Executive Summary

PPP Cost–Benefit Modelling Annex

Preventive Fiscal Efficiency and Political Time Horizons: The Case of Obstructive Sleep Apnoea (OSA)

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1. Purpose of the Annex

This annex provides a formal quantitative framework for evaluating preventive public policy through intertemporal fiscal modelling. Using obstructive sleep apnoea (OSA) intervention via national CPAP rollout as a structured case study, the annex tests the central Preventive Public Policy (PPP) hypothesis:

That upstream preventive intervention can generate long-term fiscal efficiency, but that such efficiency may be structurally obscured by political time preference and institutional discounting.

The objective is not advocacy but parameter identification: to determine the conditions under which preventive intervention is fiscally efficient, and to identify the structural thresholds beyond which it is not.

2. Methodological Framework

The annex introduces the Preventive Fiscal Efficiency Model (PFEM), which evaluates preventive expenditure as an intertemporal net present value (NPV) calculation:

$$NPFE = \Sigma (A_t / (1 + r)^t) – C_0$$

Where:

C_0 = initial preventive investment

A_t = expected avoided fiscal costs

r = discount rate

T = time horizon

The model is extended to incorporate:

Crash risk reduction (clinical effectiveness)

NHS healthcare savings

Capital replacement cycles

Treatment adherence

Political discount bias (higher effective discount rate)

This allows the annex to move beyond narrative prevention claims toward structured fiscal boundary testing.

3. Baseline Findings (Moderate Assumptions)

Under moderate and evidence-based assumptions:

Eligible OSA population: ~1.75 million

Driver participation: 50%

Crash risk reduction: 50–72%

NHS savings: ~£55m annually

Initial rollout cost: ~£875m

Social discount rate: 3%

Results indicate:

Annual integrated fiscal savings between £159m and £355m

Cumulative discounted benefits substantially exceed rollout cost

Break-even achieved well within 20 years

Conclusion:

Under realistic parameter ranges, preventive OSA intervention is fiscally efficient and robust to moderate uncertainty.

4. Political Discount Distortion

When evaluated under elevated discounting (10%), representing electoral short-termism:

Long-run benefits compress significantly in present value terms

Margins of apparent fiscal efficiency narrow

However, preventive intervention remains positive under moderate assumptions

This demonstrates a core PPP insight:

Democratic time horizons structurally underweight long-tail preventive gains relative to socially optimal evaluation.

5. Hostile Scenario Stress Test

A deliberately pessimistic model was constructed:

Driver participation: 30%

Crash reduction: 35%

Adherence: 65%

NHS savings reduced

Rollout cost increased to £1.1bn

Replacement cycles at years 5, 10, 15 (50% capital)

Under this configuration:

20-year NPV ≈ –£1.5bn

Preventive intervention is fiscally inefficient

Crucially, adherence improvements alone could not restore viability.

Conclusion:

Preventive fiscal efficiency is capital-cycle constrained under hostile parameter bundles.

6. Structural Insights

The modelling demonstrates that preventive viability is most sensitive to:

Capital depreciation and replacement structure

Clinical crash-risk reduction magnitude

Driver participation exposure

Political discount rate

Sustained adherence

Adherence alone is insufficient if lifecycle capital costs are structurally excessive.

This shifts preventive evaluation from rhetorical optimism to institutional design analysis.

7. Threshold Findings

The annex establishes:

There exists a parameter space within which OSA prevention is fiscally efficient.

There exists a hostile parameter space where it is not.

The boundary between these spaces is primarily determined by capital structure and clinical effectiveness.

This leads to a refined PPP conclusion:

Preventive policy is conditionally efficient, not universally efficient. Its fiscal success depends on governance quality, cost discipline, behavioural compliance, and institutional time horizon alignment.

8. Implications for Preventive Public Policy Doctrine

The modelling annex strengthens PPP in three ways:

It formalises preventive claims into measurable fiscal equations.

It identifies the institutional distortions (discounting bias) that suppress preventive investment.

It demonstrates that preventive policy must be designed around lifecycle sustainability, not just initial intervention.

This moves PPP from philosophical doctrine to quantitative governance framework.

9. Final Conclusion

The OSA case study demonstrates that preventive public policy:

Can be fiscally robust under realistic assumptions

Is vulnerable to capital mismanagement and short-term political discounting

Requires structural alignment between clinical effectiveness, institutional discipline, and behavioural compliance

Preventive governance is therefore not an automatic fiscal good; it is a design-dependent economic strategy.

The annex concludes that PPP’s central hypothesis is supported under defined and defensible parameter ranges, but that preventive investment must be rigorously stress-tested across capital, behavioural, and temporal dimensions before adoption.

Figure 1: Integrated Preventive Benefits

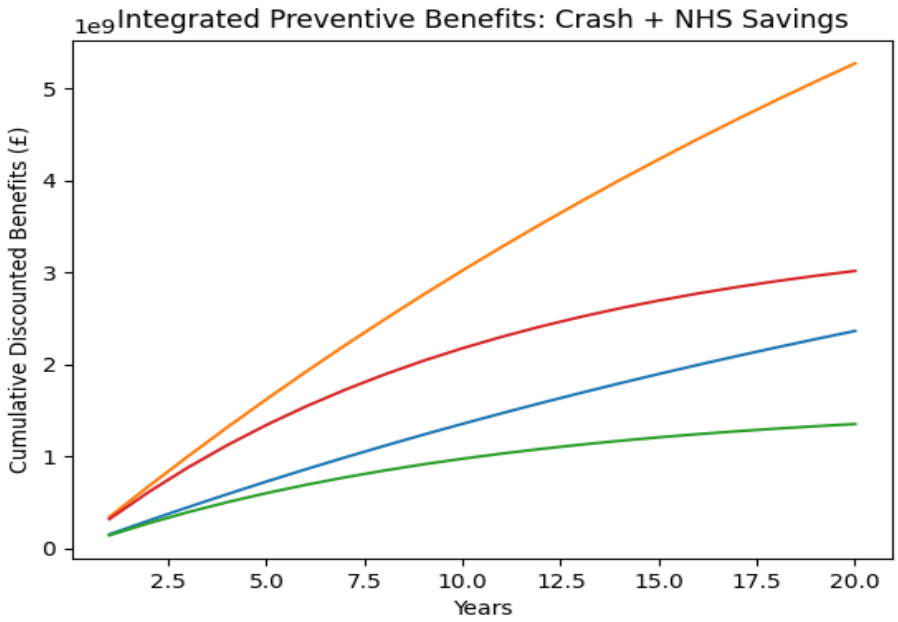

Figure 2: Break-even Comparison