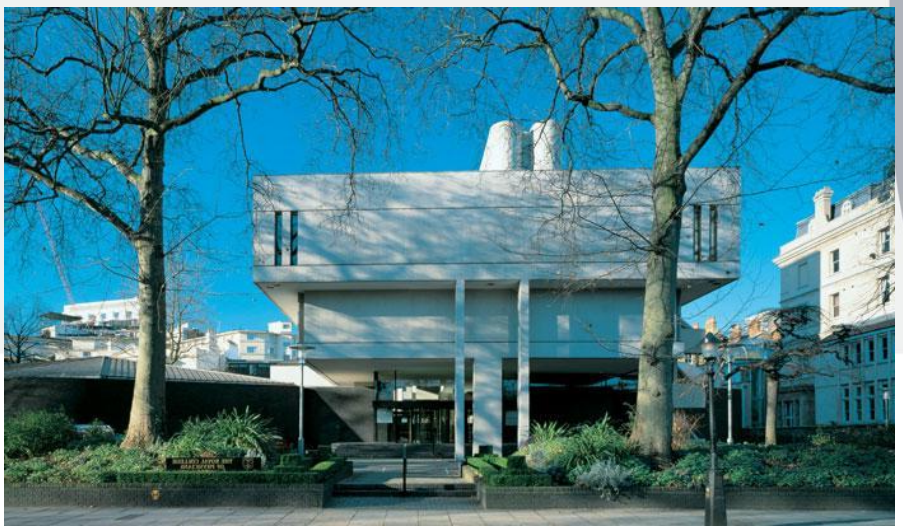
Value of an economic analysis on diagnostic tests conducted for the Pneumonia NICE Clinical Guideline

Presenter: Elisabetta Fenu, Health Economics Lead
Co-author: Chris Kiff
National Clinical Guideline Centre
Royal College of Physicians, London, UK

NCGC | National Clinical Guideline Centre

Background

- National Clinical Guideline Centre (NCGC)
  - based at the Royal College of Physicians
  - clinical practice guidelines for England
  - evidence-based
  - National Institute for Health and Care Excellence (NICE).
- Guideline Committee has to consider both clinical and cost effectiveness evidence
- Recommendations are often based on original economic modelling

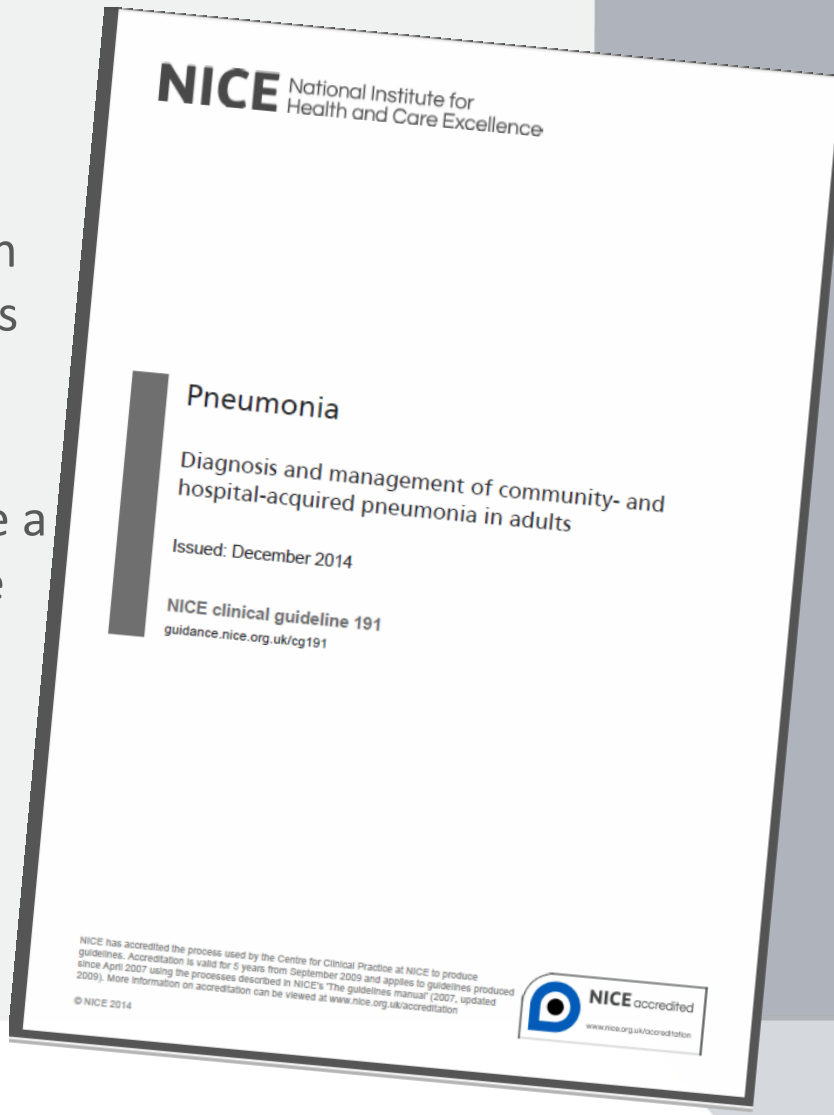


NCGC | National Clinical Guideline Centre

Aims

To present

- our experience in the development of an economic model on microbiological tests for the Pneumonia Guideline (CG191)
- illustrate how an economic model was used alongside clinical evidence to make a more informed recommendation for the guideline.



Methods - question in the Clinical Guideline

- Population: patients diagnosed with pneumonia.
  - Initially everyone is treated with empirical antibiotic therapy (based on likely pathogens)
- Interventions: microbiological tests to identify the correct pathogen which is causing pneumonia.
  - antibiotic treatment can be optimised or changed if pathogen not covered by empirical treatment (targeted treatment)
    - potential benefits of minimising side effects and resistance of pathogens in the wider population
- A systematic review was conducted to assess the clinical effectiveness of microbiological tests to guide antibiotic therapy compared with no test (empirical treatment)
- The clinical evidence was deemed inconclusive: very low quality and could not establish which, if any, test would be useful.

Methods – model question

- Different tests detect different pathogens

	S. pneumonia	***H. influenza***	***S. aureus***	***L. pneumophila***	**Atypical pathogens**	**Gram-negative pathogens**
Blood culture	Yes	Yes	Yes	No	No	Yes
Routine sputum culture	Yes	Yes	Yes	No	No	Yes
Urinary pneumococcal antigen	Yes	No	No	No	No	No
Urinary legionella antigen	No	No	No	Yes	No	No

Methods – model data and structure

- The following data were inputted into the model:
  - Prevalence of pathogens in the UK
  - Accuracy (sensitivity and specificity) of each test at detecting specific pathogens

Sensitivity: The probability that a test will be positive in a patient who has the disease

Specificity: The probability that a test will be negative in a patient who does not have the disease

Methods – model data and structure

- The following data were inputted into the model:
  - Prevalence of pathogens in the UK
  - Accuracy (sensitivity and specificity) of each test at detecting specific pathogens

- Initially everyone receives empirical treatment
- According to accuracy of tests a pathogen is detected
- Targeted antibiotic treatment for detected pathogen is assigned (based on the susceptibility of pathogens to different antibiotics)

Methods – costs and health effects

Costs

- Cost of tests performed
- Cost of antibiotic treatment prescribed
- Cost of additional 3 days of hospital stay if pathogen was resistant to the antibiotic treatment assigned

Effects

- Mortality at 30 days
  - Pathogen-specific
  - For some pathogens reduced if targeted treatment provided
- This was combined with a quality of life (QoL) value – EQ5D - for people with pneumonia to estimate quality-adjusted life years (QALYs).

QALYs are the combination of QoL estimates with survival such that:

1 year in full health (QoL =1) = 1 QALY

2 years in half health (QoL = 0.5) = 1 QALY

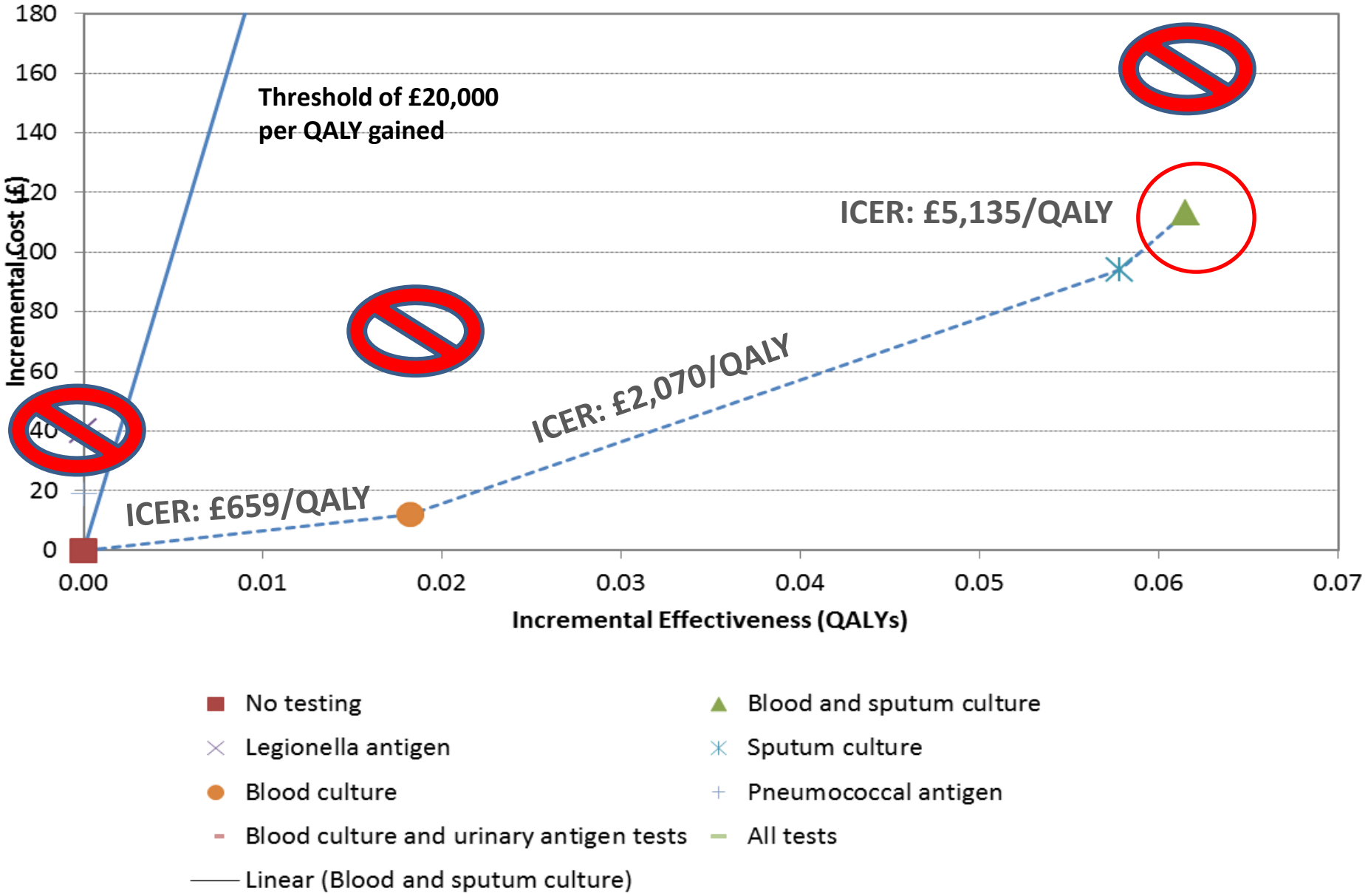
Methods – assessing cost-effectiveness

1. Calculate mean costs and QALYs for all strategies
2. Calculate the incremental cost-effectiveness ratio (ICER) between strategies

$$\text{ICER} = \frac{cost\ strategy\ A - cost\ strategy\ B}{QALYs\ strategy\ A - QALYs\ strategy\ B}$$

3. Compare the ICER to the cost-effectiveness threshold (£20,000 per QALY used in NICE Clinical Guidelines) selecting the option with the highest benefits and the ICER below the threshold.

Results – base case analysis



Limits

The Guideline Committee was aware that the model may have underestimated the health benefits of targeted treatment, and therefore the benefits of conducting all tests, such as:

- Decrease in mortality for all pathogens (including for those detected by the antigen tests)
- Decrease in antibiotic resistance across the whole population
- Decrease in adverse events from antibiotic treatment (not incorporated in the model)

Due to lack of data on these areas.

Results - sensitivity analysis

Two sensitivity analyses to address the limitations:

a) We quantified the QALY gain associated with any targeted treatment assigned to patients in the model which made the 'all tests' strategy cost effective.

→ If targeted treatment was able to generate at least 0.0134 additional QALYs, all tests in combination would be the most cost-effective strategy.

b) In the base case same mortality with or without targeted treatment for the two pathogens detected by the antigen tests; when mortality with targeted treatment varied 'all tests' was cost effective if this was:

→for *L. pneumophila:* 10.4% (vs 11% non-targeted)

→for *S. pneumoniae:* 13.8% (vs 14% non-targeted)

The Committee agreed there was still uncertainty over the cost effectiveness of 'all tests' but they could be considered.

Sensitivity analyses allow us to re-run the analysis using different values to see how robust the conclusions are from the model.

Bottom line

- Despite the limitations, this model was able to inform the guideline recommendations, while a simple review of accuracy studies would not have been enough to identify the optimal combination of tests.
- The recommendations had different strength based on the model uncertainty.

For patients with moderate of high severity community acquired pneumonia:

- take blood and sputum cultures
- consider pneumococcal and legionella urinary antigen tests

Thank you!

Any questions?

The NCGC is a governance partnership between:

Royal College of Physicians

Royal College of Nursing

Royal College of General Practitioners

RCS
ADVANCING SURGICAL STANDARDS