Fiscal Impact of Adult Vaccination in The Netherlands

An Analysis Conducted On Behalf of the Supporting Active Ageing Through Immunisation (SAATI) Initiative

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Background

Healthcare: a government perspective on investing in immunization

The conventional economic framework for evaluating health conditions predominantly focuses on the direct costs of healthcare, and that has been addressed elsewhere in this Scorecard Report. However, an economic framework focusing purely on direct costs ignores the wider costs and benefits to the public sector of poor health or changes in health status achieved through publicly funded programs. By adopting a *government perspective* framework to population health, as described in this chapter of the Scorecard Report, it is possible to explore how poor health of some individuals place demands on government resources not only in relation to health services but also in relation to disability payments and social services, as well as lost productive output which influences government tax receipts. When impaired health strikes a person of working age, the demands placed on public services in terms of health and social services will need to be paid for through tax contributions of the remaining workers.

To complete our economic assessment of the value of adult immunization for Europe, we consider this relationship between investments in health and resulting changes in morbidity and mortality on government accounts for adult immunization for the seven communicable diseases identified by the SAATI partnership. We apply a government perspective framework to adult vaccination costs to determine the return on investment in future discounted net tax revenue. The aim is to estimate to what extent the fiscal benefits associated with vaccinating a cohort of adults aged 50 will exceed the costs of vaccination.

Because this evaluation applies a longitudinal approach to assessing the impacts of adult immunization in direct and indirect effects, we first needed to identify a country case study to evaluate the fiscal impact of adult vaccination based on changes in lifetime changes in gross tax receipts and transfer costs attributed to changes in morbidity and mortality associated with vaccine preventable conditions. We selected the Netherlands as the case study because of the availability of data on public expenditure and meaningful data on the clinical benefits of vaccination. The analysis considers a comprehensive adult vaccination program in those over the age of 50.

Method

The analytic framework described here considers the government perspective with respect to public investments in adult vaccinations for a cohort at the age of 50. From the government perspective, changes in health and productivity gains attributed to investments in health will have fiscal implications for government. To assess the fiscal impact of health requires following a lifetime modeling approach which considers how investments influence both government transfers (eg, pensions, healthcare) compared with ongoing tax transfers to government (eg, income tax, value added tax, social insurance).

The analysis described here depicts the gross tax receipts to the government for the seven communicable diseases commonly administered to adults. Based on projected incidence rates for each we derive estimates for productivity and labour force participation linked to each vaccine preventable condition. Linked to vaccine investment costs we project the future tax revenue associated with the resulting changes in morbidity and mortality. This entails accounting for future income tax payments based on retirement at the age of 67, lifetime value added tax contributions, and social insurance contributions. These three tax transfers from citizen to state over their remaining lifetime reflect the financial value of changes in tax revenue linked to infection rates from the perspective of the Dutch government.

For deriving the fiscal impact of vaccination the cost of vaccination were based on a vaccination schedule for the seven vaccine preventable conditions, which includes annual influenza vaccination. The costs for vaccine administration were also included based on historical evidence on influenza vaccination coverage rates of 77% for all vaccines.

Findings

The adult immunization programme for the seven vaccine preventable conditions in the Netherlands is projected to prevent 34,528 infectious disease cases over a period of 50 years, and roughly 5,782 premature deaths from infections. This was estimated to reduce the number of lost work days by 127,480 days with an estimate of 29 fewer disability cases over the remaining number working years for those vaccinated at 50-years of age.

The economic consequences from reducing the number infectious cases in adults was projected to yield a range of benefits for government including medical cost-savings, reduced disability costs and increased tax revenue linked to labour force activity. Specifically, the health cost savings is projected to reach €6.6 million, with €4.2 million in social insurance savings paid towards sick day payments to workers. The most important fiscal benefit was linked to future lifetime tax contributions from implementing adult vaccination compared with no vaccination with €54.1 billion and €54.7 billion, respectively, resulting in revenue gain of €537 million over the remaining life years of the cohort.

The budgetary estimates for vaccinating those aged 50 was estimated to be €136 million, which includes annual costs for influenza vaccination for the remainder of life. Based on the investment costs of vaccinating those age 50 in the year 2012, the project revenue gains yields a benefit-cost ratio of 4.02. This would suggest that for every €1 invested in adult vaccination for those aged 50 would yield €4.02 over the lifetime of the cohort.

Table 1 Impact of adult vaccination on government costs and tax revenue over lifetime of 50-year old cohort in the Netherlands

Government budget item	Value	Incremental Fiscal impact
Medical cost-savings	Savings	€6,651,724
Productivity loss (social insurance)	Savings	€4,199,281
Prevented disability costs	savings	€502,426
Gross discounted tax	Revenue	€537,394,410

Discussion and Policy Considerations

Over the past century dramatic reductions in morbidity and mortality in developed economies have provided considerable economic benefits to nations as people have lived longer more productive lives (WHO, 2002). To a large extent vaccination has contributed to these economic benefits (Bloom, 2005). In coming generations the opportunities for economic growth are under threat due to fewer numbers of working aged adults supporting tax financed public programs.

Looking ahead to the future, a report commissioned by the European Commission exploring the relationship between health and economic outcomes noted that even within advanced economies today that economic growth could be achieved through improved population health (Suhrcke, 2005). These recommendations suggest that how nations spend their healthcare resources can continue to influence future economic outcomes. As many countries in Europe start to age and the numbers of working aged adults starts to decline, the relationship between health and economic growth is an important policy consideration with respect to the allocation of scare healthcare resources. In the context of ageing populations the report to the European Commission provides an economic rationale for maintaining a healthy workforce.

As the number of working aged adults is starting to shrink, the importance of a healthy workforce for maintaining economic growth is one of the opportunities where health policy can influence population health and in-turn economic outcomes (Connolly, 2009). It is also important to recognize that the relationship between healthcare and economics is not just about keeping people alive for longer, but recognizes that economic growth is driven by the healthy that are able to supply labour to the market and to continue working into older ages (van Zon, 2005). Consequently, the manner in which health investments influence labour force participation, labour productivity and creativity, and the absolute number of hours on the job needs to be taken into consideration when evaluating medical funding and healthcare priority setting.

The fiscal consequences of population health status and investments in health are pervasive, although seldom evaluated and reported in the health economic literature. For governments, changes in population health that have occurred over the past half century have brought both positive and negative fiscal consequences attributed to increased tax revenues from people working and paying taxes for longer, as well as increased financial responsibilities to care for an ageing society in the form of pensions and healthcare, respectively (European Commission, 2012; Manton, 2009). In light of the fiscal consequences of health, the ongoing demographic transition in Europe poses challenges for health services faced with meeting the needs of an ageing population without neglecting the health of those working and supporting publicly financed programs. Estimates from the UK National Health Service suggest that 50% of healthcare spending is targeted at those over the age of 65. [1] As populations continue to age the demand on health services for those aged more than 65 are likely to increase while the proportion of people supporting tax funded health systems starts to decline.

[1] http://www.if.org.uk/projects/health

The risks associated with an ageing society are not restricted to the purely financial. Considering the increased demands of an ageing population on public finances and the necessity to increase taxes on those working to fund commitments to social programs, commentators have suggested that age-related expenditure patterns could lead to intergenerational conflict between generations (Binstock 2010; Walker, 1990). In support of the intergenerational conflict ideology, research into the subject of intergenerational inequity has noted a steady deterioration in intergenerational fairness over the past two decades with increasing burden being placed on younger generations (Leach, 2012). The authors have base these conclusions by measuring the impact of government policies on different age groups using an index compromised of health, pensions, employment, and government debt. In light of the potential intergenerational fairness within health services, health policies will need to take into consideration the intertemporal and intergenerational consideration in relation to expenditure patterns. The ongoing demographic transition impending increased taxes to be asked of younger generations has raised questions about intergenerational equity and whether such a system is sustainable and fair. The resulting consequences are unknown but have the potential to raise considerable social

The analysis described here demonstrates that investments in adult immunisation yield positive benefits for government in terms of cost savings and increased tax revenue. The increased tax revenue is attributed to higher rates attributed to increased labour force participation of those vaccinated based on lower mortality, reduced disability and increase productivity compared to an equivalent non vaccinated scenario. An investment in vaccination of €1 is likely to provide over €4 of future economic revenue for government. These findings are consistent with a study of Health, Ageing and Retirement in Europe (2005) which demonstrated that elderly populations, despite diminishing earnings have a significant residual societal and fiscal value in terms of disposable income and consumption which translates into tax revenue for the government Considering the impending fiscal challenges associated with an ageing population, the findings describe here could be an important consideration in future health policies.

Policy considerations

- European policy-makers should consider comprehensive adult vaccination as one of the policy options for improving the welfare of society that will also influence a broad range of economic outcomes.
- Public investments in adult vaccination provide an approximate 4-fold return on investment attributed to reduced government expenditure and increased tax revenues
- Intergenerational fairness is an important policy consideration with respect to how resources are allocated throughout members of society and those that are required to pay for public programs

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Quantitative analytic methods

A cohort model was developed in order to simulate the lifetime of a vaccinated and an unvaccinated cohort of 50 year old Dutch individuals. The survival of an average cohort was simulated based on the current Dutch life-tables (http://statline.cbs.nl/).

<u>Epidemiological inputs</u>

Epidemiological evidence was collected, for the scope diseases, from the published literature. Specifically, the age-specific incidence and mortality of each disease was collected and applied to the simulation using the survival tables for Dutch 50-year old cohort. Table 1 illustrates the annual age-specific incidence and mortality employed in the model. Subsequently, annual infection cases were estimated for a period of 50 years. Similarly, the annual fraction of deaths attributable to each disease was estimated. The health economics literature was also searched to identify direct medical cost estimates for each of the scope infections. In addition, estimates of sick-days per disease were identified. Finally, estimates from the literature were obtained for the disability cases resulting from infection and the associated costs.

Table 1 Epidemiological inputs

Age	Influenza[1]	Pneumonia[1]	IPD[1]	Pertussis[2]	Diptheria[1]	Herpes zoster[3]	Tetanus[1]
Age-specific incidence							
50-55	0.011000	0.008500	0.000110	0.000117	0.00000	0.005110	0.00000
55-60	0.013000	0.009500	0.000150	0.000117	0.00000	0.005110	0.00000
60-65	0.014500	0.011000	0.000260	0.000117	0.00000	0.006580	0.00000
65-70	0.012000	0.013500	0.000400	0.000117	0.00000	0.006450	0.00000
70-75	0.012500	0.019000	0.000550	0.000117	0.00000	0.007200	0.00000
75+	0.013000	0.025500	0.000680	0.000117	0.00000	0.007750	0.00000
Age-specific mortality							
50-55	0.000050	0.000447	0.00001	0.00000	0.00000	0.00000	0.00000
55-60	0.000050	0.000748	0.00001	0.00000	0.00000	0.00000	0.00000
60-65	0.000050	0.001614	0.00004	0.00000	0.00000	0.00000	0.00000
65-70	0.000304	0.002718	0.00008	0.00000	0.00000	0.00000	0.00000
70-75	0.000304	0.006772	0.00020	0.00000	0.00000	0.00000	0.00000
75+	0.004178	0.019268	0.00051	0.00000	0.00000	0.00000	0.00000

Sources: 1.http://statline.cbs.nl/ 2. De Greeff et al 2008 3. Van lier et al 2010

Vaccine efficacy and health economics

The efficacy assumptions for each of the scope vaccinations was obtained from published cost-effectiveness analyses in the Netherlands. The same sources were used to identify vaccination coverage rates as well as the vaccination schedule per scope disease. A 77% coverage rate was applied to all vaccinations based on historical Dutch evidence for the coverage of the adult annual influenza vaccination program. Vaccination unit costs originated from the list vaccine prices in the Netherlands. Institutional costs per vaccine dose were also included in the analysis. Table 2 summarises the health economics, vaccine efficacy and coverage assumptions used in the cohort model.

Table 2 Health economics and vaccination inputs

	Influenza[1,6]	**Pneumonia[2]**	**IPD[2]**	**Pertussis[3,8]**	**Diphtheria**	**Herpes zoster[5]**	**Tetanus**
Health economic variables							
Direct per case medical cost	87	1,462	1,541	1,031	0	179	0
Sick-days per case	3.25	5	5	5.98	0	10.1	0
Disability cases	0%	1.5%	1.5%	0%	0%	0%	0%
Vaccines' efficacy and cost							
RRR incidence	27%	11%	97%	89%	0%	67%	0%
RRR mortality	42%	11%	97%	89%	0%	0%	0%
Vaccination coverage	77%	77%	77%	77%	77%	77%	77%
Vaccination cost per immunization[7]	12.35	137.12	137.12	18.30		77.00	
Institutional costs per immunization	5.95	11.90	11.90	5.95	0.00	5.95	0.00

Sources: 1. Jefferson et al 2005 2. Rosenbaum et al 2010 3. De Vries et al 2010 4.Tacken et al 2009 5. Van lier et al 2010 6. Postma et al 2007 7. http://www.medicijnkosten.nl/ 8. McGarry et al 2012

Earnings, productivity and tax

The national statistics were researched to identify age-specific earnings which were, in turn, adjusted for unemployment based on the current age-specific unemployment rates. The household surveys were used to quantify the age-specific level of earnings, disposable income and direct tax paid by an average individual over his or her lifetime. A proportion of the disposable income was considered to be indirect tax paid in the form of VAT. Age-specific earnings were also used to quantify the losses associated with sick-days. In particular, the analysis included the fraction of the cost which is paid by the national insurance system in order to reimburse employees for a sick-day based on the existing local labour legislation. An average expected retirement age of 67 years was assumed.

Model's assessments

For each cohort the present value (PV) of total lifetime direct and indirect tax was calculated. In order to quantify the fiscal benefit of vaccinations the model quantified the incremental PV of total direct and indirect tax between the vaccinated and the unvaccinated cohorts. In addition, the model quantified the PV of the direct medical cost-saving resulting from the reduction of morbidity as well as the prevented disability costs. Moreover, the model quantified the indirect benefit of reducing the sick-days cost burden for the national insurance. Finally, the model quantified the PV of vaccination costs. Cost and benefits were discounted at the long-term (10-year) bond rate of the European Central Bank (1.8%). Furthermore, costs and earnings were inflated at 2% to reflect future cost-inflation and productivity changes. Vaccination costs were deducted from the total benefits of vaccinations to calculate the Net Present Value of investing in an adult vaccination program. The Benefit-Cost ratio was estimated to reflect the rate of return from investing in vaccinations from the perspective of the Dutch government (Table 3).

Table 3 Model's assessments

$$Vaccination\ benefits = \sum_{t=1}^{Le} \frac{(Incremental\ Tax + Incremental\ Health\ Cost + National\ insurance\ benefits))}{(1+r)^t}$$

$$Vaccination\ cost = \sum_{t=1}^{Le} \frac{Cov_{tj} x Cost_{tj}\ x\ S_t}{(1+r)^t}$$

$$NPV = Vaccination\ benefits - Vaccination\ cost$$

$$ROI = Vaccination\ benefit/Vaccination\ cost$$

Where r: discount rate; t: year; j: Vaccine type; Cov: Vaccination coverage rate; Cost: Vaccine cost; S_t*: Number of survivors in year t*

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