University of BRISTOL
Centre for Academic Primary Care

NIHR | School for Primary Care Research

How do GPs make sense of diagnostic tests?

Dr Jessica Watson @drjessicawatson

GP West Walk Surgery Yate

NIHR Academic Clinical Lecturer

University of Bristol

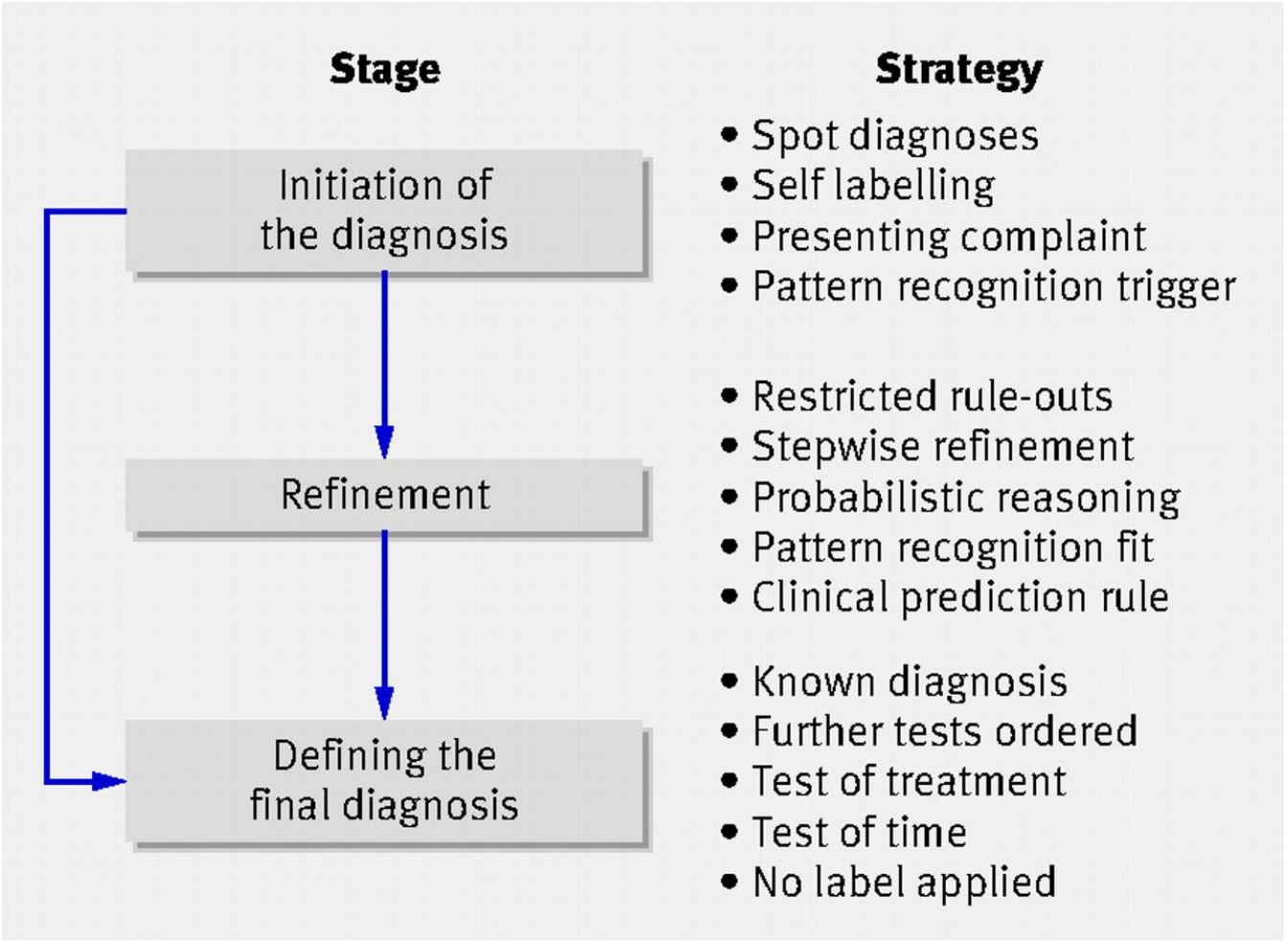
www.bristol.ac.uk/capc

@capcbristol

Outline

- How do GPs make a diagnosis?
- What are diagnostic tests?
- Interpreting tests – the theory
- Interpreting tests – the reality

How do GPs make a diagnosis?

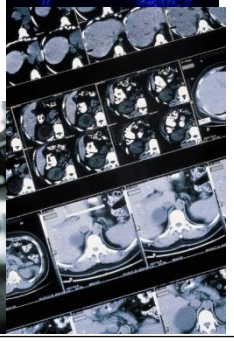


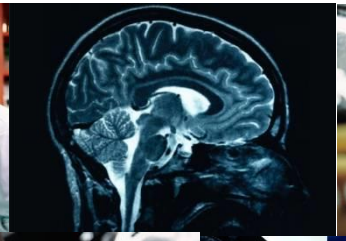
C Heneghan et al. BMJ 2009;338:bmj.b946

What is a diagnostic test?

“any procedure, or test, that tries to confirm or identify the presence or absence of a target condition”

- Includes laboratory tests, point of care tests, imaging, invasive procedures, patient history, physical examination, questionnaires, test of time, test of treatment





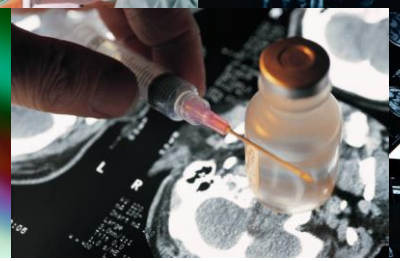


Table 11. The CAGE Questionnaire.

- Have you ever felt the need to **C**ut down on your drinking?
- Have you ever felt **A**nnoyed by criticism of your drinking?
- Have you ever felt **G**uilty about your drinking?
- Have you ever felt the need to drink a morning **E**ye-opener?

What do tests do?

Tests determine if you have a disease

What do tests do?

~~Tests determine if you have a disease~~

Tests determine your chances of having a disease

What do tests do?

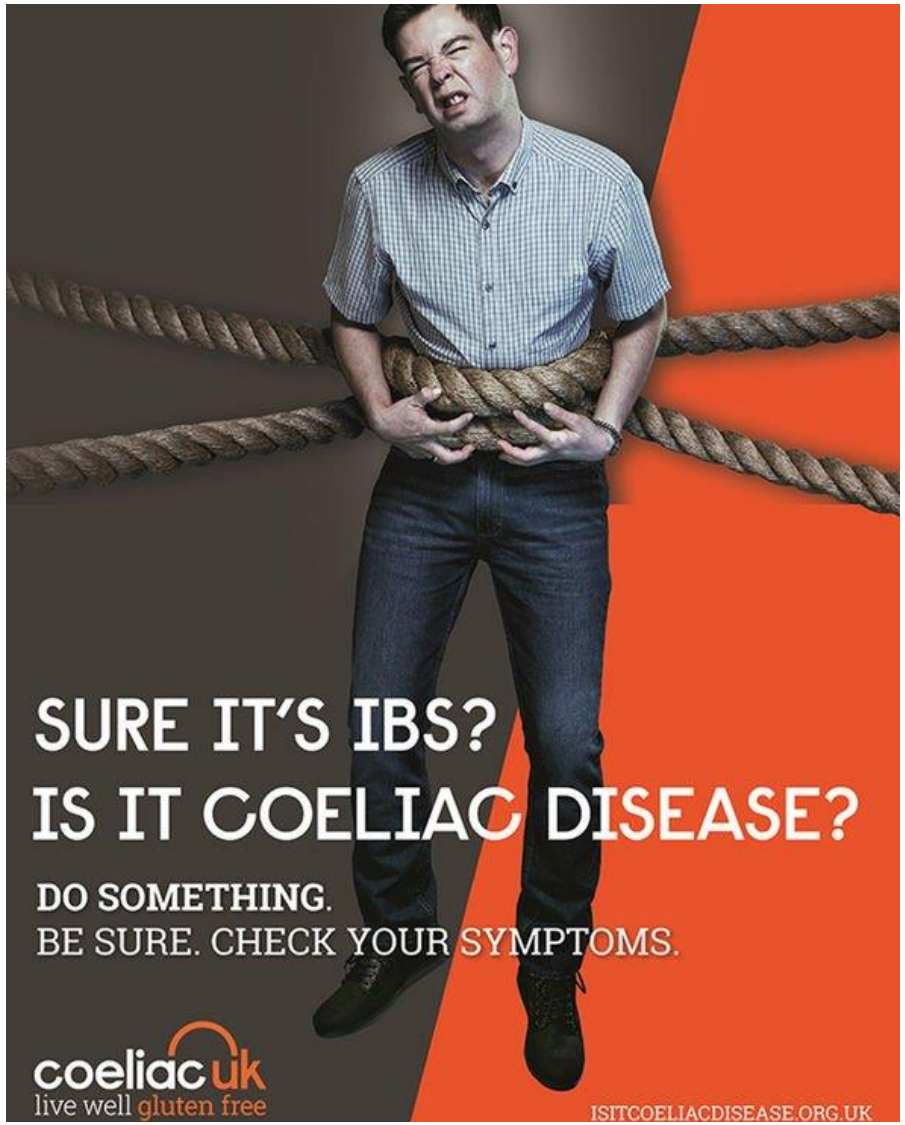
~~Tests determine if you have a disease~~

~~Tests determine your chances of having a disease~~

Tests update your chances of having a disease

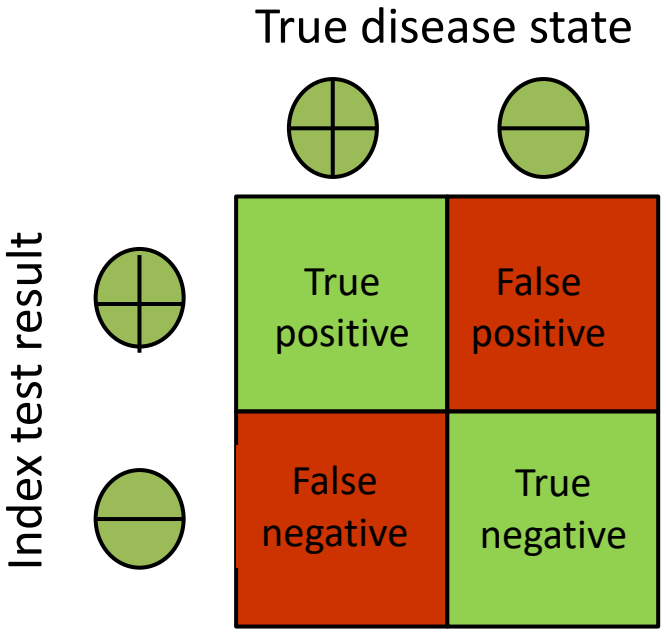
Mary’s story

Could Mary have coeliac disease?

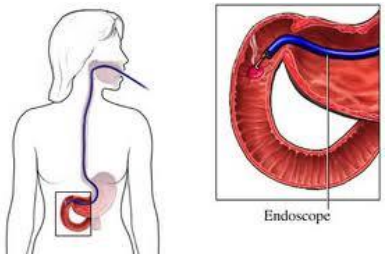


How do we calculate coeliac disease test accuracy?

Index test result
Blood test (tissue transglutaminase)



True disease state
Duodenal biopsy
(reference standard)



Sensitivity = TP/(TP + FN)

Specificity = TN/(TN + FP)

Interpreting diagnostic tests – the theory

Sensitivity: Proportion of individuals *with* the condition who test *positive*

Sensitivity = TP/(TP + FN)

Specificity: Proportion of individuals *without* the condition who test *negative*

Specificity = TN/(TN + FP)

Mary’s story - continued

- Mary’s blood test result is positive
- Sensitivity of IgA TTG is estimated at 90.7%, specificity 87.4%9*
- What is the likelihood that she has coeliac disease?
- Does she need a biopsy to confirm?

*Elwenspoek, et al. *Identifying the optimum strategy for identifying adults and children with coeliac disease: systematic review and economic modelling*. NIHR Journals Library.

Conditional probabilities

- Sensitivity: Proportion of individuals with the condition who test positive

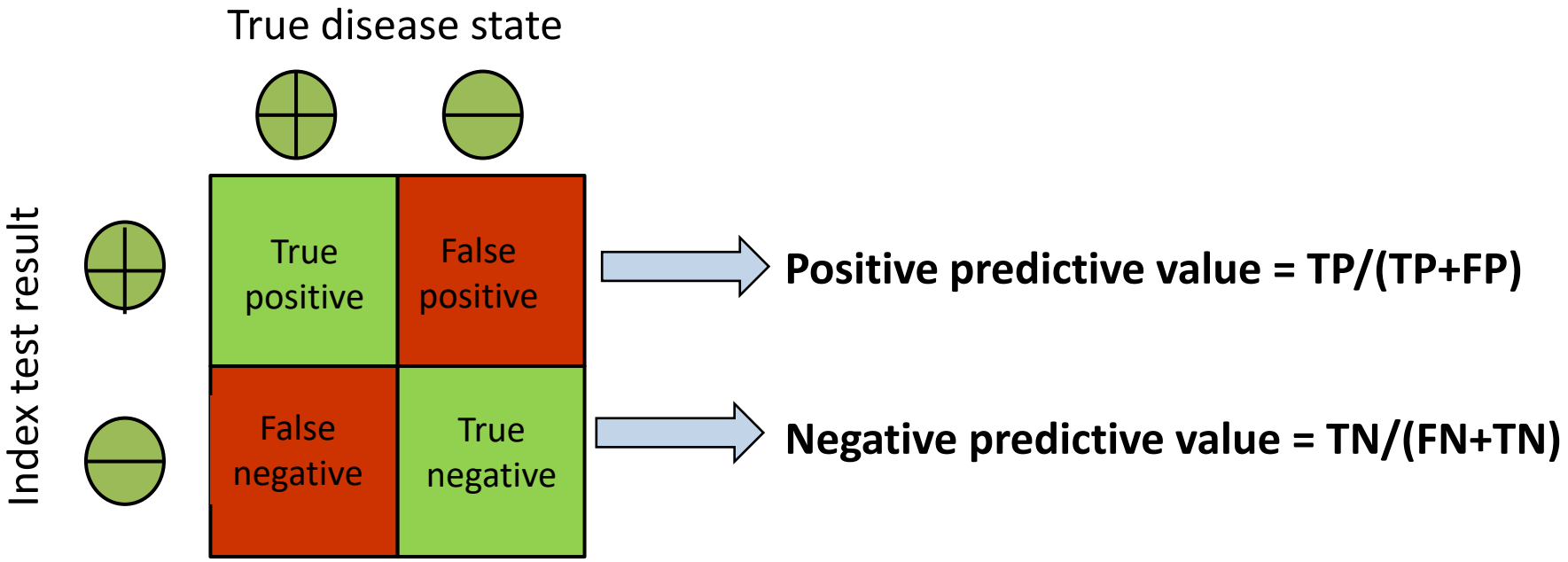
P(Test positive|disease)

- Positive Predictive Value (PPV): Probability of having the disease in a patient with a positive result

P(Disease|Test positive)

$$\mathrm{P}(Disease|Test\ positive) = \frac{P(Disease) \times P(Test\ positive|Disease)}{P(Test\ positive)}$$

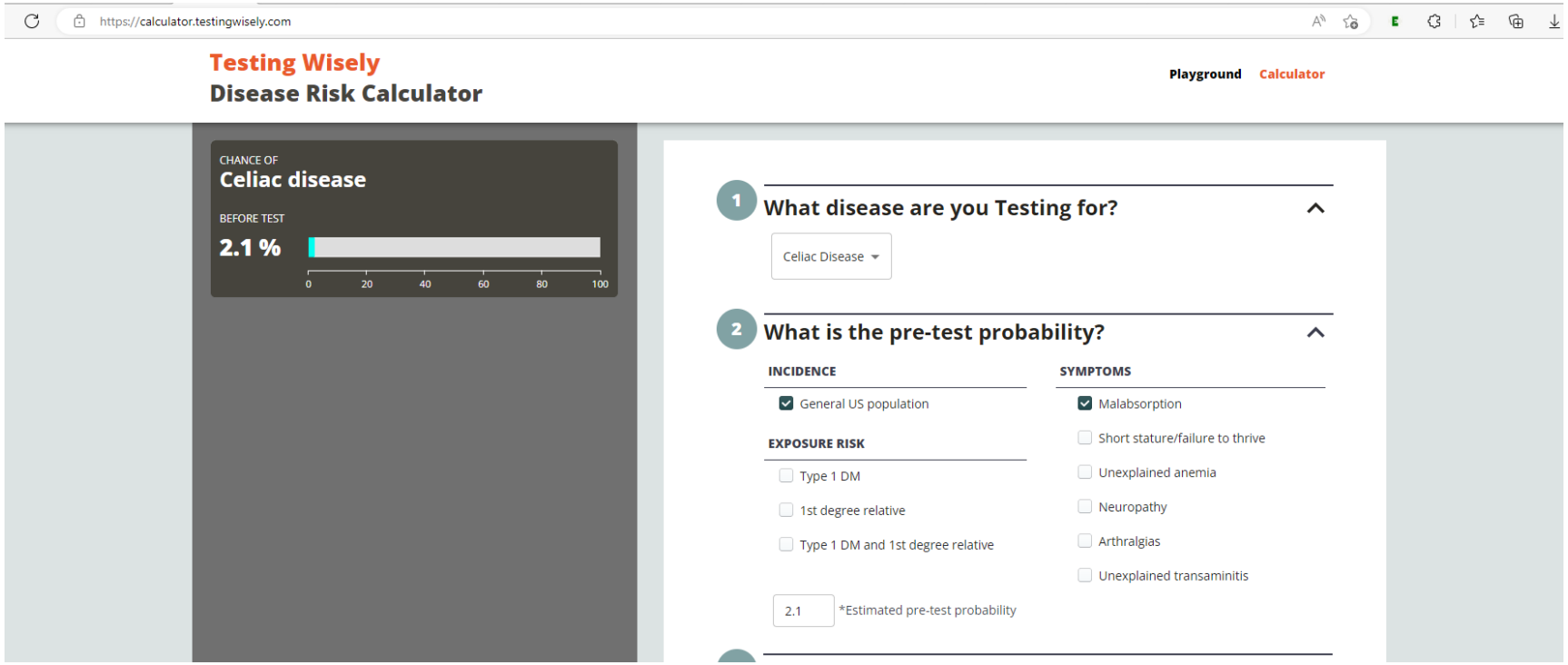
Predictive values



PPV is mathematically dependent on pre-test probability (for an individual) or prevalence (at a population level)

Estimating pre-test probability

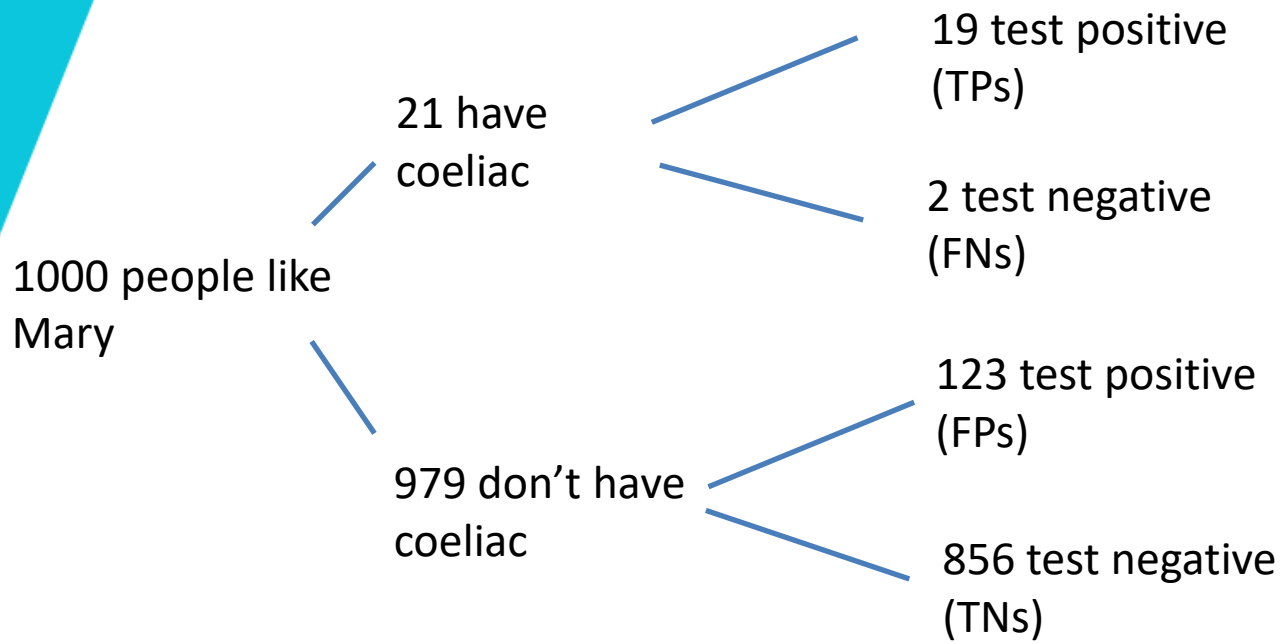
- Prevalence coeliac disease: roughly 1%
- History and examination used to update pre-test probability:
  - Symptoms? Family history? Past medical history?



Calculating predictive values:

Sensitivity = 90.7%, specificity = 87.4%

Mary has a pre-test probability of coeliac of 2.1%



If Mary tests positive, the probability she has coeliac is:

19 (19 + 123)

= 13.4 %

If Mary tests negative, the probability she has coeliac is:

2/(2 + 856)

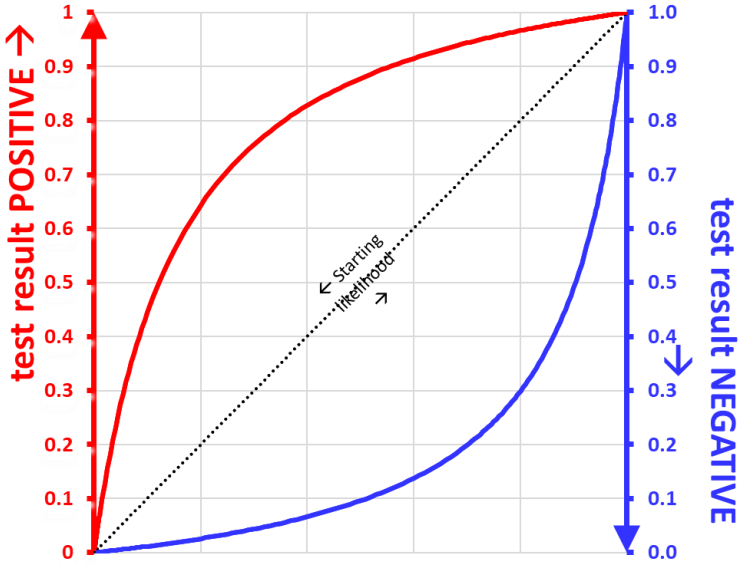
= 0.02%

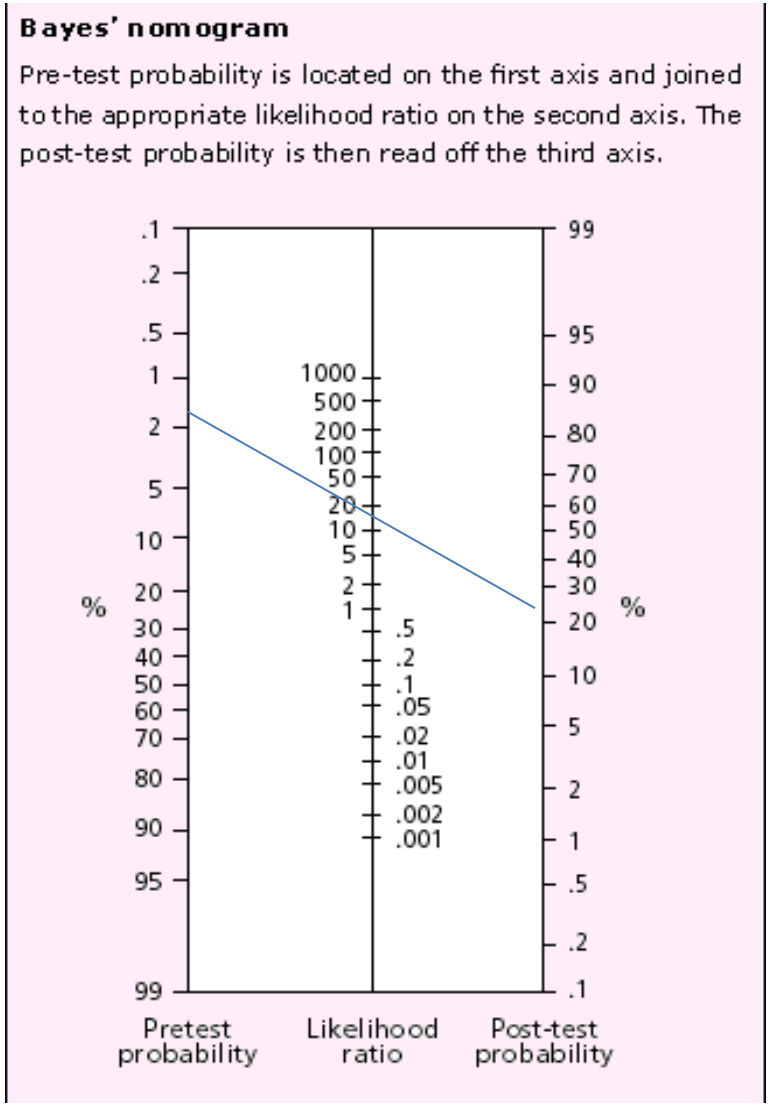
Calculating predictive values: tools

$$\mathrm{P}(A|B) = \frac{P(A) \times P(B|A)}{P(B)}$$

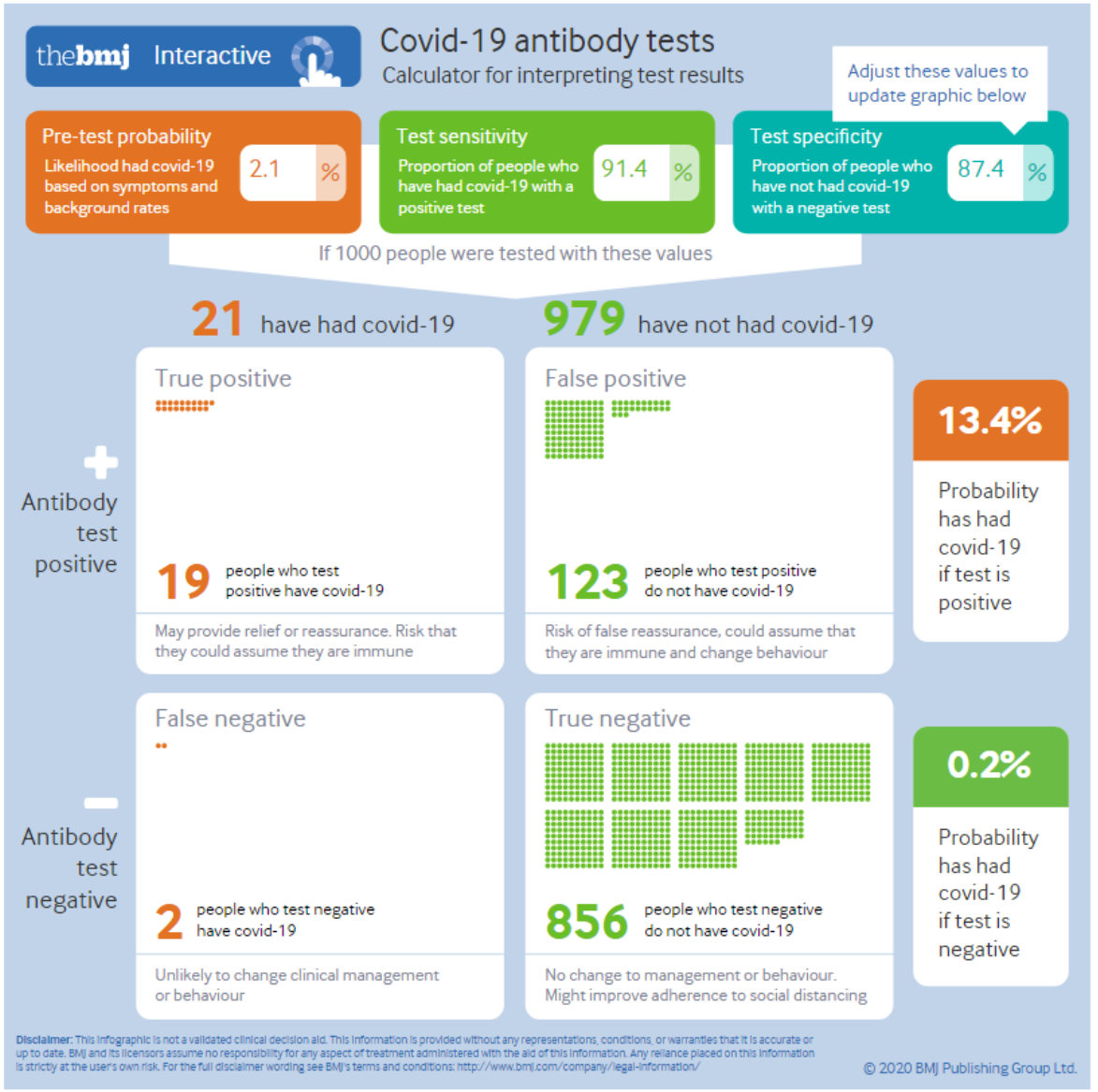
where

- P(A|B) = how likely is A given B
- P(B|A) = how likely is B given A
- P(A) = how likely is A overall
- P(B) = how likely is B overall



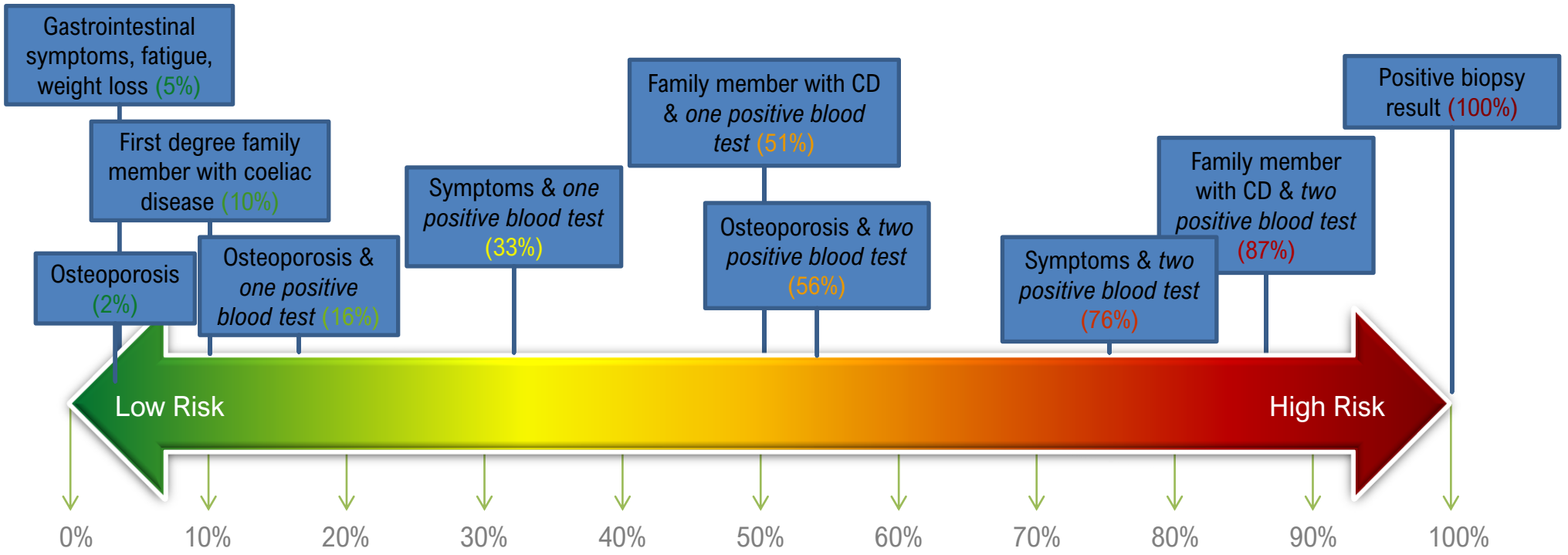


Calculating predictive values: tools



Estimating the predictive values: the reality

- Heuristics (learned mental short cut):
  - Anchoring (the pre-test probability)
  - Adjusting (based on the test result)


Gastrointestinal symptoms, fatigue, weight loss (5%)
First degree family member with coeliac disease (10%)
Osteoporosis (2%)
Osteoporosis & one positive blood test (16%)
Symptoms & one positive blood test (33%)
Family member with CD & one positive blood test (51%)
Osteoporosis & two positive blood test (56%)
Symptoms & two positive blood test (76%)
Family member with CD & two positive blood test (87%)
Positive biopsy result (100%)
Low Risk
High Risk
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

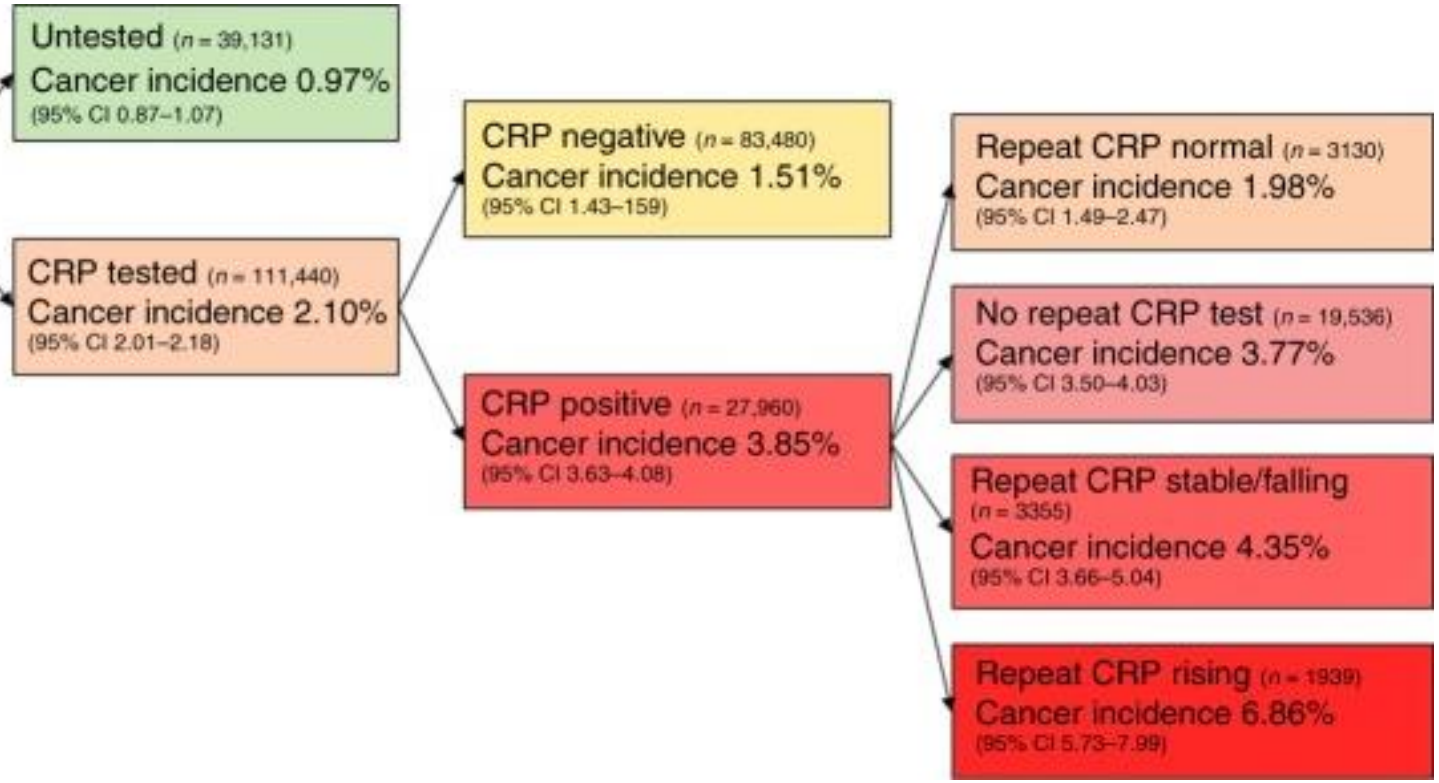
Does Mary need a biopsy?

- *How sure would you like to be before starting a gluten free diet?*

Martin’s story

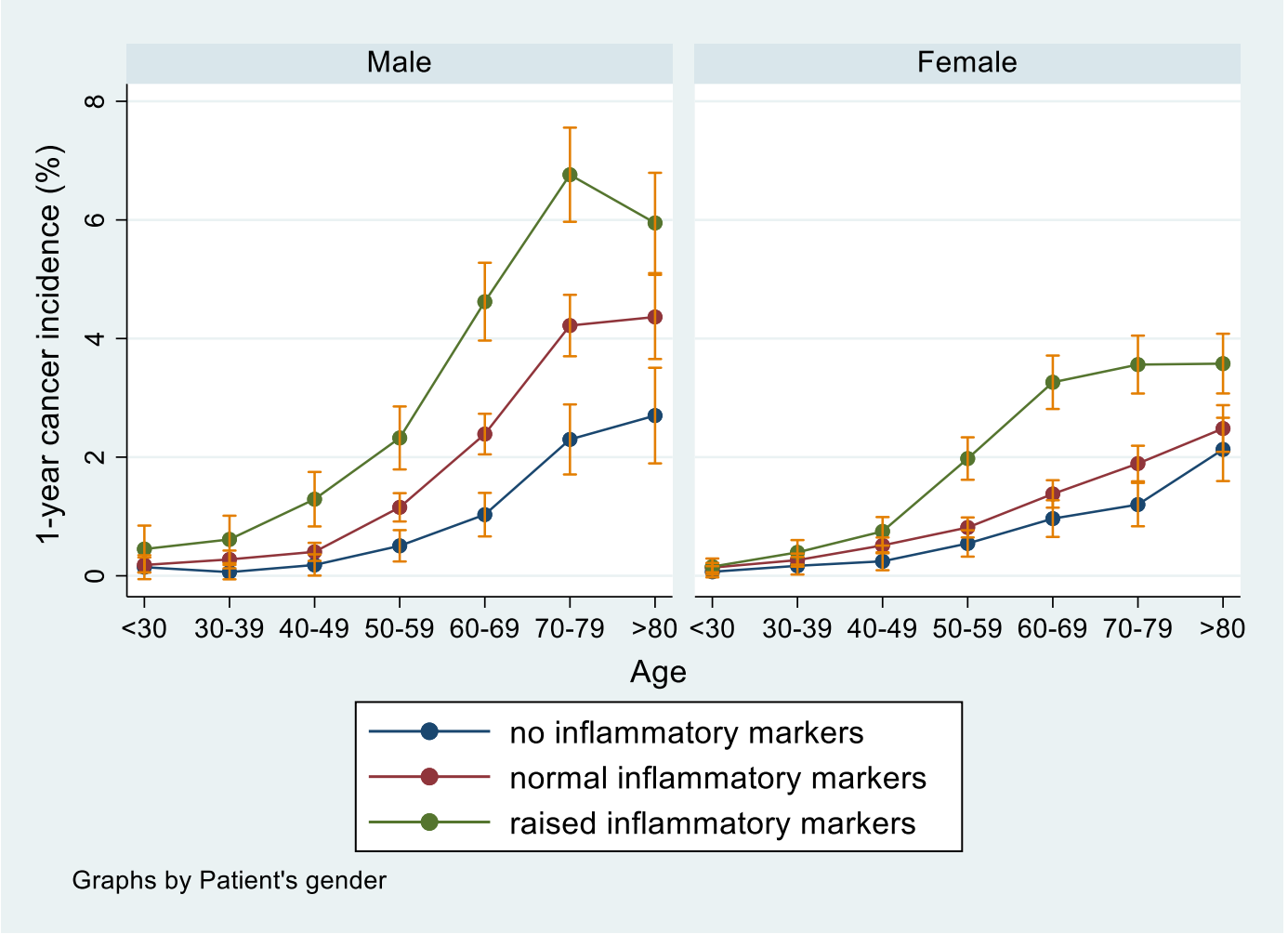
- Martin has the same symptoms as Mary
- His coeliac serology tests were negative
- All other blood tests were normal apart from a raised CRP test result (non-specific marker of inflammation)

Testing is a series of Bayesian steps



The paradox of the normal test result

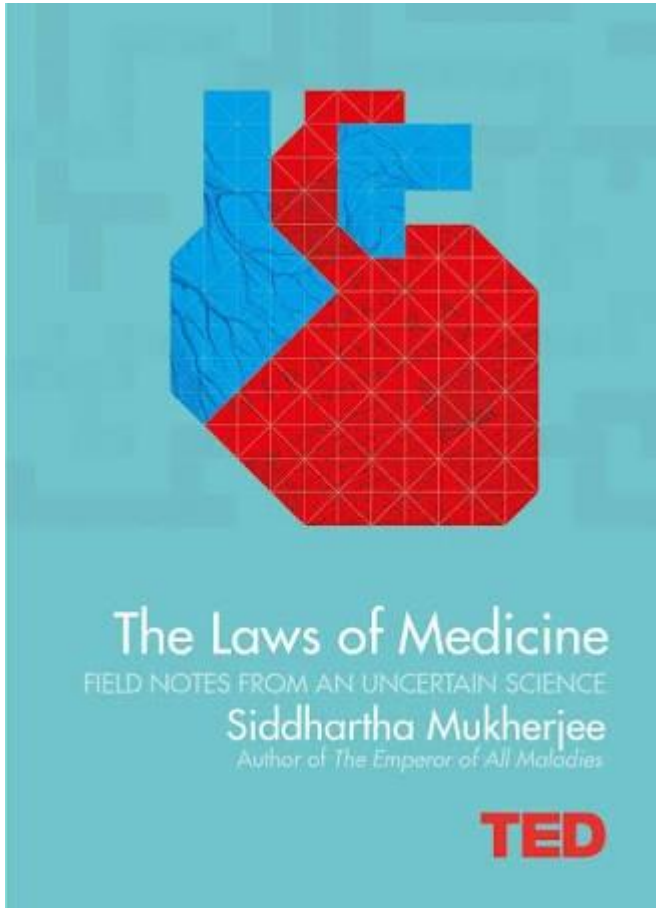
- The mere fact that a test result has been performed increases the risk of cancer
- This additional risk is only partly eliminated by a negative test result



Cognitive biases – base rate neglect

- Anchoring and adjustment heuristics can be prone to bias
- Base rate neglect - the tendency to trust results of an ‘objective’ test more than ones own ‘subjective’ clinical judgement.

- “A strong intuition is much more powerful than a weak test”
  - Siddhartha Mukherjee’s first ‘Law of Medicine’



Take home messages

- Tests *update your chance* of having disease
- To understand a test result you need to know the test accuracy and the pre-test probability
- Doctors use mental shortcuts (heuristics) called anchoring and adjusting
- This can be prone to cognitive biases
- More tools to help interpret test results could help diagnostic decision making

Thank you

@drjessicawatson

Jessica.Watson@bristol.ac.uk