

# Online Supplementary Material to: Cost-effectiveness analysis of non-surgical periodontal treatment for preventing strokes and myocardial infarction in the UK

## 1 Consolidated Health Economic Evaluation Reporting Standards 2022 Checklist

Table 1: CHEERS 2022 Checklist

Topic	No.	Item	Location
<b>Title</b>			
Title	1	Identify the study as an economic evaluation and specify the interventions being compared.	Page 1
<b>Abstract</b>			
Abstract	2	Provide a structured summary that highlights context, key methods, results, and alternative analyses.	Page 2
<b>Introduction</b>			
Background and objectives	3	Give the context for the study, the study question, and its practical relevance for decision making in policy or practice.	Page 3-4
<b>Methods</b>			
Health economic analysis plan	4	Indicate whether a health economic analysis plan was developed and where available.	Page 4-5, 2.1 Model Structure
Study population	5	Describe characteristics of the study population (such as age range, demographics, socioeconomic, or clinical characteristics).	Page 5
Setting and location	6	Provide relevant contextual information that may influence findings.	Page 5
Comparators	7	Describe the interventions or strategies being compared and why chosen.	Page 4-5
Perspective	8	State the perspective(s) adopted by the study and why chosen.	Page 6
Time horizon	9	State the time horizon for the study and why appropriate.	Page 4 and Page 8
Discount rate	10	Report the discount rate(s) and reason chosen.	Page 7
Selection of outcomes	11	Describe what outcomes were used as the measure(s) of benefit(s) and harm(s).	Page 7-8

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<b>Topic</b>	<b>No.</b>	<b>Item</b>	<b>Location</b>
Measurement of outcomes	12	Describe how outcomes used to capture benefit(s) and harm(s) were measured.	Page 7-8
Valuation of outcomes	13	Describe the population and methods used to measure and value outcomes.	Page 7-8
Measurement and valuation of resources and costs	14	Describe how costs were valued.	Page 6-7
Currency, price date, and conversion	15	Report the dates of the estimated resource quantities and unit costs, plus the currency and year of conversion.	Page 6
Rationale and description of model	16	If modelling is used, describe in detail and why used. Report if the model is publicly available and where it can be accessed.	Page 4-6
Analytics and assumptions	17	Describe any methods for analysing or statistically transforming data, any extrapolation methods, and approaches for validating any model used.	Page 4-6
Characterising heterogeneity	18	Describe any methods used for estimating how the results of the study vary for subgroups.	Page 5
Characterising distributional effects	19	Describe how impacts are distributed across different individuals or adjustments made to reflect priority populations.	Page 5
Characterising uncertainty	20	Describe methods to characterise any sources of uncertainty in the analysis.	Page 8
Approach to engagement with patients and others affected by the study	21	Describe any approaches to engage patients or service recipients, the general public, communities, or stakeholders (such as clinicians or payers) in the design of the study.	N/A
<b>Results</b>			
Study parameters	22	Report all analytic inputs (such as values, ranges, references) including uncertainty or distributional assumptions.	Supplementary material Page 4 and Page 10-12
Summary of main results	23	Report the mean values for the main categories of costs and outcomes of interest and summarise them in the most appropriate overall measure.	Page 8-9
Effect of uncertainty	24	Describe how uncertainty about analytic judgments, inputs, or projections affect findings. Report the effect of choice of discount rate and time horizon, if applicable.	Page 9-13

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<b>Topic</b>	<b>No.</b>	<b>Item</b>	<b>Location</b>
Effect of engagement with patients and others affected by the study	25	Report on any difference patient/service recipient, general public, community, or stakeholder involvement made to the approach or findings of the study	N/A
<b>Discussion</b>			
Study findings, limitations, generalisability, and current knowledge	26	Report key findings, limitations, ethical or equity considerations not captured, and how these could affect patients, policy, or practice.	Page 13-15
<b>Other relevant information</b>			
Source of funding	27	Describe how the study was funded and any role of the funder in the identification, design, conduct, and reporting of the analysis	
Conflicts of interest	28	Report authors conflicts of interest according to journal or International Committee of Medical Journal Editors requirements.	Declarations Page

## 2 Model Parameters And Values

Table 2: All model parameters and values

Parameter	Value	Reference
<b>Baseline Hazards</b>		
Base state stroke hazard	0.0336	[1]
Base state CHD hazard	0.0463	[2]
Background death hazard	0.0126	[3]
<b>Case Fatality Rates</b>		
Stroke fatality	0.1	[4]
CHD fatality	0.14	[5]
<b>Hazard multipliers by state</b>		
Stroke Post-Stroke Y1	1.36	[6]
Stroke Post-Stroke Y2	1.36	[6]
CHD Post CHD Y1	1.19	[6]
CHD Post CHD Y2	1.19	[6]
Stroke Post Both Y1	1.94	[6]
Stroke Post Both Y2	1.94	[6]
CHD Post Both Y1	1.94	[6]
CHD Post Both Y2	1.94	[6]
<b>Utilities</b>		
Base	0.83	[7]
Post-Stroke Y1	0.7	[7]
Post-Stroke Y2	0.68	[7]
Post CHD Y1	0.77	[7]
Post CHD Y2	0.74	[7]
Post Both Y1	0.54	Multiplicative approach
Post Both Y2	0.50	Multiplicative approach
Dead	0	
Disutility of stroke event	-0.59	[8]
Disutility of CHD event	-0.03	[9]

### 3 Transition Matrices

Table 3: Base Markov model transition matrices

	Base (no CVD)	Post-Stroke (Y1)	Post-Stroke (Y2)	Post-CHD (Y1)	Post-CHD (Y2)	Post-Both (Y1)	Post-Both (Y2)	Dead (absorbing)
<b>Base Arm</b>								
Base (no prior CVD)	0.912	0.028	0.000	0.037	0.000	0.001	0.000	0.022
Post-Stroke (Y1)	0.000	0.000	0.987	0.000	0.000	0.000	0.000	0.013
Post-Stroke (Y2)	0.000	0.038	0.901	0.000	0.000	0.038	0.000	0.023
Post-CHD (Y1)	0.000	0.000	0.000	0.000	0.987	0.000	0.000	0.013
Post-CHD (Y2)	0.000	0.000	0.000	0.044	0.904	0.029	0.000	0.023
Post-Both (Y1)	0.000	0.000	0.000	0.000	0.000	0.000	0.987	0.013
Post-Both (Y2)	0.000	0.051	0.000	0.068	0.000	0.004	0.846	0.031
Dead (absorbing)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
<b>Treated Arm</b>								
Base (no prior CVD)	0.938	0.016	0.000	0.027	0.000	0.000	0.000	0.019
Post-Stroke (Y1)	0.000	0.000	0.987	0.000	0.000	0.000	0.000	0.013
Post-Stroke (Y2)	0.000	0.021	0.932	0.000	0.000	0.027	0.000	0.019
Post-CHD (Y1)	0.000	0.000	0.000	0.000	0.987	0.000	0.000	0.013
Post-CHD (Y2)	0.000	0.000	0.000	0.032	0.933	0.016	0.000	0.020
Post-Both (Y1)	0.000	0.000	0.000	0.000	0.000	0.000	0.987	0.013
Post-Both (Y2)	0.000	0.029	0.000	0.050	0.000	0.002	0.895	0.024
Dead (absorbing)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

## 4 Cost Associated With Periodontal Disease

Table 4: Full breakdown of periodontal costs

Procedure	Labour Cost (£)	Laboratory Cost (£)	Total Cost (£)	Expected amount/cycle	Expected cost per cycle (£)
Initial periodontal treatment	530.75	-	530.75	0.1	53.07
Periodontal re-treatment	265.37	-	265.37	1	265.37
Periodontal maintenance	35.90	-	35.90	0.5	17.95
Extraction	71.79	-	71.79	1	71.79
Resin-bonded bridge	285.89	96.15	382.04	1	382.04
Removable partial denture	356.40	128.20	484.60	1	484.60

## 5 Costs Associated With Markov States

Costs sourced from Patel et al. (2020) [10] were multiplied using a 2014/2015 GPD inflator value of 1.3396 to get our 2024 deterministic value. A value of 1.1706 was used for costs sourced from Morton et al. (2024) [9].

Table 5: Breakdown of costs per Markov state

State	Value from source (year)	Deterministic 2024 Value (£)	Description	Ref.
Base	0	0	Base state costs were assumed to be zero as we are evaluating the costs of CVD events and individuals enter CVD free.	N/a
Post Stroke Y1	15,577 (2014)	20,866.95	The mean NHS & PSS first year cost for an individual aged 65-74 years old was used here.	[10]
Post Stroke Y2	5,761(2014)	7,717.44	The mean NHS & PSS first year cost for an individual aged 65-74 years old was used here.	[10]
Post CHD Y1	4,705.45 (2020)	6,303.42	Healthcare costs for an individual in the first six months after a MI.	[9]
Post CHD Y2	1,015.21 (2020)	1,359.98	Healthcare costs for an individual per year after a MI.	[9]
Post Both Y1	15,577 (2014)	20,866.95	The highest cost of the two events was selected to model for post-both in order to capture an accurate value in the absence of evidence.	[10]

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Table 5 – continued from previous page

<b>State</b>	<b>Value from source (year)</b>	<b>Deterministic 2024 Value (£)</b>	<b>Description</b>	<b>Ref.</b>
Post Both Y2	5,761(2014)	7,717.44	The highest cost of the two events was selected to model for post-both in order to capture an accurate value in the absence of evidence.	[10]
Dead	0	0	-	N/a
Stroke event (one-off)	3,061.20 (2003)	5,240.77	Cost to the NHS over 5 years was £15,306, which we divided by 5 to give the single year cost. The cost inflator value was 1.712.	[11]
CHD event (one-off)	2,047.31 (2020)	2,396.58	Direct healthcare costs of the acute event.	[12]

## 6 Sensitivity Analysis

Table 6: Parameters and related values used in sensitivity analysis

Parameter	Deterministic way	Parameter	Probabilistic sensitivity analysis
Value	sensitivity analysis	Distribution	analysis
		$\alpha$	$\beta$
<b>Baseline Hazards</b>			
Base state stroke hazard	0.0336	(0.030-0.037)	Beta 4 96
Base state CHD hazard	0.0463	(0.042-0.51)	Beta 12.5 258
Background death hazard	0.0126	(0.011-0.014)	Beta 1.7 132.5
<b>Case Fatality Rates</b>			
Stroke fatality	0.1	(0.09-0.11)	Beta 1 3
CHD fatality	0.14	(0.126-0.154)	Beta 1 4
<b>Hazard Multipliers by state</b>			
Stroke Post-Stroke Y1	1.36	(1.03-1.80)	Beta 1.19 1.58
Stroke Post-Stroke Y2	1.36	(1.03-1.80)	Beta 1.19 1.58
CHD Post CHD Y1	1.19	(1.05-1.34)	Beta 1.37 1.47
CHD Post CHD Y2	1.19	(1.05-1.34)	Beta 1.37 1.47
Stroke Post Both Y1	1.94	(1.23-3.04)	Beta 1.045 1.619
Stroke Post Both Y2	1.94	(1.23-3.04)	Beta 1.045 1.619
CHD Post Both Y1	1.94	(1.23-3.04)	Beta 1.045 1.619
CHD Post Both Y2	1.94	(1.23-3.04)	Beta 1.045 1.619
<b>Treatment Effects</b>			
Stroke	0.55	(0.29-0.81)	Beta 1.59 1.16
CHD	0.7	(0.44-0.95)	Beta 2.15 2.3
<b>Utilities</b>			
Post-Stroke Y1	0.70	(0.65-0.76)	Beta 11.1 4.8
Post-Stroke Y2	0.68	(0.64-0.74)	Beta 12.1 5.6
Post CHD Y1	0.77	(0.73-0.81)	Beta 420 125.5

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Parameter	Deterministic	for one-way	Parameter	Probabilistic	sensitivity
	Value	sensitivity analysis	Distribution	analysis	analysis
				$\alpha$	$\beta$
Post CHD Y2	0.74	(0.70-0.78)	Beta	16.7	5.9
Post Both Y1	0.54	(0.49-0.59)	Beta	10.5	9
Post Both Y2	0.50	(0.45-0.54)	Beta	10.75	10.61
Dead	0	-	Beta	-	-
Stroke event	-0.59	(-0.885- -0.295)	Beta	5	5
CHD event	-0.03	(-0.045- -0.015)	Beta	5	5
<b>Costs (£)</b>					
Base	0	-	Gamma	-	-
Post Stroke Y1	20,866.95	(19,748.38- 21,985.52)	Gamma	1337.4	15.61
Post Stroke Y2	7,717.44	(5,886.20- 9,550.01)	Gamma	68.2	113.2
Post CHD Y1	6,303.42	(6,082.51- 6,524.33)	Gamma	3,127.72	2.01
Post CHD Y2	1,359.98	(1,024.37- 1,695.59)	Gamma	63.17	21.56
Post Both Y1	20,866.95	(19,748.38- 21,985.52)	Gamma	1337.4	15.61
Post Both Y2	7,717.44	(5,886.20- 9,550.01)	Gamma	68.2	113.2
Dead	0	-	Gamma	-	-
Stroke Event	5,240.77	(4,716.69- 5,764.85)	Gamma	25	209.63
CHD Event	2,3996.58	(2,037.09- 2,756.07)	Gamma	170.6	14.05

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Table 6 – continued from previous page

Parameter	Deterministic	for one-way	Parameter	Probabilistic sensitivity
	Value	sensitivity analysis	Distribution analysis	analysis
			$\alpha$	$\beta$
Per cycle periodontal cost	non-1,274.82	-	Gamma 25	50.99

## References

## References

- [1] Zemedikun DT, Chandan JS, Raindi D, et al. Burden of chronic diseases associated with periodontal diseases: a retrospective cohort study using UK primary care data. *BMJ Open*. 2021;11(12):e048296. doi:10.1136/bmjopen-2020-048296.
- [2] Seoane T, Bullon B, Fernandez-Riejos P, et al. Periodontitis and other risk factors related to myocardial infarction and its follow-up. *J Clin Med*. 2022;11(9):2618. doi:10.3390/jcm11092618.
- [3] Office for National Statistics. National Life Tables: UK [Internet]. London, England: Office for National Statistics; March 18, 2025. Accessed October 23, 2025. Available from: <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/datasets/nationallifetablesunitedkingdomreferencetables>
- [4] Morgan A, Sinnott SJ, Smeeth L, Minassian C, Quint J. Concordance in the recording of stroke across UK primary and secondary care datasets: a population-based cohort study. *BJGP Open*. 2021;5(2):BJGPO.2020.0117. doi:10.3399/BJGPO.2020.0117
- [5] Allara E, Shi W, Bolton T, et al. Burden of cardiovascular diseases in England (2020–24): a national cohort using electronic health records data. *Lancet Public Health*. 2025;10(11):e943–e954. doi:10.1016/S2468-2667(25)00163-X.
- [6] Danese MD, Pemberton-Ross P, Catterick D, Villa G. Estimation of the increased risk associated with recurrent events or polyvascular atherosclerotic cardiovascular disease in the United Kingdom. *Eur J Prev Cardiol*. 2021;28(3):335–343. doi:10.1177/2047487319899212.
- [7] Lui JN, Williams C, Keng MJ, et al; REVEAL Collaborative Group. Impact of new cardiovascular events on quality of life and hospital costs in people with cardiovascular disease in the United Kingdom and United States. *J Am Heart Assoc*. 2023;12(19):e030766. doi:10.1161/JAHA.123.030766.
- [8] Thom HH, Hollingworth W, Sofat R, et al. Directly acting oral anticoagulants for the prevention of stroke in atrial fibrillation in England and Wales: cost-effectiveness model and value of information analysis. *MDM Policy Pract*. 2019;4(2):2381468319866828. doi:10.1177/2381468319866828.
- [9] Morton JI, Marquina C, Lloyd M, Watts GF, Zoungas S, Liew D, Ademi Z. Lipid-lowering strategies for primary prevention of coronary heart disease in the UK: a cost-effectiveness analysis. *Pharmacoeconomics*. 2024;42(1):91–107. doi:10.1007/s40273-023-01306-2.
- [10] Patel A, Berdunov V, Quayyum Z, King D, Knapp M, Wittenberg R. Estimated societal costs of stroke in the UK based on a discrete event simulation. *Age Ageing*. 2020;49(2):270–276. doi:10.1093/ageing/afz162.
- [11] Youman P, Wilson K, Harraf F, Kalra L. The economic burden of stroke in the United Kingdom. *Pharmacoeconomics*. 2003;21:43–50. doi:10.2165/00019053-200321001-00005.
- [12] National Health Service. 2020/21 National Cost Collection for the NHS. Available from: <https://www.england.nhs.uk/costing-in-the-nhs/national-cost-collection/>. Accessed December 1, 2025.