UK Health Economic Model Demonstrates Use of Adjuvanted Trivalent Seasonal Influenza Vaccine in Older Adults to be Highly Cost-Effective

Van Hung Nguyen [1], Claudia Kelly [2], James A. Mansi [3]

[1] VHN Consulting, Montréal, Canada; [2] Seqirus Inc., Cambridge, MA, USA; [3] Seqirus Canada Inc., Montréal, Canada

BACKGROUND

- Despite a current vaccination coverage of ~75% in the UK[1], influenza infection in older adults (> 65 years of age) continues to have severe consequences, resulting in approximately 13,000 deaths[1], 15,000 hospital admissions[2], and 109,000 general practitioner (GP) consultations[2] every year. This high burden of disease in the elderly population is in part due to immunosenescence and the resulting suboptimal clinical effectiveness of influenza vaccines in this age group.
- There is a significant, unmet clinical need for specialized influenza vaccines which provide enhanced protection to older adults.
- Here we present cost-effectiveness data to support the use of an inactivated, seasonal, MF59®-adjuvanted, trivalent influenza vaccine (aTIV; Fluad™, Seqirus Inc.) in older adults.

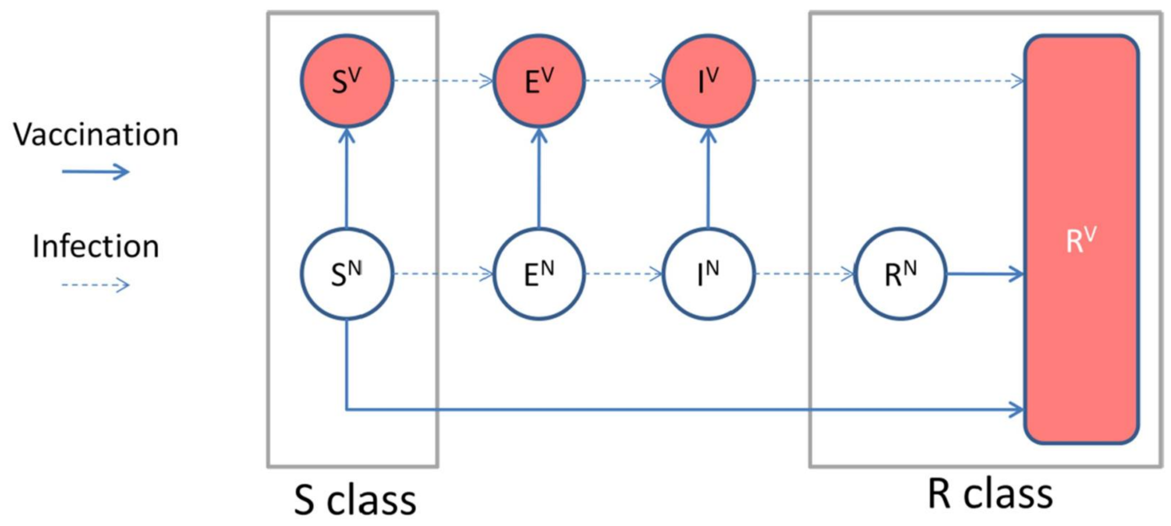
OBJECTIVES

- The objective of this study was to evaluate the cost-effectiveness of aTIV introduction in the UK for use in adults over 65 years of age.

METHODS

- A Susceptible-Exposed-Infected-Recovered (SEIR) dynamic influenza transmission model adapted from Baguelin et al[3] was developed to estimate the epidemiological impact of aTIV (**Figure 1**)

Figure 1: SEIR Influenza transmission model structure



S^V: susceptible vaccinated; E^V: exposed vaccinated; I^V: infected vaccinated; R^V: recovered vaccinated; S^N: susceptible non-vaccinated; E^N: exposed non-vaccinated; I^N :infected non-vaccinated; R^N: recovered non-vaccinated

- The model is structured by age (seven age groups) and by risk groups (high and low risk) (**Table 1**)
- Contrary to the Baguelin model[3], a Bayesian framework was not used to estimate likely posterior distributions for unknown parameters.
- Central values from available posterior distributions published by Baguelin et al[3] as inputs were used
- The probability of influenza transmission in the model is calibrated to reproduce the ‘No vaccination scenario’ (low, high and base case) as per the Baguelin[1] model.
- Vaccine effectiveness assumptions are represented in **Table 2** and economic inputs are listed in **Table 3**.
- Polymod data for the UK was used to estimate the contact matrix between age groups
- Current UK influenza vaccination strategy was compared to a strategy where aTIV was used in adults over 65 years of age. The NHS perspective was used for the analysis.
- Probabilistic sensitivity analysis were conducted on influenza incidence, vaccine effectiveness and costs (primary and hospitalisation).

Table 1: Probability of Influenza related Hospitalisation by age

	Low risk	High risk
<1 year	0.1603	0.0982
1-4 years	0.1051	0.0587
5-14 years	0.0094	0.0356
15-24 years	0.0172	0.0557
25-44 years	0.061	0.1973
45-64 years	0.0347	0.1033
>65 years	0.3466	0.4165

Table 2: Vaccine effectiveness assumptions

		Under 65	Over 65
TIV	Match	70%	46%
	Mismatch	42%	28%
QIV	Match	70%	45%
	Mismatch	42%	45%
aTIV	Match	NA	73%
	Mismatch	NA	45%

Table 3: Economic inputs

Parameter	Estimate
Relative risk of consulting a GP in a risk group	1.51
Cost of vaccination (administration of vaccine)	£10
Febrile cases	0.406
All acute respiratory infection cases	0.645
QALY loss per non-fatal ILI case	7.49 x 10-3
QALY loss per non-fatal acute respiratory infection case	1.01 x10-3
QALY loss per hospitalisation	0.018
Hospital cost (per episode) 0-1 years	£1,606
Hospital cost (per episode) 1-4 years	£1,606
Hospital cost (per episode) 5-14 years	£1,606
Hospital cost (per episode) 15-24 years	£1,634
Hospital cost (per episode) 25-44 years	£1,662
Hospital cost (per episode) 45-64 years	£1,983
Hospital cost (per episode) >65 years	£5,354
GP cost (per consultation) 0-1 years	£88.11
GP cost (per consultation) 1-4 years	£64.54
GP cost (per consultation) 5-14 years	£54.32
GP cost (per consultation) 15-24 years	£65.87
GP cost (per consultation) 25-44 years	£84.78
GP cost (per consultation) 45-64 years	£100.72
GP cost (per consultation) >65 years	£100.02
Cost aTIV	£16
Cost TIV	£6.50
Cost of Fluenz	£18

RESULTS

- The base case compares current vaccination in the UK across all ages with current vaccination up to age 65 and aTIV in patients aged 65+ years.

Table 4: Base Case Results

	Current	Current Plus aTIV	Incremental Analysis
Number of Cases	1,509,600	1,331,400	- 195,600
Number of GP Visits	165,400	143,600	- 21,800
Number of Hospitalisations	12,523	10,229	- 2294
Number of Deaths	4633	2926	- 1707
Cost of GP Visits	£12,189,500	£10,519,000	- £1,670,500
Cost of Hospitalisations	£32,489,800	£24,042,100	- £8,447,700
Vaccine Administration Cost	£117,903,000	£117,903,000	£0
Vaccine Cost	£88,901,800	£163,050,700	£74,148,900
Total Direct Costs	£246,366,400	£301,397,100	£64,030,700

Table 5: Health Outcomes

	Current	Current Plus aTIV	Incremental Analysis
Life Years Lost	71,479	49,030	22,449
Life Years Lost (Discounted)	48,908	32,290	16,618
QALY Lost Due to Sickness	11,532	10,026	1506
QALY Lost Due to Death	70,140	47,857	22,283
QALY Lost Due to Death (Discounted)	48,506	31,938	16,568
Total QALY Lost	81,672	57,882	23,790
Total QALY Lost (Discounted)	60,038	41,964	18,074

- As shown in **Table 4**, use of aTIV in all patients aged 65+ years reduces the number of cases of influenza by 195,600, with attendant reductions in GP visits, hospitalisations and deaths.
- Health Outcomes are shown in **Table 5**.
- Assuming a vaccine cost of £16, aTIV has an ICER of £3,540 per QALY (discounted), which is significantly below the £20,000 threshold (**Table 6**).
- Scenario analyses show that the results are sensitive to vaccine efficacy. Reducing efficacy of aTIV to 60% from 73% would increase the ICER to £6,630 per QALY, still comfortably below the threshold.
- Probabilistic sensitivity analyses demonstrate that more than 97% of the simulations result in ICER below £19,048. (**Table 7; Figure 2**). That is, even if increased efficacy was only 1% over the standard dose, the vaccine remained cost-effective.
- Additional analyses have also demonstrated that between a price range of £10 to £13, the utilisation of aTIV in individuals 65+ years in the UK is cost-neutral to the NHS

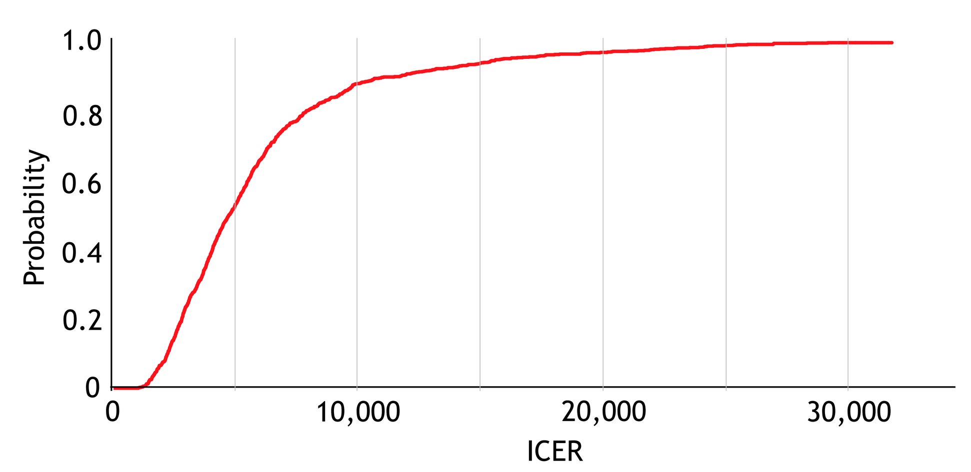
Table 6: Incremental Cost-Effectiveness Ratio

Items	ICER
£ per Life Gained (Undisc)	2850
£ per Life Gained (Disc)	3850
£ per QALY Gained (Undisc)	2690
£ per QALY Gained (Disc)	3540

Table 7: Simulation and Associated ICER

Quantile of Simulation	ICER
25%	£3016
Median	£4625
75%	£6864
90%	£10,919
95%	£15,398
97%	£19,048

Figure 2: Incremental Cost-Effectiveness Ratio Acceptability Curve



CONCLUSIONS

- The clinical and public health benefits, when inputted into an established and published influenza dynamic transmission model for the UK, demonstrate that aTIV is cost-effective with an ICER of £3,540, if used preferentially to current UK vaccination practice in patients aged 65+ years.
- This ICER is robust to sensitivity and scenario analyses, and significantly below the £20,000 ICER threshold. This analysis is based on a benchmark price of £16
- Other analyses carried out in Germany[4] the US[5] and Canada[6] have demonstrated that use of aTIV in people aged 65+ years is cost effective.

REFERENCES

1. Fleming DM, Taylor RJ, Haguinet F, et al. **Influenza-attributable burden in United Kingdom primary care**. *Epidemiology and infection 2016; 144(3): 537-47.*; 2. Matias G, Taylor RJ, Haguinet F, Schuck-Paim C, Lustig RL, Fleming DM. **Modelling estimates of age-specific influenza-related hospitalisation and mortality in the United Kingdom**. *BMC public health 2016; 16: 481.*; 3. Baguelin M, Flasche S, Camacho A, Demiris N, Miller E, Edmunds WJ.: **Assessing optimal target populations for influenza vaccination programmes: an evidence synthesis and modelling study**. *PLoS medicine 2013; 10(10).*; 4. Petri E.: **Gesundheitsökonomische Betrachtung neuartiger saisonaler Influenzaimpfstoffe für ältere Erwachsene (poster).** *Nationale Impfkonferenz (National vaccination conference); 2013; Munich, Germany*; 5. Mullikin M, Tan L, Jansen JP, Van Ranst M, Farkas N, Petri E.: **A Novel Dynamic Model for Health Economic Analysis of Influenza Vaccination in the Elderly**. *Infectious diseases and therapy 2015; 4(4): 459-87.*; 6. Fisman DN, Tuite AR.: **Estimation of the health impact and cost-effectiveness of influenza vaccination with enhanced effectiveness in Canada**. *PloS one 2011; 6(11).*

The Sixth ESWI Influenza Conference: 10 – 13 September 2017. Riga, Latvia