Cost-effectiveness of antimicrobial resistance point-of-care testing for optimising the treatment of gonorrhoea

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Disclaimer

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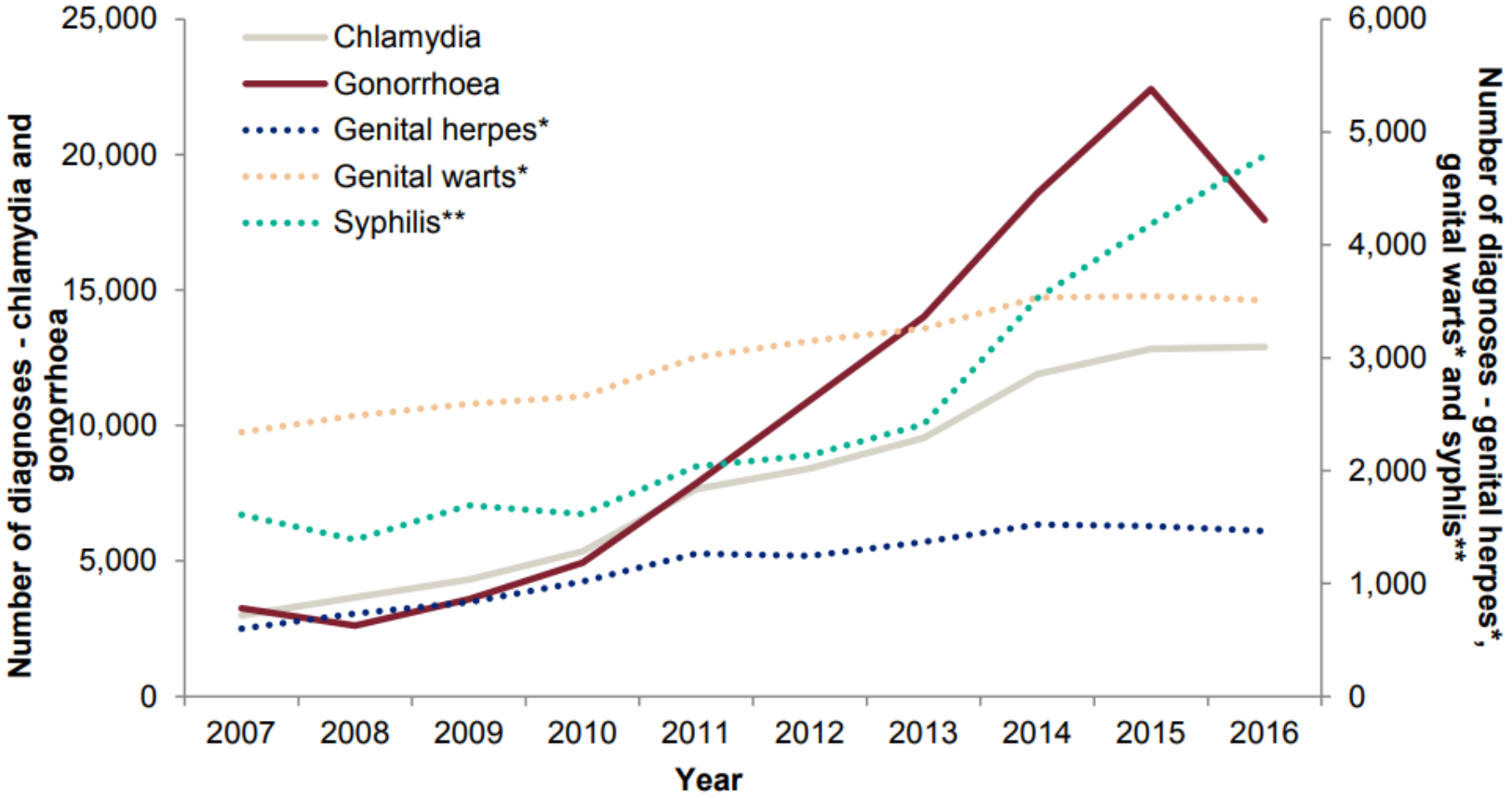
- Member of the BD Diagnostics Advisory Panel on UK Provision of Sexual Health Services.

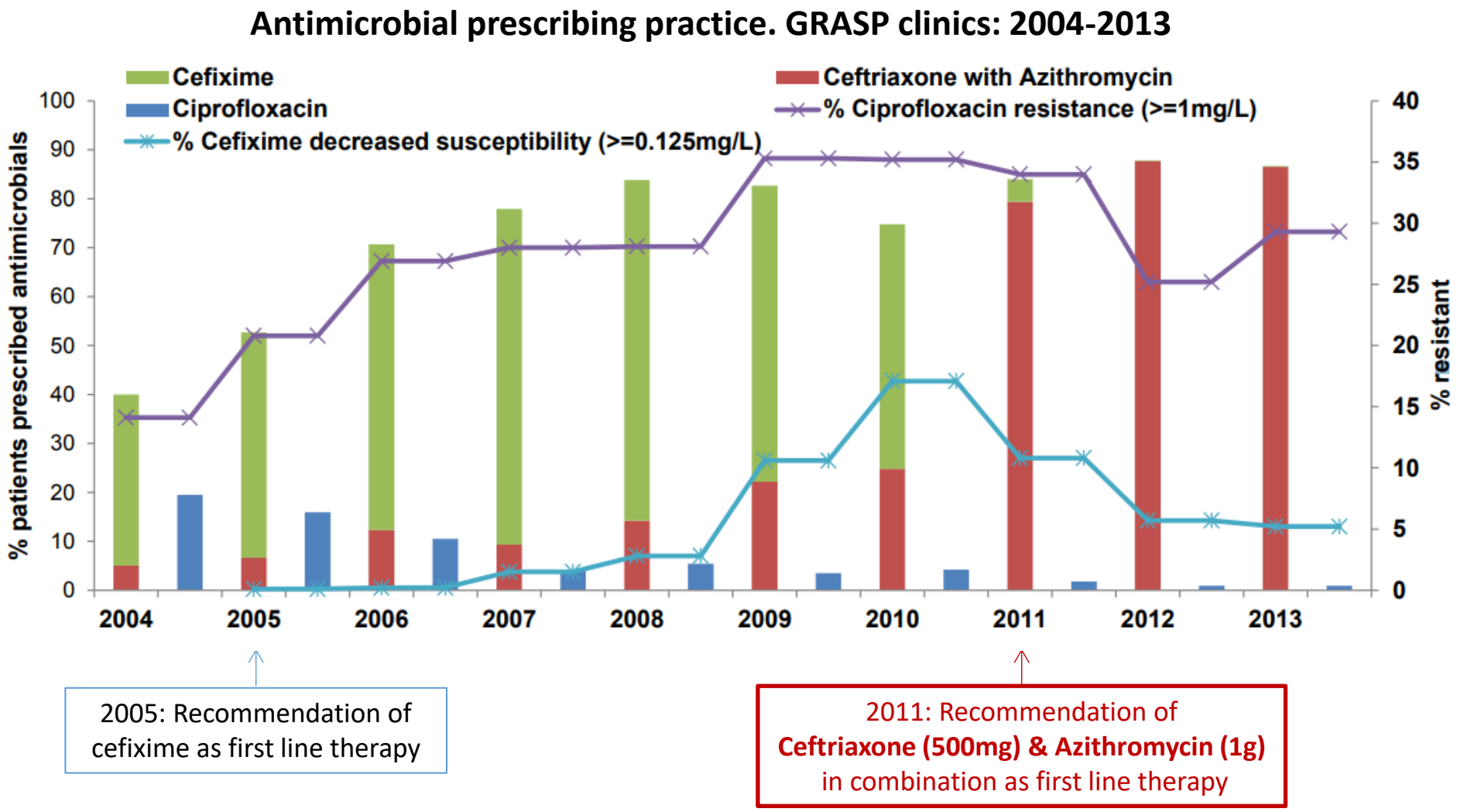
Background

New diagnoses of selected STIs in men-who-have-sex-with-men (MSM) in England sexual health services, 2007-2016



Source: Public Health England (2017) Health Protection Report

Background



Source: Adapted from Public Health England (2014) GRASP report

Background

- Infection control
- Research
- Education
- Monitoring antimicrobial consumption
- Rationalise use of antimicrobials in humans and livestock

Rapid diagnostic tests for AMR

- POCT with susceptibility testing
- Accurate antibiotic treatment
- Reuse of abandoned antibiotics
- Reduce selection pressure

Aims & objectives

Assess the cost-effectiveness of Standard Care (SC)

versus

six hypothetical AMR-POCT strategies

in Sexual Health Clinics (SHCs)

AMR-POCT strategies

- **Standard Care (SC):** intramuscular ceftriaxone (500mg) and oral azithromycin (1g single dose)

Dual therapy optimisation strategies (AMR-POCT determines second agent *in addition* to ceftriaxone (500mg): 500mg ciprofloxacin or 1g azithromycin):

A: **AMR-POCT for ciprofloxacin**

B: **Dual AMR-POCT for azithromycin** and **ciprofloxacin** (result used if azithromycin resistant)

C: **Dual AMR-POCT for ciprofloxacin** and **azithromycin** (result used if ciprofloxacin resistant)

Single therapy optimisation strategies (AMR-POCT determines *alternative* to ceftriaxone: 2g azithromycin, 500mg ciprofloxacin, or penicillin (3g amoxicillin + 1g probenecid)):

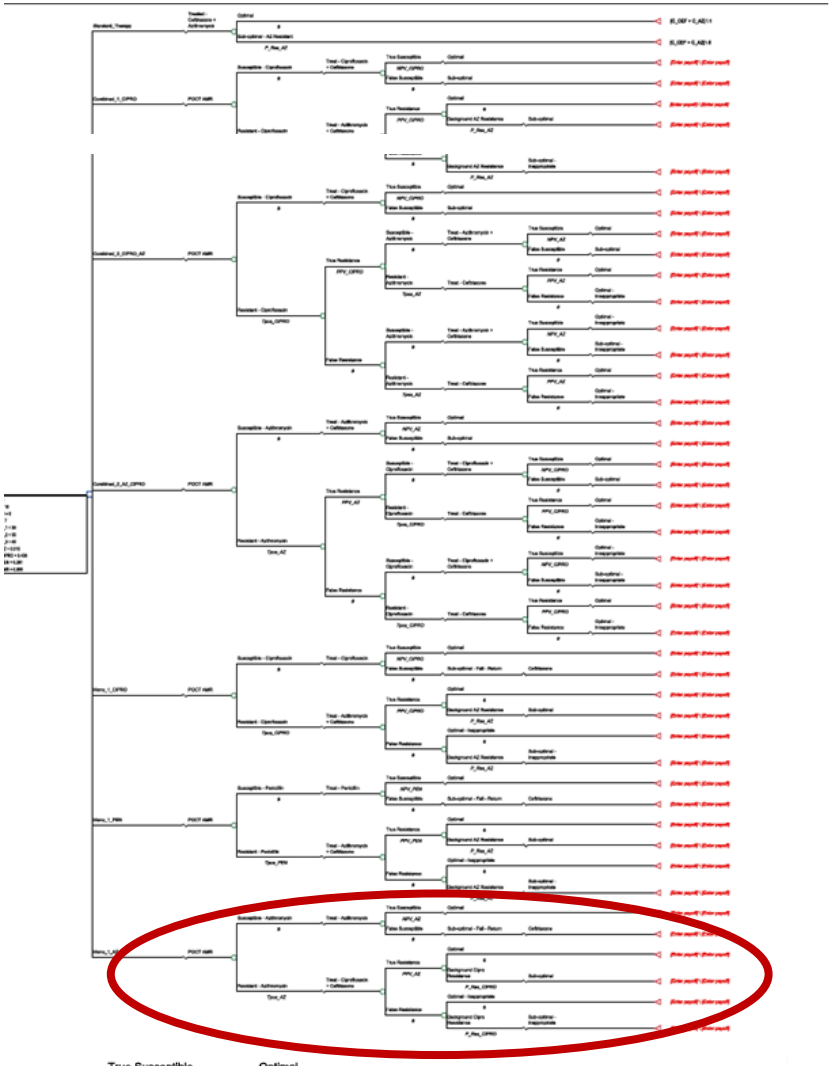
D: **AMR-POCT for azithromycin**. If azithromycin resistant, ***ceftriaxone*** and ***ciprofloxacin*** dual therapy is given

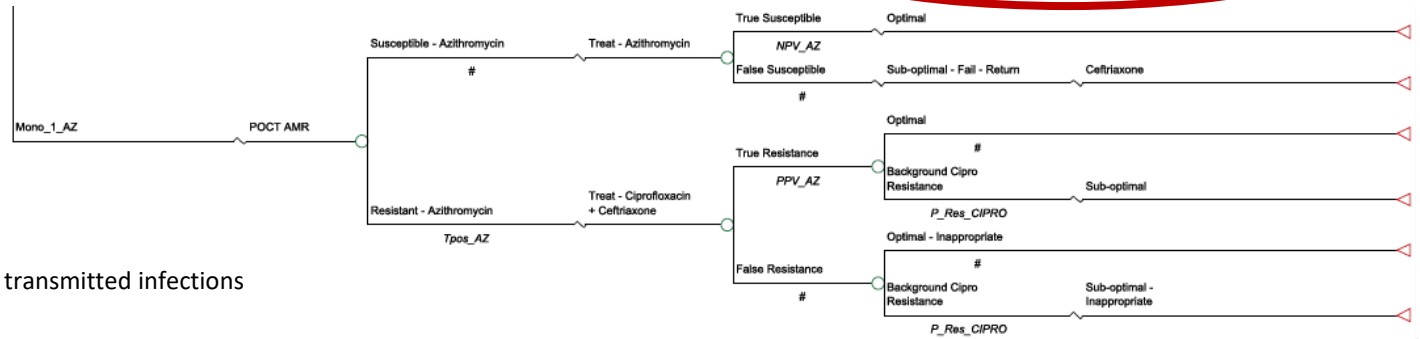
E: **AMR-POCT for ciprofloxacin**. If ciprofloxacin resistant, ***SC*** is given

F: **AMR-POCT for penicillin**. If penicillin resistant, ***SC*** is given

Model

- Decision tree model
- Simulated hypothetical cohort:
  - 38,870 SHC attendees diagnosed with NG[a]
    - 8,488 women
    - 21,915 men who have sex with men (MSM)
    - 8,467 men who have sex with women (MSW)





[a] Public Health England (2016) Sexually transmitted infections (STIs): annual data tables, 2006-2015.

Inputs and outcome measures

- Data from published and unpublished sources, and clinician interviews

Costs	
Retail costs	AMR-POCT
	Drugs (ceftriaxone, azithromycin, ciprofloxacin, penicillin)
Implementation costs[a]	Management of NG (oral medication/intramuscular injection)
	Additional cost of performing AMR POCT
	Test of cure for NG (using POCT for NG)
	Return visit due to treatment failure

[a] Adapted from Adams *et al.* BMJ Open 2014; 4(7): e005322.

Measures of effectiveness	
Number of each drug used to treat NG	• Ceftriaxone, azithromycin, ciprofloxacin, penicillin
Number of optimal treatments	• Cures the infection and does not contain any drug against which there is resistance
Number of sub-optimal treatments	• Contains drugs against which there is resistance
Number of inappropriate treatments	• A 'later' drug used when an 'earlier' drug could have been used and would have been optimal
Number of treatment failures	• Failure to cure an infection due to resistance to a drug given as monotherapy

Outcomes & analyses

- **Primary outcomes:**
  - Incremental cost-effectiveness ratio (ICER):

$$\frac{\textit{Cost of AMR-POCT - Cost of SC}}{\textit{Effectiveness of AMR-POCT - Effectiveness of SC}}$$

    - Cost per additional optimal treatment gained
    - Cost per additional ceftriaxone treatment avoided

- **Secondary outcomes:**
  - % people given an inappropriate treatment
  - % people failing treatment due to resistance

- **Sensitivity analyses:**
  - Responsiveness of outcomes to changes in parameter inputs & model assumptions
  - 18 analyses per parameter: 6 AMR-POCT strategies, 3 population groups

- **Cost-effectiveness acceptability curves (CEACs):**
  - Probability that strategies are cost-effective at different willingness to pay thresholds
  - Monte Carlo simulations

Results

£1 = 1.29 USD

AMR-POCT strategies

Dual therapy with ceftriaxone optimisation:

A: AMR-POCT for ciprofloxacin (500mg) only
B: Dual AMR-POCT for azithromycin (1g) and ciprofloxacin (500mg)
C: Dual AMR-POCT for ciprofloxacin (500mg) and azithromycin (1g)

Monotherapy optimisation:

D: AMR-POCT for azithromycin (2g)
E: AMR-POCT for ciprofloxacin (500mg)
F: AMR-POCT for penicillin (amoxicillin (3g) + probenecid (1g))

Comparison	Total additional cost	Additional cost per patient	Number of optimal treatments	Additional cost per optimal treatment gained	Number of ceftriaxone treatments avoided	Additional cost per ceftriaxone-sparing treatment
AMR POC A vs SC	£1,286,215	£33.09	-66	Dominated	0	Dominated
AMR POC B vs SC	£1,426,131	£36.69	315	£4,532	0	Dominated
AMR POC C vs SC	£1,398,638	£35.98	62	£22,704	0	Dominated
AMR POC D vs SC	£620,747	£15.97	63	£9,890	38,157	£16.27
AMR POC E vs SC	£805,480	£20.72	-66	Dominated	25,406	£31.70
AMR POC F vs SC	£782,865	£20.14	87	£8,981	30,486	£25.68

A strategy is 'dominated' if it is more expensive and provides fewer/equivalent benefits.

Results by population group

AMR-POCT strategies

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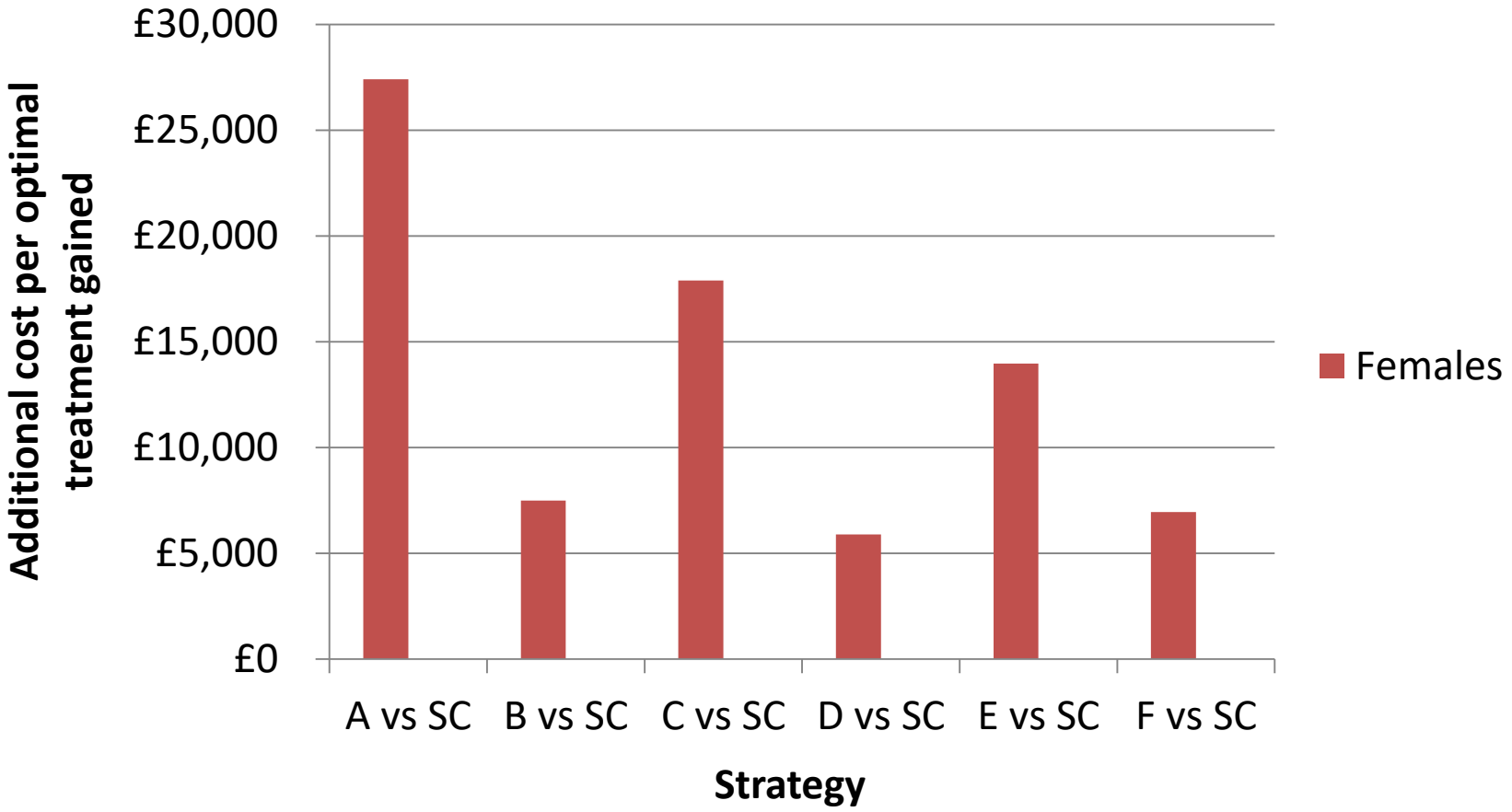

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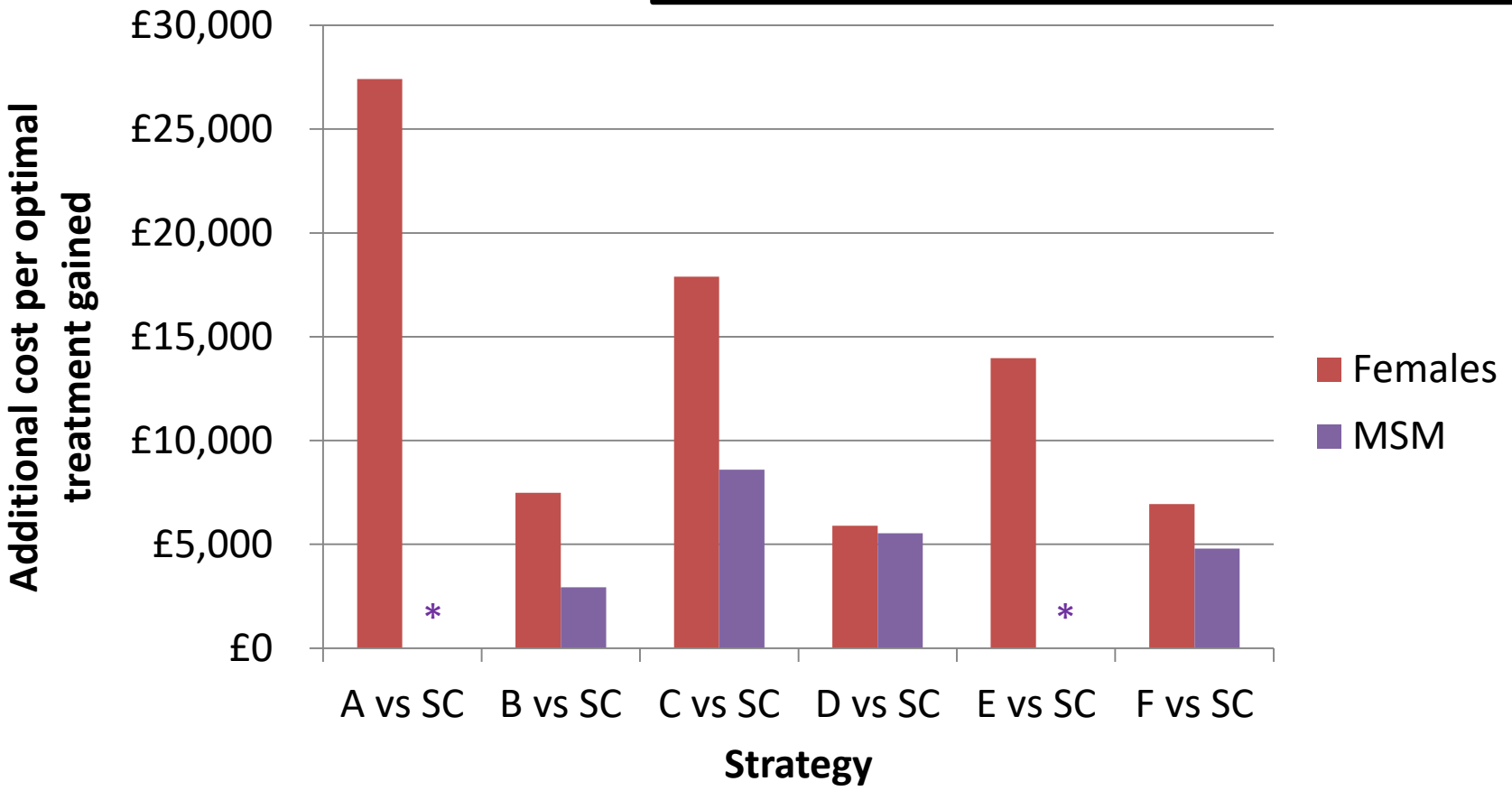
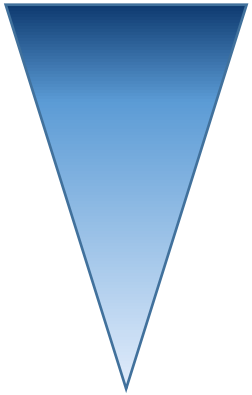


* Strategies A and E were dominated by SC for MSM. For MSW, all strategies were dominated by SC.

Results

- **Sensitivity analyses:**



1. Probability of NG being resistant to azithromycin (18/18)
2. Sensitivity (13/18)
3. Probability of NG being resistant to ciprofloxacin (13/18)
4. Specificity (6/18)
5. Cost of single *vs.* dual AMR-POCT (5/18)

Overall CEAC for optimal treatment

AMR-POCT strategies

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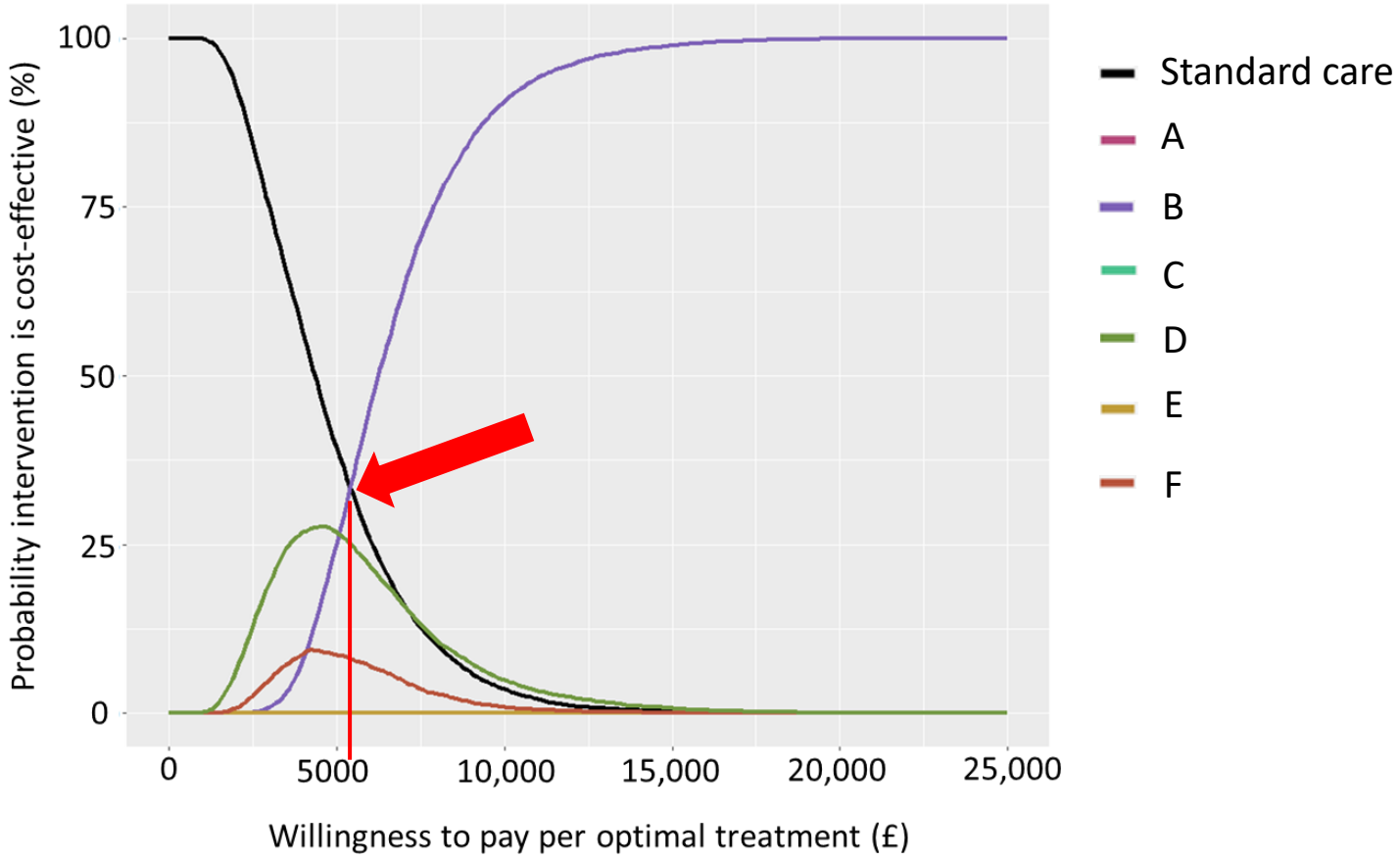

Key points

AMR-POCT strategies

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- SC is the cheapest option
- AMR-POCTs may be cost-effective:
  - Depends on willingness to pay
  - Maximising number of effective agents in treatment regimens
  - Enabling avoidance of ceftriaxone use
- Most cost-effective strategies:
  - B: for optimal treatment
  - D: for ceftriaxone avoidance
  - Both enable re-use of ciprofloxacin, previously abandoned for the treatment of NG
- Variation by population group
- Short-term investment for long-term benefit

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UK Clinical Research Collaboration igniting our potential