vaccine uptake among HCWs remains far below the health objectives, systematic programs are needed to take full advantage of such vaccination.

Methods

We applied the intervention mapping (IM) method to develop a theory- and evidence-based intervention program to change vaccination behaviour among HCWs in nursing homes.

Results

After a comprehensive needs assessment we were able to specify proximal program objectives and select methods and strategies for inducing behavioural change. By consensus, we decided on planning of three main program components, i.e. an outreach visit to all nursing homes, plenary information meetings and the appointment of a program coordinator, preferably a physician, in each home. Finally, we planned program adoption, implementation and evaluation.

Conclusion

The IM methodology resulted in a systematic, comprehensive and transparent procedure of program development. A promising intervention program to change influenza vaccination behaviour among HCWs was developed and its impact will be assessed in a clustered randomised controlled trial.

Introduction

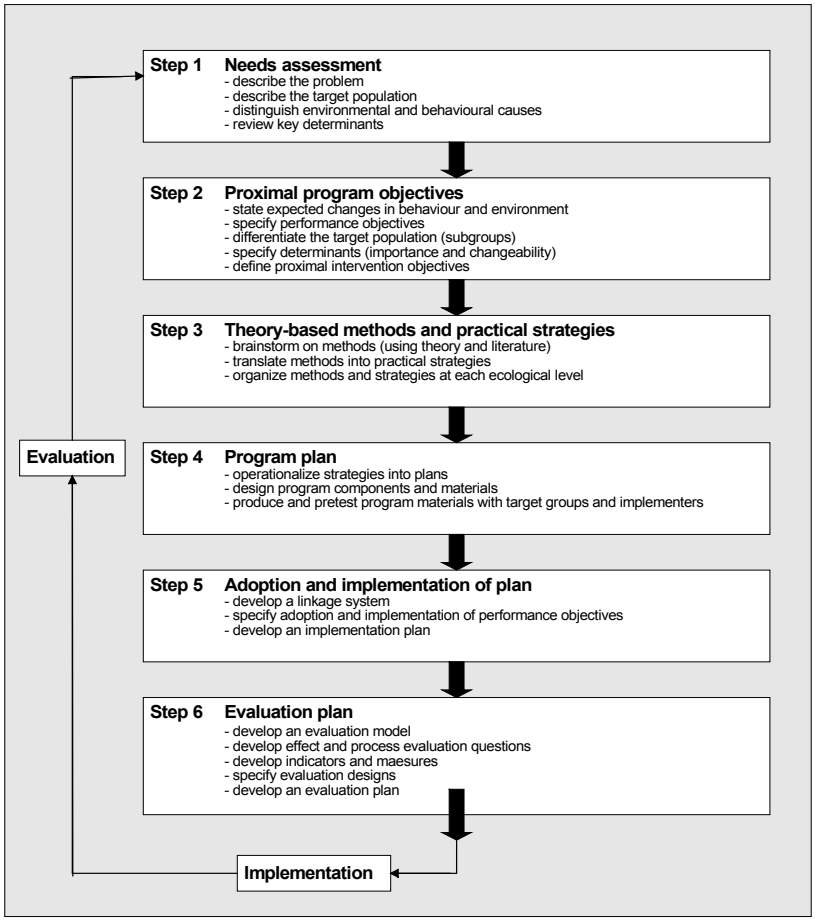
Following guidelines by the WHO, as of 2004 the Dutch association of nursing home physicians (NVVA) has been recommending influenza vaccination of Health Care Workers (HCWs).[1] In nursing homes, higher uptake of influenza vaccines is associated with reduced morbidity and mortality among their frail patient population.[2-4] Since immunisation of HCWs reduces the occurrence of influenza infections and associated productivity loss among the HCWs, it also ensures continuity of care during influenza epidemics.[5-7] A significant number of HCWs are infected with influenza each winter [8;9] and most of them continue to work despite of infection.[5;10;11] Therefore, HCWs can introduce influenza in health care settings and increase the risk of an influenza outbreak. Such an outbreak in turn can have significant consequences for patients and continuity of care in long-term care institutions such as nursing homes.[9] However, despite recommendations to immunize this specific target group against influenza, vaccine uptake among HCWs in this high-risk setting remains far below the health objectives.[12]

To be most effective, implementation programs to change behaviour should be built upon a coherent theoretical base and should target all relevant determinants of influenza vaccine uptake among HCWs.[13-16] Previous programs targeting HCWs have, to our knowledge, never been developed in such a systematic manner. Often it remains unclear why specific interventions are chosen in implementation studies reported in the literature. There are several more or less systematic methods available to develop implementation programs, including both exploratory methods (mainly based on brainstorming and consensus) and theory-based methods. One of these methods is the intervention mapping (IM) method which offers a very structured approach to develop theory- and evidence-based programs.[17-19] We used this IM method to systematically develop an intervention program to change vaccination behaviour among HCWs that could be implemented in nursing homes in The Netherlands.

Methods

The IM method is a framework developed in the field of health education and promotion to systematically design theory- and evidence-based health promotion programs.[17] It was originally developed for interventions aimed at high-risk behaviours (e.g. HIV prevention[18]), and has also been used for other types of interventions (e.g. quality improvement interventions[19]). The IM method follows several consecutive steps giving planners a systematic method for decision making in each phase of intervention development.[17] The process of intervention design can be divided into six steps: (1) a needs assessment, (2) specification of proximal program objectives, (3) selection of theory-based methods and practical strategies for inducing change, (4) planning the program, (5) planning of program adoption and implementation and (6) planning for evaluation. The steps of the IM method and their components are shown in figure 1.

Figure 1 Intervention Mapping method (adapted from Bartholomew et al.)34



Developing the program

Step 1: needs assessment

To improve influenza vaccine uptake among HCWs of nursing homes, we first identified relevant barriers to and facilitators of vaccination uptake. These determinants may be related to the individual HCW or to the social, organisational and economic context.[16] To explore all these levels, we organised three individual in-depth interviews with nursing home physicians and two focus group sessions (one with four nursing home physicians and one with three nursing assistants and two nurses). These were used to explore in a structured manner what determinants of influenza vaccination behaviour the participants experienced in daily practise. Next, to complement these determinants identified by exploratory methods with theory-based determinants, we conducted a review of the international literature on determinants of influenza vaccine uptake among HCWs.

Finally, we conducted two studies to specifically assess these determinants of vaccine uptake among HCWs in Dutch nursing homes.

Determinants of influenza vaccine uptake at management level

The first study was a questionnaire study among the management of all nursing homes in The Netherlands assessing organisational determinants at management level known from the literature to be associated with higher influenza vaccine uptake among their HCWs.[12] In October 2005, the following items were assessed: uptake of influenza vaccination among patients and HCWs in the preceding season (2004-2005 season), whether the institution had a written policy on influenza vaccination for HCWs, what the current offering policy was (active request, HCWs initiative or none) and if HCWs were currently offered information on influenza vaccination.

Determinants of influenza vaccine uptake at HCW level

The second study was a questionnaire study among HCWs of Dutch nursing homes assessing demographical, behavioural and organisational determinants associated with uptake of influenza vaccination among HCWs. This questionnaire was based on the in-depth interviews and the focus group sessions, a review of the literature [20-27], and two previously developed questionnaires by our research group.[28;29] The questionnaire contained 12 questions on demographical determinants and 39 questions on behavioural determinants. Questions on behavioural determinants were based on the "Health Belief model" [30] and the "Behavioural Intention Model".[31] These models were selected because results of the in-depth interviews and focus group sessions indicated that most participants experienced determinants on this individual level. The following five Health Belief Model domains were assessed: perceived susceptibility, perceived severity, perceived benefits, perceived barriers and cues to action. These were complemented with the two Behavioural Intention Model domains: attitude (including ethical views) and social influences. Finally, six questions assessed organisational determinants consisting of the current situation concerning organisation of information on influenza vaccination (information received or not, route of information and whether information has been sufficient or not), opinion towards various routes of receiving information and the current situation concerning the organisation of vaccine provision (if and how provision is organised and if this has been adequate). In December 2005, these determinants of influenza vaccination uptake were assessed by an anonymous, self-administered, questionnaire with a total of 59 questions.

Combined these two studies resulted in a total of 73 possible determinants of influenza vaccine uptake relevant for the development of the intervention program; 70 determinants on HCW level (12 demographical, 39 behavioural and 19 organisational determinants) and three organisational determinants on management level.

Step 2: specification of proximal program objectives

To specify our intervention objectives, we analysed the relation between all 73 possible determinants (step 0) and actual vaccine uptake. The outcomes of our first study on management level with a response rate of 45% (149 out of 335 nursing homes) showed that having a written policy, actively requesting HCWs to get vaccinated and informing HCWs about influenza vaccination were all associated with a significantly higher uptake of influenza vaccination among HCWs.[12] Mean differences (MD) of these three determinants were reported as measures of associations (table 1).

The outcomes of our second study on HCW level with data from 1,125 respondents (response rate 60%) enabled us to accurately predict influenza vaccine uptake on a HCW level based on a multivariate prediction model with 13 determinants (area under the receiver operating characteristic curve [AUC] of 0.95). This model included two demographical determinants, nine behavioural determinants and two organisational determinants in which odds ratios (OR) were reported as measures of associations (table 1).

To quantify the 'importance' of the determinants resulting from both studies we used the measures of association of the determinant with influenza vaccine uptake, i.e. the mean differences and odds ratios. We prioritised the importance of the determinants based on the strength of these associations (table 1).

Table 1 Determinants resulting from the needs assessment and their importance and changeability

		Importance[1]	Changeability[2]
Determinants of influenza uptake at management level			
1	having a written policy	4.58	+
2	actively requesting HCWs to get vaccinated	6.77	+
3	informing HCWs about influenza vaccination	8.27	+
Determinants of influenza uptake at HCW level			
Demographical			
a	presence of chronic illness	8.50	-
b	working in health care for more than 15 years	2.32	-
Behavioural			
c	perceived high personal risk	2.80	+
d	perceived reduction of personal risk	2.56	+
e	perceived reduction of risk to infect patients	3.29	+
f	awareness of the existence of a guideline	1.86	+
g	agreement with this existing guideline	2.75	+
h	social influence of people close to the HCWs	5.33	-
i	influence of media attention for avian influenza	2.24	+
j	all HCWs should get vaccinated	2.25	+
k	HCWs should get vaccinated because of their duty not to harm	4.71	+
Organisational			
l	information received through an information meeting	3.40	+
m	information received from a nursing home physician	2.11	+

[1] determinants at management level: importance defined by mean differences
determinants at HCW level: importance defined by odds ratios
[2] - :not changeable, + :changeable

Next, to specify 'changeability', we judged the changeability of the determinants based on consensus among all project group members (table 1). Since the two demographical determinants (presence of chronic illness and working in health care for more than 15 years) were positively associated with influenza vaccine uptake, but not changeable, we did not define intervention objectives for these specific determinants nor used these determinants to define specific target subgroups.

Finally, the combination of importance and changeability of determinants was used to define intervention objectives (table 2). For example, the determinant 'perceived high personal risk' was considered important (OR= 2.80) and changeable and therefore 'accomplishing awareness among HCWs of being at risk for an influenza infection and knowledge on the height of this risk' was defined as an intervention objective.

Step 3: selection of methods and strategies

For the selection of theoretical methods and strategies we used the list of known types of implementation interventions from the EPOC data collection checklist.[32] In addition, we used both the general literature on the effectiveness of these different interventions [14] and the literature on previous studies that specifically tested intervention methods to increase influenza vaccine uptake among HCWs. A systematic review from 2006 evaluating whether promotional campaigns could improve uptake of influenza vaccination in HCWs was among the used literature.[7] Reviewing all available information, the project group finally decided on methods and strategies to be used in order to reach the intervention objectives (table 2). For example, to reach the intervention objective of 'accomplishing awareness among HCWs of being at risk for an influenza infection and knowledge on the height of this risk' the project group decided in consensus to provide risk information using plenary information meetings, leaflets and a website, to show a video with role models during the information meetings and have HCWs evaluate their own behaviour in smaller groups.

Step 4: planning of the program

Next, the methods described in table 2 were operationalized into practical strategies and materials (Box 1). By consensus, the intervention program consisted of three main components. Component A included an outreach visit during which homes were to receive a step by step script of the program, all required materials and background information on influenza vaccination of HCWs. The required materials consisted of announcements, a personal invitation letter, leaflets, posters and the reference to the programs' website. Component B consisted of the plenary information meetings with a plenary presentation, discussion in smaller groups and a video with role models. These meetings were to be organized by specialised nurses guided by a protocol. And, finally, component C prescribed the appointment of preferably a physician as a local program coordinator to organize and promote influenza vaccination.

Table 2 Selected intervention objectives, methods and strategies

Determinants	Objectives	Methods and strategies
Management level		
Having a written policy	Stimulating nursing homes to develop a written policy on influenza vaccination of HCWs	Informing management on effect of a written policy (outreach visit, written information)
Actively requesting HCWs to get vaccinated	Actively requesting HCWs to get vaccinated	Executing the intervention program automatically leads to an active request
Informing HCWs about influenza vaccination	Having HCWs informed on influenza vaccination	Informing HCWs by plenary meetings, discussion in smaller groups, invitation letter, leaflets, posters, video, website
HCW level		
Presence of chronic illness	No objective set due to limited changeability	
Working in health care for more than 15 years	No objective set due to limited changeability	
Perceived high personal risk	Awareness among HCWs of being at risk for an influenza infection and knowing how high this risk is	- Provide risk information (plenary meeting, leaflets, website) - Evaluate own behaviour in smaller groups - Show a video with role-models
Perceived reduction of personal risk	HCWs being convinced that vaccination is effective in reducing the personal risk for an influenza infection	- Provide effectiveness information concerning reduction of personal risk (plenary meeting, leaflets, posters, website) - Interactive information provision by discussion in smaller groups - Show a video with role models
Perceived reduction of risk to infect patients	HCWs being convinced that vaccination is effective in reducing the risk to infect patients with influenza	- Providing effectiveness information concerning the reduction of infecting patients (leaflets, posters, website, plenary meeting) - Interactive information provision by discussion in smaller groups - Show a video with role-models
Awareness of the existence of a guideline	HCWs being aware of existence of guideline	Mention the existence of the guideline in program materials (leaflets, website, information meeting)
Agreement with this guideline	HCWs understanding reasoning of guideline	- Explain guideline (leaflets, website, plenary meetings) - Discuss the guideline in smaller groups
Social influence of people close to the HCWs	Also informing people close to the HCWs	Send a personal invitation letter for the plenary meetings to the home address of all HCWs together with an information leaflet
Influence of media attention for avian influenza	HCWs understand what avian influenza is and how it relates to annual human influenza	- Explain avian influenza on website
All HCWs should get vaccinated	HCWs understand the ethical aspects of influenza vaccination among HCWs	- Explain and discuss ethical aspects (leaflets, website) - Show a video with role-models - Discussion in smaller groups
HCWs should get vaccinated because of their duty not to harm	HCWs understand the ethical aspects of influenza vaccination among HCWs	- Explain and discuss ethical aspects (leaflets, website) - Show a video with role-models - Discussion in smaller groups
Information received through an information meeting	Conducting an information meeting	Organize an information meeting with plenary information on influenza and influenza vaccination and discussion in smaller groups
Information received from a nursing home physician	Having preferably a physician as local program coordinator	Nursing home physician signing invitation letters and shows his support during information meetings

Box 1 Components of the implementation program targeting determinants from table 1

Component
A: Outreach visit during which the homes received: ▪ a step by step script of the program ▪ all required materials: • announcement's (for the program, meetings and vaccination) [2,3,c,d,e,m] • personal invitation letter for the meetings [2,3,h,m] • information leaflets [2,3,c,d,e,f,g,h,j,k] • posters [2,3,d,e] • reference to the website: www.gepriktvooru.nl *(in Dutch)* [1,2,3,c,d,e,f,g,i,j,k,m] ▪ background information [1,f]
B: Two plenary information meetings with: ▪ plenary presentation on influenza and influenza vaccination [2,3,c,d,e,l] ▪ discussion in small groups [2,3,c,d,e,f,g,h,i,j,k,l] ▪ a video with role models [2,3,c,d,e,j,k,m] ▪ held by a specialised nurse of the local municipal health centre ▪ guided by a protocol
C: Appointment of preferably a physician as a local program coordinator: ▪ to organize and promote influenza vaccination [2,m]

[ ]: determinants integrated in program component indicated by corresponding number or letter from table 1

All required materials were developed by our study group. The information leaflets and posters were developed in collaboration with the design department of the University Medical Center Utrecht and the information leaflet was pre-tested by 3 nursing assistants. They evaluated clearness, meaningfulness and usefulness of the leaflet and were asked if any information was missing. The PowerPoint presentation for the information meetings, the leaflets, the posters, the video and the website were all designed in a uniform style according to regulations of the University Medical Center Utrecht. For development of the website we were assisted by our ICT department. The video was recorded in a nursing home in Utrecht by a professional cameraman from the design department of the University Medical Center Utrecht. In the video a nursing home physician, a nurse and a patient shared their experiences on influenza and influenza vaccination with the viewers. The announcements and the personal invitation letter for the meetings were developed with standardised texts, leaving room to change dates, locations and names according to the individual situation of nursing homes. Finally, all digital materials (announcements, invitation letter, PowerPoint presentation and video) were stored on CDROMs. All materials are available on request.

Step 5: planning of program adoption and implementation

To assure program adoption, implementation and sustainability, stakeholders were approached to give feedback on and to support the program. Representatives of the Dutch association of nursing home physicians (NVVA) and the association of nurses and nursing assistants (V&VN) were approached to judge the different elements of the program. They were asked for feedback on usefulness of the program elements and if program elements could be improved. This feedback was used to fine-tune the program elements, mainly by adjustment of language use. Support to the

program was given by the NVVA, V&VN and two other relevant associations (Sting and ActiZ) and visualised with their logo on program materials (e.g. the information leaflets). Furthermore, to support future implementation of the program -without assistance by our study group- a step by step script of the total program was developed. In addition, the plenary information meetings were held by specialised nurses of the local municipal health centre guided by a standardised protocol. In this protocol we also included a list of frequently asked questions and corresponding answers.

We planned to send all Dutch nursing homes an invitation letter to participate in the program mid 2006. Nursing homes who responded positive to this invitation would then be asked to appoint preferably a physician as local program coordinator (component C). Next, all nursing homes would be visited in September to deliver the step by step script of the program, all required materials and the background information on influenza vaccination of HCWs (component A). Following these visits, execution of all program activities would be planned for October and November prior to the actual immunization of HCWs. During this period the plenary information meetings were to be held by a specialised nurse of the local municipal health centre (component B).

Step 6: planning for evaluation

Our evaluation plan included both an effect and a process evaluation. We planned to evaluate the effectiveness of the program on influenza vaccine uptake among HCWs in Dutch nursing homes by comparing uptake in a group of at least 12 nursing homes randomly allocated to receive the intervention program with the uptake in a similar number of control homes. For this we planned to perform a cluster randomised controlled trial (see chapter 4.4). Furthermore, we decided to measure compliance with the programme components (process evaluation). For this purpose we planned to register whether nursing homes were visited, whether plenary information meetings were organised and how many HCWs visited these meetings, what the profession of the local program coordinator was and, finally, all costs related to the program. In this manner we could, on the one hand, explore whether compliance with the components of the program influenced the effectiveness of the program. This information can be used to, if necessary, adapt the program. On the other hand, we could use this information to estimate program costs.

Discussion

This paper presents the process by which a theory- and evidence-based intervention was developed to improve influenza vaccination behaviour among HCWs. The IM method was used to systematically develop this intervention.

Major strength of the developing process was the comprehensive and thorough needs assessment which clearly identified relevant determinants for influenza vaccine uptake among HCWs on both management and HCW level. Combining explorative and theory-based methods assured that determinants not anticipated beforehand were included in the needs assessment and helped

broaden the scope of this needs assessment. Based on the results of the needs assessment we were able to quantify the importance of the determinants. This provided an anchor for the specification of program objectives and the successful further development of the intervention.

The selection of methods and strategies (step 3 of the IM method) is challenging, because specific objectives can ask for a variety of different interventions and consensus is needed by the developers on the intervention with presumed highest impact.[14] As yet there is no firm guidance on what interventions should be linked to what specific objectives. To facilitate this process, we considered the "Health Belief model" [30] and the "Behavioural Intention Model"[31], and the available evidence regarding the effectiveness of interventions [14;32] combined with common sense and creativity to reach consensus.

Our systematic, comprehensive and transparent description of all the steps in the development of the program enables future users to assess and adapt the program where necessary or to replicate the steps described when developing a similar program for a different population. Applying the systematic, comprehensive and transparent IM approach guided and facilitated our development process. It may seem elaborate and time consuming, but a review of health promotion intervention studies has shown that the quality of planning is important for the success of the intervention.[33] In all, we do have reason to assume that we developed an intervention with high a priori chances of success.

In conclusion, we developed a promising intervention program to change influenza vaccination behaviour among HCWs. The effectiveness of this program will be evaluated as planned by performing the cluster randomised controlled trial including both an effect and a process evaluation.

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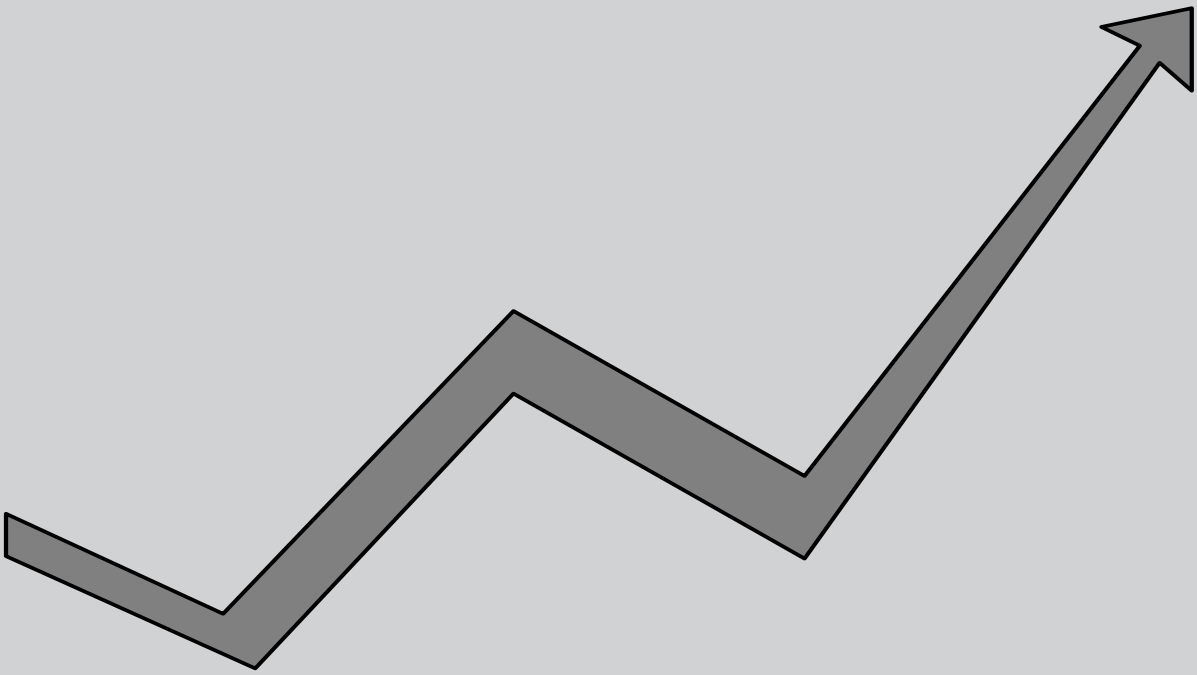
Chapter 4.4



Effects of a Multi-faceted Program to Increase Influenza Vaccine Uptake among Health Care Workers in Nursing Homes: a Cluster Randomised Controlled Trial

Abstract

Background

Immunizing health care workers (HCWs) against influenza reduces the occurrence of influenza infections and associated productivity loss among HCWs and enhances indirect protection of frail patients.

Following guidelines by the WHO, the Dutch association of nursing home physicians has been recommending influenza vaccination, but vaccine uptake among HCWs in nursing homes has remained unacceptably low.

Methods

Therefore we conducted a cluster randomised controlled trial in Dutch nursing homes in 2006. To assess the effects of a systematically developed multi-faceted intervention program on influenza vaccine uptake among HCWs in Dutch nursing homes influenza vaccine uptake in the intervention group was compared with that in the control group. We also explored whether compliance to certain elements of the program influenced the vaccine uptake and we estimated the program costs.

Results

In all 33 nursing homes with a total of 6,636 HCWs participated in the trial. The systematically developed multi-faceted intervention program was executed in 16 intervention homes and in the 17 control homes the usual programs were executed. Baseline vaccination rates were comparable (20 and 21%). In the intervention group, influenza vaccine uptake after the program was on average 9% higher than in the control group (relative risk 1.59, 95% confidence interval: 1.08 to 2.34, p=0.02). In all, 25% of all HCWs in the intervention group were vaccinated against influenza compared with 16% in the control group. There was a non-significant trend towards higher uptake when nursing homes complied with more elements of the intervention program. The estimated average program costs were €1,421 per intervention home.

Conclusions

The intervention program resulted in a significantly higher, though moderate, influenza vaccine uptake among HCWs in nursing homes and higher compliance with program elements was associated with higher vaccine uptake. Hence, to take full advantage of this preventive measure, either the program should be adjusted and implemented over a longer time period or mandatory influenza vaccination should be considered.

Trial registration

Dutch trial register NTR1617 (www.trialregister.nl).

Introduction

Immunizing health care workers (HCWs) against influenza reduces the occurrence of influenza infections and associated productivity loss among HCWs.[1-3] Even more important, it enhances indirect protection of frail patients by reducing influenza virus transmission.[4-6] Following guidelines by the WHO, in 2004 the Dutch association of nursing home physicians (NVVA) recommended influenza vaccination of this specific target group.[7] In spite of this, vaccine uptake among HCWs in nursing homes remains unacceptably low.[8] To be most effective, implementation programs to change behaviour should be built upon a coherent theoretical base and should target all relevant determinants of influenza vaccine uptake among HCWs.[9-12] To our knowledge, so far comprehensive studies on vaccination behaviour of this specific group are lacking and available studies assessing the impact of existing implementation programs were susceptible to bias because of their non-randomized design and therefore generalisability was limited.[3]

Prior to the conduct of a cluster randomised implementation trial among HCWs in Dutch nursing homes, we assessed demographical, behavioural and organizational determinants of influenza vaccine uptake and were able to develop a 13-item multivariate prediction model with 95% accuracy among this target group [for detailed information see chapter 4.2]. The implementation program was largely based on these determinants and developed according to the intervention mapping method [for detailed information see chapter 4.3].[13] Our main objective was to assess the effectiveness of this systematically developed intervention program at cluster level. We also explored whether compliance to certain elements of the program influenced the outcome and estimated the program costs in terms of time and money.[14]

Methods

Setting and study population

We performed a cluster randomised trial to assess the effects of a multi-faceted intervention program on the increase of influenza vaccine uptake among HCWs in Dutch nursing homes. In May 2006, all Dutch nursing homes (n=335) were sent an invitation letter to participate in this study. Nursing homes that did not intend to offer routine influenza vaccination to their HCWs were ineligible for the trial. By June 2006, 36 eligible nursing homes (11%) were included into the trial and were randomly allocated to an intervention and control group, each consisting of 18 homes. Allocation was balanced on 3 variables; number of beds (a measure for size), influenza vaccine uptake among HCWs in 2005 and topographical region (northern, eastern, southern or western Netherlands). All intervention homes were visited between September 28th and October 12th to prepare for the trial. We pragmatically defined HCWs as all the nursing home personnel with direct patient contact for more than one hour a week.

Multi-faceted implementation program

We developed the multi-faceted implementation program under study based on results of two studies conducted prior to the beginning of the trial. A first questionnaire study with data from 1,125 respondents (response rate 60%) assessed demographical, behavioural and organisational determinants associated with uptake of influenza vaccination among HCWs. We were able to accurately predict vaccine uptake based on a 13-item multivariate prediction model (area under the receiver operating characteristic curve 0.95). This model includes two demographical determinants, nine behavioural determinants and two organisational determinants (box 1) [for more detailed information see chapter 4.2]. The second study assessed determinants on management level and showed that having a written policy (mean HCWs vaccination rate with 12.4% versus 7.8% without), actively requesting HCWs to get vaccinated (12.1% versus 5.3%) and informing HCWs about influenza vaccination (11.9% versus 3.6%) were associated with a significantly higher uptake of influenza vaccination among HCWs (for more detailed information see chapter 4.1).[8] We then applied the intervention mapping (IM) method to systematically develop our implementation program based on these outcomes (for more detailed information see chapter 4.3). The IM method is a framework developed in the field of health education and promotion to systematically design theory and evidence-based health promotion programs.[13] It was originally developed to design interventions aimed at high-risk behaviours (e.g. HIV prevention[15]), and has been applied for the design of other types of interventions (e.g. quality improvement interventions[16]). The IM method follows several consecutive steps: problem analysis, development of intervention objectives, selection of methods and strategies for inducing change, designing and organizing the program, planning of program implementation and evaluation of its impact.

Box 1 Determinants of influenza vaccine uptake among HCWs resulting from a questionnaire study (n=1,125)

Determinants	
Demographical	
a:	presence of chronic illness
b:	working in health care for more than 15 years
Behavioural	
c:	perceived high personal risk
d:	perceived reduction of personal risk
e:	perceived reduction of risk to infect patients
f:	awareness of the existence of a guideline
g:	agreement with this existing guideline
h:	social influence of people close to the HCWs
i:	influence of media attention for avian influenza
j:	all HCWs should get vaccinated
k:	HCWs should get vaccinated because of their duty not to harm
Organisational	
l:	information received through an information meeting
m:	information received from a nursing home physician

Our multifaceted intervention program consisted of three main components; an outreach visit by the primary researcher during which the homes received a script of the program, all

required materials and background information (component A), two plenary information meetings organized by a specialised nurse of the local municipal health centre (component B) and appointment of preferably a physician as local program coordinator (component C). More information on the components is shown in box 2 (for more detailed information on the separate IM steps see chapter 4.3).

Box 2 Components of the implementation program targeting determinants from box 1

Component

A: Outreach visit during which the homes received:
- a step by step script of the program
- all required materials:
  - announcement's (for the program, meetings and vaccination) [c,d,e,m]
  - personal invitation letter for the meetings [h,m]
  - information leaflets [c,d,e,f,g,h,j,k]
  - posters [d,e]
  - reference to the website: www.gepriktvooru.nl *(in Dutch)* [c,d,e,f,g,i,j,k,m]
- background information [f]

B: Two plenary information meetings with:
- plenary presentation on influenza and influenza vaccination [c,d,e,l]
- discussion in small groups [c,d,e,f,g,h,i,j,k,l]
- a video with role models [c,d,e,j,k,m]
- held by a specialised nurse of the local municipal health centre
- guided by a protocol

C: Appointment of preferably a physician as a local program coordinator:
- to organize and promote influenza vaccination [m]

[ ]: determinants integrated in program component indicated by corresponding letter from box 1

All activities in both intervention (according to the developed program) and control groups (usual program) were undertaken in the nursing homes between October 16th and November 15th.
The actual immunization of HCWs against influenza took part during the preferred period, prior to the epidemic and immediately after the program activities had taken place.

Data collection

Baseline characteristics of participating nursing homes
All local program coordinators of the participating nursing homes filled out a form with baseline characteristics prior to the start of the study period (see also table1). The following nursing home characteristics were recorded: total number of HCWs and patients, influenza vaccination rate of patients in 2005, if the nursing home experienced an influenza outbreak in the last two years, presence of a written policy on influenza vaccination of HCWs, offering policy concerning influenza vaccination of HCWs in the previous season (active request or HCWs' initiative) and way of informing HCWs in the previous season (personal written, group written and/or group oral). HCWs characteristics that were recorded included mean age, number and proportion of females and influenza vaccination rate of HCWs in 2005.

Influenza vaccine uptake

The primary effect parameter of this study was the proportion of HCWs that were vaccinated against influenza after the implementation or usual program in the intervention group compared with the control group. Vaccine uptake among all HCWs was registered on an individual level throughout the vaccination period (till December 20th) in both groups. Actual vaccination was measured by individual registration on site. The vaccinating professional recorded age, profession and sex of each vaccinated HCW on a registration card directly after vaccinating the HCW.

Compliance with elements of the implementation program

To measure compliance with elements of the implementation program, we registered whether nursing homes were visited by the primary researcher and received all materials during these outreach visits, and whether plenary information meetings were organised and how many HCWs visited these meetings. We also registered the profession of the local program coordinators responsible for organisation and promotion of influenza vaccination. In the intervention homes, the program coordinators were asked, in a questionnaire, what elements of the program were executed and how much time was invested in the program.

Cost of the implementation program

Finally we registered all costs of the intervention program elements. The costs included costs for development and production of program materials (step by step scripts, leaflets, posters, videos, information meeting protocols, CD-ROMs), costs of sending invitations to the home address of HCWs (e.g. stamps) and travelling expenses for the outreach visits. Time invested by specialised nurses of the local municipal health centres on preparing, executing and travelling to the information meetings was registered and multiplied by their hourly rate of €64.5. Time invested by the local program coordinators has been registered and multiplied by an average hourly rate of €50.

Sample size and randomisation

Sample size calculations for cluster randomised trials[17] were applied to data from a previous study and from Statistics Netherlands.[8;18] With at least 12 participating homes in each arm, we would be able to detect a minimum increase of vaccination rates among HCWs from 10.5% (average vaccination rate among HCWs in Dutch nursing homes in 2004)[8] to 25% or more (based on vaccination rates found among HCWs in Europe in a previous study).[19] With an intracluster variance of 1.1% (as found in a previous study by our study group)[8], an average of 232 HCWs per nursing home[18] (intracluster correlation coefficient [ICC] 0.107) we would have 90% power at the 5% significance level.

We were able to recruit 18 houses in each arm which guarded against loss of power due to drop out of the study. A researcher blinded to the identity of the homes carried out randomisation into two groups of 18 nursing homes each.

Statistical analysis

Data were analyzed using SPSS for Windows (version 15.0). We analysed outcomes at a cluster level rather than an individual level. To take account of the clustered design we used Generalised Estimation Equation analysis with nursing homes as the clustering variable to analyse data on influenza vaccine uptake. We calculated the adjusted relative risk (RR), 95% confidence interval (95% CI) and level of statistical significance for influenza vaccination of all HCWs, and for physicians, nurses and nursing assistants, separately. At nursing home level we counted compliance with the intervention components A, B and C (box 1). For each group of nursing homes with similar compliance we calculated the mean HCWs vaccination rates before the intervention (2005) and after the intervention (2006) and the standard deviation of these means (SD). Vaccination rates across these compliance groups were compared using the One-way ANOVA test and reported by level of statistical significance.

Results

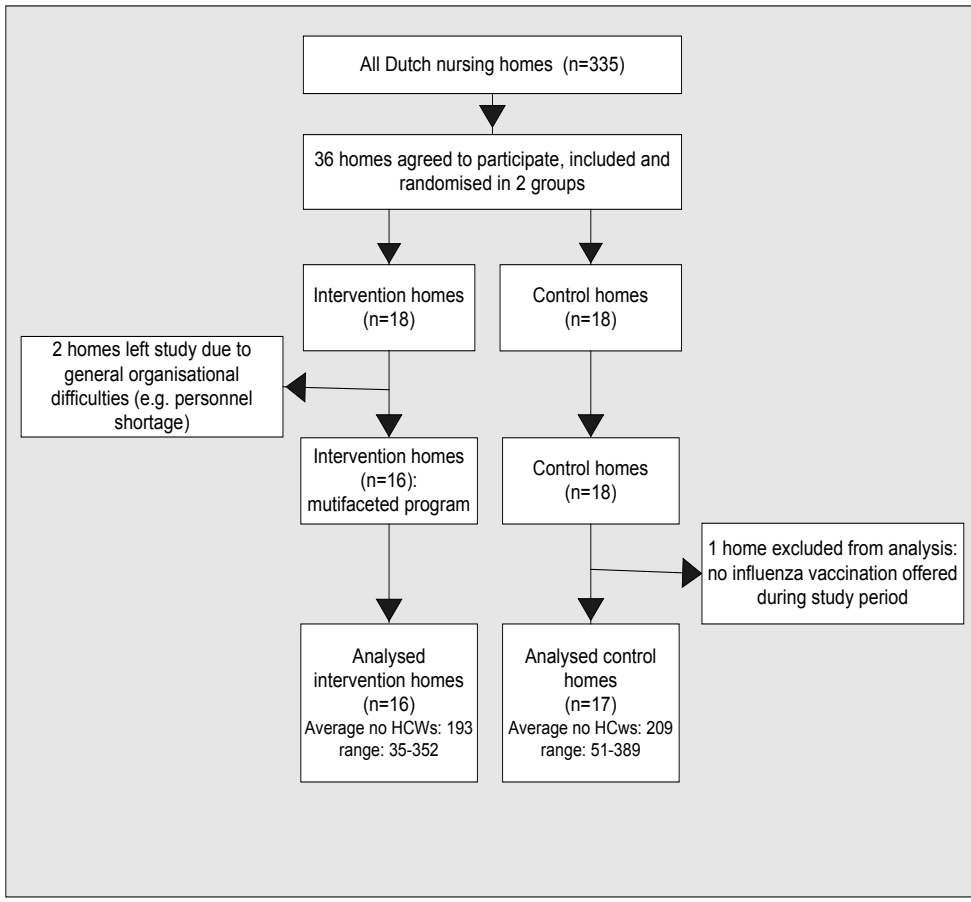
Baseline Characteristics of participating homes

After randomization, but prior to the start of the program, two homes in the intervention group left the study due to general organisational difficulties (e.g. personnel shortage) that made execution of the implementation program impossible. In the control group one nursing home was excluded before analysing the data because HCWs had not been offered influenza vaccination during the study period which was an eligibility criterion. In all, the implementation program was conducted in 16 nursing homes and a total of 17 nursing homes participated in the control group with a total of 6,636 HCWs (figure 1). Baseline characteristics of the intervention and control group were comparable (table 1) with baseline influenza vaccination rates in the previous year (2005) of respectively 20 and 21%.

Table 1 Baseline characteristics of participating nursing homes (n=33)

	Intervention (n=16)	Control (n=17)
Nursing home factors		
Mean No (SD) HCWs	192.9 (95.0)	208.8 (86.4)
Mean No (SD)patients	151.1 (58.7)	187.1 (78.6)
Mean % (SD) patients vaccinated in 2005	88.8 (11.6)	88.6 (11.2)
No (%) homes that experienced an influenza outbreak in the last 2 years	5 (31.3)	10 (58.8)
Written policy present [No (%)]	5 (31.3)	10 (58.8)
HCWs factors		
Mean age of HCWs [years (SD)]	40.1 (2.6)	40.7 (4.7)
Mean % (SD) of HCWs female	91.3 (4.0)	90.7 (9.1)
Mean % (SD) HCWs vaccinated in 2005	20.3 (16.1)	21.0 (12.4)

Figure 1 Participant flow diagram



Influenza vaccine uptake

In the intervention group, influenza vaccine uptake during the study period was on average 9% higher than in the control group (RR 1.59, 95% CI: 1.08 to 2.34, p=0.02). In all, 25% of all HCWs in the intervention group were vaccinated against influenza compared to 16% in the control group (table 2). In the intervention homes the vaccination rate of HCWs per nursing home ranged from 6 to 81% and in the control homes from 0.4 to 36% (table 3). Among the intervention homes there were three homes with a vaccination rate between 48 and 81%. Vaccination rates were on average higher among physicians and nurses than nursing assistants and effectiveness of the program was comparable among these different professions (table 2).

Table 2 Vaccination status of HCWs

	Intervention	Control	Adjusted RR	95% CI	*p* value
No of homes	16	17			
No of HCWs	3,086	3,550			
No (%) all HCWs vaccinated	774/3,085 (25.1)	582/3,550 (16.4)	1.59	1.08-2.34	0.02
No (%) physicians vaccinated	43/70 (61.4)	37/75 (49.3)	1.23	0.88-1.72	0.22
No (%) nurses vaccinated	94/179 (52.5)	79/287 (27.5)	1.41	0.93-2.17	0.11
No (%) nursing assistants vaccinated	429/2,095 (20.5)	296/2,138 (13.8)	1.45	0.87-2.38	0.16

RR: relative risk
95% CI: 95% confidence interval

Table 3 Vaccine uptake at nursing home level (n=33)

Homes	Mean % HCWs vac before	Mean % HCWs vac after	Δ of vac % (after-before)
Intervention group			
1	31.0	19.4	-11.6
2	10.0	24.7	+14.7
3	33.0	27.0	-6.0
4	6.0	21.6	+15.6
5	13.0	16.9	+3.9
6	16.0	15.9	-0.1
7	20.0	48.0	+28.0
8	22.0	28.9	+6.9
9	15.3	19.6	+4.3
10	14.0	16.8	+2.8
11	70.0	80.6	+10.6
12	33.0	55.6	+22.6
13	10.0	5.7	-4.3
14	4.0	18.5	+14.5
15	7.0	12.2	+5.2
16	20.2	28.4	+8.2
Total	20.3	27.5	+7.2
Control group			
1	50.0	23.2	-26.8
2	16.2	9.4	-6.8
3	10.0	13.7	+3.7
4	14.0	9.5	-4.5
5	17.2	20.2	+3.0
6	17.0	22.3	+5.3
7	20.0	13.6	-6.4
8	1.9	0.4	-1.5
9	25.0	14.0	-11.0
10	30.0	35.8	+5.8
11	22.0	24.3	+2.3
12	8.0	5.9	-2.1
13	27.4	22.6	-4.8
14	35.0	22.5	-12.5
15	10.0	21.7	+11.7
16	11.0	14.4	+3.4
17	35.0	21.8	-13.2
Total	20.6	17.4	-3.2

Compliance with elements of the implementation program

All intervention homes were visited and received the needed materials for the program (component A). All homes organised plenary information meetings, however, attendance of HCWs was low and only 7% of HCWs (range 1 to 31%) visited one of the meetings (component B). Local program coordinators had a variety of professions; in six out of 16 homes it was a physician (as we recommended), in five a manager, in three a coordinator of occupational health and in one home a medical secretary (component C). At nursing home level we found a variation in compliance with the intervention (table 4). Three homes were visited and received the information package, so in these homes intervention component A was exclusively performed (group 1). In six homes on top of this outreach visit and package, more than 5% of HCWs visited one of the information meetings (components A and B performed: group 2). Six other homes were visited, received the package and appointed a physician to organize and promote influenza vaccination (component A and C performed: group 3). Only one home was visited, received the package, had more than 5% of HCWs visiting the information meetings and appointed a physician to organize and promote influenza vaccination (component A, B and C performed: group 4). Comparing vaccination rates after the intervention across these groups we found that there was a non-significant trend towards higher uptake when nursing homes complied to more elements of the intervention (p=0.08), ranging from 17% in the control group to 33% in group 3 and 48% in group 4 (table 4).

Table 4 Nursing home compliance with the implementation program

Group	0	1	2	3	4
Number of nursing homes	17	3	6	6	1
Mean HCWs vaccination rate 2006 [%(SD)]					
After the intervention (2006)	17.4 (8.4)	17.8 (4.9)	23.4 (17.1)	33.0 (23.8)	48.0
Before the intervention (2005)	20.6 (12.1)	9.4 (5.1)	17.8 (12.3)	28.2 (21.6)	20.0

Group 0: control homes
Group 1: Outreach visit (A) exclusively preformed
Group 2: Outreach visit (A) and over 5% of HCWs visited information meetings (B)
Group 3: Outreach visit (A) and physician as local program coordinator (C)
Group 4: Outreach visit (A), over 5% of HCWs visited information meetings (B) and physician as local program coordinator (C)

Cost of the implementation program

Overall costs for program materials in the intervention group consisted of development costs for the posters and leaflets (€420) and the video (€1,500), step by step scripts for the entire program and protocols for the information meetings (€630), CD-ROMs (€47) and printing of a total of 270 posters (€180) and 8100 leaflets (€775). Performance costs were sending costs (€2,716) and travel expenses (€450). Specialised nurses invested a total of 143 hours in the meetings leading to a cost of €9,224 (hourly rate of €64.5). Local program coordinators invested an average of 8.5 hours inthe

program leading to a total of 136 hours and a cost of €6,800 (average hourly rate €50). In total, €22,742 was needed for all 16 intervention homes which was on average €1,421 per intervention home.

Discussion

We showed that our multi-faceted intervention program resulted in an average 25% uptake of influenza vaccines among HCWs in the participating nursing homes and a significant 9% higher uptake compared with nursing homes that offered vaccines to HCWs as usual. Vaccine uptake at nursing home level did show a large variation in effects between individual homes. Part of this variation in effect may be explained by the nursing home compliance with the different elements of the program. Major strengths of this study were the structured method used to develop the implementation program, the applied randomized design, adequate sample size and the highly reliable measurement of influenza vaccine uptake among HCWs in all nursing homes.

To fully appreciate the results of our trial, some potential limitations need to be addressed. First, a limited number of two intervention homes left the study prior to the program and one control home was excluded before analysing the data. The remaining 16 intervention and 17 control homes did however have similar vaccination rates of HCWs in the previous year (2005) and baseline characteristics were comparable. Second, both intervention and control homes had higher baseline vaccination rates among HCWs than the expected 10%, this might be because nursing homes that did not offer vaccination to their HCWs were ineligible for inclusion. Another explanation could be that the 36 homes included in the study (11% of all Dutch nursing homes) were already more active at baseline as this were homes that responded positively a few weeks after a single invitation to participate in the study. Benefits of the intervention program might be higher if the program is implemented in homes less active at baseline.

Although our intervention resulted in a significantly higher influenza vaccine uptake among health care workers in the nursing homes, and the effect might have been underestimated due to the at baseline somewhat more active participating homes, much higher vaccination rates than 25% are needed to fully benefit from this preventive measure. In a few studies from the US influenza vaccination rates of 66% to 75% were reached.{Kuntz, 2008 151 /id;Shah, 2008 161 /id;Nace, 2007 162 /id} However, all these studies were single centre studies (hospital or long term care facility) and all started with levels above 40% prior to the intervention campaigns. They used mobile vaccination carts, pandemic preparedness drills and refusal consent to further increase the vaccination rates among HCWs. In European studies, however, the highest reached overall vaccine uptake among HCWs has been reported to be between 30 and 50%.[4;6;23-25] The only two cluster randomised trials were designed to study the effects of vaccination of HCWs on mortality and morbidity among residents of UK care homes.[4;6] In those trials the uptake of vaccination among HCWs was not the main outcome and therefore statistical analysis on this part of the data was not

preformed. The implementation programs were not described in great detail, but both appeared to have used a personal approach. The remaining more successful European studies were all before-after studies, all studied vaccination rates in a single hospital and all used information meetings and on site vaccination.[23-25]

The question remains when influenza vaccine rates among HCWs can be considered high enough. A recent mathematical modelling study indicated that a threshold for herd immunity does not exist.[5] Therefore, vaccination of additional HCWs protects an additional fraction of patients. So the average influenza vaccination rate in HCWs of 25% resulting from our program is of some value but should be improved further to take full advantage of this measure. There may be a few options to accomplish this. First, in three homes an influenza vaccine uptake was reached of 48% or higher, and these homes had already been promoting influenza vaccination among their HCWs for several years. Second, the trend towards higher uptake with increasing compliance of program elements most likely indicates that optimal implementation with full compliance can lead to a higher vaccine uptake. To reach such an optimal compliance, the visiting rates of the meetings should be higher which might be achieved by integrating them within an existing meeting (e.g. ward meeting). Another aspect needed for an optimal use of the intervention was the support of physicians for the organisation and promotion of the intervention and thereby achieving a more top-down approach. Considering the results of previous European studies it can, however, be debated whether voluntary influenza vaccination will be sufficient. It might be that implementing mandatory influenza vaccination would be a more effective means to achieve higher uptake among HCWs.[26-28] Mandatory vaccination, not to be confused with forced vaccination, implies a conditional program in which HCWs must consent to vaccination when they want to (continue to) work in the nursing home. It will undoubtedly have positive effects on the vaccine uptake.

In conclusion, our results are compatible with two main options for nursing homes to further benefit from influenza vaccination programs among HCWs. One option is to further adjust and implement the developed intervention program focussing on compliance with specific program elements over a longer time period, as there are indications that the effect of an intervention program increases over time. The other option is to implement mandatory vaccination. Given the general resistance to mandatory vaccination in many European countries, more evidence concerning the effects of mandatory vaccination on uptake and acceptance among management of the nursing homes and their HCWs is now warranted.

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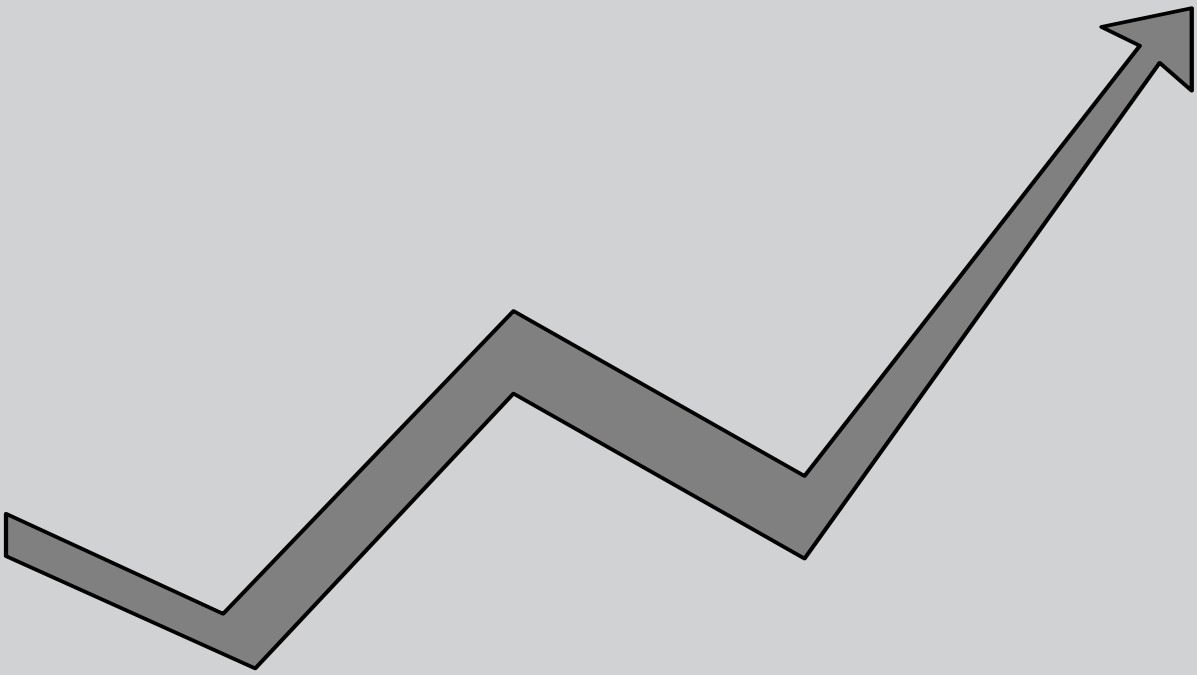
Chapter 4.5



Appreciation of Mandatory Influenza Vaccination of Health Care Workers in Nursing Homes: a Questionnaire Study from The Netherlands

Abstract

Background

Immunizing health care workers (HCWs) against influenza reduces the occurrence of influenza infections and associated productivity loss among HCWs and enhances indirect protection of frail patients, but vaccine uptake among HCWs in nursing homes has remained unacceptably low. Therefore debate has been started on the ethics of implementing mandatory influenza vaccination.

Methods

To quantify the appreciation among management of nursing homes of the ethical arguments used in favour of implementation of mandatory influenza vaccination of HCWs we conducted an anonymous questionnaire study among the management of all Dutch nursing homes in 2008. We assessed uptake of influenza vaccination among patients and HCWs, organizational aspects of influenza vaccination of HCWs and agreement of respondents with arguments in favour of implementation of mandatory influenza vaccination among HCWs.

Results

Of all 310 distributed questionnaires 185 were returned (response rate 60%). The average vaccination rate among HCWs was 19% and among patients 92%. In all, 126 (68%) homes had a written policy, 161 (87%) homes actively requested their HCWs to be immunized and 161 (87%) homes offered information to HCWs in any way. Despite the fact that the majority of nursing home management (>69%) agreed with all relevant arguments in favour of implementation of mandatory influenza vaccination, only a minority (24%) agreed that mandatory vaccination should be implemented if voluntary vaccination fails to reach sufficient vaccine uptake

Conclusions

Apparently nursing home management is not yet ready to implement mandatory influenza vaccination of HCWs, therefore, it is critical to continue the ethical debate concerning this issue.

Introduction

Studies have demonstrated that influenza vaccination of health care workers (HCWs) reduces mortality and morbidity among nursing home patients.[1-3] In addition, it reduces the medical and non-health care costs related to influenza outbreaks and influenza-associated absenteeism of HCWs.[4;5] The Dutch association of nursing home physicians (NVVA) published a guideline in 2004 in which it recommended to immunize all HCWs in nursing homes against influenza followed by the Health Council of The Netherlands in 2007.[6,7] Despite these official recommendations and the efforts of institutions to increase uptake, the vaccine uptake among HCWs remains low, less than 25% in Europe.[8]

Because of these disappointing vaccination rates debate has been started on the ethics of implementing mandatory influenza vaccination. Different arguments have been used in favour of this measure. One of these is the professional responsibility of HCWs which justifies some infringement of personal autonomy. Another argument is the duty of HCWs not to frustrate the collective efforts of the institution at which they work.[9-11]

We conducted a questionnaire study following a previous study performed by our group[12] to assess if organizational improvements were made by nursing homes to increase influenza vaccine uptake among HCWs. In addition we quantified to which extent the management of Dutch nursing homes agrees with the arguments used to justify the implementation of mandatory influenza vaccination for HCWs.

Methods

Participants and methods

In October 2005 we sent a questionnaire to the management of all Dutch nursing homes (n=335).[12] The following items were assessed: uptake of influenza vaccination among patients and HCWs in the preceding season (2004-2005 season), whether the institution had a written policy on influenza vaccination for HCWs, what the current offering policy was (active request, HCWs initiative or none) and if HCWs were currently offered information on influenza vaccination. In October and November 2008 we asked similar questions supplemented with items concerning arguments used in the literature for implementation of mandatory influenza vaccination among HCWs.[9] This self-administered, 11-item anonymous questionnaire was sent to the management of all Dutch nursing homes (n=310). After 2 and 4 weeks, reminders were sent.

Items concerning implementation of mandatory influenza vaccination were: influenza vaccination of HCWs is effective in reducing mortality and morbidity of patients, influenza vaccination of HCWs is effective in reducing the costs related to influenza, HCWs have a special responsibility

in preventing influenza transmission to patients, management has a moral responsibility to implement voluntary influenza vaccination of HCWs and mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination fails to reach a sufficient vaccination rate (table 1). Respondents were asked to state to which extent they agreed or disagreed with these propositions on a five-point Likert scale ranging from 'strongly agree' to 'strongly disagree'. Finally we asked respondents if they had any supplementary comments. For the English translation of the questionnaire see appendix D.

Statistical analysis

Data were analysed using SPSS for windows (Version 14.0). The question on the current offering policy was dichotomized in the following way: active request versus HCWs initiative or none. The question on information offered to HCWs was dichotomized in any form of information versus no information offered. Questions on the five-point Likert scale were dichotomized in agree (number 1 and 2 of the scale) versus uncertain and disagree (numbers 3 to 5 of the scale). Descriptive statistics such as inter-quartile range were used to relate the vaccination rate among HCWs with other variables. To determine which factors are associated with influenza vaccination rate, univariate associations were assessed. Mean differences and their 95% confidence intervals (95% CI) were reported as measures of associations.

Results

Study population

Of all 310 distributed questionnaires, 185 were returned (response rate of 60%). The average vaccination rate among HCWs was 19% (95% CI 16-21, range 0-80%, median value 15%, 25% value 10%, 75% value 25%) and 92% among patients (95% CI 90-93).

Organizational factors

In all, 126 (68%) homes had a written policy, 161 (87%) homes actively requested their HCWs to be immunized and 161 (87%) homes offered information to HCWs in any way. Actively requesting HCWs to be immunized and informing HCWs about influenza vaccination were associated with significantly higher mean vaccination rates among HCWs (table 2). Nursing homes with HCWs vaccination rates in the first quartile had lower percentages of having a written policy than those in the second to fourth quartile (percentages were 59%/75%/76%/72% for the quartiles I/II/III/IV). These nursing homes also had the lowest percentages of actively requesting HCWs to be immunized (75%/97%/96%/92%) and offering information to HCWs in any way (75%/97%/96%/92%).

Ethical factors

The majority (>69%) of nursing homes agreed with the first four ethical statements as described before (table 1). However, only 24% of nursing homes agreed with the fact that mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination programs fail to reach a

Table 1 Agreement of nursing home management with ethical statements concerning influenza vaccination of HCWs (n=185)

Statement	N	%
Influenza vaccination of HCWs is effective in reducing mortality and morbidity of patients	153	82.7
Influenza vaccination of HCWs is effective in reducing the costs related to influenza	128	69.2
HCWs have a special responsibility in preventing influenza transmission to patients	160	86.5
The management has a moral responsibility to implement voluntary influenza vaccination of HCWs	154	83.2
Mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination fails to reach a sufficient vaccination rate	45	24.3

N: number of homes
%: Percentage of nursing homes which agreed/ agreed totally

Table 2 Effects of policy and ethical determinants on mean influenza vaccination rates among HCWs (n=185)

	Yes		No		
Factors	N	% HCWs vac	N	% HCWs vac	MD (95% CI)
Having a written policy	126	19.5	56	16.5	2.9 (-2.0 to 7.9)
Actively requesting HCWs to be immunized	161	19.7	23	12.3	7.4 (0.3-14.4)
Offering information to HCWs in any way	161	19.9	23	10.7	9.2 (2.2-16.2)
Agreement with the fact that influenza vaccination of HCWs is effective in reducing mortality and morbidity of patients	153	19.3	32	16.4	2.8 (-3.3 to 9.0)
Agreement with the fact that influenza vaccination of HCWs is effective in reducing the costs related to influenza	128	20.6	57	14.7	5.9 (1.0-10.8)
Agreement with the fact that HCWs have a special responsibility in preventing influenza transmission to patients	160	20.3	25	8.2	12.1 (8.1-16.1)
Agreement with the fact that the management has a moral responsibility to implement voluntary influenza vaccination of HCWs	154	20.0	29	11.4	8.6 (2.2-15.1)
Agreement with the fact that mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination fails to reach a sufficient vaccination rate	45	22.3	133	17.5	4.8 (-0.6 to 10.1)

N: number of nursing homes
% HCWs vac: mean percentage of HCWs vaccinated
MD (95% CI): Mean difference of 95% confidence interval

sufficient vaccination rate. Nursing homes of which the management agreed with the following ethical statements had a significantly higher mean vaccination rate among HCWs; Influenza vaccination is effective in reducing the costs related to influenza, HCWs have a special responsibility in preventing influenza transmission to patients and the management has a moral responsibility to implement voluntary influenza vaccination of HCWs (table 2). In addition, we encountered some

comments against the implementation of mandatory vaccination. The arguments used were the infringement of autonomy of HCWs and religious backgrounds.
There were also comments of respondents who terminated voluntary influenza vaccination of HCWs because it did not result in a relevant increase of vaccine uptake. One of the respondents stated that programmes to stimulate vaccine uptake among HCWs are a waste of time.

Discussion

This study showed that influenza vaccination rates among HCWs only slightly increased despite organizational improvements and increasing awareness of institutions on influenza vaccination. It also showed that most nursing homes agreed with all arguments in favour of implementation of mandatory influenza vaccination. However, most nursing homes were against mandatory vaccination if voluntary programmes fail to reach a sufficient vaccination rate.

This is the first study that quantified to what extent the managements of nursing homes agreed with the ethical arguments in favour of implementation of mandatory influenza vaccination. The response rate of 60% was reasonable and comparable to that in previous studies. It was however, an anonymous questionnaire study and we could not compare responders to all Dutch nursing homes. Therefore response bias cannot be ruled out and an overestimation of the vaccination rate among HCWs as well as an underestimation of the organizational improvements and agreement with the ethical arguments in our study is possible.[13-15] We did however find similar vaccination rates among patients compared to rates found in previous studies.[12;16] The uptake of influenza vaccination among HCWs was higher compared to our previous study performed in 2005 (19% vs. 10%). Furthermore a higher percentage was observed in having a written policy (68% vs. 45%), in actively requesting HCWs to be immunized (87% vs. 72%) and in informing HCWs in any way (87% vs. 74%).[12] These organizational improvements most likely contributed to the slight increase in influenza vaccine uptake among HCWs. Actively requesting HCWs to be immunized and informing HCWs about influenza vaccination were also associated with significantly higher mean vaccination rates among HCWs (table 2). Comparable associations were found in our previous study.[12] We also found that the nursing homes in the second through fourth quartile of HCWs vaccination rates had steady high percentages in actively requesting HCWs to be immunized and in offering information to HCWs in any way. Above this threshold standard measures seem to be ineffective in further increasing the vaccination rate of HCWs.

The question remains when influenza vaccine rates among HCWs can be considered high enough. A previously performed mathematical modelling study indicated that a threshold for herd immunity does not exist.[17] Therefore vaccination of additional HCWs protects an additional fraction of patients (number needed to vaccinate to prevent one infection being seven). So the influenza vaccination rate of HCWs and the increase of it found in our study are of some value

but should be improved further. Most studies that evaluated the effectiveness of promotional campaigns among HCWs were of limited quality and results varied.[4] If future studies prove that voluntary programmes are ineffective in increasing the influenza vaccination rate among HCWs, implementation of mandatory influenza vaccination might be an option.[9] But a great majority of our respondents did not agree with the fact that mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination fails to reach a sufficient vaccination rate (table 1).

In conclusion the management of nursing homes supported the ethical arguments in favour of implementing mandatory vaccination but they did not support implementing this measure. It might be that they find the arguments against implementation of mandatory vaccination, such as the autonomy of HCWs, more important than all ethical arguments in favour of implementing mandatory vaccination. We, however, think there are good reasons to justify an infringement of the freedom of HCWs.[9] It is therefore critical to continue the ethical debate concerning implementation of this measure.

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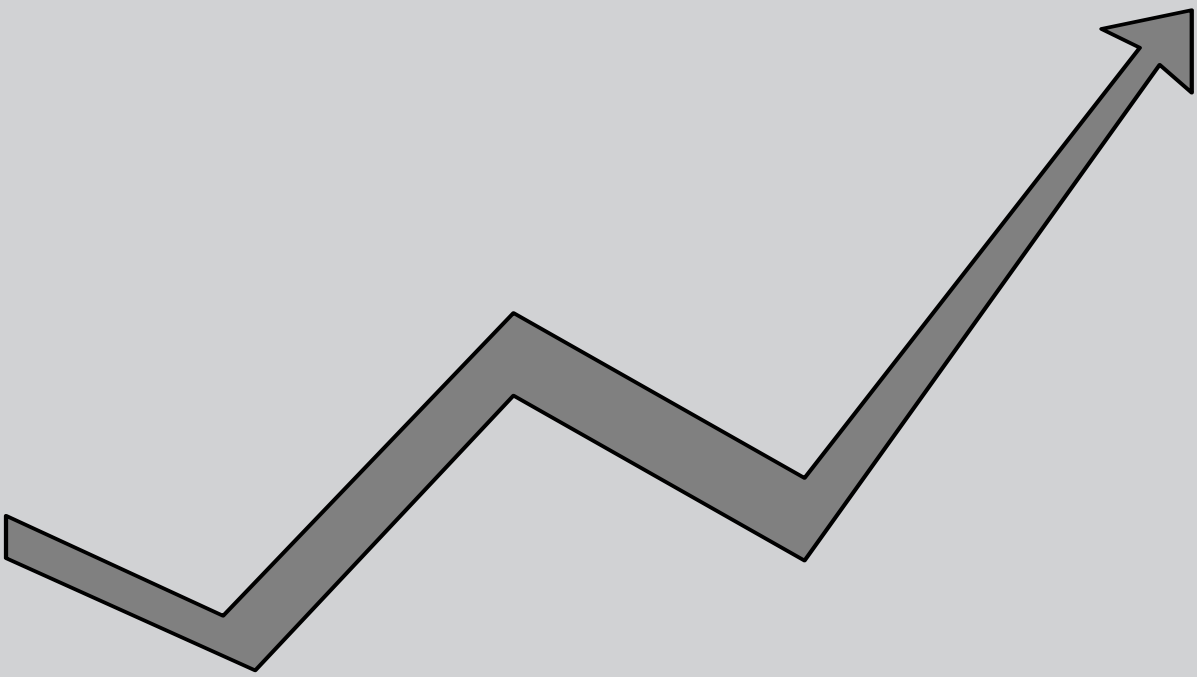
Chapter 5



General Discussion

General discussion

In this thesis we presented several studies that focused on different aspects of increasing influenza vaccine uptake in various target groups. In **chapter 2** we showed that influenza vaccine is effective in patients with diabetes. In **chapter 3** we showed that there are no substantial differences in determinants associated with non-compliance with influenza and pneumococcal vaccination programs between smokers and non-smokers. In **chapter 4** we focused on health care workers (HCWs) in nursing homes. First, in **chapter 4.1** we showed that introduction of the guideline on influenza vaccination in nursing homes by the Dutch association of nursing home physicians (NVVA) resulted in organisational improvements concerning influenza vaccination of HCWs in Dutch nursing homes. However, despite organisational improvements, the uptake of influenza vaccination among HCWs in Dutch nursing homes did not improve substantially. To further increase influenza vaccine uptake among HCWs more understanding of determinants associated with uptake on HCW level was needed. In **chapter 4.2** we showed that a multivariable model consisting of a combination of two demographical, nine behavioural and two organisational determinants is highly associated with influenza vaccine uptake among HCWs in Dutch nursing homes. In **chapter 4.3** we applied the Intervention Mapping method to use the determinants on HCW level described in chapter 4.2 together with the determinants on management level described in chapter 4.1 to develop a theory- and evidence-based intervention program in order to change vaccination behaviour among HCWs in nursing homes. In **chapter 4.4** we showed that this program resulted in a significantly higher, though still moderate, influenza vaccine uptake among HCWs in nursing homes and that higher compliance with program elements was associated with higher vaccine uptake. At an international level, disappointingly low vaccination rates among HCWs have resulted in a debate on the ethics of implementing mandatory influenza vaccination. In **chapter 4.5** we showed that influenza vaccination rates among HCWs in Dutch nursing homes only slightly increased despite further organizational improvements and increasing awareness of institutions on influenza vaccination. We also showed that most nursing homes agreed with all arguments in favour of mandatory influenza vaccination. However, most nursing homes were still against implementation of mandatory vaccination if voluntary programmes would fail to reach a sufficient vaccination rate.

Next steps to further increase influenza vaccine uptake

Patients with diabetes

We showed that the incidence rate of hospitalizations among patients with diabetes of 18 to 64 years of age was two times higher in unvaccinated individuals (25 per 1,000) than in vaccinated individuals (12 per 1,000). Most of these hospitalizations were due to diabetes dysregulation (59 of 61 outcomes). Among the elderly incidence rates of hospitalization did not substantially differ between vaccinated and unvaccinated individuals. However, incidence rates of mortality did

substantially differ between elderly unvaccinated (19 per 1,000) and elderly vaccinated individuals (8 per 1,000). Since we showed that influenza vaccination is effective in patients with type 2 diabetes regardless of age efforts should be renewed to further increase influenza vaccine uptake among this high-risk group. Especially in those 65 years and younger since vaccination rates are lower in this age group than in those over 65 years of age.

Healthy smokers

Our study showed that in smokers and non-smokers similar determinants are associated with non- compliance with influenza and pneumococcal vaccination. In addition, we showed that if smokers are considered a high-risk group and therefore targeted for vaccination some important issues need to be taken into account in vaccination programs. The necessity to inform healthy smokers was shown by the smokers' beliefs that pneumonia is not dangerous, that influenza and pneumococcal vaccines are not effective, and that they are not susceptible to disease. This study also showed that special attention should be addressed to smokers with high levels of education and that general practitioners should clearly recommend vaccination to smokers.

Health care workers in nursing homes

In 2008, four years after the development of the NVVA guideline, the average influenza vaccine uptake among HCWs in Dutch nursing homes was still only 19 percent. Considering that our comprehensive intervention program resulted in a moderate 9 percent higher uptake, there is an obvious need to further increase influenza vaccine uptake among HCWs. There have been a few single-centre studies from the US that reached influenza vaccination rates of between 66 and 75 percent.[1-3] In these studies vaccination levels were already above 40 percent prior to studying the intervention campaigns. This indicates that in these study settings management had already been active in increasing influenza vaccine uptake among HCWs in the past. Therefore, a longer exposure to intervention programs is possibly needed to reach satisfactory influenza vaccination levels among HCWs. This is supported by findings from a subgroup in our trial on the effectiveness of the developed intervention program. The three homes with the largest effect were homes that had already been promoting influenza vaccination among their HCWs for several years.

Our trial also showed a trend towards higher uptake with increasing compliance with program elements. To reach an optimal compliance a few elements of the developed program should be improved. Only few HCWs actually visited the plenary information meetings and higher visiting rates might be achieved by integrating these sessions with an existing meeting (e.g. ward meeting) and recommendation by their management. Also, more support of nursing home physicians for the organisation and promotion of the intervention is needed. After improving the program we recommend implementing it nationwide over a longer time period, as there are indications that the effect of an intervention program increases over time. However, considering the moderate influenza vaccine uptake among HCWs that resulted from the intervention program in our study, the disappointing results of previous European studies[4-8] and the average influenza vaccination rate

among HCWs from the US in 2005 of 34 percent[9] it can be debated whether voluntary influenza vaccination will result in sufficient protection of nursing home patients.[10;11]

Voluntary or mandatory vaccination of HCWs?

Arguments used in the literature in favour of implementing mandatory influenza vaccination of HCWs are: the proven effectiveness and cost-effectiveness of this measure, the duty not to harm which applies to all individuals, the professional obligation of HCWs not to harm their patients, consistency between own vaccination behaviour and the advice of vaccination given to patients and the view that voluntary vaccination programs have failed.[10-13] Arguments used against this measure are the constraints to personal autonomy and freedom of choice that mandatory vaccination will entail, the view that there are alternatives to mandatory vaccination, possible costs related to tracking those who do not comply, the view that vaccination of HCWs is only in the employer's interest and the risk of alienating HCWs and damaging morale.[10;13;14] Obviously it would be morally superior if voluntary programs would result in sufficient influenza vaccine uptake among HCWs. However, as said before, it is unlikely that voluntary programs will succeed to reach sufficient uptake (see chapter 4.4) and therefore mandatory vaccination may be considered a reasonable option.

What is mandatory vaccination?
Mandatory vaccination should not be confused with forced vaccination. It implies a conditional program in which HCWs must consent with vaccination if they want to (continue to) work in the nursing home as is already the case for vaccination against hepatitis B. It has been argued that to enforce such a program, there should be significant barriers to opting out and that patients should be informed when they are seeing a HCW who refuses vaccination.[12] We do, however, believe that HCWs with medical contraindications or arguments from conscience or philosophical objections (conscientious objectors) should be granted the possibility to opt-out without any consequence. Whether they should be allowed to continue to work during an influenza epidemic can be debated however. Therefore, when we speak of a mandatory vaccination program we mean a conditional one in which yearly vaccination is considered to be a requirement for the job.

Will mandatory vaccination increase influenza vaccine uptake of HCWs?
The effectiveness of a mandatory influenza vaccination program for HCWs has not been subject of extensive research. There is, however, some empirical evidence from the US concerning the effectiveness of this measure. The Virginia Mason Medical Center mandated influenza vaccination for all HCWs in 2004.[15] Signed declarations to opt-out were not allowed for those without medical or religious contraindications for vaccination and unvaccinated HCWs were required to wear face-masks during the entire influenza season. The mandate was implemented in conjunction with a promotional campaign. Vaccination rates exceeded 98 percent for the more than 5,000 HCWs

within a year. The effectiveness of this mandate on influenza vaccine uptake among HCWs can not be argued. We therefore think that mandatory influenza vaccination of HCWs in Dutch nursing homes will undoubtedly be a more effective means to achieve higher uptake among HCWs than voluntary vaccination.

How to implement mandatory influenza vaccination of HCWs?
Implementation of mandatory influenza vaccination does not dismiss nursing home management from educating and informing HCWs on influenza vaccination. Vaccines should also remain free of charge and readily accessible. In our opinion implementation of mandatory vaccination should be organized in conjunction with our adjusted multi-faceted intervention program. Of course, the legal aspects of implementation of mandatory influenza vaccination of HCWs should be studied. A possibility might be the adoption of influenza vaccination of HCWs as a professional standard and therefore endorsing it as an obligation for good clinical practise. This would make influenza vaccination of HCWs part of the Dutch law on quality of health care institutions (kwaliteitswet zorginstellingen). Since our study in chapter 4.5 showed that the management of Dutch nursing homes is not yet ready to implement mandatory influenza vaccination they should also be informed on and involved in the implementation of this measure.

Applicability of findings to other health care settings

HCWs in acute care or hospital settings
Effectiveness of influenza vaccination of HCWs on morbidity and mortality among patients has only been studied in long-term care settings such as nursing homes. It may, however, be reasonable to assume that frail patients in hospitals will also benefit from influenza vaccination of HCWs. Influenza vaccination of hospital-based HCWs has been recommended by the Health Council of The Netherlands as of 2007.[16] It has not yet been common practice in Dutch hospitals and influenza vaccination rates among hospital-based HCWs in The Netherlands are still low (range 15 to 50 percent in University Medical Centres in 2008). Since it is unclear if voluntary vaccination programs can sufficiently increase influenza vaccine uptake among Dutch hospital-based HCWs, effort should be made to investigate the possibility of increasing influenza vaccine uptake among them on a voluntary basis. Firstly, research on determinants of influenza vaccination behaviour among hospital-based HCWs is needed. We have shown a method to conduct such a study in chapter 4.2. Next, an implementation program on influenza vaccine uptake among hospital-based HCWs should be developed, preferably by using the Intervention Mapping, as shown in chapter 4.3. Finally, the effectiveness of such a program should be assessed, as shown in chapter 4.5.

General practitioners
General practitioners have frequent contact with community-based frail elderly patients. Although the effectiveness of influenza vaccination of these general practitioners to protect community-based frail elderly has not been studied it seems reasonable to assume some effectiveness.

Therefore, and because side effects of influenza vaccination are mild, it seems reasonable to also advise general practitioners to be vaccinated against influenza. Influenza vaccination of Dutch general practitioners has only been actively recommended since the fall of 2008. A study from 2007 showed that influenza vaccine uptake among Dutch general practitioners was 36 percent[17] and, therefore, needs to be increased. The same study showed a number of misconceptions on influenza vaccination among Dutch general practitioners. To increase influenza vaccine uptake among general practitioners further promotional programs and research is needed as for hospital-based HCWs.

Concluding remarks

In this thesis we have shown that influenza vaccination is effective in patients with diabetes and that there are no substantial differences in determinants associated with non compliance with influenza and pneumococcal vaccination between smokers and non-smokers. We have also shown that increasing influenza vaccine uptake among HCWs in nursing homes on a voluntary basis is challenging. We recommend improving our intervention program and implementing it nationwide over a longer time period. However, if this does not result in sufficient vaccination rates we advocate the implementation of mandatory influenza vaccination for HCWs in nursing homes in conjunction with the intervention program. Influenza vaccine uptake among hospital-based HCWs and general practitioners also needs to be increased. For these HCWs influenza vaccination has been recommended only very recently, therefore, the possibility of increasing uptake on a voluntary basis should be investigated before mandatory vaccination can be considered.

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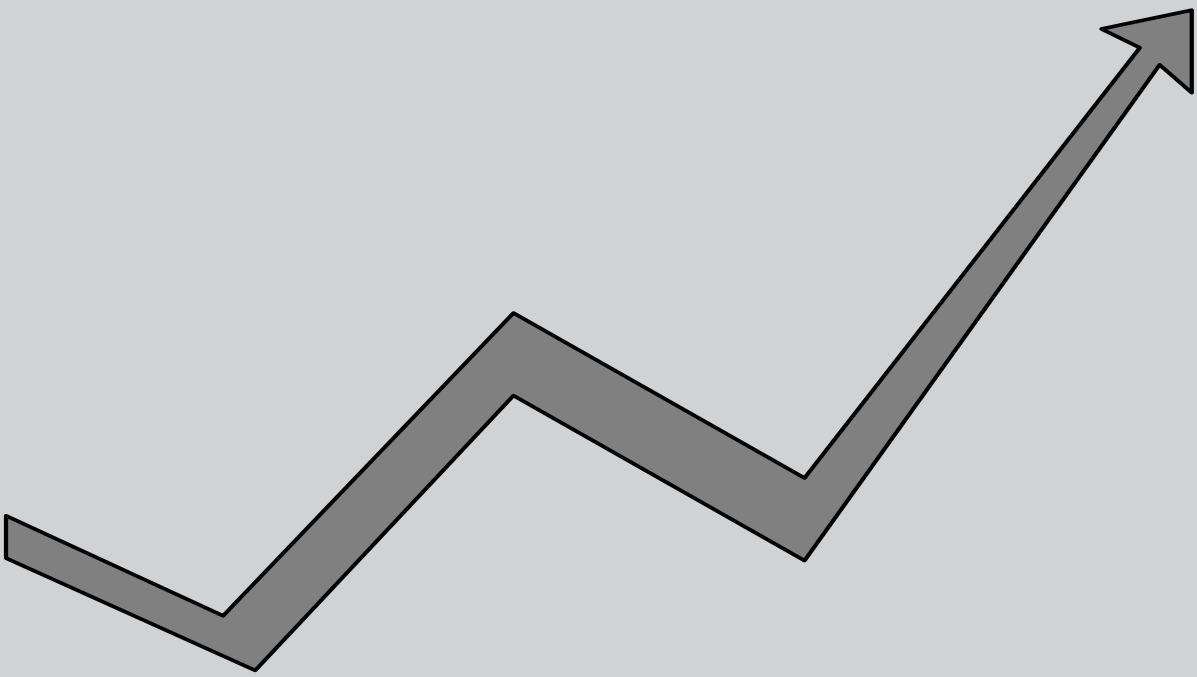
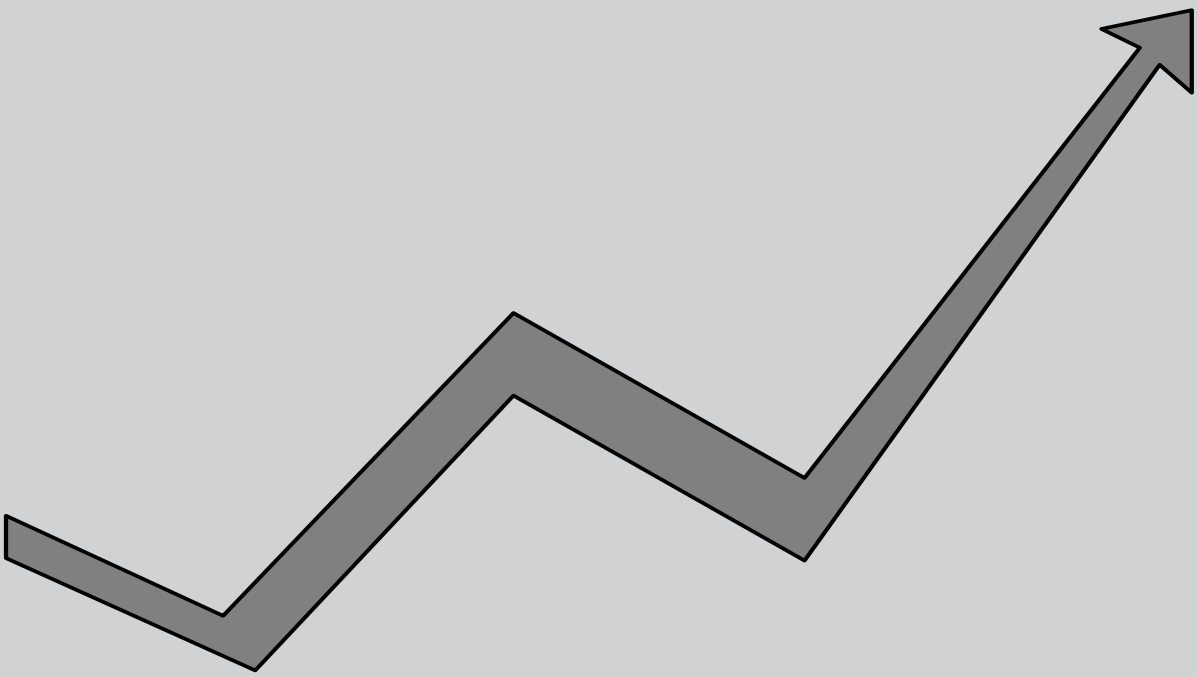
Chapter 6



Summaries, Acknowledgements and Curriculum Vitae

Chapter 6.1



Summary

General introduction

To prevent influenza virus infection, immunization against influenza has been recommended for individuals with increased risk of complications. These groups comprise individuals of 60 years and older, individuals with risk-elevating co-morbid conditions, residents of nursing homes and other chronic care facilities in The Netherlands and, only recently, health care workers.

A reason for suboptimal vaccine uptake in some target groups might be that evidence regarding the clinical benefits of influenza vaccination is conflicting (e.g. in patients with diabetes). However, to obtain a high influenza vaccine uptake, epidemiological evidence on the effectiveness of the vaccine alone is not enough to convince patients and health care providers. To reach high levels of vaccine uptake, a comprehensive approach towards behavioural change among those who qualify for influenza vaccination is needed. In order to invoke behavioural change in a specific group (e.g. in smokers or health care workers) it is necessary to identify relevant determinants of vaccination behaviour at different levels from a behavioural, organisational and ethical perspective in that group based on health behavioural theories. After identifying relevant determinants of behaviour the next step is the development of an intervention to actually invoke a change in this behaviour. To be most effective, such interventions should be built upon a coherent theoretical base incorporating also the organisational and ethical context, for example, by use of the Intervention Mapping method. If such voluntary programs fail to reach sufficiently high levels of vaccine uptake in the target group as an alternative it has been suggested to implement mandatory vaccination programs.

Clinical effectiveness of influenza vaccination in diabetic patients

Independent of their age, patients with diabetes are among those at high risk for developing a complicated course from influenza infections such as pneumonia or diabetes dysregulation. Hence annual influenza vaccination has been recommended for decades in these individuals. Despite these long-term recommendations, vaccination coverage in The Netherlands is around 60 percent in younger patients with diabetes. In other countries uptake is even lower. One of the major reasons for the disappointing vaccine uptake in patients with diabetes might be that evidence regarding the clinical benefits of influenza vaccination in these patients with diabetes is conflicting. In **chapter 2** we assessed the clinical effectiveness of influenza vaccination in adults with diabetes. We showed that the incidence rate of hospitalizations among patients with diabetes of 18 to 64 years of age was two times higher in unvaccinated individuals (25 per 1,000) than in vaccinated individuals (12 per 1,000). Most of these hospitalizations were due to diabetes dysregulation (59 of 61 outcomes). Among the elderly incidence rates of hospitalization did not substantially differ between vaccinated and unvaccinated individuals. However, incidence rates of mortality did substantially differ between elderly unvaccinated (19 per 1,000) and elderly vaccinated individuals (8 per 1,000). In all, vaccination was associated with a 56% reduction in any complication (95% confidence interval [95% CI] 36-70%), a 54% reduction in hospitalizations (95% CI 26-71%) and

58% reduction in deaths (95% CI 13-80%). Among study subjects aged 18-64 years reductions in the occurrence of any complication were higher than among those aged over 65 years (72% versus 39%). Since we showed that influenza vaccination is effective in patients with type 2 diabetes regardless of age, efforts should be renewed to further increase influenza vaccine uptake among this high-risk group. Especially in those 65 years and younger since vaccination rates are lower in this age group than in those over 65 years of age.

Behavioural determinants of influenza and pneumococcal vaccination among smokers and non-smokers

Smokers have a substantially higher risk of developing influenza and pneumococcal diseases than non-smokers. Although there are no official recommendations to offer smokers influenza or pneumococcal vaccination yet, it might be implemented in the future. If implemented it is of importance to first assess determinants of influenza and pneumococcal vaccination behaviour before influenza or pneumococcal vaccination behaviour in this group can be changed. In **chapter 3** we assessed independent factors associated with not complying with influenza and pneumococcal vaccination among smokers and non-smokers. This study showed that in smokers and non-smokers similar determinants are associated with non-compliance. In addition, we showed that if smokers are considered a high-risk group and therefore targeted for vaccination some important issues need to be taken into account in vaccination programs. The necessity to inform healthy smokers was shown by the smokers' beliefs that pneumonia is not dangerous, that influenza and pneumococcal vaccines are not effective, and that they are not susceptible to disease. This study also showed that special attention should be addressed to smokers with high levels of education and that general practitioners should clearly recommend vaccination to smokers.

Influenza vaccination of health care workers

The studies described in **chapter 4** focused on influenza vaccination of health care workers (HCWs). Studies have demonstrated that influenza vaccination of HCWs reduces mortality and morbidity among nursing home patients. In addition, it reduces the medical and non-health care costs related to influenza outbreaks and influenza-associated absenteeism of HCWs. In 2003, the WHO officially welcomed the initiatives of countries to also offer influenza vaccination to HCWs in contact with high-risk individuals. In response, the Dutch association of nursing home physicians (NVVA) developed a guideline for influenza vaccination in nursing homes in 2004. In this guideline it was strongly recommended to immunize HCWs against influenza. In **chapter 4.1** we showed that the uptake of influenza vaccination among HCWs in Dutch nursing homes did not improve substantially, from 5 to 8% before to 11% in the year after the introduction of this guideline. Furthermore, we showed that on management level having a written policy, actively requesting HCWs to get vaccinated and informing HCWs about influenza vaccination were all associated with a significantly higher uptake of influenza vaccination among the HCWs. In **chapter 4.2** we assessed determinants associated with uptake of influenza vaccination among HCWs

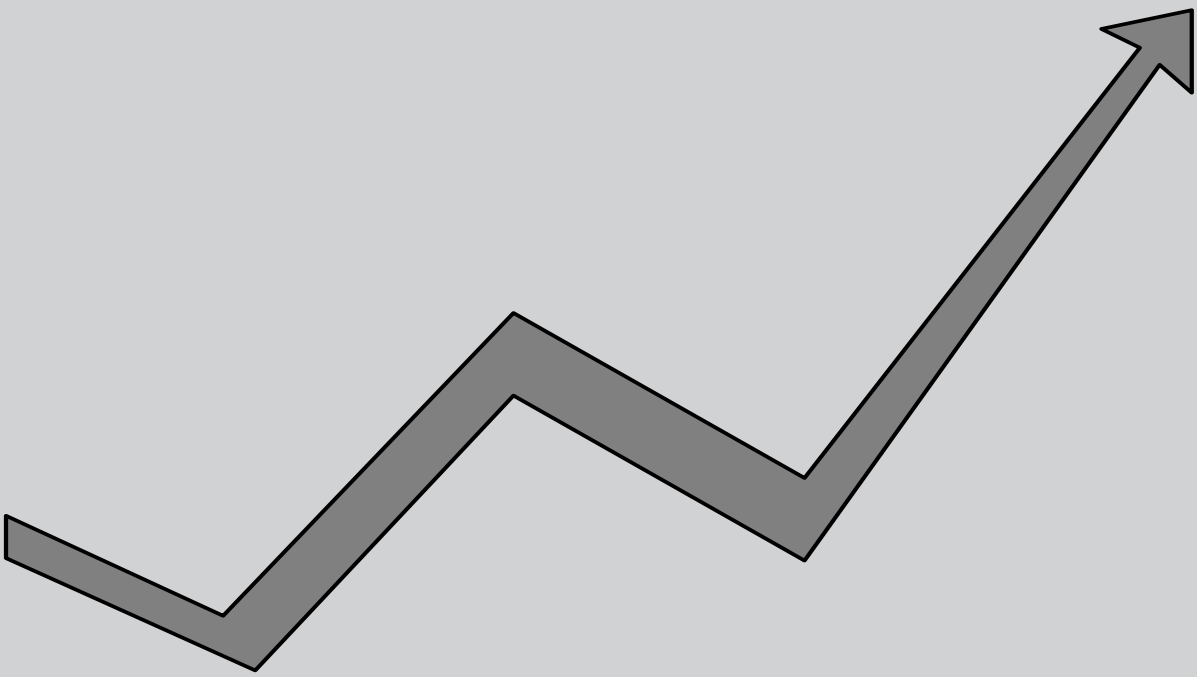
in Dutch nursing homes. The outcomes of this study enabled us to accurately predict influenza vaccine uptake on a HCW level based on a multivariate prediction model with 13 determinants (area under the receiver operating characteristic curve [AUC] of 0.95). This model included two demographical, nine behavioural and two organisational determinants. In **chapter 4.3** we used all determinants associated with uptake of influenza vaccination among HCWs and applied the intervention mapping method to develop a theory- and evidence-based intervention program to change vaccination behaviour among HCWs in nursing homes. In **chapter 4.4** we conducted a cluster randomised controlled trial in 33 Dutch nursing homes to assess the effects of this systematically developed multi-faceted intervention program on influenza vaccine uptake among HCWs. In the intervention group, influenza vaccine uptake after the program was on average 9% higher than in the control group (relative risk 1.59, 95% confidence interval: 1.08 to 2.34, p=0.02). In all, 25% of all HCWs in the intervention group were vaccinated against influenza compared with 16% in the control group. There was a non-significant trend towards higher uptake when nursing homes complied with more elements of the intervention program. So, the intervention program resulted in a significantly higher, though moderate, influenza vaccine uptake among HCWs in nursing homes and higher compliance with program elements was associated with higher vaccine uptake. Hence, to take full advantage of this preventive measure, either the program should be adjusted and implemented over a longer time period or mandatory influenza vaccination should be considered. In **chapter 4.5** we showed that in 2008, four years after the development of the NVVA guideline, the average influenza vaccine uptake among HCWs in Dutch nursing homes was still only 19 percent. Furthermore, we showed that despite the fact that the majority of nursing home management (>69%) agreed with all relevant arguments in favour of implementation of mandatory influenza vaccination, only a minority (24%) agreed that mandatory vaccination should be implemented if voluntary vaccination fails to reach sufficient vaccine uptake among HCWs.

General discussion

In **chapter 5** we discussed next steps to further increase influenza vaccine uptake, the possibility of implementing mandatory vaccination of HCWs and the applicability of findings to other health care settings. To further increase influenza vaccine uptake we encourage that efforts to further increase influenza vaccine uptake among patients with diabetes will be renewed, especially in those younger than 65 years. Healthy smokers should be informed on influenza vaccination and special attention should be addressed to smokers with high levels of education. To further increase influenza vaccine uptake among HCWs we recommend improving our intervention program and implementing it nationwide over a longer time period. However, if this does not result in sufficient vaccination rates we advocate the implementation of mandatory influenza vaccination of HCWs in Dutch nursing homes. This, however, does not dismiss nursing home management from educating and informing HCWs on influenza vaccination. In our opinion implementation of mandatory vaccination should be organized in conjunction with our adjusted multi-faceted intervention program. Also, nursing home management should be informed on and involved in such implementation of mandatory influenza vaccination of HCWs. For Dutch hospital-based

HCWs and general practitioners efforts should be undertaken to investigate the possibility of increasing influenza vaccine uptake on a voluntary basis. Firstly, research on determinants of influenza vaccination behaviour among these HCWs is needed. Next, an implementation program on influenza vaccine uptake among these HCWs should be developed and finally, the effectiveness of such a program should be assessed.

Chapter 6.2



Samenvatting

Algemene inleiding

Ter preventie van influenza-infecties wordt immunisatie tegen influenza geadviseerd voor individuen met een verhoogd risico op complicaties. Dit betreft individuen van 60 jaar en ouder, individuen met een risico verhogende comorbiditeit, bewoners van Nederlandse verpleeghuizen en andere chronische zorginstelling en, pas sinds kort, gezondheidszorgmedewerkers.

Een mogelijke reden voor een suboptimale vaccinatiegraad in sommige doelgroepen is dat het bewijs betreffende de klinische voordelen van griepvaccinatie (bijv. bij patiënten met diabetes) niet eenduidig is. Om echter een hoge influenzavaccinatiegraad te bereiken is alleen epidemiologisch bewijs met betrekking tot de effectiviteit van vaccinatie onvoldoende om patiënten en zorgverleners te overtuigen. Om een hoge vaccinatiegraad te bereiken is een veelomvattende benadering met als doel gedragsverandering, onder diegenen die in aanmerking komen voor influenzavaccinatie, nodig. Om gedragsverandering in een specifieke groep (bijv. bij rokers of gezondheidszorgmedewerkers) te bewerkstelligen is het noodzakelijk om, bij de betreffende groep, op verschillende niveaus relevante determinanten van vaccinatiegedrag te identificeren. Dit vanuit een gedrags-, organisatorisch en ethisch perspectief, gebaseerd op theorieën met betrekking tot gezondheidsgedrag. Na het identificeren van relevante determinanten van gedrag is de volgende stap de ontwikkeling van een interventie, om een verandering in dit gedrag ook daadwerkelijk te bewerkstelligen. Om maximaal effectief te zijn, zouden dergelijke interventies op een coherente theoretische basis gebaseerd moeten worden, hierbij ook de organisatorische en ethische context meenemend. Dit zou bijvoorbeeld bewerkstelligd kunnen worden met behulp van de "Intervention Mapping" methode. En als dergelijke vrijwillige programma's er dan uiteindelijk toch niet in slagen om een voldoende hoge vaccinatiegraad in de doelgroep te bereiken is een gesuggereerd alternatief de implementatie van verplichte vaccinatieprogramma's.

Klinische effectiviteit van griepvaccinatie bij patiënten met diabetes

Patiënten met diabetes behoren, ongeacht hun leeftijd, tot diegene met een verhoogd risico om een gecompliceerd beloop van een influenza-infectie door te maken, bijvoorbeeld een longontsteking of metabole disregulatie. Vandaar dat bij hen al decennia lang een jaarlijkse griepvaccinatie geadviseerd wordt. Ondanks deze lange termijn van aanbeveling, is de vaccinatiegraad bij jongere patiënten met diabetes in Nederland ongeveerd 60 procent. In andere landen is de vaccinatiegraad in deze groep nog lager. Één van de belangrijkste redenen voor deze beperkte vaccinatiegraad bij patiënten met diabetes zou kunnen zijn dat het bewijsmateriaal betreffende de klinische voordelen van influenzavaccinatie bij hen niet eenduidig is. In **hoofdstuk 2** onderzochten wij daarom de klinische effectiviteit van influenzavaccinatie bij volwassenen met diabetes. Wij toonden aan dat de incidentie van ziekenhuisopnames bij patiënten met diabetes van 18 tot 64 jaar oud twee keer hoger was bij ongevaccineerde individuen (25 per 1.000) dan bij gevaccineerde individuen (12 per 1.000). Het grootste deel van deze ziekenhuisopnames was toe te schrijven aan metabole disregulatie (59 van 61). Onder de ouderen verschilde de incidentie van ziekenhuisopnames niet

wezenlijk tussen gevaccineerde en ongevaccineerde individuen. De sterfte incidentie verschilde echter wel wezenlijk tussen ongevaccineerde ouderen (19 per 1.000) en gevaccineerde ouderen (8 per 1.000). Over het geheel genomen was vaccinatie geassocieerd met 56% vermindering van alle complicaties (95% betrouwbaarheidsinterval [95% BI] 36-70%), 54% vermindering van ziekenhuisopnames (95% BI 26-71%) en 58% vermindering van sterfgevallen (95% BI 13-80%). Bij onderzochte individuen in de leeftijd van 18 tot 64 jaar was de verminderingen in het voorkomen van alle complicaties hoger dan onder diegene ouder dan 65 jaar (72% tegenover 39%). Wij toonden dus aan dat influenzavaccinatie bij patiënten met diabetes mellitus type II effectief is, ongeacht de leeftijd. En daarom zouden inspanningen, om de vaccinatiegraad bij deze hoogrisico groep te verhogen, moeten worden hernieuwd. Vooral bij diegene jonger dan 65 jaar, omdat bij hen de vaccinatiegraad lager is dan bij diegene van 65 jaar en ouder.

Gedragsdeterminanten van influenza en pneumokokken vaccinatie bij rokers en niet rokers

Rokers hebben een hoger risico op een influenza of pneumokokken infectie dan niet rokers. Op dit moment zijn er nog geen officiële aanbevelingen om rokers influenza of pneumokokken vaccinatie aan te bieden, maar dit zou mogelijk in de toekomst kunnen worden geïmplementeerd. Als dit geïmplementeerd wordt dan is het van belang om eerst de determinanten van influenza en pneumokokken vaccinatie vast te stellen, voordat het influenza of pneumokokken vaccinatiegedrag in deze groep daadwerkelijk veranderd kan worden. In **hoofdstuk 3** beoordeelden wij daarom de onafhankelijke factoren geassocieerd met het niet accepteren van influenza en pneumokokken vaccinatie bij rokers en niet rokers. Deze studie toonde aan dat bij rokers en niet rokers dezelfde determinanten geassocieerd zijn met het niet accepteren van vaccinatie. Bovendien toonden wij aan dat indien vaccinatie aanbevolen gaat worden aan rokers, omdat zij als een hoog risico groep worden beschouwd, er in de vaccinatieprogramma's rekening gehouden moet worden met enkele belangrijke kwesties. De noodzaak om gezonde rokers te informeren werd aangetoond door de overtuigingen van rokers dat longontsteking niet gevaarlijk is, dat influenza en pneumokokken vaccinatie niet effectief is, en dat zij toch niet vatbaar zijn voor ziekte. Deze studie toonde ook aan dat er speciale aandacht aan rokers met een hoog opleidingsniveau besteed zou moeten worden en dat huisartsen vaccinatie duidelijk zouden moeten adviseren aan rokers.

Influenzavaccinatie van gezondheidszorgmedewerkers

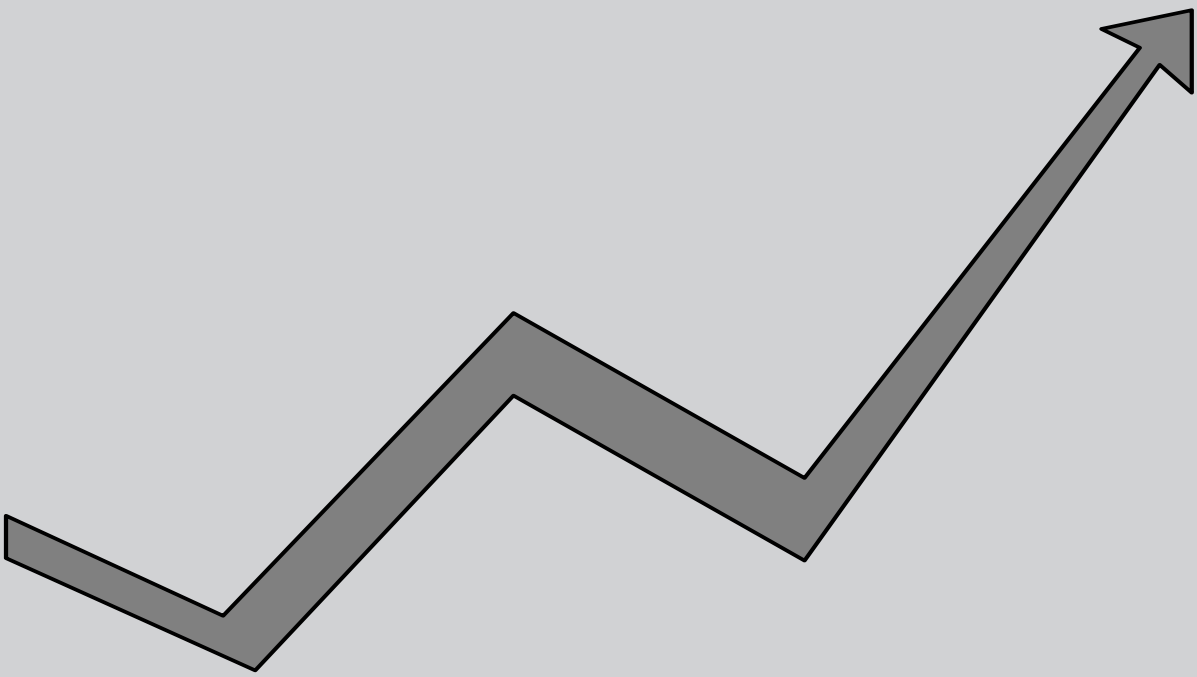
De studies die in **hoofdstuk 4** worden beschreven, concentreerden zich op influenzavaccinatie van gezondheidszorgmedewerkers. Eerdere studies hebben aangetoond dat influenzavaccinatie van gezondheidszorgmedewerkers mortaliteit en morbiditeit onder verpleeghuispatiënten reduceert. Bovendien reduceert het de medische en niet-gezondheidszorg gebonden kosten gerelateerd aan influenza-uitbraken en influenza geassocieerd verzuim onder gezondheidszorgmedewerkers. In 2003, verwelkomde de WHO officieel initiatieven van landen om influenzavaccinatie aan te bieden aan gezondheidszorgmedewerkers in contact met hoog risico individuen. In reactie

hierop ontwikkelde de Nederlandse vereniging van verpleeghuisartsen (NVVA) in 2004 een richtlijn voor influenzavaccinatie in verpleeghuizen. In deze richtlijn werd sterk geadviseerd om gezondheidszorgmedewerkers tegen griep te vaccineren. In **hoofdstuk 4.1** toonden wij aan dat de influenzavaccinatiegraad bij gezondheidszorgmedewerkers in Nederlandse verpleeghuizen niet wezenlijk verbeterde na introductie van deze richtlijn. Deze steeg namelijk slechts van 5 tot 8% voor introductie van de richtlijn naar 11% in het jaar na introductie van de richtlijn. Voorts toonden wij aan dat op management niveau het hebben van een geschreven beleid, het actief verzoeken van gezondheidszorgmedewerkers om zich te laten vaccineren en het informeren van gezondheidszorgmedewerkers over influenzavaccinatie allen geassocieerd zijn met een significant hogere vaccinatiegraad bij de gezondheidszorgmedewerkers. In **hoofdstuk 4.2** beoordeelden wij determinanten geassocieerd met influenzavaccinatiegedrag onder gezondheidszorgmedewerkers in Nederlandse verpleeghuizen. De resultaten van deze studie maakten het mogelijk om influenzavaccinatiegedrag op het niveau van de gezondheidszorgmedewerkers accuraat te voorspellen. Gebaseerd op een multivariaat predictiemodel met 13 determinanten (oppervlakte onder de "receiver operating characteristic curve [AUC]" van 0.95). Dit model bevatte twee demografische, negen gedrags- en twee organisatorische determinanten. In **hoofdstuk 4.3** gebruikten wij deze determinanten en pasten de "Intervention Mapping" methode toe om een interventieprogramma te ontwikkelen om vaccinatie gedrag onder gezondheidszorgmedewerkers in verpleeghuizen te veranderen, gebaseerd op theorieën en op bewijs. In **hoofdstuk 4.4** voerden wij een geclusterde gerandomiseerde trial uit in 33 Nederlandse verpleeghuizen om de effecten van dit systematisch ontwikkelde veelzijdige interventieprogramma op de influenzavaccinatiegraad bij gezondheidszorgmedewerkers te beoordelen. In de interventiegroep was de influenzavaccinatiegraad na het programma gemiddeld 9% hoger dan in de controlegroep (relatief risico 1,59; 95% betrouwbaarheidsinterval: 1,08 tot 2,34; p=0,02). Over het geheel genomen werd 25% van alle gezondheidszorgmedewerkers in de interventiegroep tegen influenza gevaccineerd, in vergelijking met 16% in de controlegroep. Er was een niet significante tendens naar een hogere vaccinatiegraad naarmate de verpleeghuizen aan meer elementen van het interventieprogramma voldeden. Het interventieprogramma resulteerde dus in een significant hogere, maar beperkte, influenzavaccinatiegraad bij gezondheidszorgmedewerkers en een betere naleving van de programma-elementen was geassocieerd met een hogere vaccinatiegraad. Om volledig te profiteren van de voordelen van deze preventieve maatregel moet daarom, of het programma worden aangepast en over een langere tijdspanne ten uitvoer worden gebracht, of verplichte influenzavaccinatie zou moeten worden overwogen. In **hoofdstuk 4.5** toonden wij aan dat in 2008, vier jaar na de ontwikkeling van de NVVA richtlijn, de gemiddelde influenzavaccinatiegraad bij gezondheidszorgmedewerkers in Nederlandse verpleeghuizen nog slechts 19 procenten betrof. Verder lieten wij zien dat, ondanks het feit dat de meerderheid van het verpleeghuismanagement (> 69%) het eens is met alle relevante argumenten ten gunste van implementatie van verplichte influenzavaccinatie, slechts een minderheid (24%) van het verpleeghuismanagement het ermee eens is dat verplichte vaccinatie ingevoerd zou moeten worden als vrijwillige vaccinatie niet resulteert in een voldoende hoge vaccinatiegraad bij gezondheidszorgmedewerkers.

Algemene discussie

In **hoofdstuk 5** bespraken wij volgende stappen om de influenzavaccinatiegraad verder te verhogen, de mogelijkheid om verplichte vaccinatie van gezondheidszorgmedewerkers te implementeren en de toepasbaarheid van de bevindingen in andere settingen in de gezondheidszorg. Om de influenzavaccinatiegraad verder te verhogen bevelen wij aan dat inspanningen, om de influenzavaccinatiegraad bij patiënten met diabetes verder te verhogen, hernieuwd zullen worden, vooral bij diegenen jonger dan 65 jaar. Gezonde rokers zouden over influenzavaccinatie geïnformeerd moeten worden en speciale aandacht zou besteed moeten worden aan rokers met een hoog opleidingsniveau. Om de influenzavaccinatiegraad bij gezondheidszorgmedewerkers verder te verhogen bevelen wij aan om ons interventieprogramma te verbeteren en het nationaal en over een langere tijdspanne te implementeren. Als dit echter niet resulteert in een voldoende hoge vaccinatiegraad, dan bepleiten wij de implementatie van verplichte influenzavaccinatie bij gezondheidszorgmedewerkers in Nederlandse verpleeghuizen. Dit ontslaat verpleeghuismanagement echter niet van de verplichting om gezondheidszorgmedewerkers te informeren en voor te lichten over influenzavaccinatie. Naar onze mening zou de implementatie van verplichte vaccinatie georganiseerd moeten worden in samenhang met de implementatie van ons aangepast interventieprogramma. Ook het verpleeghuismanagement zou geïnformeerd moeten worden over, en betrokken worden bij, een dergelijke implementatie van verplichte influenzavaccinatie bij gezondheidszorgmedewerkers. Voor Nederlandse gezondheidszorgmedewerkers in ziekenhuizen en voor huisartsen zouden aanvullende inspanningen geleverd moeten worden, om de mogelijkheid te onderzoeken om de influenzavaccinatiegraad op een vrijwillige basis te verhogen. Op de eerste plaats is onderzoek nodig naar determinanten van influenzavaccinatiegedrag bij deze gezondheidszorgmedewerkers. Daarna zou een implementatieprogramma, om de influenzavaccinatiegraad bij deze gezondheidszorgmedewerkers te verhogen, moeten worden ontwikkeld en ten slotte zou de effectiviteit van een dergelijk programma moeten worden vastgesteld.

Chapter 6.3



Dankwoord

Dankwoord

Toen was daar, na veel hard werk en de nodige zweetdruppels, eindelijk mijn proefschrift! Uiteraard heb ik al het werk niet alleen gedaan en had ik dit natuurlijk nooit kunnen bereiken zonder de nodige hulp en steun van anderen. Daarom wil ik iedereen die op welke manier dan ook zijn steentje bijgedrage heeft bij deze heel erg bedanken.

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Beste leden van de beoordelingscommissie, Prof Dr. I.M. Hoepelman, Prof. Dr. R.P.T.M. Grol, Prof. Dr. H.J.M. Cools en Prof. Dr. J.A. Knottnerus bedankt voor het beoordelen van mijn manuscript. Beste André, eerst was er onze samenwerking bij de Gezondheidsraad met als afronding een mooi advies. Nu maak je deel uit van de eindfase van mijn promotietraject met als afronding een mooi proefschrift. Ik ben zeer vereerd dat je in de beoordelingscommissie wilde plaats nemen.

Uiteraard ook mijn dank aan de overige co-auteurs. Ted van Essen, Marianne van der Sande, Erik Buskens, Guy Rutten en Kristin Nichol. Bedankt voor jullie bijdragen.

Ik wil ook alle contactpersonen en alle andere personen van de deelnemende verpleeghuizen die zich ingezet hebben voor de uitvoering van de onderzoeken bedanken. Niet te vergeten ook een woord van dank aan alle GGD medewerkers die tijdens de campagne de informatiebijeenkomsten begeleid hebben. Zonder jullie was het allemaal niet mogelijk geweest!

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Maud, jou doorzettingsvermogen en je positieve instelling gaven altijd een prima werksfeer. Heel veel succes met de aller laatste loodjes voor de afronding je eigen proefschrift!

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Mijn collega's bij de Gezondheidsraad wil ik bedanken voor de leerzame en leuke tijd. Wat ik geleerd heb in het adviesproces was een zeer nuttige en welkome toevoeging aan mijn onderzoekservaring. Maar daarnaast was het uiteraard ook gezellig en leuk. André, Kees, Hans, Nienke, Senol, Debbie, Olga, Sujata, Irene en alle andere bedankt!

De huisartsenopleiding wil ik bedanken voor de mogelijkheid om mijn huisartsenopleiding te kunnen combineren met een promotietraject. Ik denk zeker dat het mij een completer arts maakt.

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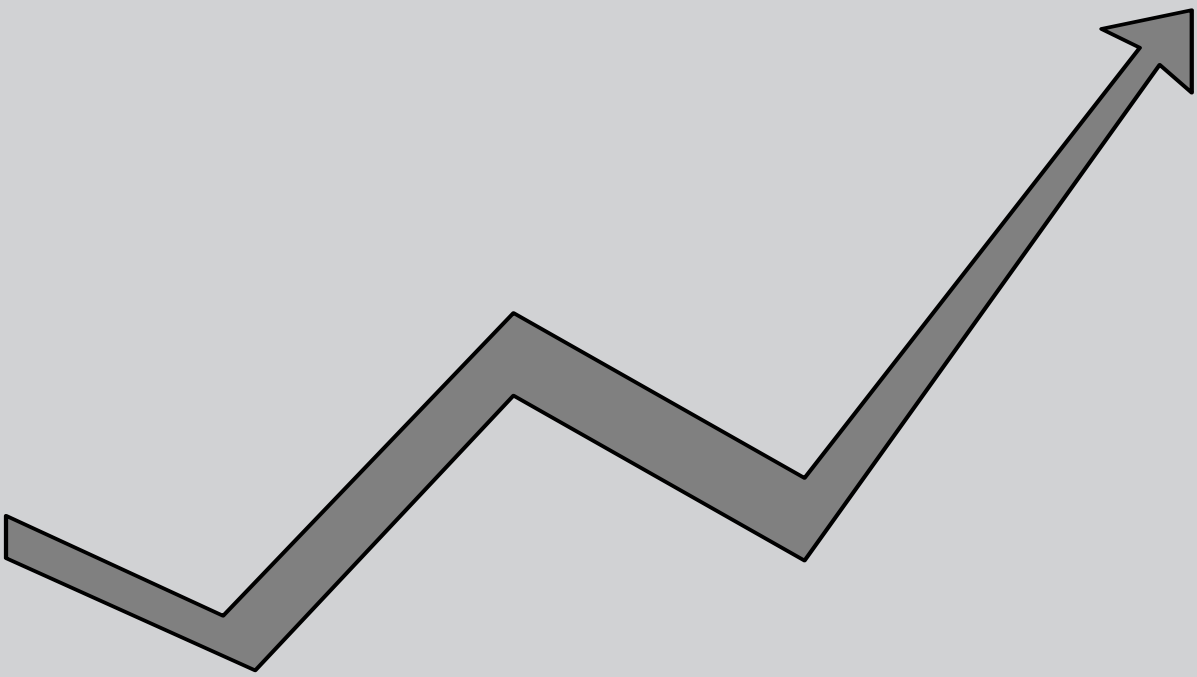
Beste familieleden, lieve schoonouders, zwager en schoonzus. Jullie weten ongetwijfeld nog steeds niet precies wat ik nou onderzocht. En toch was er altijd interesse en begrip. Bedankt daar voor!

Lieve pa en ma, bedankt voor jullie altijd aanwezige onvoorwaardelijke steun en interesse. Ik prijs mij gelukkig dat jullie mijn ouders zijn. Jullie trots en vertrouwen heeft me zeker sterker gemaakt. Ik hou van jullie!

Danny, lieve schat. Sorry, voor alle avonden werken achter mijn laptop op de bank. Gezellig hè…..... Bedankt voor je begrip, steun en liefde. Het doet ontzettend goed om te weten dat je achter me staat! Ik hou ontzettend veel van je, voor altijd!

Gijs, kleine vent. Nog zo klein, maar mamma is al zo trots op je. En ik kan je beloven dat dat altijd zo blijft, ook als je straks een broertje of zusje hebt. Ik hou ook heel veel van jou!

Chapter 6.4

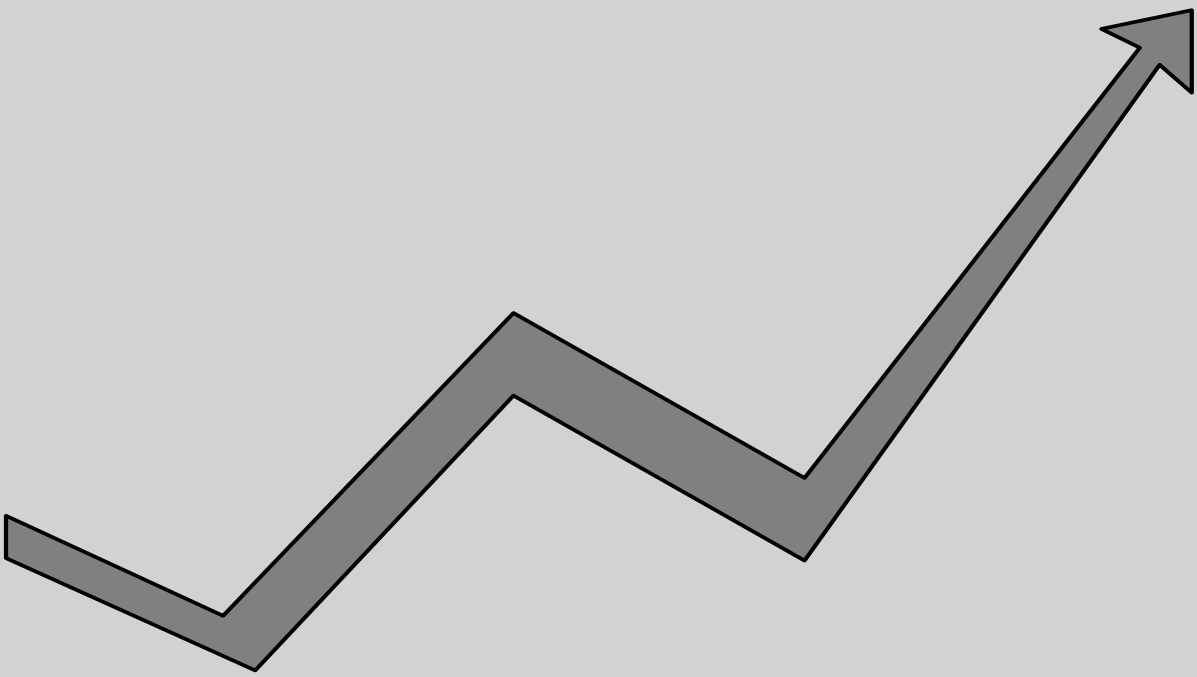


Curriculum Vitae

Curriculum Vitae

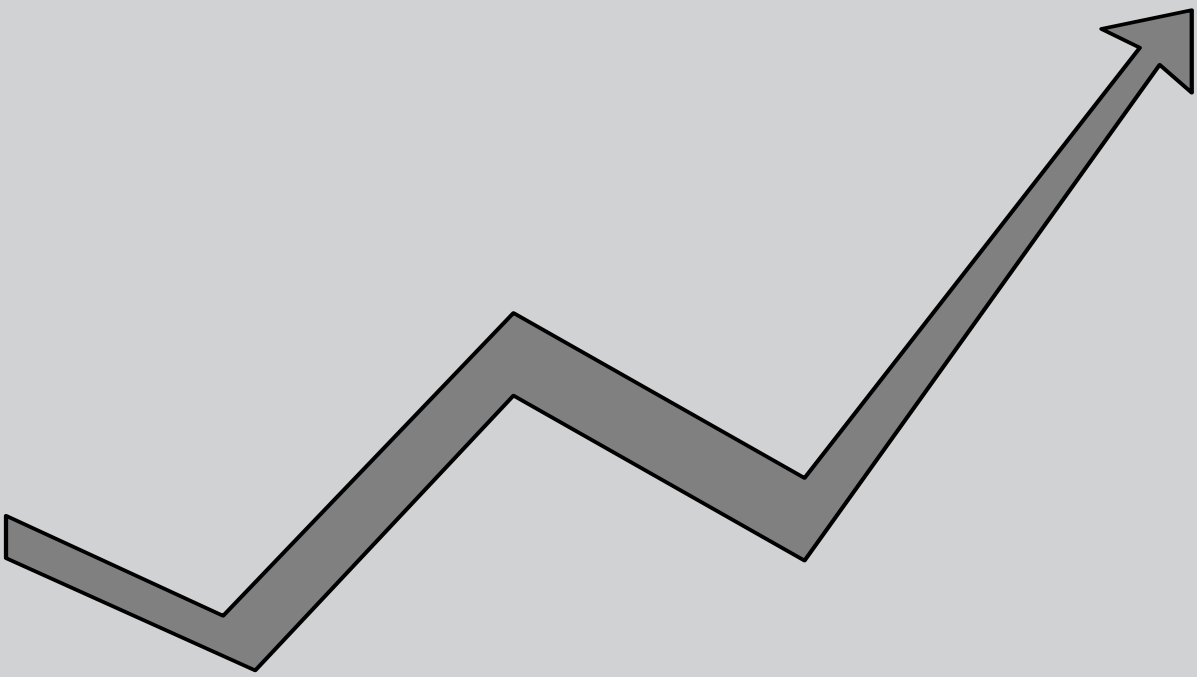
Ingrid Looijmans -van den Akker was born on May 28th, 1976 in Best, the Netherlands. She graduated from Secondary school at the "Bisschop Beckers College" in Eindhoven. In 2005 she graduated as a Medical Doctor at the University Utrecht. In September 2005 she started the work described in this thesis at the Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, under supervision of Prof. dr. J.J.M. van Delden, Prof. dr. Th.J.M. Verheij, Dr. E. Hak and Dr. M.E. Hulscher. As of January 2006 she combines this PhD-project with her vocational training in General Practice. From January 2006 till February 2007 she also combined her research work with the position of scientific secretary of the advisory committee "Influenza vaccination: revision of the indication" at the Health Council of the Netherlands.

Chapter 7



Appendices

Appendix A



Shortened English Translation of the Questionnaire Used for the Study Described in Chapter 3

1. Are you at this moment suffering from a chronical ilness with a duration of more than 3 months? ☐ Yes ☐ No

2. How many times did you have one of the following airway infections during the previous 12 months?

   a. Flu (acute fever, muscle aches and coughing)

   _____ times

. b. Acute broncitis (coughing, somtimes with fever)

   _____ times

   c. Pneumonia (diagnosed by General practitioner [GP])

   _____ times

3. How many times have you contacted your GP because of airway problems during the previous 12 months? (by telephone, consult or home visit) _____ times

4. How many times did your GP prescribe you antibiotics because of airway problems during the previous 12 months? _____ times

5. I am convinced that the flu is absolutely not dangerous for me.
   ☐ strongly agree
   ☐ agree
   ☐ uncertain
   ☐ disagree
   ☐ strongly disagree

6. I am convinced that pneumonia is very dangerous for me.
   ☐ strongly agree
   ☐ agree
   ☐ uncertain
   ☐ disagree
   ☐ strongly disagree

7. *At this time pneumococcal vaccination is only recommended to some high risk patients.*

   I am convinced that pneumococcal vaccination can prevent pneumonia.
   ☐ strongly agree
   ☐ agree
   ☐ uncertain
   ☐ disagree
   ☐ strongly disagree

8.	*At this time the GP informs patients for whom influenza vaccination is recommended.* I am convinced that influenza vaccination can prevent the flu.	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
9.	I am more susceptible to getting airway infections (flu, pneumonia) than others of my age	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
10.	Vaccinations definitely weaken the natural immune response.	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
11.	After influenza or pneumococcal vaccination I do not expect to suffer from side effects, such as pain at the location of injection.	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
12.	I expect to get a serious disease because of influenza or pneumococcal vaccination (e.g. diabetes, rheumatism or an immune disorder).	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
13.	My GP thinks it is very important to prevent infections.	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree
14.	I absolutely do not think it is important to follow the advice of a GP.	☐ strongly agree ☐ agree ☐ uncertain ☐ disagree ☐ strongly disagree

15. I am against vaccinations in general.
- ☐ strongly agree
- ☐ agree
- ☐ uncertain
- ☐ disagree
- ☐ strongly disagree

16. I find it very hard to go to the GP's office to get vaccinated.
- ☐ strongly agree
- ☐ agree
- ☐ uncertain
- ☐ disagree
- ☐ strongly disagree

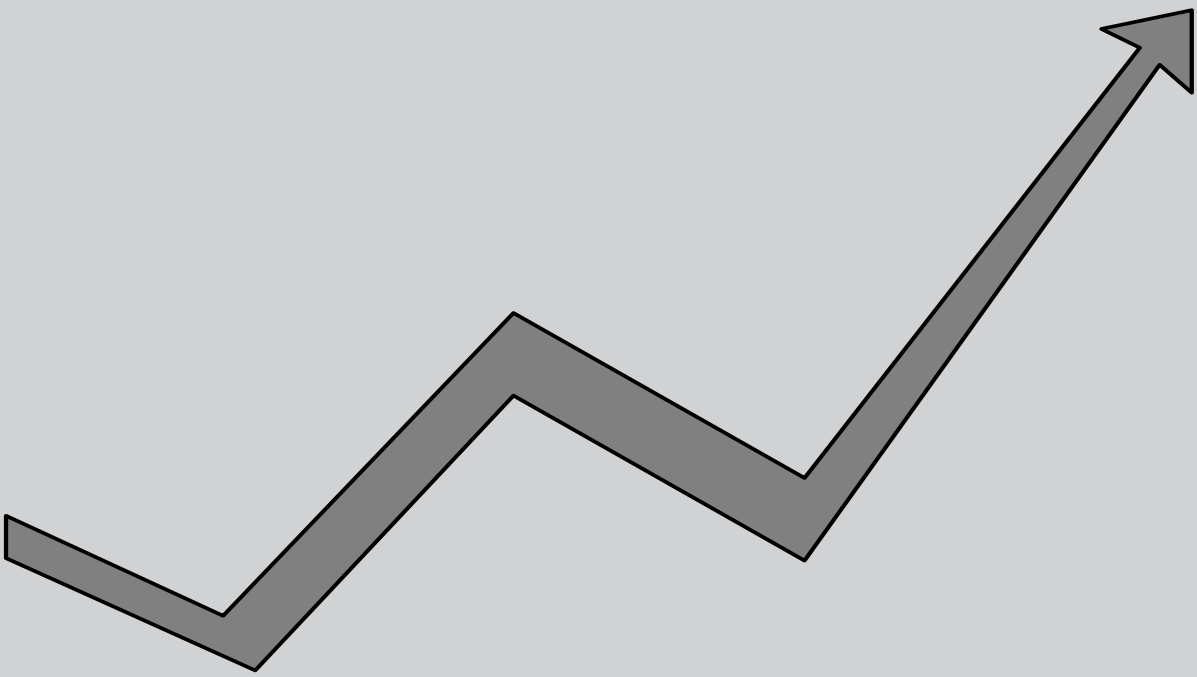
17. Did you receive the influenza and/or the pneumococcal vaccine in the past five years?
- ☐ Yes, the influenza vaccine
- ☐ Yes, the peumococcal vaccine
- ☐ Yes, both vaccines
- ☐ No

18. Are you willing to be immunized against flu and pneumococcal disease in the future?
- ☐ Yes
- ☐ No

19. Do you smoke?
- ☐ Yes
- ☐ No

20. Are you an health care worker?
- ☐ Yes
- ☐ No

Appendix B



Questionnaire among Nursing Home Management Used for the Study Described in Chapter 4.1

Questionnaire for management of Dutch nursing homes

Contact information:
««AddressBlock»»

Contact person: ……
Telephone number: ……

1. Does your nursing home currently have a written policy on influenza vaccination for HCWs? Yes / No

2. What percentage of the patients in your nursing home was vaccinated against influenza last year (autumn 2004)? ____ %

3. What percentage of HCWs (health care workers) in your nursing home was vaccinated against influenza last year (autumn 2004)? ____ %

4. What is the current policy on offering influenza vaccination to HCWs in your nursing home?
   ☐ We actively request HCWs to get vaccinated against influenza
   ☐ HCWs can only get vaccinated on their own initiative
   ☐ We do not offer influenza vaccination to the HCWs

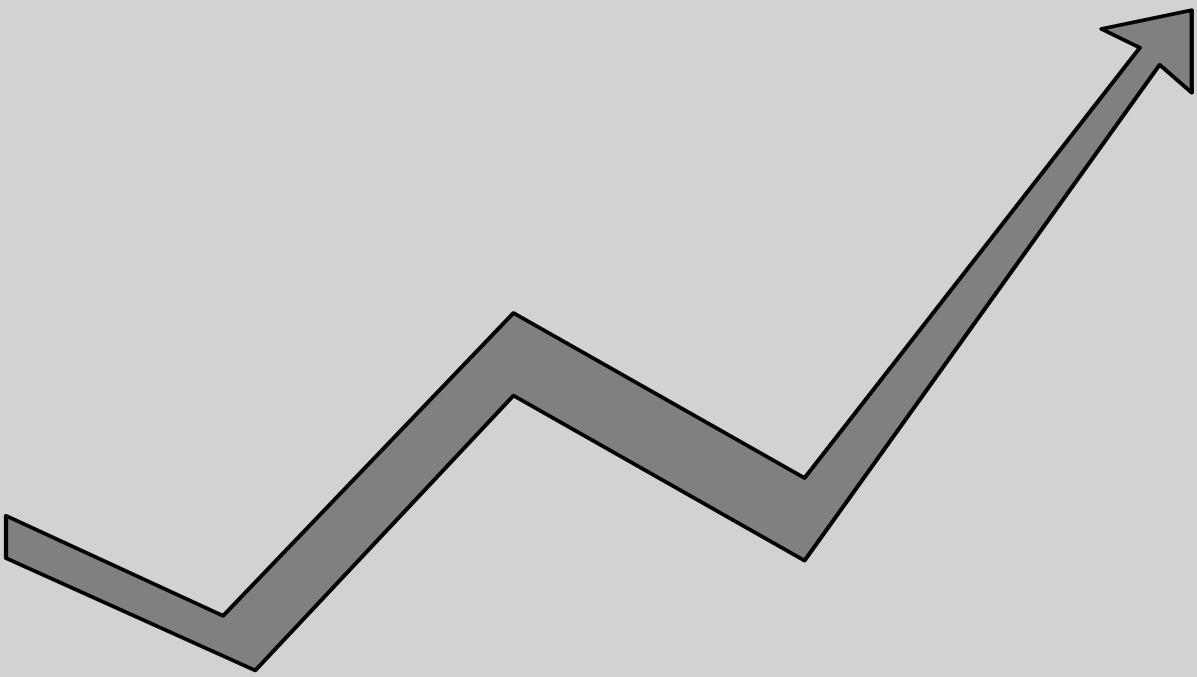
5. How are HCWs currently informed about influenza vaccination? (more than one answers allowed)

   ☐ By personal written information (e.g. invitation letters, leaflets)
   ☐ By collective written information (e.g. posters)
   ☐ By group oral information (e.g. information meeting)
   ☐ Other, namely……..

6. Is the management of your nursing home prepared to participate in a questionnaire study among the HCWs? Yes / No

7. Do you have any supplementary comments?

Appendix C



Questionnaire among Health Care Workers Used for the Study Described in Chapter 4.2

Influenza vaccination among Health Care Workers in Dutch nursing homes

Julius Centre for Health Sciences and Primary Care

General instruction:
Please tick off the boxes as clearly as possible with a blue or a black pen.
For every question, there is only one possible answer unless otherwise stated.
We ask you to consider your current situation when filling out the form.

A. Influenza vaccination among HCWs in nursing homes

1. Did you receive influenza vaccination this year (autumn 2005)?
   ☐ No
   ☐ Yes

2. Do you have a chronic illness for which annual influenza vaccination by your general practitioner is indicated?
   ☐ No
   ☐ yes, but I do not get vaccinated
   ☐ Yes, and I do get vaccinated

3. In case you got vaccinated against influenza before, did you ever experience any side effects?
   ☐ No
   ☐ Yes
   ☐ Not applicable/never got vaccinated against influenza

4. If you ever experienced side effects, have these been uncomfortable enough to be a reason not to get vaccinated in the future?
   ☐ No
   ☐ Yes
   ☐ Not applicable/ never experienced side effects of influenza vaccination

5. Has there been an influenza outbreak in the nursing home at which you work, during the past 3 years?
   ☐ No
   ☐ Yes
   ☐ I don't know

6. Did you receive information on influenza vaccination this year?
   ☐ No
   ☐ Yes

7. How did you receive information on influenza vaccination this year? *(multiple answers possible)*
   ☐ By poster/leaflet
   ☐ By letter
   ☐ Through an information meeting
   ☐ Through the media (e.g. newspaper, magazine, radio, television)
   ☐ By internet
   ☐ From a nursing home physician
   ☐ Other. _____
   _____

8. Do you think that received information on influenza vaccination has been sufficient?
☐ No
☐ Yes

9. Please state below how important you think it is to receive information on influenza vaccination in the described ways.

		Very important	Important	Not important, not unimportant	Unimportant	Very unimportant
a.	By Poster/leaflet	☐	☐	☐	☐	☐
b.	By letter	☐	☐	☐	☐	☐
c.	Through an information meeting	☐	☐	☐	☐	☐
d.	From a nursing home physician	☐	☐	☐	☐	☐
e.	By internet	☐	☐	☐	☐	☐
f.	Through the media (e.g. newspaper, magazine, radio, television)	☐	☐	☐	☐	☐
g.	Other._____ _____	☐	☐	☐	☐	☐

10. How is the provision of influenza vaccination organised in your nursing home?
☐ Not organized
☐ On a fixed day and time
☐ On a fixed day, but flexible time
☐ On a flexible day and time
☐ Otherwise. _____ _____

11. Has the provision of influenza vaccination been adequate?
☐ No
☐ Yes
☐ Not applicable/execution not organized

12.	Has the media attention for avian influenza influenced your ideas about influenza vaccination?	☐ No ☐ Yes
13.	Do you know that there is a guideline by the Dutch association of nursing home physicians (NVVA) called: 'Influenza prevention in nursing homes'?	☐ No ☐ Yes
14.	The NVVA guideline: 'Influenza prevention in nursing homes' recommends vaccinating all HCWs in nursing homes against influenza. Did you know about the contents of the guideline?	☐ No ☐ Yes
15.	Do you agree with the contents of the NVVA guideline: 'Influenza prevention in nursing homes'	☐ No ☐ Yes

Stated below are some propositions about influenza and influenza vaccination. We like to know your opinion on these propositions.

B.	**Propositions about influenza and influenza vaccination**	
16.	I think I have a high personal risk for getting an influenza infection.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
17.	I think that influenza is dangerous for me	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
18.	I think that influenza is dangerous for the patients in the nursing home at which I work.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree

19.	I think that it's very likely that I can infect patients with influenza.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
20.	I think that influenza vaccination is more effective in those under 65 years of age.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
21.	I think that during an influenza epidemic, HCWs are more likely to get an influenza infection.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
22.	Vaccinations don't reduce resistance.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
23.	Influenza vaccination can't cause influenza infection.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
24.	After getting vaccinated against influenza once, you do not have to get vaccinated every year.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
25.	I think it's very important that HCWs do not infect patients.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree

26.	If I get vaccinated against influenza, this will give me more certainty that I will not get an influenza infection.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
27.	If I get vaccinated against influenza, this will give me more certainty that I will not infect patients.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
28.	If I get vaccinated against influenza, this will give me more certainty that I will not infect family members.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
29.	I think influenza vaccination can reduce work pressure.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
30.	I do not expect any side effects (e.g. local tenderness or infection) after influenza vaccination.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
31.	I do not expect an allergic reaction or autoimmune disease after influenza vaccination.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
32.	I think that influenza vaccination for HCWs is useful in preventing influenza infection among patients, in spite of the constant flow of visitors.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree

33.	I am not against vaccination in general.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
34.	I am not specifically against influenza vaccination among HCWs in nursing homes.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
35.	I do not think that nursing homes just offer influenza vaccination to reduce costs (for example by not having to replace sick HCWs).	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
36.	I do not think that nursing homes just offer influenza vaccination because they want to reduce sick-leave.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
37.	I think that HCWs should get vaccinated against influenza because this can ensure continuity of care.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
38.	I think all HCWs should be vaccinated against influenza.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree
39.	I do not think it's important that HCWs have freedom of choice concerning influenza vaccination.	❑ I strongly agree ❑ I agree ❑ I do not agree/I do not disagree ❑ I disagree ❑ I strongly disagree

40.	I think that in case of an influenza outbreak in the nursing home, unvaccinated HCWs should be banned from work.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
41.	I think that in case of an influenza outbreak in the nursing home, unvaccinated HCWs should be banned from work without payment.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
42.	I think HCWs should get vaccinated against influenza because of their duty not to harm patients.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
43.	I think influenza vaccination should become mandatory for HCWs in nursing homes.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree

The next questions are about the influence people in your surrounding have on deciding to get vaccinated against influenza or not.

44.	People close to me (e.g. spouse, family, friends) think it's important for me to get vaccinated against influenza.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
45.	I find it important to do what people close to me think.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree

46.	My colleagues think it's important for me to get vaccinated against influenza.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
47.	I find it important to do what my colleagues think is important.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree
48	I feel support from people in my surrounding when deciding if I want to get vaccinated against influenza.	☐ I strongly agree ☐ I agree ☐ I do not agree/I do not disagree ☐ I disagree ☐ I strongly disagree

Next we ask for some personal characteristics. We like to emphasize one more time that we will handle all data confidentially; it will be processed anonymously and will not be shared with others without your permission.

C.	**General questions**	
49.	What is your gender?	☐ Male ☐ Female
50.	What is your age?	☐ Years
51.	Do you have one or more home living children?	☐ No ☐ Yes

52. What is the highest education you completed?

☐ I have not completed any education.
☐ Primary education.
☐ Secondary education: general certificate of secondary education (GCSE) level 1.
☐ Secondary education: GCSE level 2.
☐ Secondary education: National vocational qualification (NVQ) level 1.
☐ Secondary education: NVQ level 2.
☐ Secondary education: NVQ level 3.
☐ Secondary education: NVQ level 4.
☐ Secondary education: NVQ level 5.
☐ Higher education (HNC or HND)/ university: bachelors degree
☐ Higher education (HNC or HND)/ university: masters degree
☐ Otherwise _____

53. For how many years do you work in health care?

☐ Years

54. What is your profession?

☐ Nursing assistant (NVQ level 2)
☐ Nursing assistant (NVQ level 3)
☐ Nurse
☐ Nursing home physician
☐ Other_____
_____

55. How many hours a week do you work?

☐ Hours a week

56. What shifts do you work?
(multiple answers possible)

☐ Day shifts
☐ Evening shifts
☐ Night shifts

57. At what type of ward do you work?
(multiple answers possible)

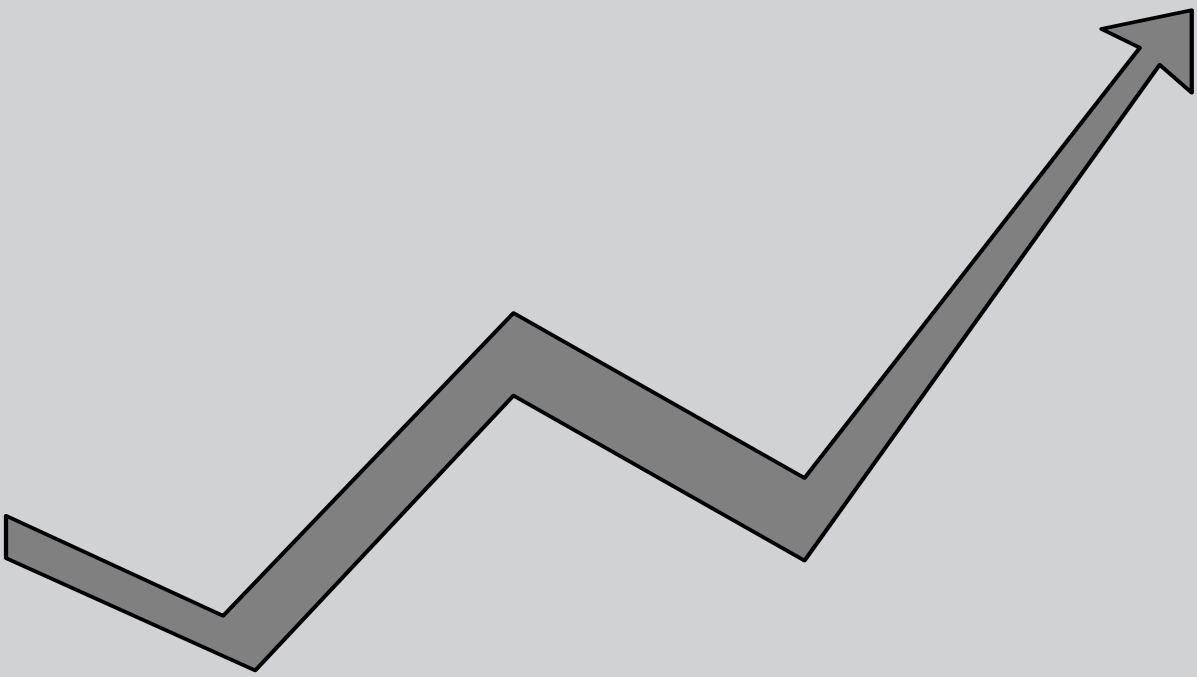
☐ Somatic care
☐ Psycho-geriatrics care
☐ Revalidation
☐ Other _____
_____

58. How many beds does the nursing home you work at have?

☐ Beds

Thank you very much for your cooperation!

Appendix D



Questionnaire among Nursing Home Management Used for the Study Described in Chapter 4.5

Questionnaire for management of Dutch nursing homes

1. What percentage of the patients in your nursing home was vaccinated against influenza last year (autumn 2007)? ____ %

2. What percentage of HCWs (health care workers) in your nursing home was vaccinated against influenza last year (autumn 2007)? ____ %

3. Does your nursing home currently have a written policy on influenza vaccination for HCWs? Yes / No

4. What is the current policy on offering influenza vaccination to HCWs in your nursing home?
   ☐ We actively request HCWs to get vaccinated against influenza
   ☐ HCWs can only get vaccinated on their own initiative
   ☐ We do not offer influenza vaccination to the HCWs

5. How are HCWs currently informed about influenza vaccination?
   (more than one answers allowed)

   ☐ By personal written information (e.g. invitation letters, leaflets)
   ☐ By collective written information (e.g. posters)
   ☐ By group oral information (e.g. information meeting)
   ☐ Other, namely……..

6. Does the management of your nursing home agree with the fact that influenza vaccination of HCWs is effective in reducing mortality and morbidity of the patients?

   ☐ Strongly agree
   ☐ Agree
   ☐ Do not agree/ Do not disagree
   ☐ Disagree
   ☐ Strongly disagree

7. Does the management of your nursing home agree with the fact that influenza vaccination of HCWs is effective in reducing the costs related to influenza?

   ☐ Strongly agree
   ☐ Agree
   ☐ Do not agree/ Do not disagree
   ☐ Disagree
   ☐ Strongly disagree

8. Does the management of your nursing home agree with the fact that HCWs have a special responsibility in preventing influenza transmission to patients?

   ☐ Strongly agree
   ☐ Agree
   ☐ Do not agree/ Do not disagree
   ☐ Disagree
   ☐ Strongly disagree

9. Does the management of your nursing home agree with the fact that they have a moral responsibility to implement voluntary influenza vaccination of HCWs?

   ☐ Strongly agree
   ☐ Agree
   ☐ Do not agree/ Do not disagree
   ☐ Disagree
   ☐ Strongly disagree

10. Does the management of your nursing home agree with the fact that mandatory influenza vaccination of HCWs should be implemented if voluntary vaccination fails to reach a sufficient vaccination rate?

    ☐ Strongly agree
    ☐ Agree
    ☐ Do not agree/ Do not disagree
    ☐ Disagree
    ☐ Strongly disagree

11. Do you have any supplementary comments?