Telemonitoring after discharge with heart failure - cost-effectiveness modelling of alternative service designs

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OBJECTIVE :

Assess the cost effectiveness of remote monitoring interventions given for 6 months for Congestive Heart Failure (HF) patients recently discharged from hospital (<28 days).

Usual Care – outpatient attendance and community nurse visiting.

Structured telephone via human to human contact [STS-HH]: patients use standard telephone equipment in order to communicate with the health care providers and transmit their vital signs and symptoms. Staff decide on appropriate advice/referral.

Structured telephone via human to machine interface [STS-HM]: patients use the telephone to communicate with a server collecting the data. Staff examine data and decide on advice/referral.

Home Telemonitoring [TM]: Patients use electronic monitoring devices which transmit data automatically. Staff examine data during office hours and decide on advice/referral.

Duration = 6 months (after which patients have GP monitoring and care)
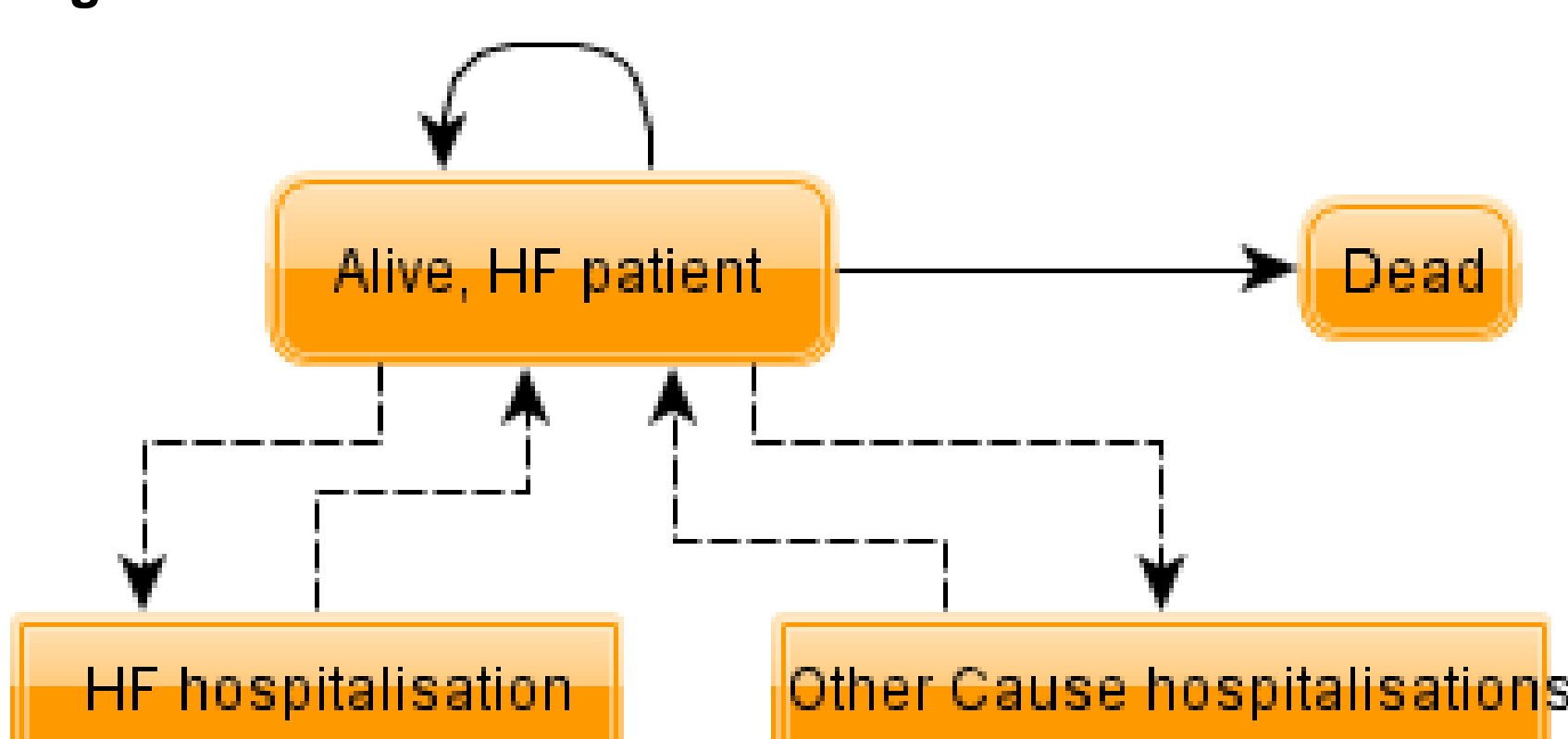
BACKGROUND

Heart Failure (HF) is an inability of the heart to provide sufficient pump action to distribute blood flow to meet the needs of the body. HF is a leading cause of hospitalisation in the UK, with 58,164 admissions recorded for HF in England and Wales[1]. The cost of inpatient bed days for HF patients has been estimated at £563 millions[2].

METHODS

A Cohort Markov model with:
• two different states (Alive at home and Dead)
• a monthly cycle length
• a monthly probability of death based on the time since discharge and the type of treatment.
• patients have a risk of re-hospitalisations i.e. readmissions to a hospital for HF-related complications
• and a risk of hospitalisation for other non-HF causes.
• a 30 year time horizon
• Perspective = NHS in England and Wales.
• Outcomes = lifetime QALYs and health care costs

Fig 1: Model Structure

Alive, HF patient → Dead

HF hospitalisation — Other Cause hospitalisations

Baseline Probability of Mortality

The monthly probability of death was estimated from the CHARM study[3] which included 7572 patients followed up for 38 months, and it was assumed that beyond 2 years the mortality hazard ration is constant.
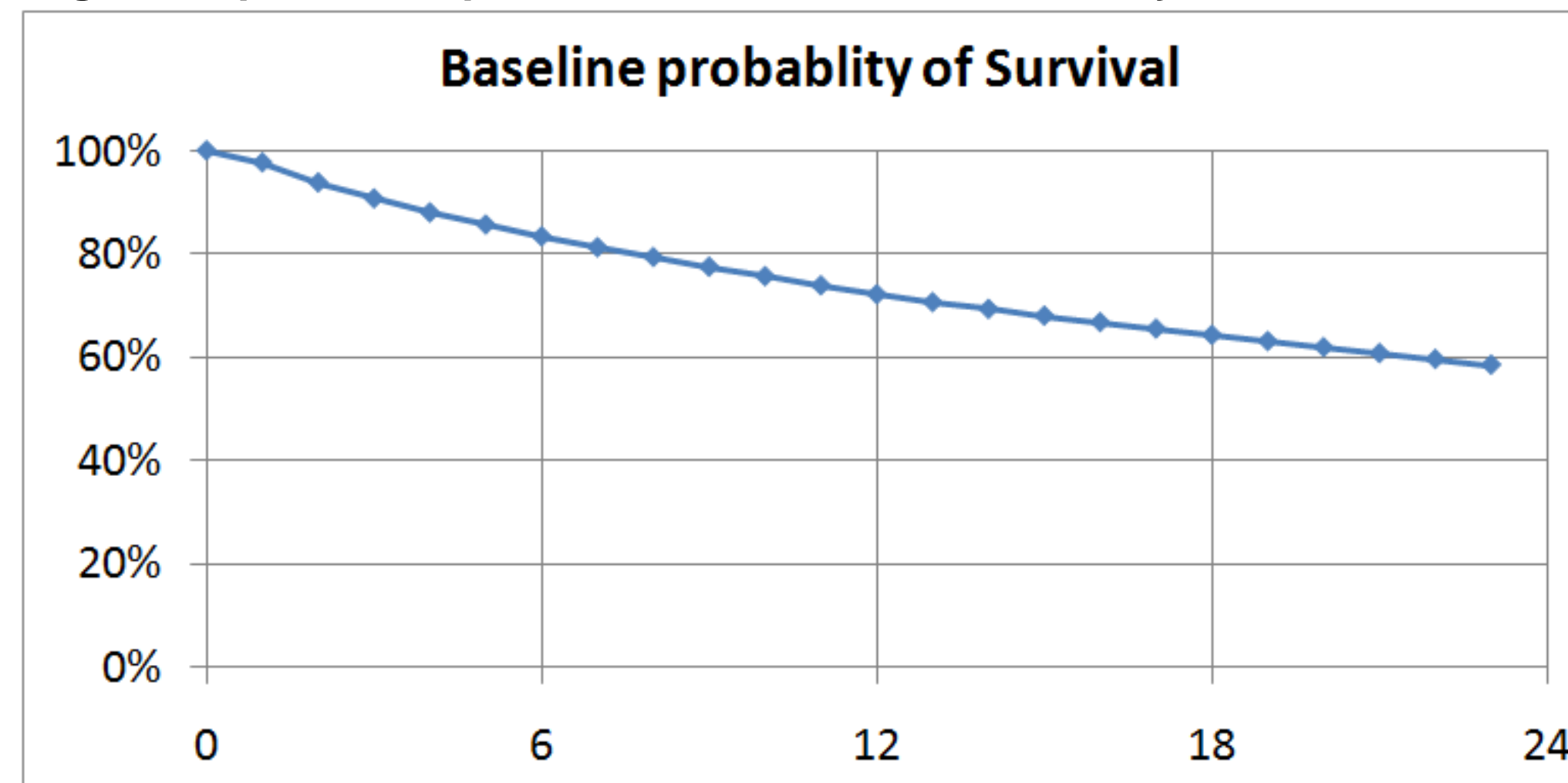
Baseline Probability of Hospitalisation

The baseline risks associated with the hospitalisations were estimated from Klersy et al. [4]

Fig 2: Proportion of patients alive at baseline over 2 years

Baseline probablity of Survival

EFFECTIVENESS

Network meta analysis of 21 studies of home TM or STS programmes.

Hazard Ratios and Credible intervals: Interventions v usual care

Type	All-cause mortality		HF-hospitalisation		All-cause hospitalisation	
	HR	95%	HR	95%	HR	95%
STS HM	0.98	(0.30, 3.23)	1.03	(0.58, 1.77)	1.06	(0.31, 3.61)
STS HH	0.77	(0.31, 1.86)	0.77	(0.50, 1.19)	0.97	(0.38, 2.43)
TM during office hours	0.76	(0.30, 1.91)	0.95	(0.59, 1.62)	0.75	(0.28, 1.91)

Costs and quality of life

Intervention Costs (in £) per six months

	Medical Care	Equipment	Monitoring
Usual Care	£ 161	£ -	£ -
STS HM	£ 392	£ 39	£ 283
STS HH	£ 392	£39	£ 643
TM	£ 336	£ 421	£ 283

Post intervention Costs (per month)

Usual Care post six months	£8.23

Hospitalisation Unit Costs

HF-related hospitalisations	£2,514.49
Other-cause hospitalisations	£1,529.79

Quality of Life

Utility for the first 12 months after HF discharge	0.58
Utility score after the first year	0.67
Disutility for HF-related hospitalisation (1 year)	0.1

RESULTS

	Usual care	STS HM	STS HH	TM
		Difference from Usual care		
Costs	£8,478	£523	£1,126	£992
Total QALYs	2.4137	-0.0232	0.1059	0.1038
ICERs		Dominated	£10,629	£9,552
Probabilistic sequential ICERs		Dominated	£63,240*	£9,552
Expected Net benefit		-£986.75	£993	£1,084
Prob cost-effective	2%	18%	36%	44%

* Versus TM

Base case monthly costs per patient were: £27 for usual care, £119 for STS HM, £179 for STS HH and £175 for TM during office hours.

Compared with usual care, TM during office hours had an estimated incremental cost effectiveness ratio (ICER) of £9,552/QALY, whereas STS HH had an ICER of £63,240/QALY against TM. STS HM was dominated by usual care.

Threshold analysis suggested that the monthly cost of TM during office hours has to be higher than £390 to have an ICER greater than £20,000/QALY against STS HH.

Scenario analyses performed using higher costs of usual care, higher costs of STS HH and lower costs of TM during office hours do not substantially change the conclusions
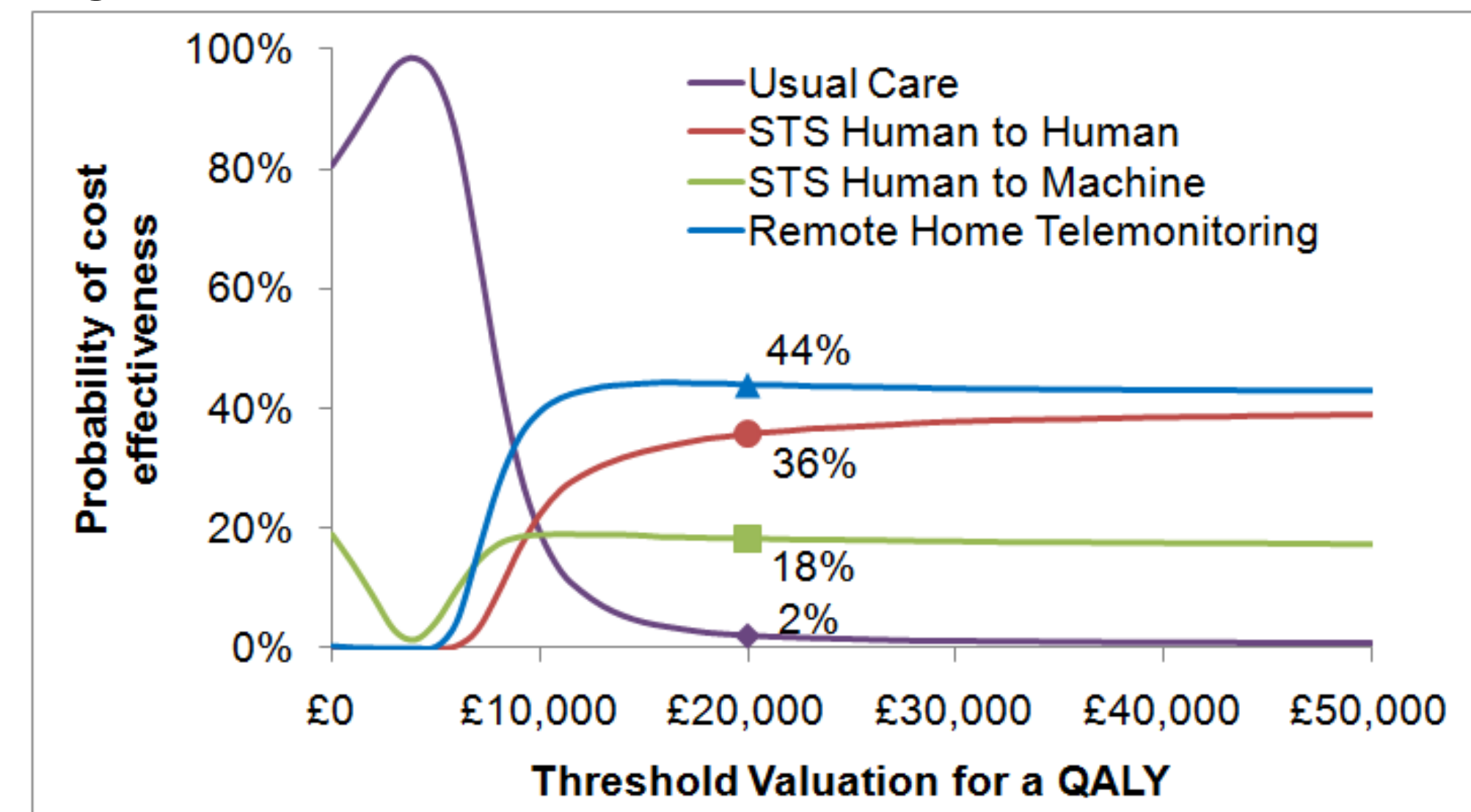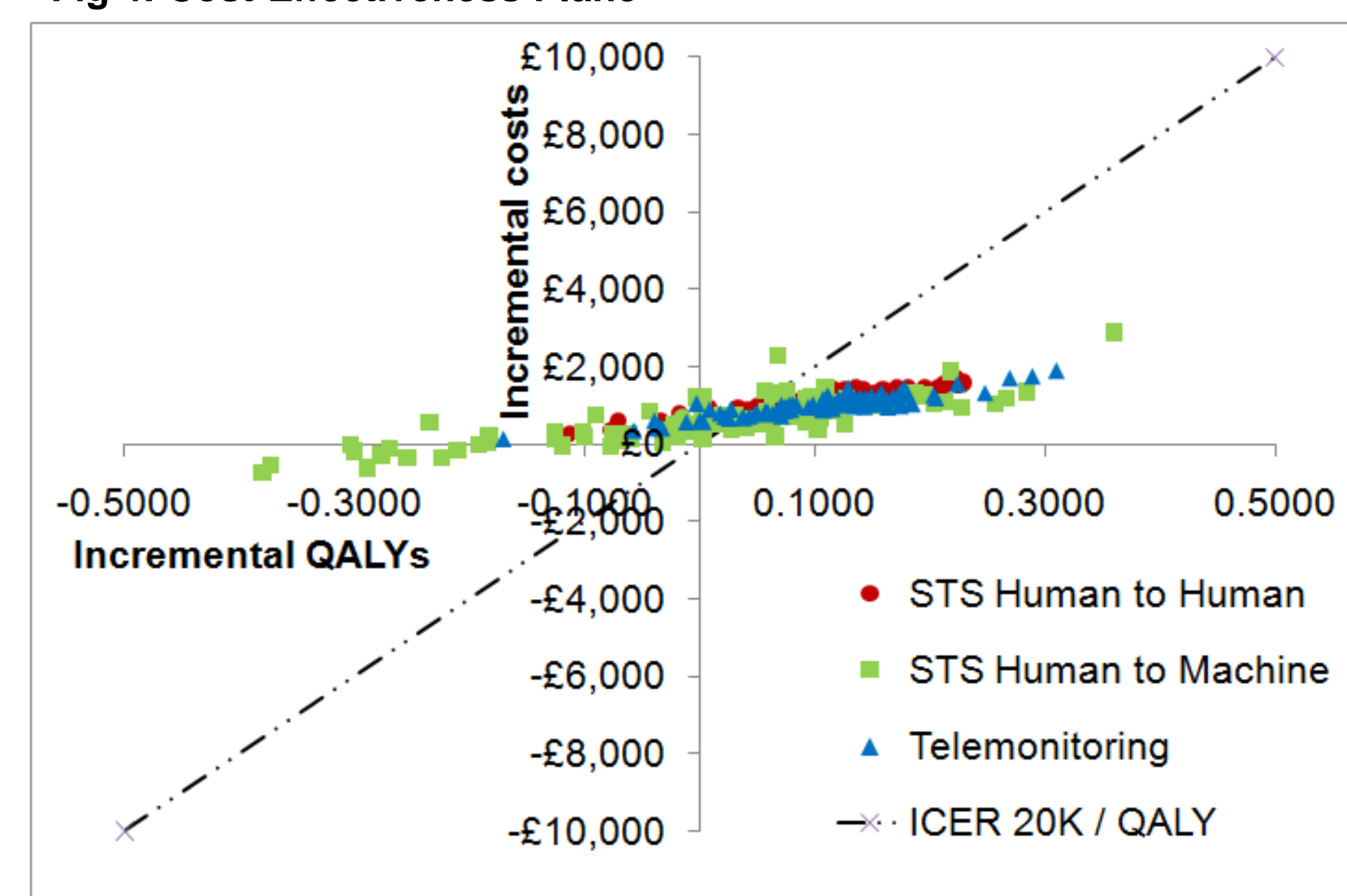
Fig 3: CEAC

Fig 4: Cost-Effectiveness Plane

Conclusions

(1) Base case cost-effectiveness analyses suggest that TM during office hours is expected to be the most cost-effective strategy at a threshold of £20,000/QALY.
(2) However, there is substantial uncertainty in relation to clear descriptions of the interventions and robust estimation of costs.
(3) Scenario excluding one particular trial (the Home HF trial[5] which had particular high intensity usual care) showed TM as slightly more cost-effective, with a reduced uncertainty.
(4) Scenario analysis using 12 month treatment duration produced similar results as in the six month treatment duration scenarios.
(5) TM during office hours for 12 months was also cost-effective when compared against TM during office hours for six months with an ICER of £12,213/QALY. However, in situations with a limited number of TM devices, it is more cost-effective to treat twice as many patients using TM for six months than using TM for 12 months on half the patients with the other half under usual care.

Further Research

A large trial – the Whole Systems Demonstrator trial[6] has recently reported. When data on the HF subgroup is published it should be added to our network meta analysis and update our model.

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