Evaluating the cost-effectiveness of nasal adrenaline spray vs. adrenaline autoinjector for treatment of anaphylaxis: A cost-utility modelling approach

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Background and aim

Anaphylaxis is a rapid-onset, life-threatening systemic hypersensitivity reaction that can escalate to anaphylactic shock: a critical state marked by hypotension, airway obstruction, and ultimately multi-organ failure. Common triggers include certain foods, insect stings, medications, and latex. In the UK, recent data show a seven-fold increase in hospital admissions related to anaphylaxis from all causes over recent years, while mortality rates have remained stable at 0.047 cases per 100,000 people per year [1].

Adrenaline autoinjectors (AAIs), while effective, face barriers that limit their use, prompting the development of alternative administration routes. This study aimed to develop a cost-utility model to assess the cost-effectiveness of nasal adrenaline spray compared to AAIs in managing anaphylaxis in the UK. Previous analyses of alternative administration routes focused on the US setting [2].

Methods

A *de novo* Markov model was developed to capture events of anaphylactic shock from a UK healthcare perspective over a lifetime horizon. The health states used in the model included alive, 1-year post-anaphylaxis, subsequent years post-anaphylaxis, and dead (Figure 1). Following an anaphylaxis episode, patients transition to the 1-year post-anaphylaxis health state. If no further episodes occur within that year, they move to the subsequent years' post-anaphylaxis state. The key inputs used in the health-economic analysis are presented in Table 1.

Figure 1: Model structure

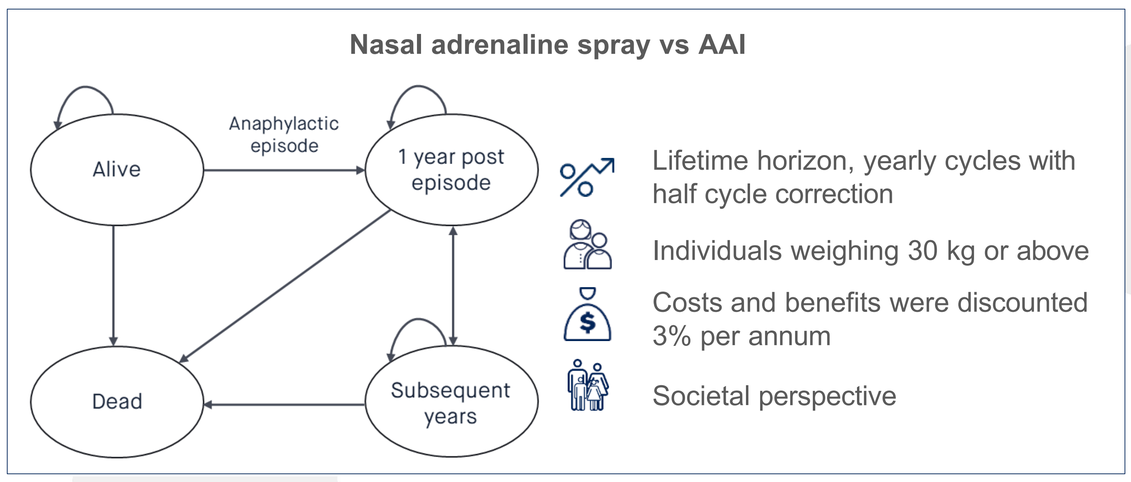


Table 1: Main inputs used in the health economic analysis

Category	Inputs	Value	Sources
Clinical Inputs	Risk of anaphylaxis episode	First year: 21.9%	Mullins, 2003 [3]
		Subsequent years: 8.3%	Resuscitation Council UK, 2021 [4]
	Proper use of the device (conditional on training)	Nasal spray: 99%	Based on Lowenthal, 2022 [5], Hernandez-Trujillo, 2024 [6]
		AAI: 65%	Based on El Turki, et al., 2017 [7]
Quality of Life	Utility decrement during anaphylaxis in hospital	0.000493	Based on Carroll, et al., 2009 [8]
Costs	Annual treatment cost over shelf life	Nasal spray: £102.48	Assumption
		AAI: £124.49	NHSBSA [9] and AAI UK [10]

Results

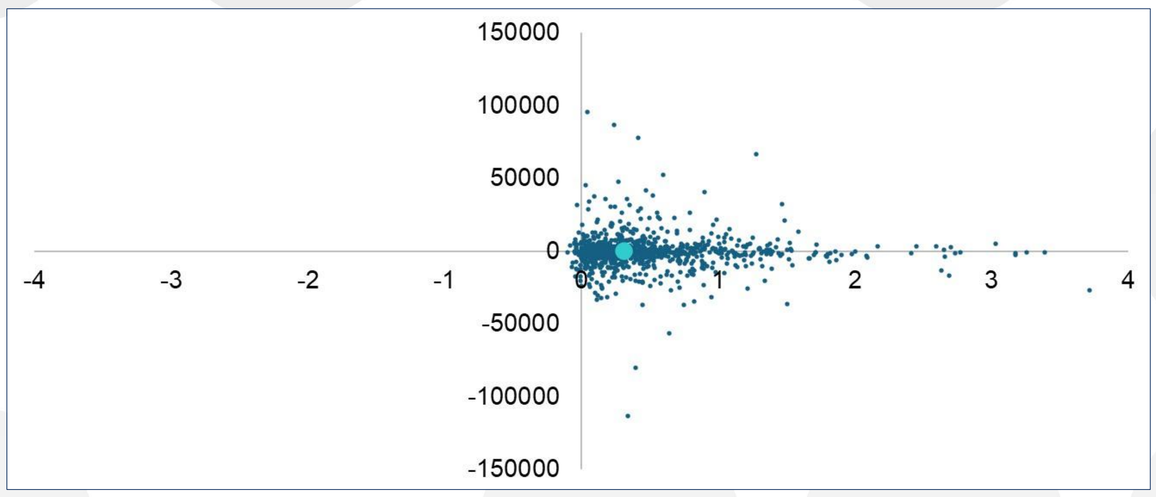
Base case results indicated that the nasal adrenaline spray was more effective and less costly than an AAI (dominant). Incremental total costs were -£706, driven by acquisition (-£474), hospitalisation (-£124) and productivity loss from hospitalisation (-£69). Gains were 0.26 life-years and 0.31 quality-adjusted life years (QALYs). Uncertainty was assessed with deterministic sensitivity analyses (DSA) and probabilistic sensitivity analyses (PSA) plus scenario analyses (Table 2). The DSA (either tested at lower and upper extremes or varied +/- 20%) identified discounting of benefits, the odds ratio for death, and the probability of carrying and using nasal adrenaline spray as key drivers of QALYs. For costs, the main drivers were the discount rate, the odds ratio for hospitalisation, and the probability of carrying and using the spray.

In the PSA (Monte Carlo n=1,000), most simulations fell in the north- and south-east quadrants, with more in the south-east, consistent with the deterministic results (Figure 2).

Table 2: Base case and scenario results

Assumption	Base case	Scenario	ΔCost (£)	ΔQALY
Base case	-	-	-706	0.31
Time horizon	92 years	50 years	-647	0.25
Perspective	Societal	Payer	-675	0.31
Anxiety disutility of not carrying AAI	0.01	0.1	-706	1.07
Disutility associated with anaphylaxis	0.07 for 1 day if no hospitalisation; 0.09 for 2 days if hospitalisation	No disutilities are associated with anaphylaxis	-706	0.31
Discount rate	Costs: 3.5% QALYs: 3.5%	Costs: 5% QALYs: 5%	-551	0.21

Figure 2: Cost-effectiveness plane



Conclusion

In the proposed analysis, nasal adrenaline spray incurred lower costs and more benefits than an AAI in the UK.

The results were primarily driven by assumptions that more individuals would carry and use a spray in comparison to an AAI in the event of anaphylaxis, in turn reducing death and hospitalisation.

As an early health-economic analysis, it highlights the need to capture real-world use of the nasal adrenaline spray to strengthen the analysis for its use in decision-making.

References

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