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Could a federal program to promote influenza vaccination among elders be cost-effective?

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Abstract

Background. Influenza-related mortality predominately and disproportionately impacts the elderly. Rates of annual influenza vaccination among the elderly are approximately 65%, far below the *Healthy People 2010* target of 90%. We estimated the cost-effectiveness of a 10-year federal program to promote influenza vaccine, intended to increase vaccination rates among persons ≥65 years old.

Methods. Published estimates regarding influenza-associated mortality rates and vaccine efficacy among the US elderly were used to calculate the number needed to vaccinate (NNV) to prevent one all-cause death due to influenza, as well as the mortality reduction expected from increased vaccination rates. The costs per life-year saved were estimated for a hypothetical federal promotional campaign, patterned after a direct-to-consumer (DTC) advertising program (2006–2015). The base case scenario presumed a 25-percentage-point increase in vaccination rates to 90%; in sensitivity analyses, we examined programs that increased rates by 10–20 points.

Results. The base case NNV was 1116 (95% CI: 993–1348). Over the 10-year DTC-style influenza vaccine promotion program, 6516 (5576–7435) elderly lives would be saved. The incremental cost-effectiveness (*C*/*E*) of the program was $16,300 ($11,347–$25,174) per life-year saved in 2006 and increased to $199,906 ($138,613-$307,423) per life-year saved by 2015. Overall, the *C*/*E* for the 10-year program was $37,621 ($32,644–$43,939) per life-year saved. Programs that yielded a 15-percentage-point increase or less in vaccination rates would have *C*/*E* values exceeding $50,000 per life-year saved and save fewer than 4000 total lives.

Conclusions. DTC-style promotional campaigns for influenza vaccine among elders may represent a cost-effective strategy for the federal government to pursue as a means of increasing elders' vaccination rates and reducing influenza-related mortality.

Keywords: Influenza; Mortality; Vaccine; Direct-to-consumer advertising; Elders; Cost-effectiveness

Introduction

Influenza is estimated to cause 36,000 deaths annually in the United States, disproportionately among the elderly (Thompson et al., 2003). Influenza vaccine effectively reduces illness, hospitalizations, and deaths attributable to influenza (Gross et al., 1995). Despite known benefits of the vaccine, recent national rates of annual influenza vaccination among the elderly are approximately 60%–65%, far below the *Healthy People 2010* target of 90% (Centers for Diseases Control and Prevention, 2003a).

Direct-to-consumer (DTC) advertising has proved to be an effective method of increasing sales of prescription pharmaceuticals (Findlay, 2001) and may represent an opportunity to improve influenza vaccination rates. Spending on pharmaceutical DTC advertising in the US increased from $266 million in 1994 to $3.2 billion in 2003 and has been credited for substantial growth in sales of the advertised products (Vogel et al., 2003; Kaiser Family Foundation, 2004).

Critics of DTC advertising assert that it promotes unnecessary and sometimes inappropriate utilization of pharmaceuticals and distorts decision making in the physician–patient relationship (Robinson et al., 2004; Hollon, 2005). However, if DTC advertising approaches were used by a government agency to promote national vaccine recommendations targeting high-risk individuals such as elders, unnecessary or inappropriate

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utilization (presuming adequate supply) would be exceedingly rare.

In this study, we examined the potential cost-effectiveness of a federal program promoting influenza vaccination of elders, designed in the style of a DTC advertising campaign, as a method of increasing vaccination rates and achieving mortality benefits in this high-risk population.

Methods

Decision analytic model

We constructed a decision analytic model of a hypothetical cohort of the US elderly population with a baseline influenza vaccination rate of 65%. As per consensus recommendations for cost-effectiveness analysis, all costs and benefits in the model were discounted annually at 3% (Gold et al., 1996).

Perspective

In estimating direct program costs and benefits, we assumed the perspective of the Department of Health and Human Services (DHHS) in its role to protect the health of elder Americans through promotion of available influenza prophylaxis.

Model estimates

Number needed to vaccinate

The number needed to vaccinate (NNV) quantifies the number of people that must be vaccinated to prevent one death and is analogous to the number needed to treat (NNT) (Laupacis et al., 1988). Other investigators have previously applied the NNV framework to an analysis of influenza vaccine for persons aged 65 and older (Kelly et al., 2004). Published data regarding influenza-associated mortality rates and vaccine efficacy among elderly in the US (Thompson et al., 2003; Gross et al., 1995) were used to calculate the NNV to prevent one all-cause death due to influenza. The NNV was estimated as 1 / [(population all-cause mortality rate) * (vaccine efficacy against all-cause mortality)] (Kelly et al., 2004), with confidence intervals corresponding to published 95% confidence intervals (Gross et al., 1995) for vaccine efficacy among the elderly.

Estimated reduction in influenza mortality

The NNV was used to calculate the estimated reduction in mortality expected to result from an increase in the national elderly influenza vaccination rate. US Census data were used to obtain elderly population projection estimates (2006–2015) (US Census Bureau, 2005) (Table 1), which were used to calculate the incremental number of elderly vaccinees with a vaccination rate increase in each year of the model. The NNV and incremental number of vaccinated elderly persons were used to calculate the number of influenza-related all-cause deaths prevented through increased vaccination.

For each year, the incremental number of vaccinated persons was calculated as the proportion of elderly who would be vaccinated as a result of the DTC program-induced increase in elderly vaccination rates in that year. For example, if the program was expected to induce a 2-percentage-point increase in the elderly influenza vaccination rate in a given year, then the incremental number of vaccinees would be 2% * [elderly population in that year]. This number, in conjunction with the NNV, then permitted a calculation of how many influenza-related deaths would be averted through this incrementally higher vaccination rate.

Published estimates of the projected elderly population distribution from the Census (US Census Bureau, 2005) (Table 1) and age-specific life expectancy for elderly persons from life tables (Centers for Disease Control and Prevention, 2004) were used to calculate the number of life-years saved. The life tables provided the life expectancy in 1-year age groups for the population at age 65, 65,..., 99, and 100 and over. The fraction of the total elderly population at each age was multiplied by the life expectancy for that age. Summation across each age group provided an overall estimate of the average life expectancy of an elderly person. This average life expectancy value was multiplied by the number of lives saved (obtained through the NNV) to estimate the number of life-years saved for each year 2006–2015.

Table 1
Model parameters

Variable	Base case estimate	Range for sensitivity analysis	Sources
Costs			
DTC advertising ($)	194.1 million	±10%	Findlay (2001)
Increase per year (%)	3		
Vaccine dosage ($)	12.20		Centers for Medicare and Medicaid Services (2005b)
Increase per year (%)	10	5–15	
Vaccine admin fee ($)	18.90		Centers for Medicare and Medicaid Services (2005a)
Increase per year (%)	3	1.5–6	
Population mortality rate	0.001325		Thompson et al. (2003)
Vaccine efficacy (%)	50	25–75	Gross et al. (1995)
Elderly population (millions)			US Census Bureau (2005)
Year 2006	37.2		
Year 2007	37.8		
Year 2008	38.7		
Year 2009	39.8		
Year 2010	40.2		
Year 2011	41.1		
Year 2012	42.6		
Year 2013	44.0		
Year 2014	45.3		
Year 2015	46.8		

DTC advertising and incremental vaccination costs

Data regarding DTC advertising costs and sales volume effects for pharmaceuticals were used to inform estimates of DTC advertising spending necessary to increase influenza vaccination rates (Findlay, 2001). In 1999, total DTC advertising spending for the 24 most heavily advertised drugs was $1.338 billion, compared to $481 million spent on DTC advertising by the rest of the market (net spending = $857 million) (Findlay, 2001). From 1998 to 1999, the incremental change in sales for the 24 most heavily advertised drugs was 41.7%, compared to 14.4% for the rest of the market, resulting in an average net sales volume increase from DTC advertising of 27.3% (Findlay, 2001).

Past annual and biannual increases in the influenza vaccination rate indicate that a vaccination rate increase of 6 percentage points in the first DTC program year is plausible (Centers for Diseases Control and Prevention, 1995). Therefore, using pharmaceutical DTC cost and volume trends as a guide (adjusted to 2005 $US), we calculated that DTC spending of $194.1 million would yield a 6-percentage-point increase in influenza vaccination volume during the first year. We assumed that DTC spending would increase equivalent to the discount rate in order to remain at its initial program benchmark (Table 1), yet we anticipated diminishing annual returns over time in the impact of the DTC advertising program on the vaccination rate (Table 2).

The estimated vaccine administration fee was based on the mean Medicare influenza vaccine administration fee (Centers for Medicare and Medicaid Services, 2005a), and the cost per incremental dose of vaccine was based on Medicare payments in 2004 (Centers for Medicare and Medicaid Services, 2005b) (Table 1). Vaccine administration fee increases were expected to offset the discount rate, and vaccine dose costs were estimated to increase according to past market trends of injectable influenza vaccine doses (Centers for Medicare