Cost-effectiveness of blood-based colorectal cancer screening tests

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CMS coverage decision

- CRC sensitivity > 74% and CRC specificity > 90%*
- Used every 3 years
- For average-risk individuals ages 50-85
- FDA approved

* The coverage decision does not specify minimum sensitivity for adenomas

Are blood-based tests that meet the CMS coverage criteria cost-effective for CRC screening?

Methods

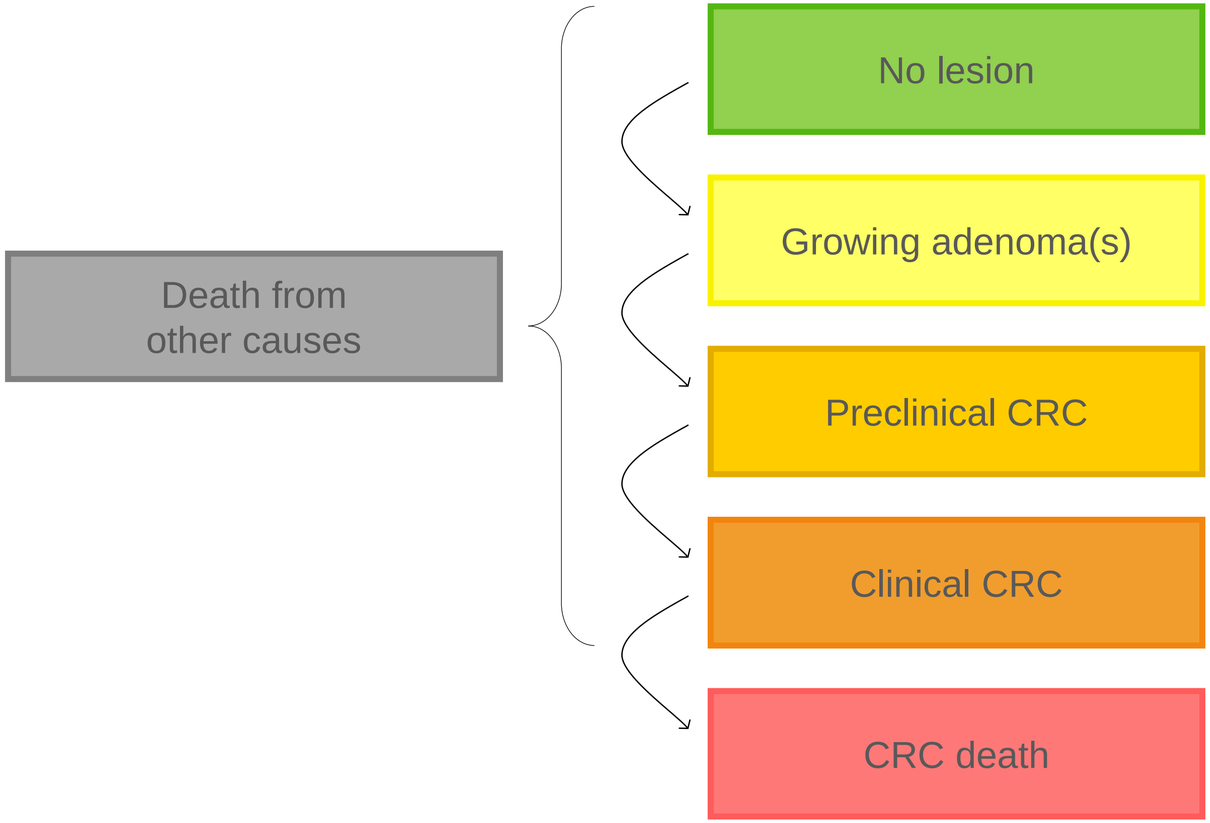
- Use the 3 CISNET models to simulate different screening strategies

MISCAN-Colon

CRC-SPIN

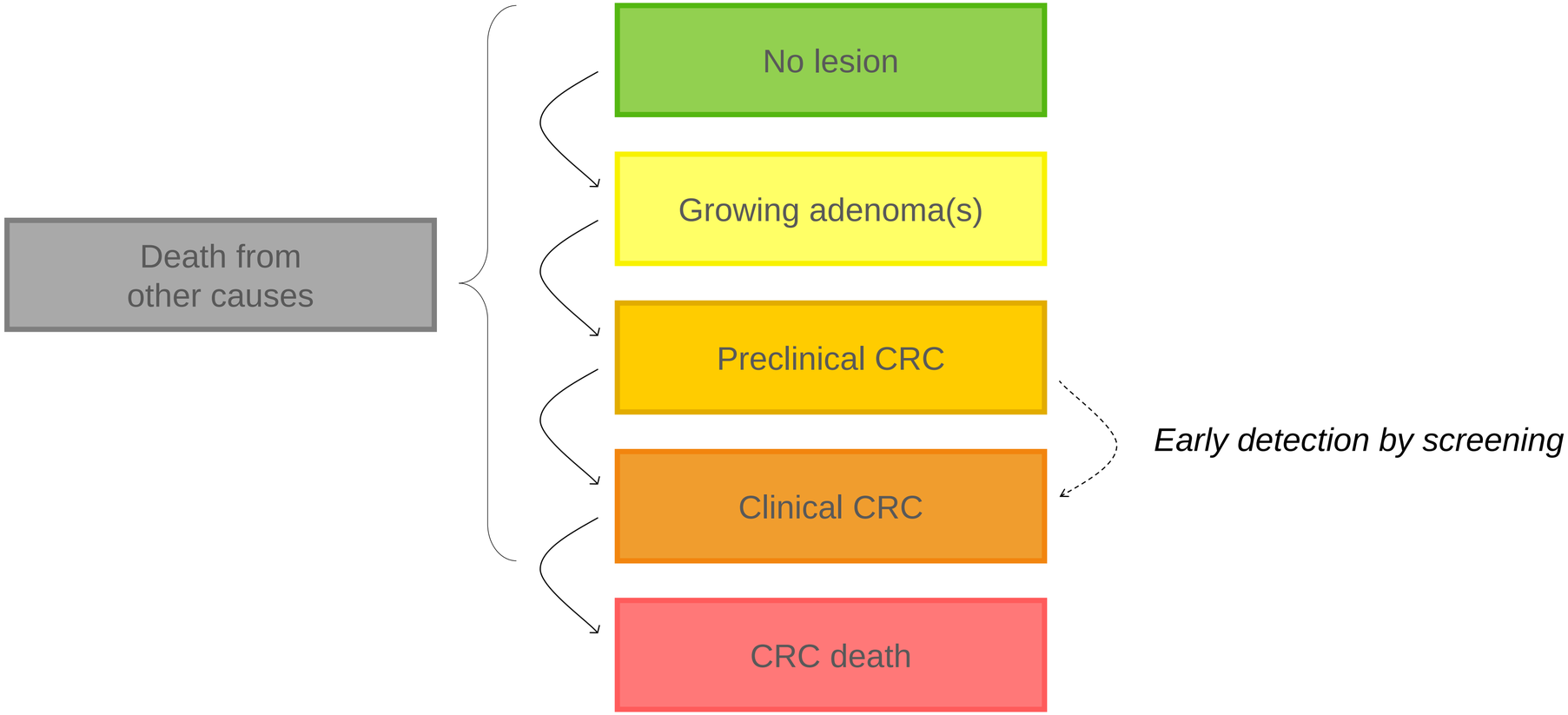
SimCRC

CRC models: adenoma-carcinoma sequence



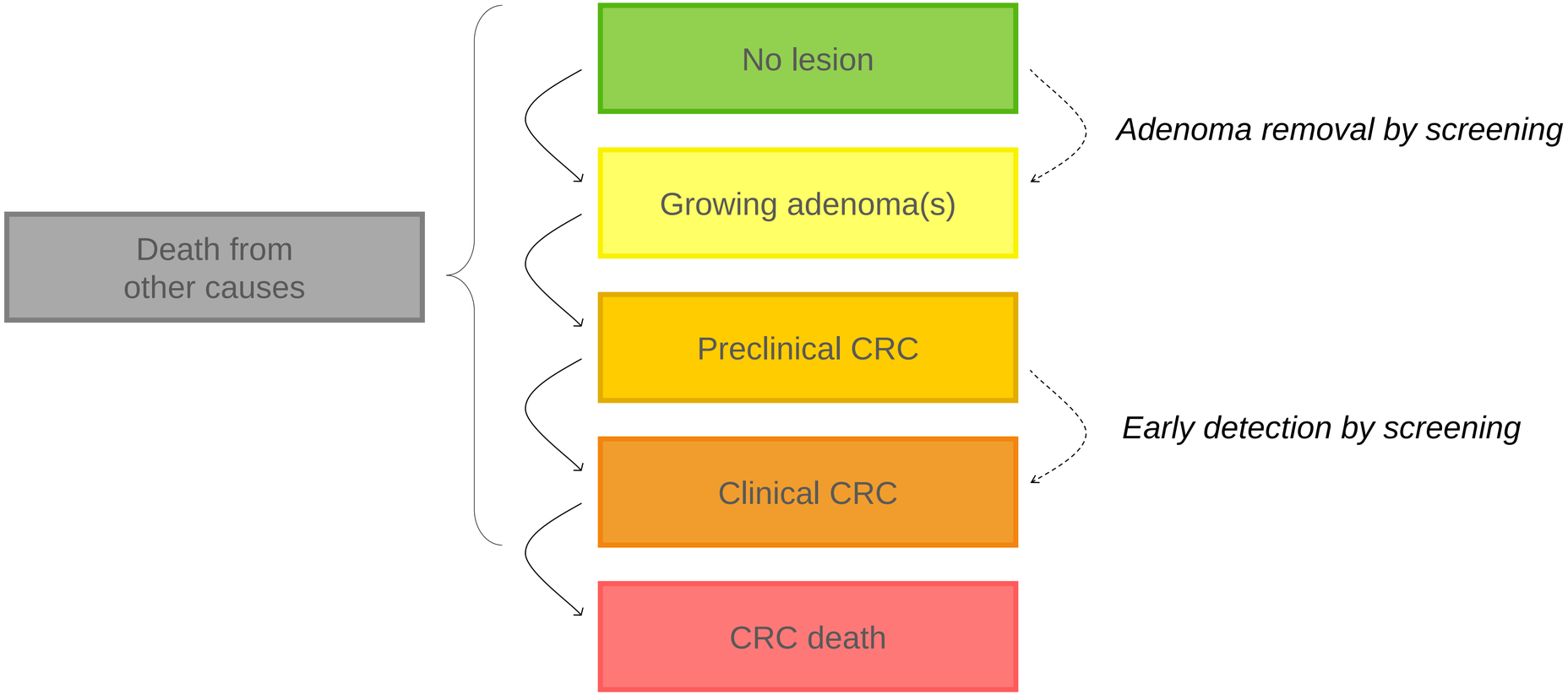
CRC models: adenoma-carcinoma sequence

With effects of screening



CRC models: adenoma-carcinoma sequence

With effects of screening



Cost-effectiveness analysis

- Determine lifetime costs and effects
  - **Effects**: quality-adjusted life-years gained (QALYs gained)
  - **Costs:** net costs (screening, follow-up, surveillance, treatment) compared to no screening

- Calculate **incremental cost-effectiveness ratios (ICER)**
  - Cost-effective if ICER < $100,000 per QALY gained

Screening strategies

Blood tests

Blood test CMS

Age	45-75
Interval	3
Sensitivity CRC	74%
Sensitivity AA	10%*
Specificity	90%

*** Adenomas are only detected by chance, with sensitivity set to the positivity rate in people without adenomas or cancer (1 – specificity).**

Screening strategies

Blood tests

Blood test CMS

Blood test Epi proColon®

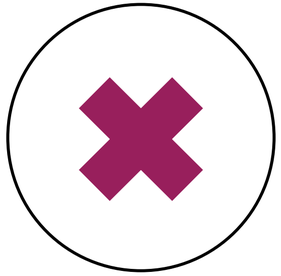
Blood test Shield™

	Blood test CMS	Blood test Epi proColon®	Blood test Shield™
Age	45-75	45-75	45-75
Interval	3	3	3
Sensitivity CRC	74%	70.2%	83%
Sensitivity AA	10%*	20%*	13%
Specificity	90%	80%	90%

*** Adenomas are only detected by chance, with sensitivity set to the positivity rate in people without adenomas or cancer (1 – specificity).**

Screening strategies

Comparator strategies



No screening

FIT

Colonoscopy

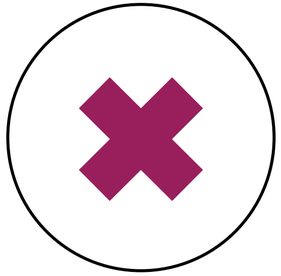
Age	45-75	45-75
Interval	1	10
Sensitivity CRC	73.8%	91%
Sensitivity AA	23.8%	91%
Specificity	96.4%	86%

*** Adenomas are only detected by chance, with sensitivity set to the positivity rate in people without adenomas or cancer (1 – specificity).**

Screening strategies

Comparator strategies

Blood test CMS



No screening

FIT

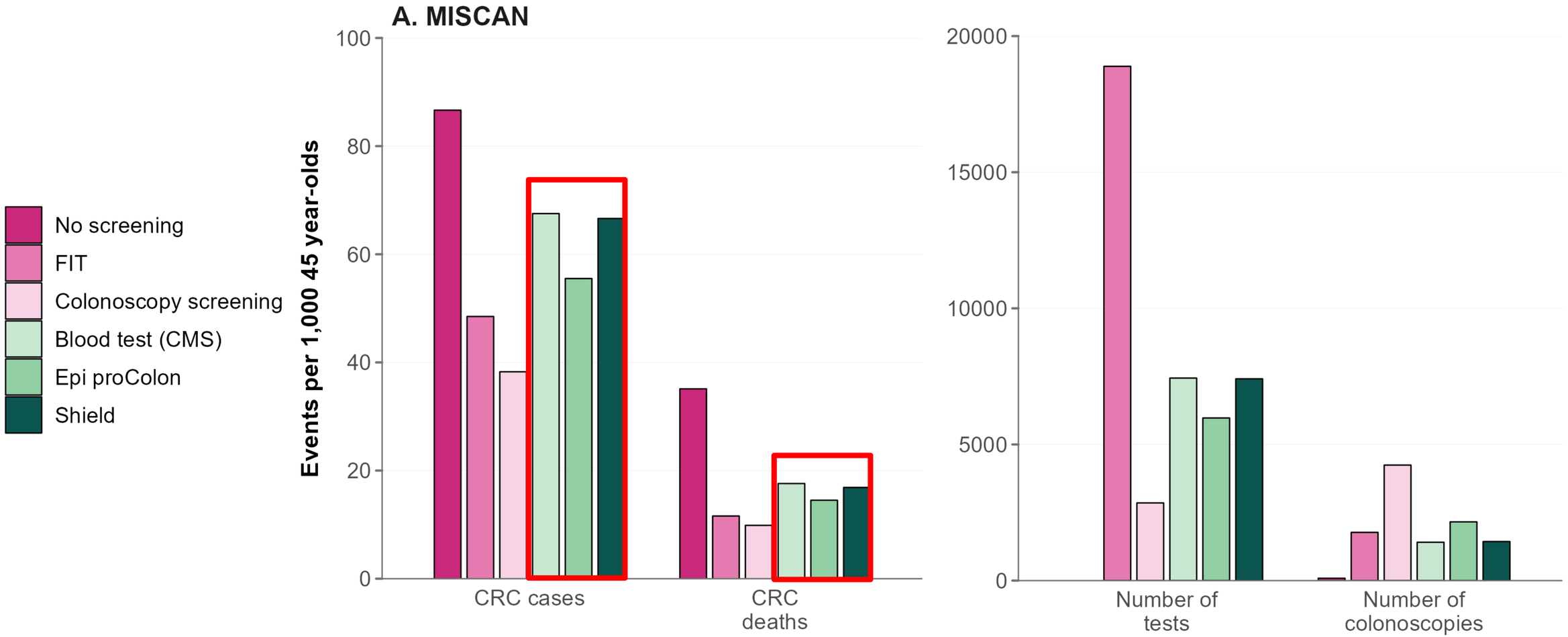
Colonoscopy

	Blood test CMS	No screening	FIT	Colonoscopy
Age	45-75		45-75	45-75
Interval	3		1	10
Sensitivity CRC	74%		73.8%	91%
Sensitivity AA	10%*		23.8%	91%
Specificity	90%		96.4%	86%

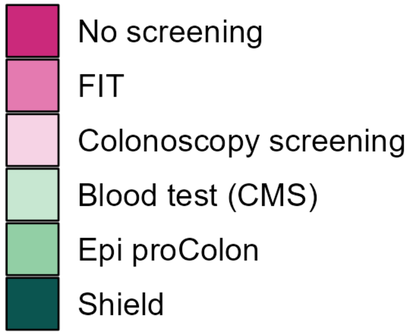
*** Adenomas are only detected by chance, with sensitivity set to the positivity rate in people without adenomas or cancer (1 – specificity).**

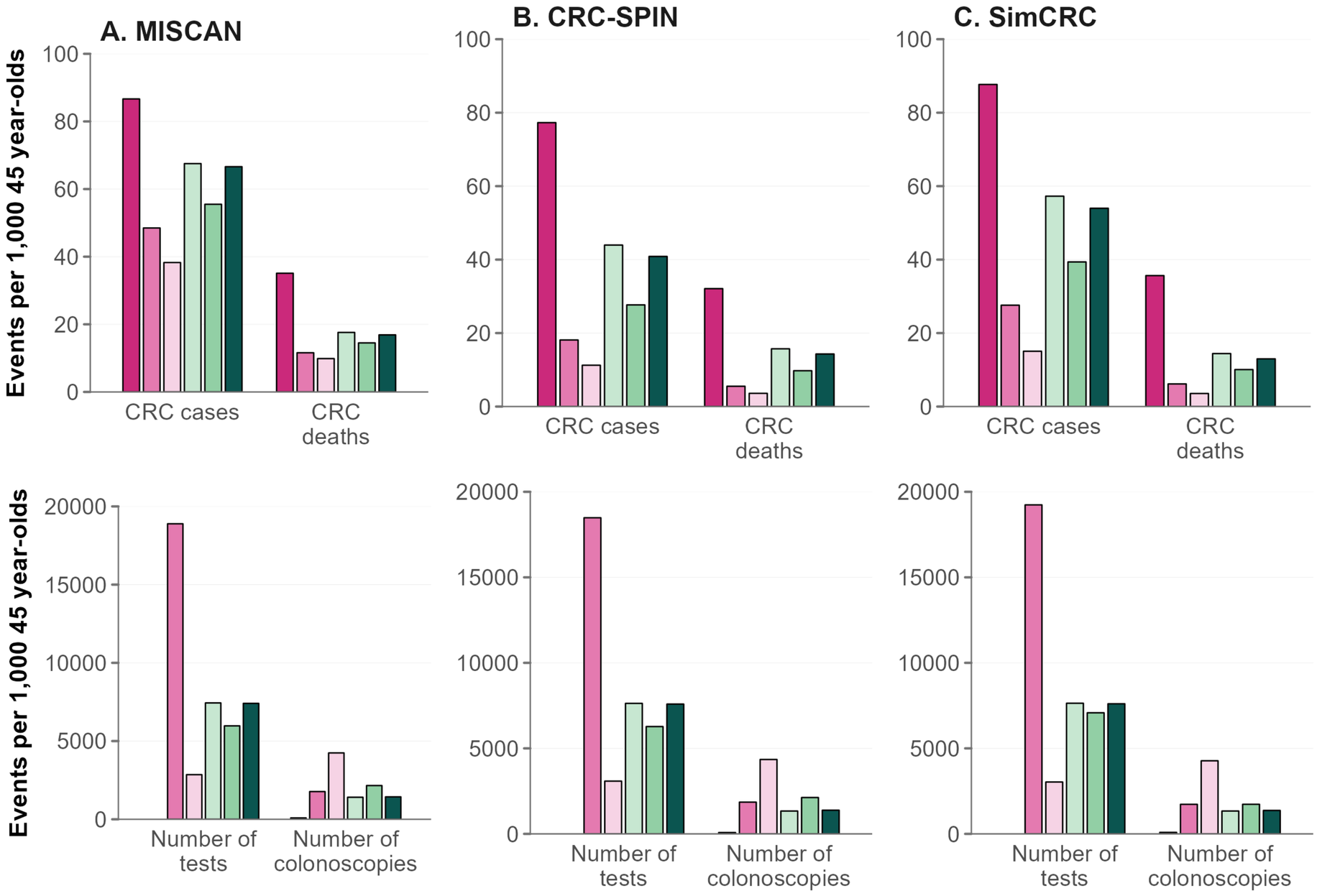
Results

Results – MISCAN



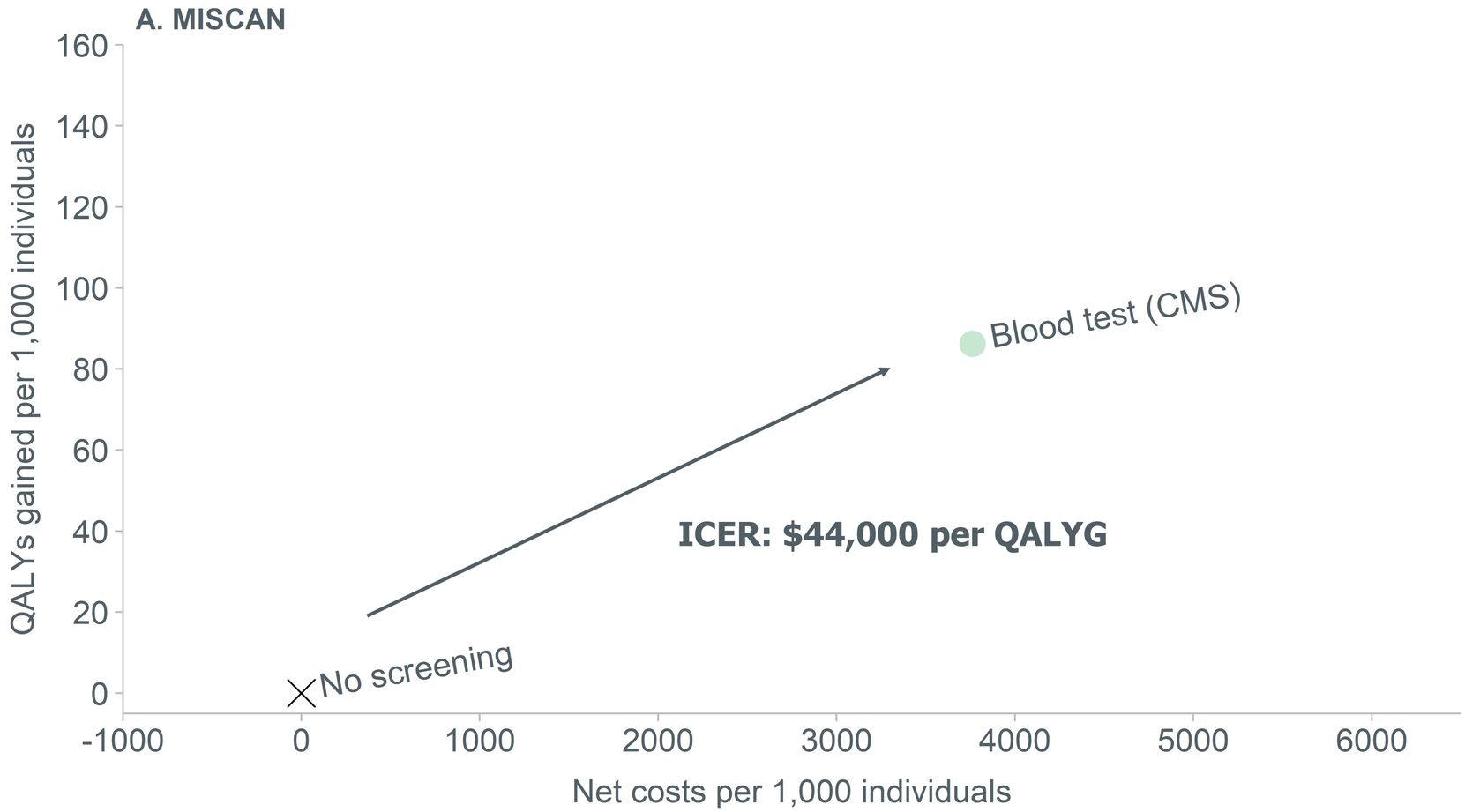
Results


No screening
FIT
Colonoscopy screening
Blood test (CMS)
Epi proColon
Shield


A. MISCAN
B. CRC-SPIN
C. SimCRC
Events per 1,000 45 year-olds
0
20
40
60
80
100
CRC cases
CRC deaths
Events per 1,000 45 year-olds
0
5000
10000
15000
20000
Number of tests
Number of colonoscopies

Cost-effectiveness

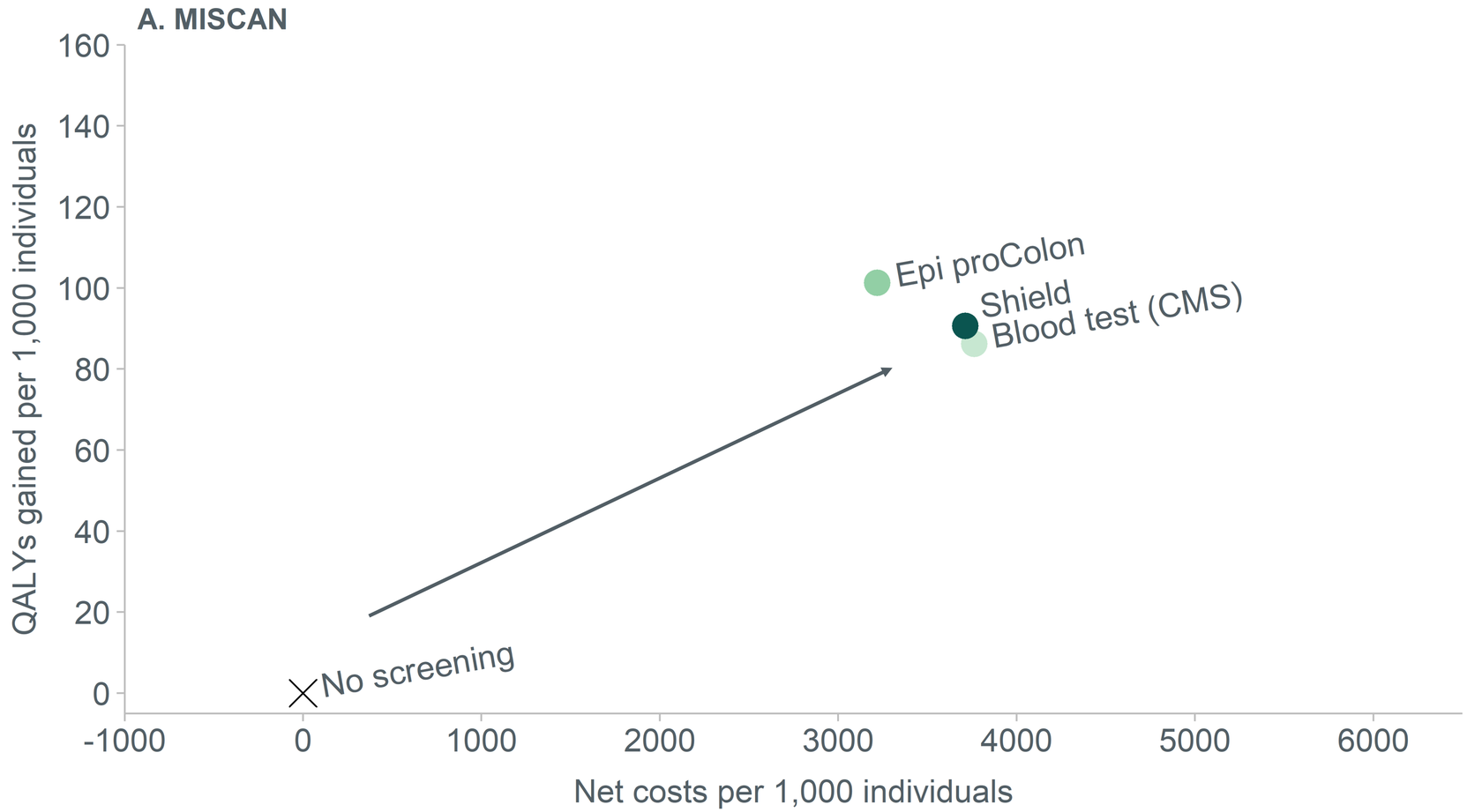
Compared with no screening



Cost-effectiveness

Compared with no screening

CMS: CRC sens 74%; spec 90%
Epi proColon: CRC sens 70%; spec 80%
Shield: CRC sens 83%; spec 90%

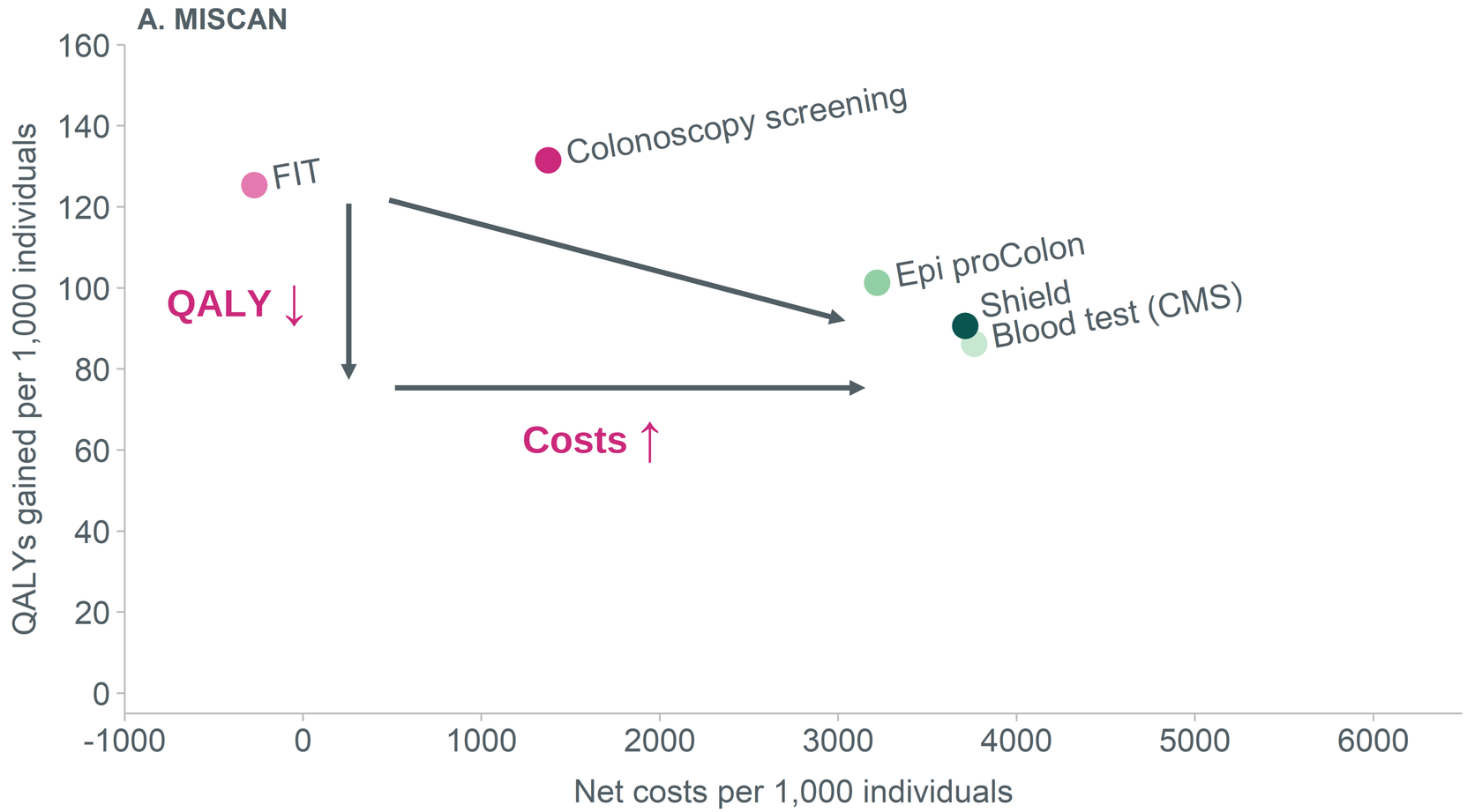


But what if people switch from FIT or colonoscopy to blood tests?

Cost-effectiveness

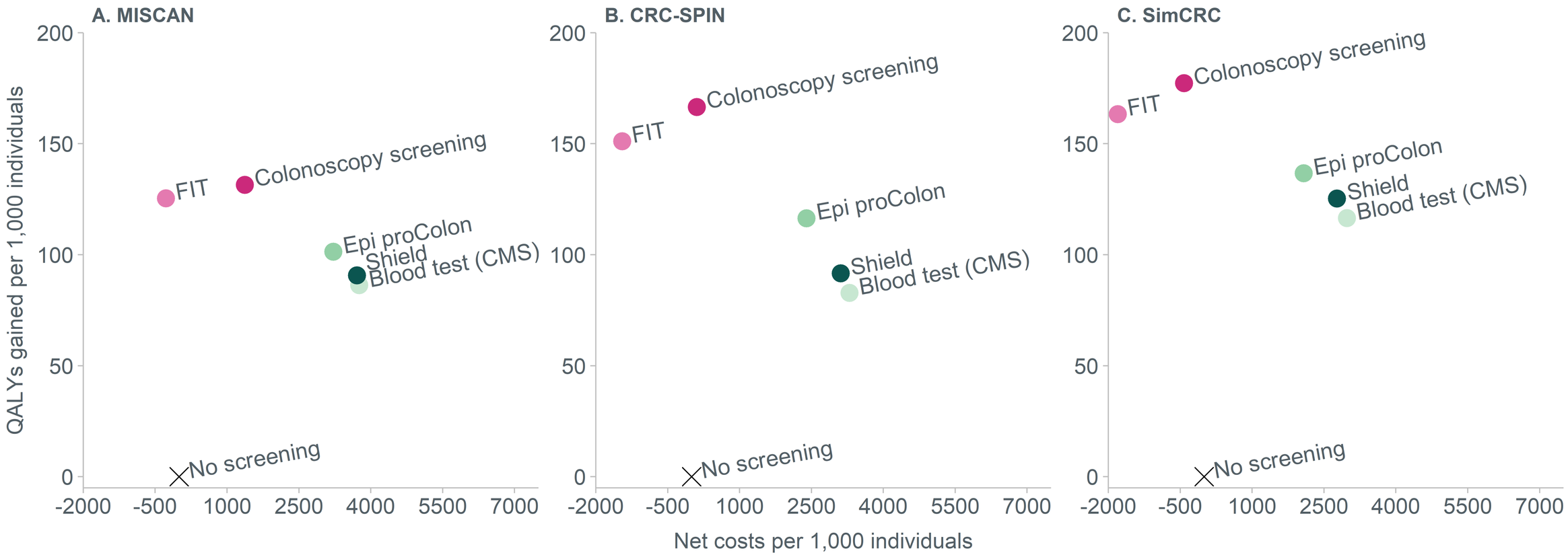
Compared with FIT and colonsocopy

Costs:
Blood test: $500
FIT: $21
COL: $~1000



Cost-effectiveness

Similar pattern across models



Under what conditions are blood tests (cost-)effective?

Screening strategies

Blood test CMS

Comparator strategies

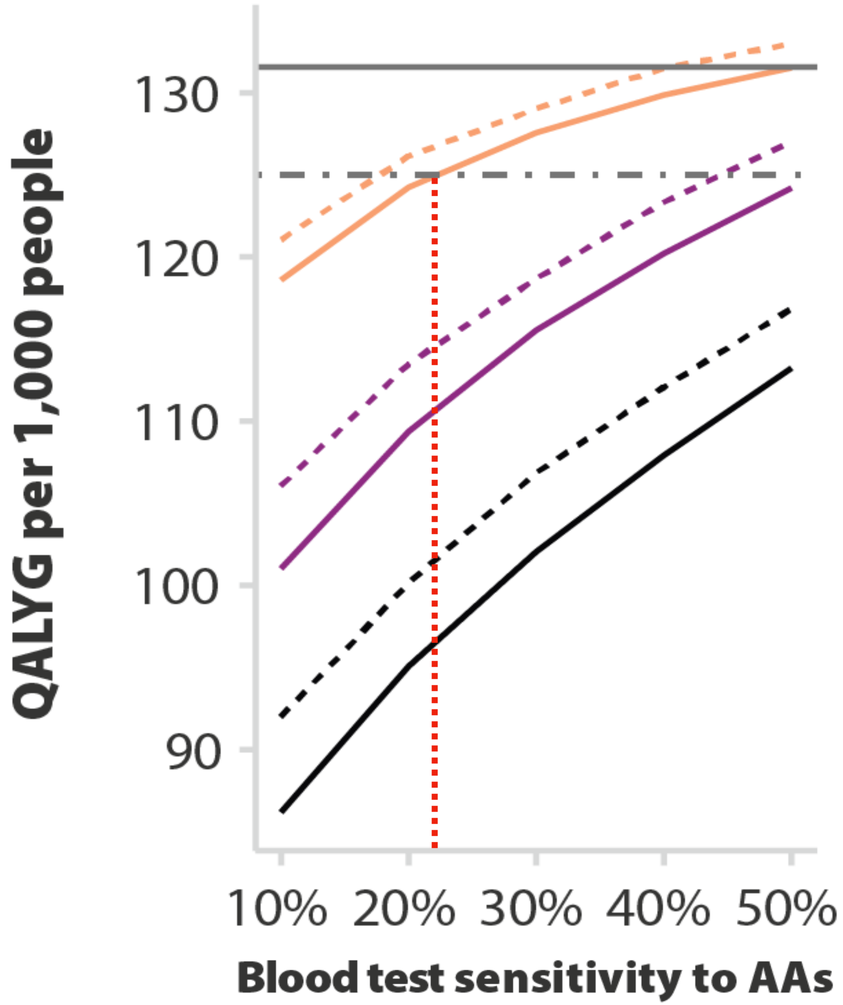
FIT

Colonoscopy

	Blood test CMS		FIT	Colonoscopy
Age	45-75		45-75	45-75
Interval	1-3	**900 different combinations!**	1	10
Sensitivity CRC	74 / 83 / 92%		73.8%	91%
Sensitivity AA	10-50%*		23.8%	91%
Specificity	90%		96.4%	86%
Costs	$25-500		$21	$1000

*** Adenomas are only detected by chance, with sensitivity set to the positivity rate in people without adenomas or cancer (1 – specificity).**

How can blood tests compete on effectiveness?



Annual
CRC sens 74%
AA sens ≥ 20%

Blood test interval

- 1 year
- 2 years
- 3 years

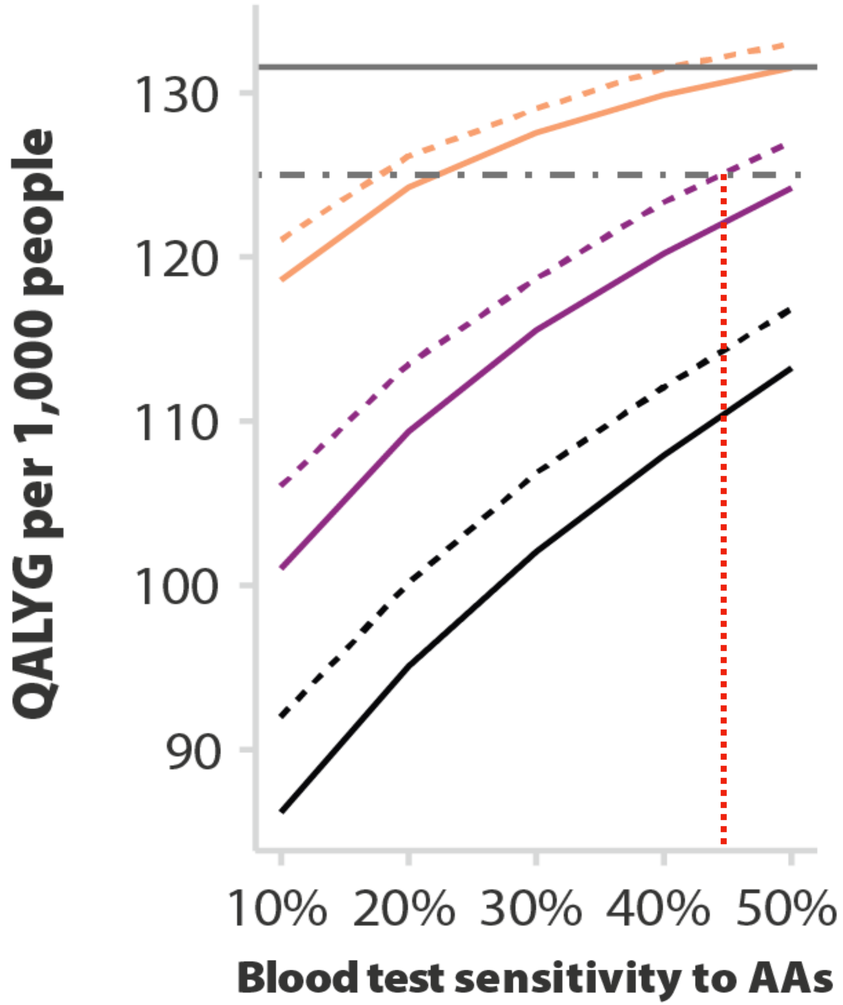
Blood CRC sensitivity

- 0.74
- 0.92

Effectiveness threshold

- COL 10 years
- FIT 1 year

How can blood tests compete on effectiveness?



Biennial
CRC sens 92%
AA sens ≥ 45%

Blood test interval

- 1 year
- 2 years
- 3 years

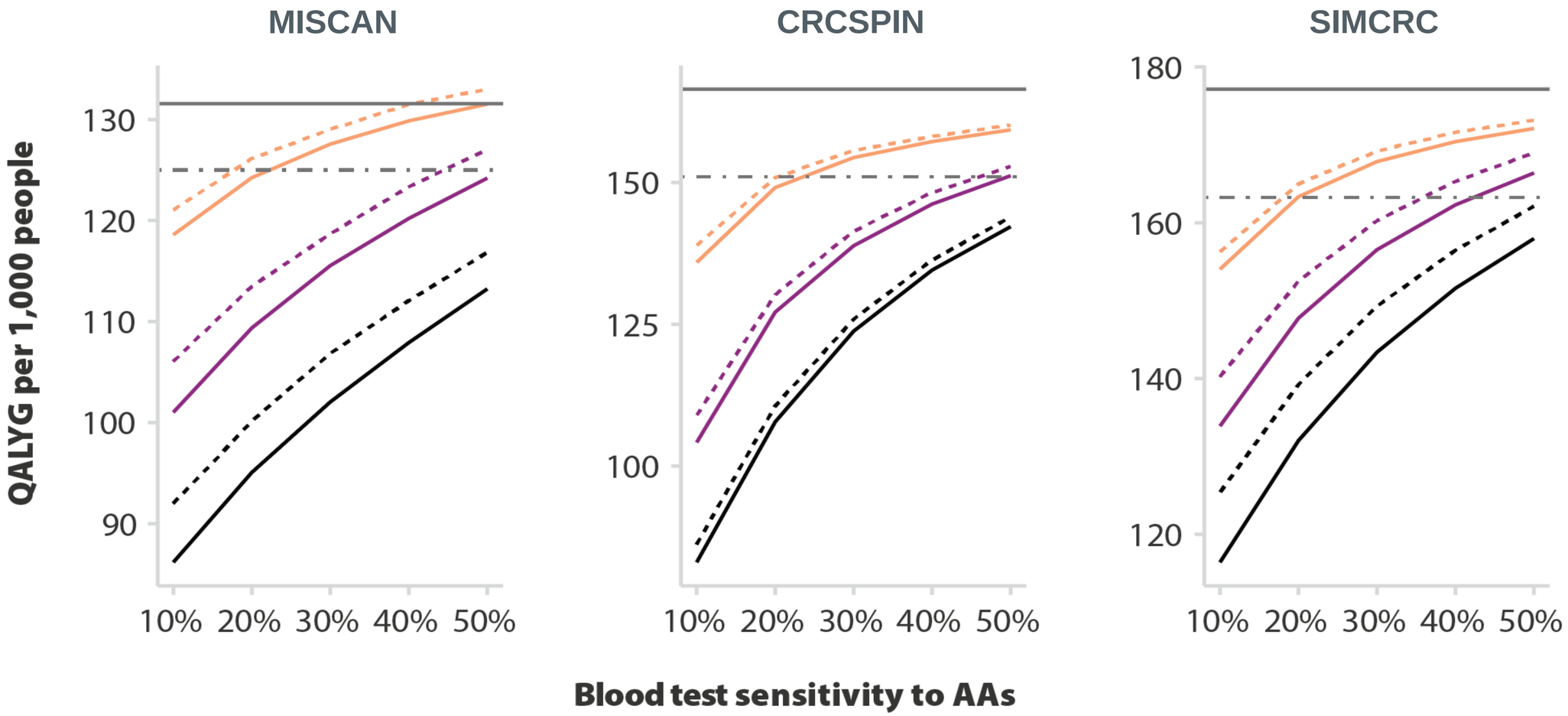
Blood CRC sensitivity

- 0.74
- 0.92

Effectiveness threshold

- COL 10 years
- FIT 1 year

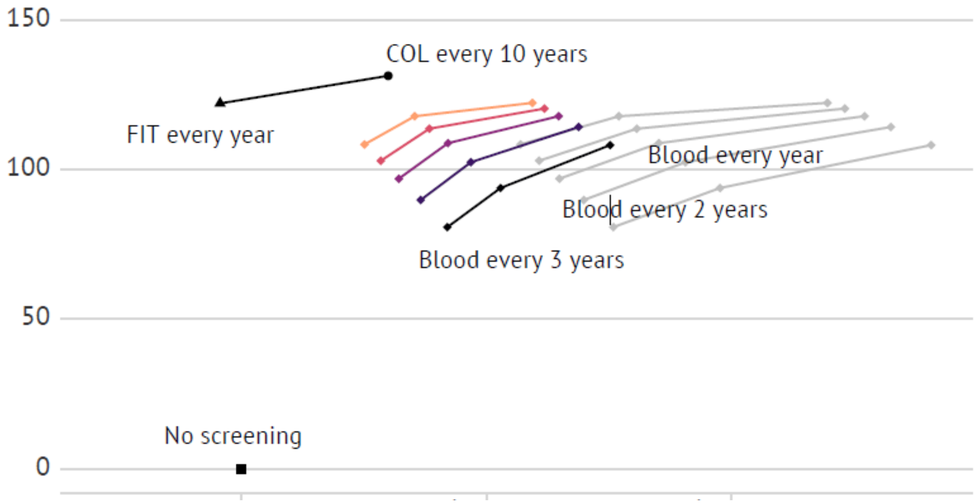
How can blood tests compete on effectiveness?



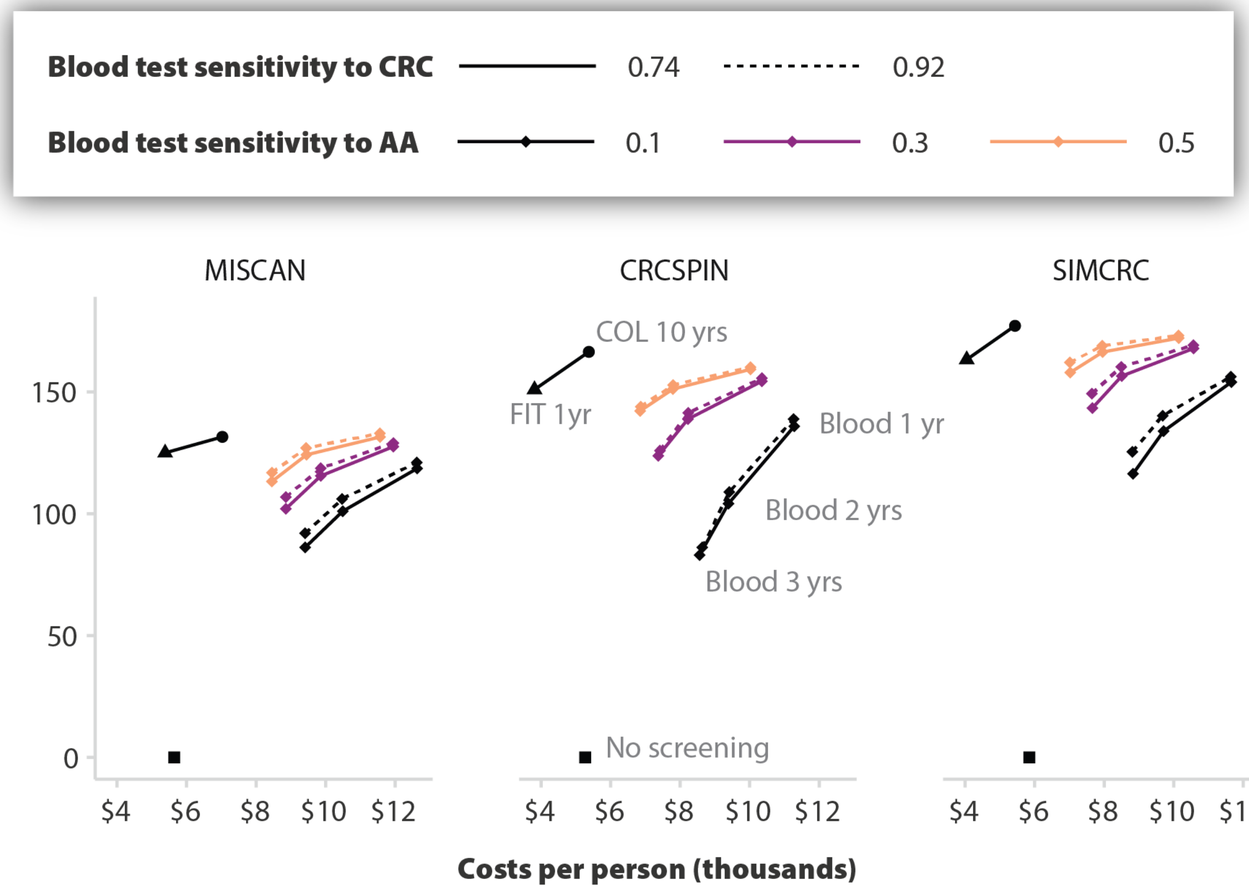
How can blood tests compete on cost-effectiveness?

Even with higher CRC and AA sensitivity, blood test would not be cost-effective

A 50% cost reduction would bring blood tests closer to the frontier



Unit cost: $500

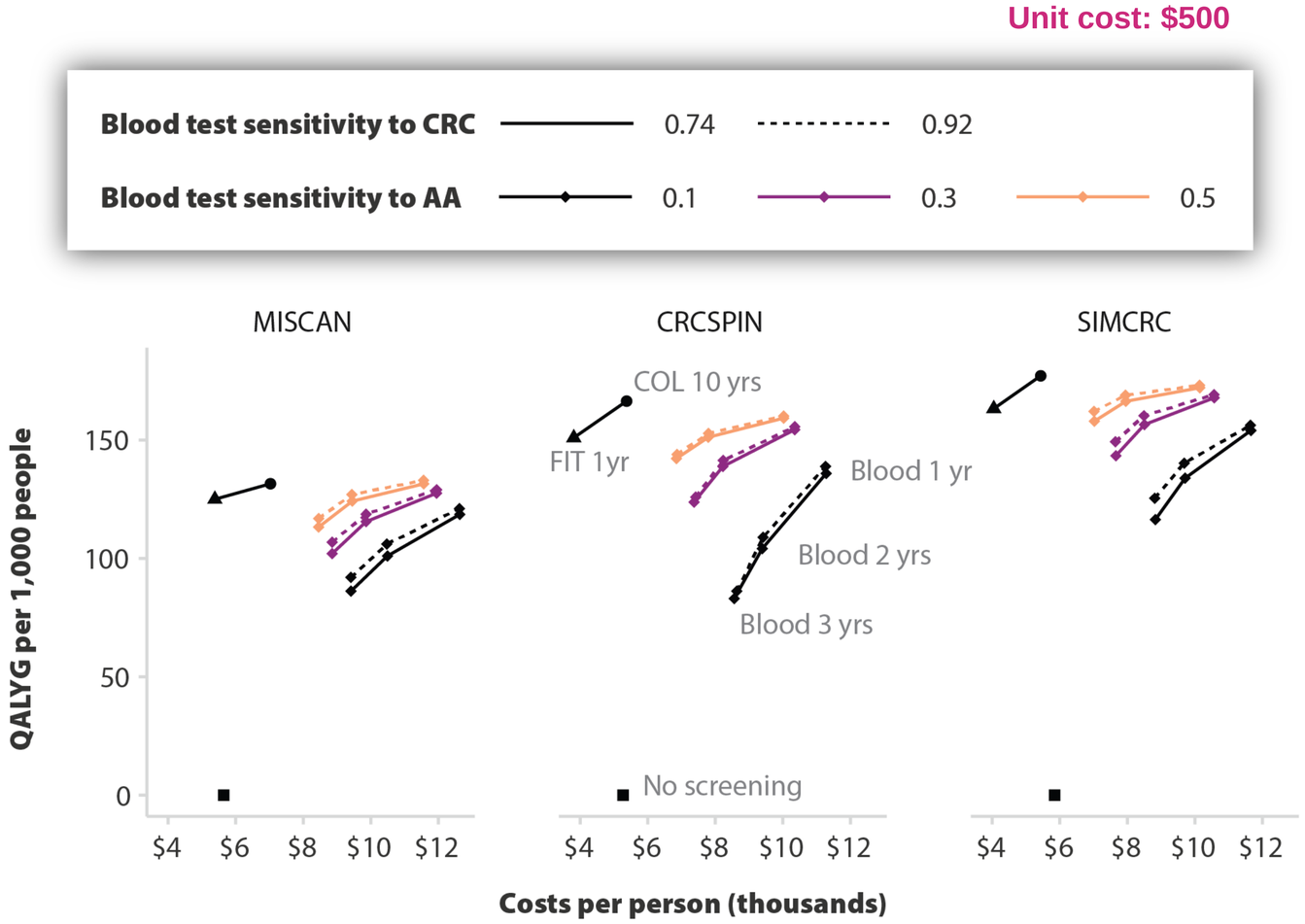


How can blood tests compete on cost-effectiveness?

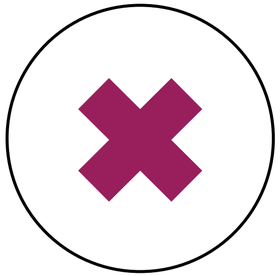
Even with higher CRC and AA sensitivity, blood test would not be cost-effective

Only 12 / 900 combinations in which a blood test would be cost-effective

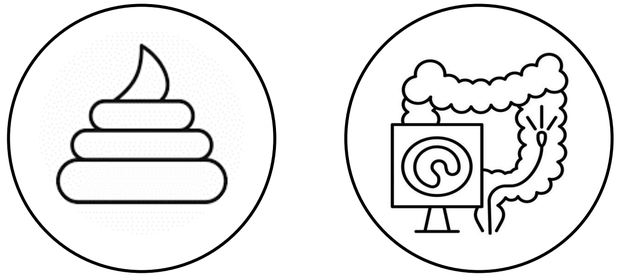
- **1-year interval**
- **Sensitivity to AA >40%**
- **25-50$ unit cost**



Conclusions



In an otherwise unscreened population
= (cost-)effective



Blood tests are **more costly** and **less effective**

Switching could worsen patient outcomes

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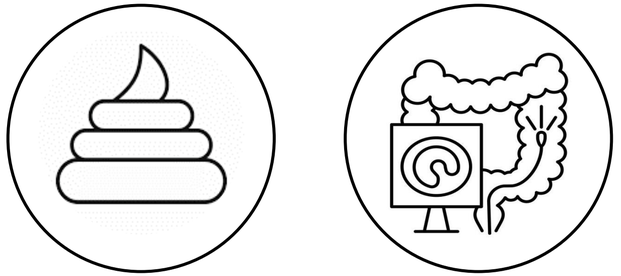

Non-inferiority on cost-effectiveness:

- Sensitivity to AA **>40%**
- **94%** reduction in costs

WEO
World Endoscopy Organization

Erasmus MC
Universitair Medisch Centrum Rotterdam

CISNET

Thank you!

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