

Screening for colorectal cancer in Ireland: would it be cost-effective and what screening test should be used?

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Burden of colorectal cancer

Worldwide

- more than 1 million new cases each year
- more than 500,000 deaths
- 2nd most common cancer in males and 3rd in females

Ireland

- 2,040 new cases and 925 deaths per annum
- Compared with other European countries
 - incidence rates are among the highest observed
 - mortality rates in men exceed those in other countries
 - survival is lower than the European average

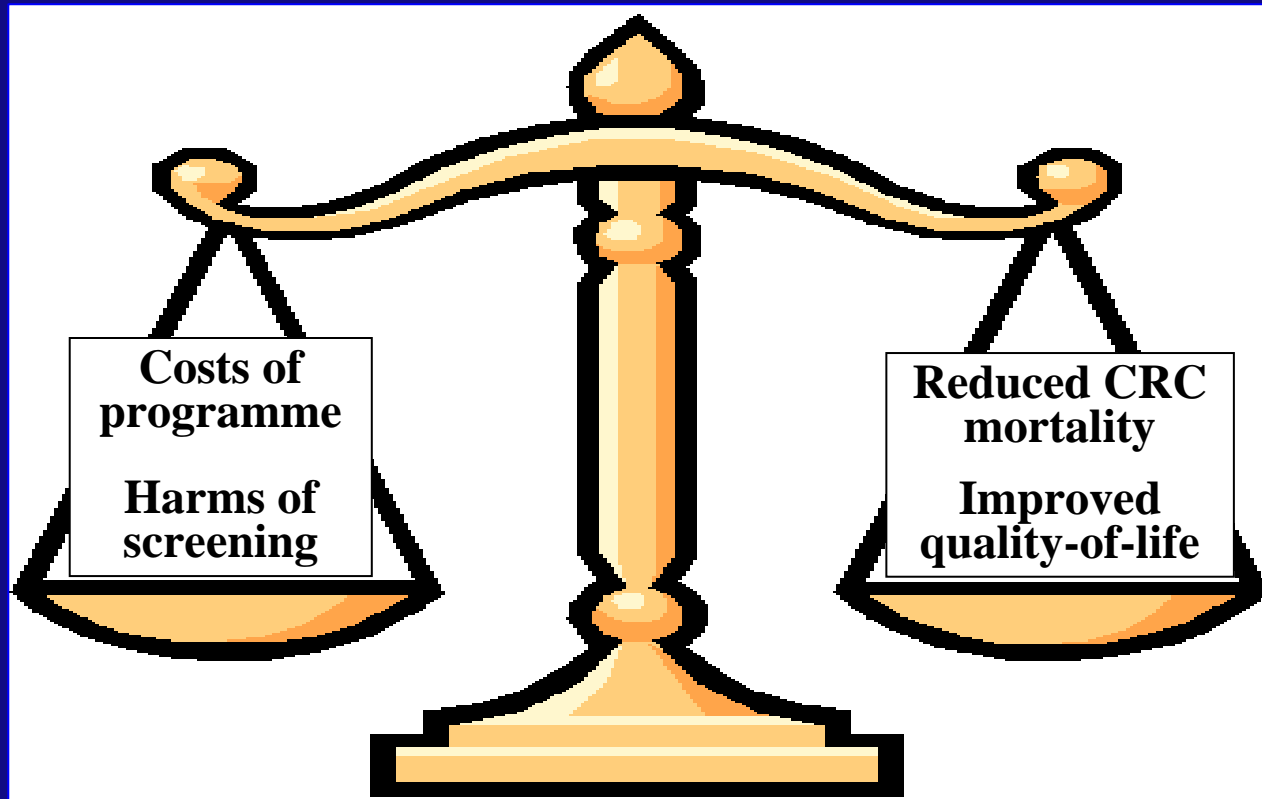
Screening for colorectal cancer

- Most colorectal cancers develop from adenomatous polyps (adenomas)
- Several screening tests are available
 - faecal tests
 - endoscopy based
- Various international organisations recommend men and women aged 50 and older should participate in colorectal cancer screening
- Screening programmes are in place, being rolled-out, or being evaluated, in many European countries

Aim

To evaluate the cost-effectiveness of various options for a population-based colorectal cancer screening programme in Ireland

Cost-effectiveness of screening: assessing costs and benefits



Evaluation using economic modelling

- bring together information from diverse sources and translate into costs and benefits
- compare alternative courses of action (e.g. screening vs no screening)

Screening scenarios

Core screening scenarios evaluated:

- biennial guaiac-based faecal occult blood testing (**gFOBT**) at ages 55-74, with reflex faecal immunochemical testing
- biennial faecal immunochemical testing (**FIT**) at ages 55-74
- flexible sigmoidoscopy (**FSIG**) once only at age 60

Diagnostic investigations: colonoscopy or CT colonography

Surveillance for those with adenoma(s) ≥ 1 cm removed:
following current consensus recommendations (Atkins & Saunders, 2002)

Methods

Model: Adaptation of ScHARR Markov model

- model of the natural history of colorectal neoplasia
- superimpose screening scenarios
- follow cohort of 55 year-old individuals over lifetime

Comparator

- primary analysis – each screening scenario versus no screening
- secondary analysis - scenarios with one another

Outcome measures

- additional costs per person; quality adjusted life years (QALYs) gained per person; Incremental Cost Effectiveness Ratio (ICERs)
 - other outcomes – lifetime reductions in colorectal cancer incidence and mortality; stage distribution of colorectal cancers; colonoscopy rates; harms (bleeding, bowel perforation, death)

Perspective: healthcare payer (i.e. HSE / Department of Health & Children)

Discount rate: 4% for costs and benefits

Data inputs and sensitivity analysis

- Model parameters include performance of screening tests, uptake, costs, etc
- Literature review; population-based screening programmes; expert clinical opinion where data lacking
- No “off-the-shelf” costs available; compiled best estimates
- Base-case estimates and range for sensitivity analysis
- Sensitivity analysis (SA) – to deal with uncertainty in true values of model parameters
 - one/multi-way SA – key parameters varied one at a time
 - probabilistic SA – all parameters varied simultaneously

Data inputs: test performance and uptake

Parameter	Base-case	Range
<i>FIT sensitivity</i>		
adenomas	21%	19% - 22%
cancers	71%	67% - 75%
<i>gFOBT sensitivity</i>		
adenomas	11%	10% - 12%
cancers	36%	31% - 42%
<i>FSIG sensitivity</i>		
adenomas	65% (low-risk)	60% - 70%
	74% (int/high-risk)	68% - 78%
cancers	90%	85% - 95%
<i>Test uptake/compliance</i>		
FIT uptake	53%	32% - 59%
gFOBT uptake	53%	32% - 59%
FSIG uptake	39%	24% - 67%
COL compliance	86%	81% - 90%

Incremental cost effectiveness ratios (ICERs), based on QALYs, for core screening scenarios

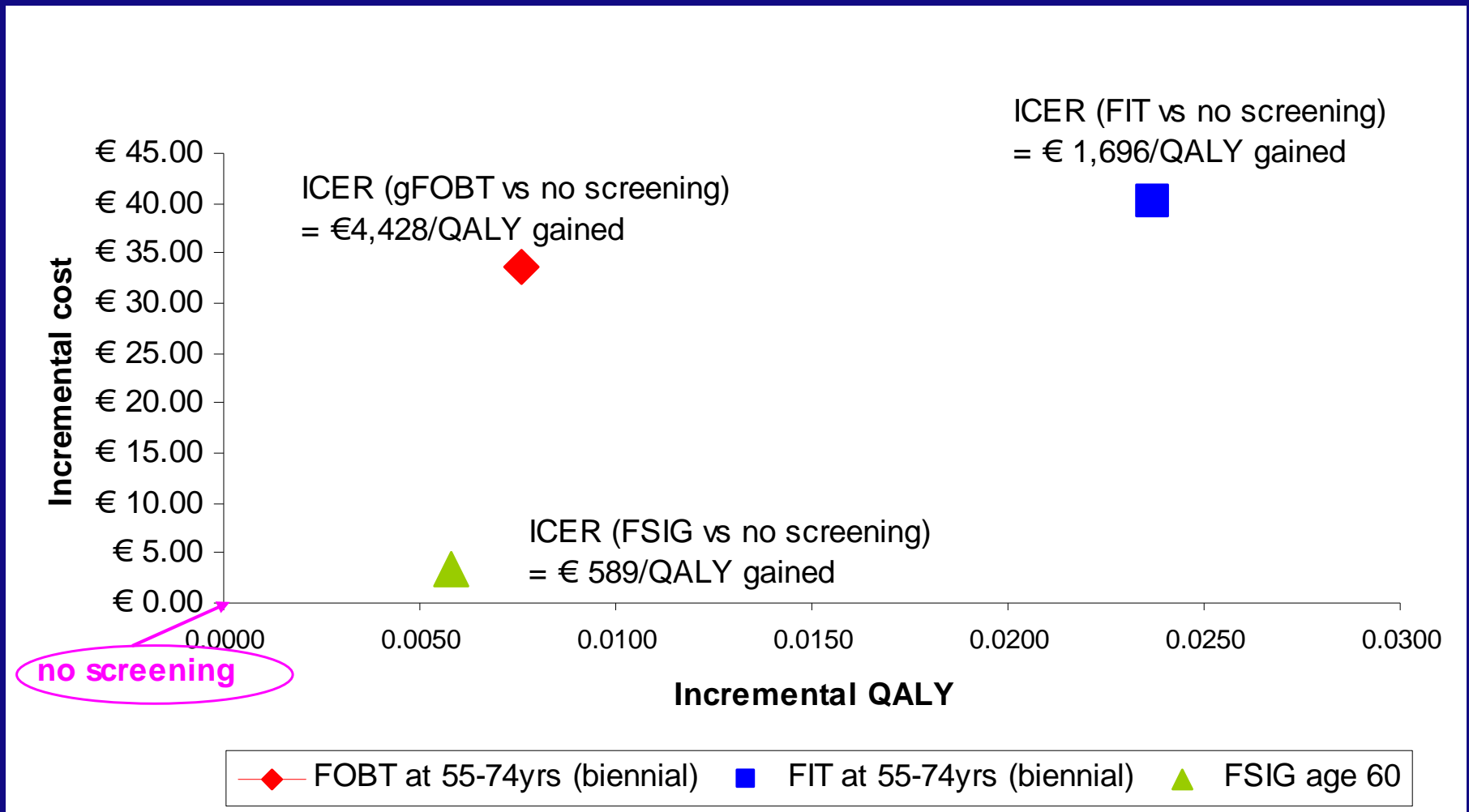
<i>Scenario</i>	<i>Cost of screening & CRC management</i>	<i>Incremental cost per person¹</i>	<i>Expected QALYs per person</i>	<i>Incremental QALY per person¹</i>	<i>ICER - Incremental cost per QALY gained</i>
No screening	€ 1074	-	10.96	-	-
gFOBT at 55-74 years	€ 1107	€ 33.63	10.97	0.0076	€ 4,428 ²
FIT at 55-74 years	€ 1114	€ 40.17	10.98	0.0237	€ 1,696
FSIG once at 60 years	€ 1077	€ 3.43	10.97	0.0058	€ 589

Costs and outcomes discounted at 4%

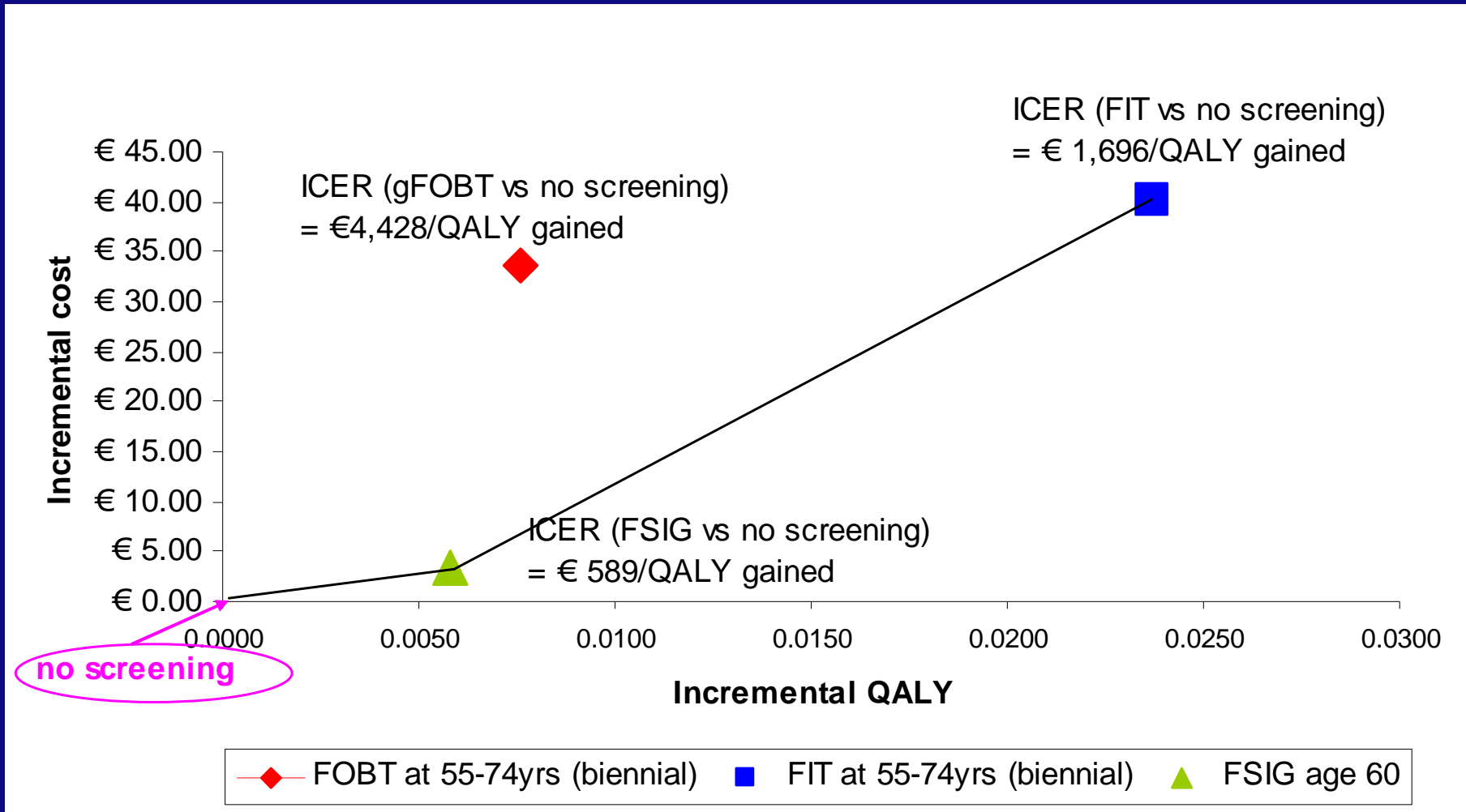
¹ Each incremental value compares value for that strategy to common baseline of no screening

² gFOBT considered dominated by a combination of FIT and FSIG

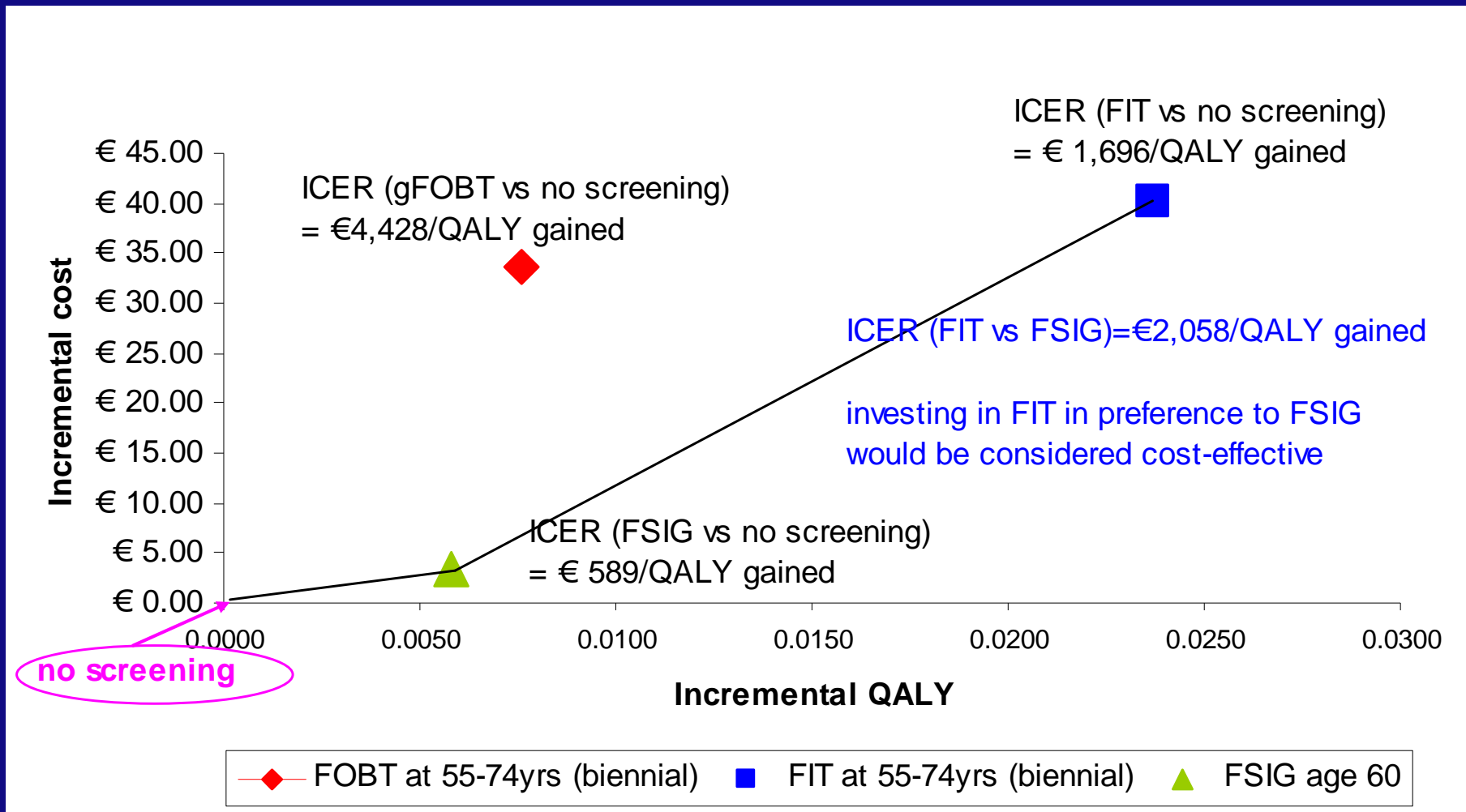
Cost-effectiveness plane for core scenarios



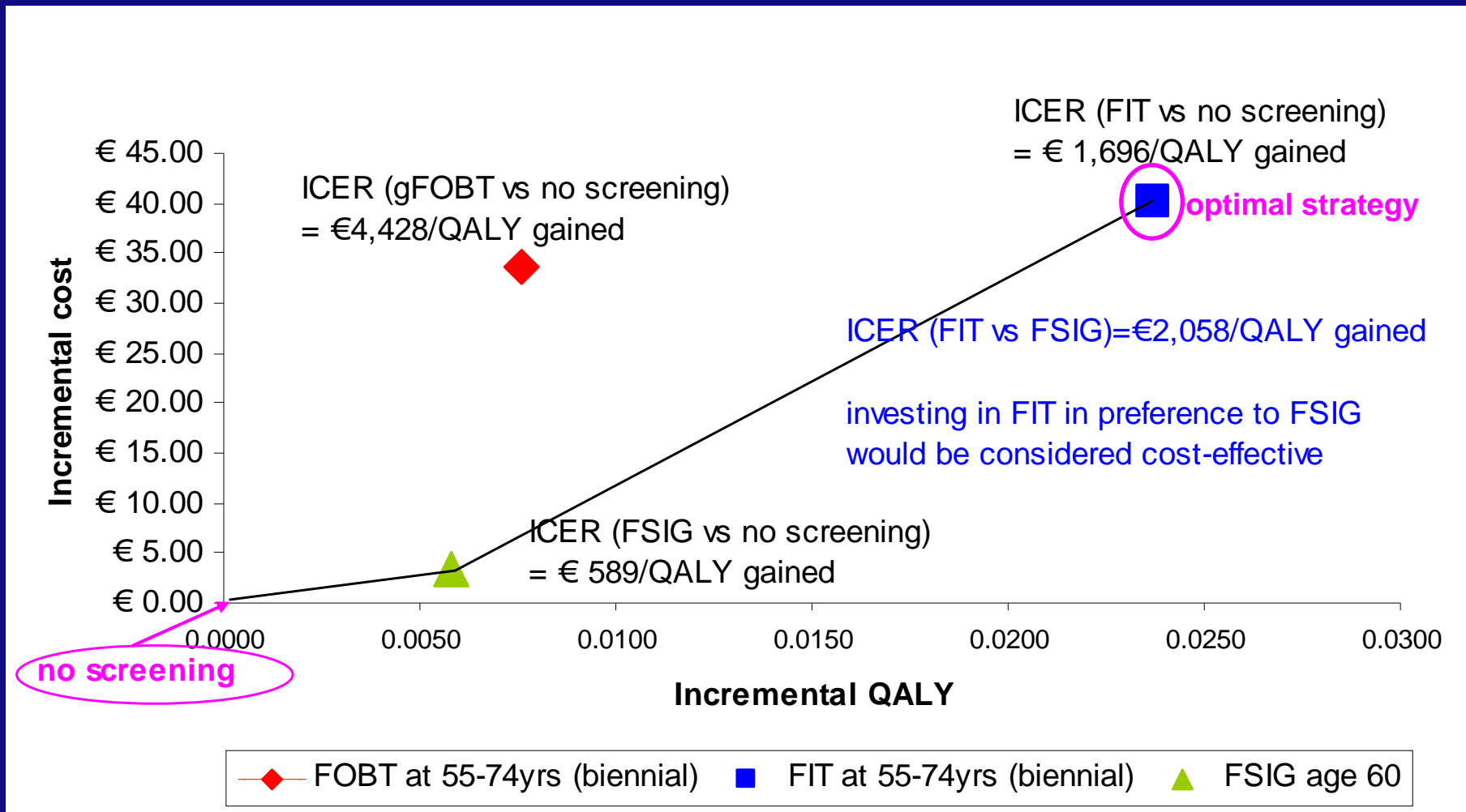
Cost-effectiveness plane for core scenarios



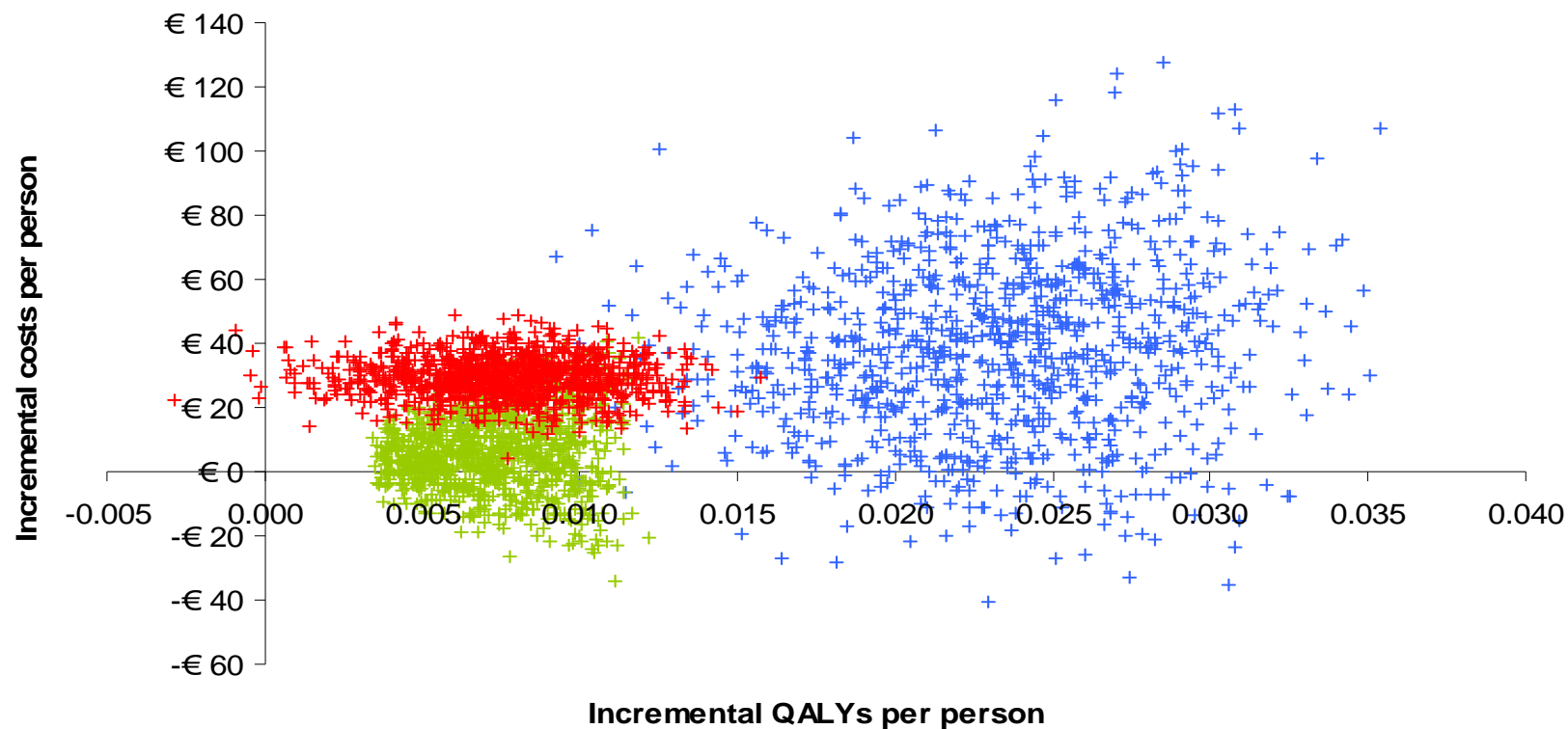
Cost-effectiveness plane for core scenarios



Cost-effectiveness plane for core scenarios



Cost-effectiveness of the core scenarios - probabilistic sensitivity analysis



+ FIT at 55-74yrs (biennial) + FSIG age 60 + FOBT at 55-74yrs (biennial)

* each symbol represents one simulation of the parameter set

Percentage reductions in lifetime¹ incidence and mortality rates compared to no screening, for core scenarios

<i>Scenario</i>	<i>% reduction in CRC incidence rate²</i>	<i>% reduction in CRC mortality rate²</i>
gFOBT at 55-74 years	1.0%	11.8%
FIT at 55-74 years	14.7%	36.0%
FSIG once at 60 years	4.9%	7.5%

¹ Over the entire lifetime of the cohort, therefore for gFOBT and FIT includes 10 screening rounds

² Compares value for that strategy to no screening

Colorectal cancers over lifetime of cohort

- Higher proportion of cancers would be screen-detected with FIT (30% of all cancers, vs 14% with gFOBT and 3% with FSIG)
- Under all scenarios, screen-detected cancers have more favourable stage distribution than those detected symptomatically/clinically

Lifetime rates of endoscopy procedures and associated complications

<i>Scenario</i>	<i>Endoscopy procedures</i> <i>Lifetime¹ rates per 100,000</i>			<i>Complication³</i> <i>Lifetime¹ rates per 100,000</i>		
	<i>FSIG²</i>	<i>Colonoscopy²</i>	<i>Polypectomy²</i>	<i>Major bleeding⁴</i>	<i>Bowel perf</i>	<i>Death from perf</i>
gFOBT	-	3,386	1,215	12	5	0.26
FIT	-	34,632	9,486	132	57	3.00
FSIG	40,177	2,543	2,487	22	5	0.25

1 Over the entire lifetime of the cohort, therefore for gFOBT and FIT includes 10 screening rounds

2 Related to screening, diagnosis or surveillance

3 Complications associated with diagnostic and surveillance colonoscopy and, where relevant, FSIG

4 Major abdominal bleeding, requiring admission or intervention

Comments/caveats

- Costs to society not included – findings likely to be conservative
- Analyses dependent on quality of data on which model based
- Important limitations in evidence-base – particularly around performance characteristics of screening and diagnostic tests
- Uncertainties around cost estimates. Lack of robust cost data is limitation for these types of analyses in Ireland and other settings.

Conclusions

- Introducing a population-based screening programme in Ireland would be a highly cost-effective healthcare intervention
- Optimal screening test is FIT at age 55-74 – greatest health gain
- However, in making implementation decisions, policy makers should also consider the greater resource requirements and higher rates of harms associated with FIT-based screening.



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Costs

Parameter	Base-case	Range
<i>Screening tests</i>		
FIT kit	€3.75	€3.00 - €4.50
FIT processing and analysis	€11.60	€9.28 - €13.92
gFOBT kit	€1.70	€1.36 - €2.04
gFOBT processing and analysis	€7.81	€6.25 - €9.37
FSIG	€150	€120 - €180
<i>Lifetime costs of managing CRC*</i>		
stage I	€23,688	€18,950 – €28,425
stage II	€37,180	€29,744 - €44,616
stage III	€48,835	€39,068 - €58,602
stage IV	€36,602	€29,281 - €43,922

* symptomatic/clinically detected colorectal cancer