Including prevalence in the interpretation of tests for Johne's Disease control

University of Glasgow — VIA VERITAS VITA

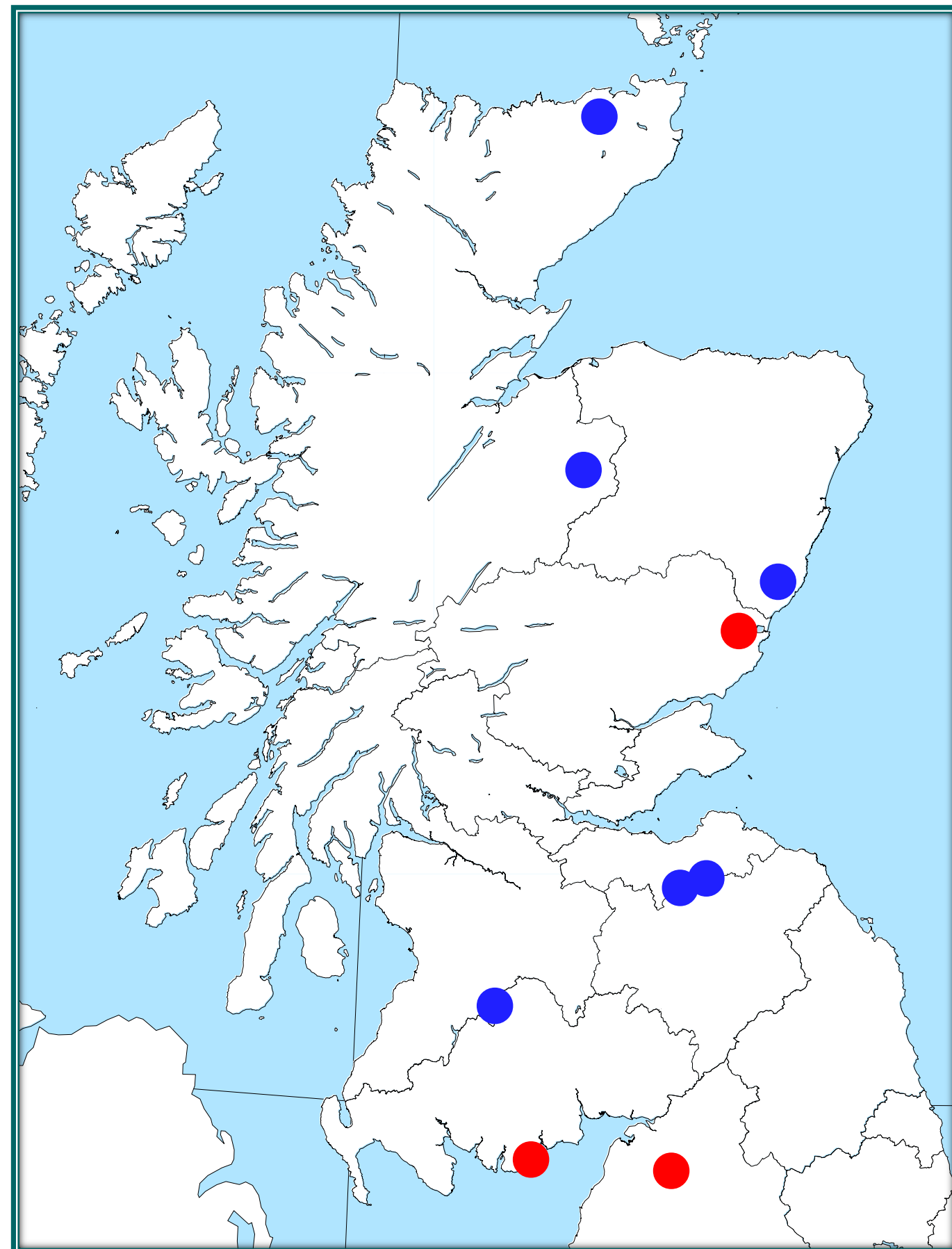**Mary Flook, Billy Steele, Fiona Houston and Dominic Mellor**

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Introduction

PARABAN — Knowledge exchange for control of Johne's Disease

A multi-partner project focused on Knowledge Exchange about development and demonstration of 'best practice' for Johne's Disease control on 'Champion Farms' (beef in blue, dairy in red).

The serology for *Mycobacterium avium* ssp *paratuberculosis* (MAP) can be difficult to interpret and make use of in farm management decisions.

As control programmes progress it is expected that prevalence of MAP within the herd will decrease.
A change in prevalence affects the predictive value of any diagnostic tests used.

Methods

Using reported sensitivity and specificity figures for the tests used by PARABAN partners the predictive values can be calculated for a range of prevalences:

$$PPV = \frac{(TP \times Se)}{(TP \times Se + (1 - TP) \times (1 - Sp))}$$

$$NPV = \frac{((1 - TP) \times Sp)}{(TP \times (1 - Se) + (1 - TP) \times Sp)}$$

P or N PV = positive or negative predictive value   TP = total prevalence   Se = sensitivity   Sp = specificity

The PARABAN project and health schemes encourage routine testing. Repeat testing has an effect on specificity and sensitivity:

$$Se_{(tot)} = Se_1 \times Se_2$$

$$Sp_{(tot)} = 1 - ((1 - Sp_1) \times (1 - Sp_2))$$

The change in predictive value of a test when it is repeated may be useful in making decisions on farm – particularly the decision of when to remove an animal from the herd.

MAP is a chronic disease so the healthy animal (left) may be infected and shedding like the end-stage animal (right).

The aim is to remove infected animals whilst they are still healthy and less likely to be shedding MAP into the environment.

Results

Test kits for MAP serology give a range of expected sensitivity due to the variability in antibody production between animals and over time.


Fig. 1: Predictive values at reported IDEXX sensitivity range (Sp = 0.992) [1]
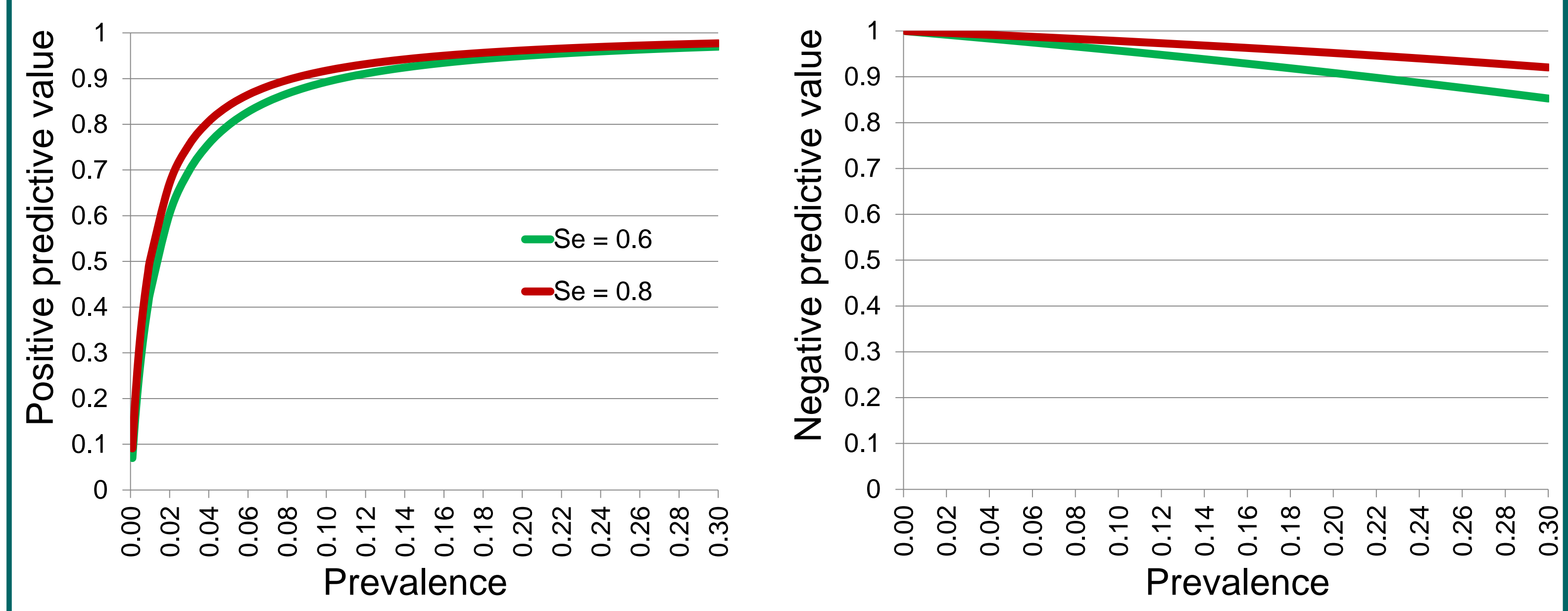
The degree of certainty required for making decisions will depend on the herd resources and the farm physical resources.

Achieving a 90% certainty that a positive result is true needs the prevalence to be over 8% - probably usual in a herd that is beginning a control programme which still has occasional clinical cases [2].

Fig. 2: Predictive values on repeated tests at Se = 0.6 and Sp = 0.992
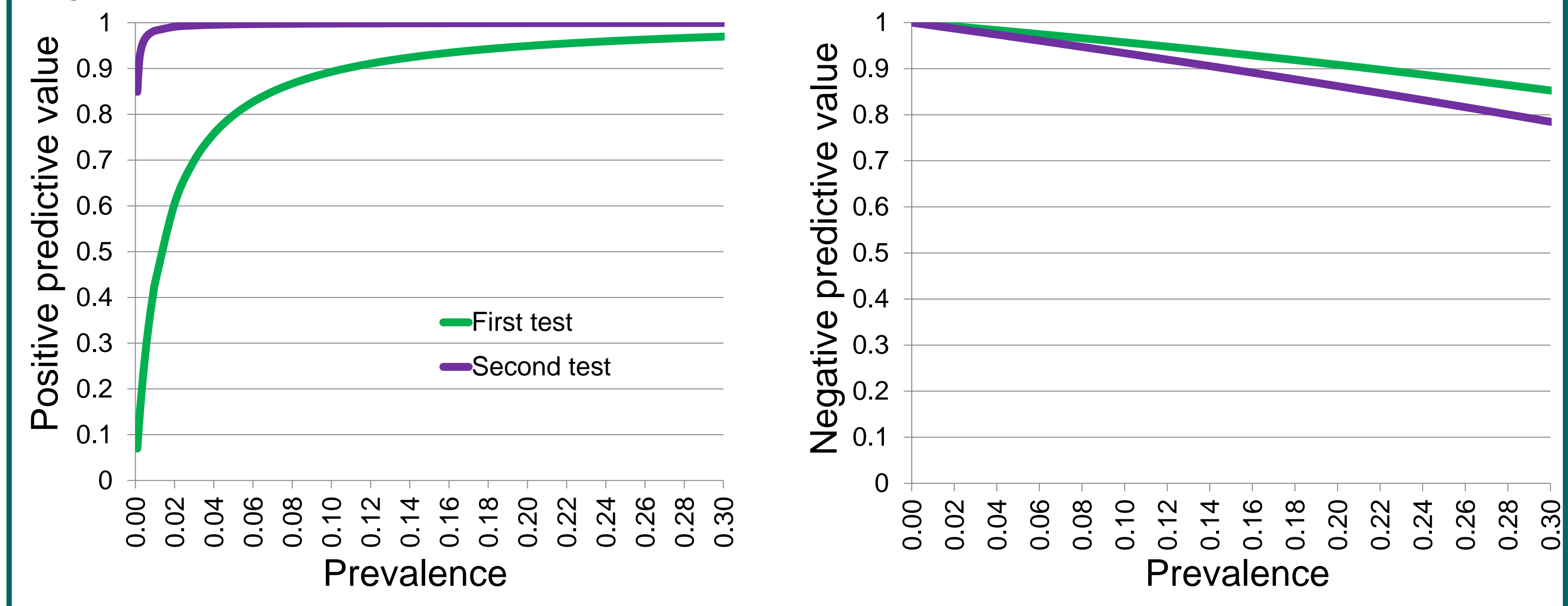
Repeating a test and getting a positive result increases the positive predictive value – in this case even at very low prevalence a 90% degree of certainty may be assumed.

The risk of a second negative not being true is increased, though the 90% degree of certainty is still plausible at prevalences up to 12%.
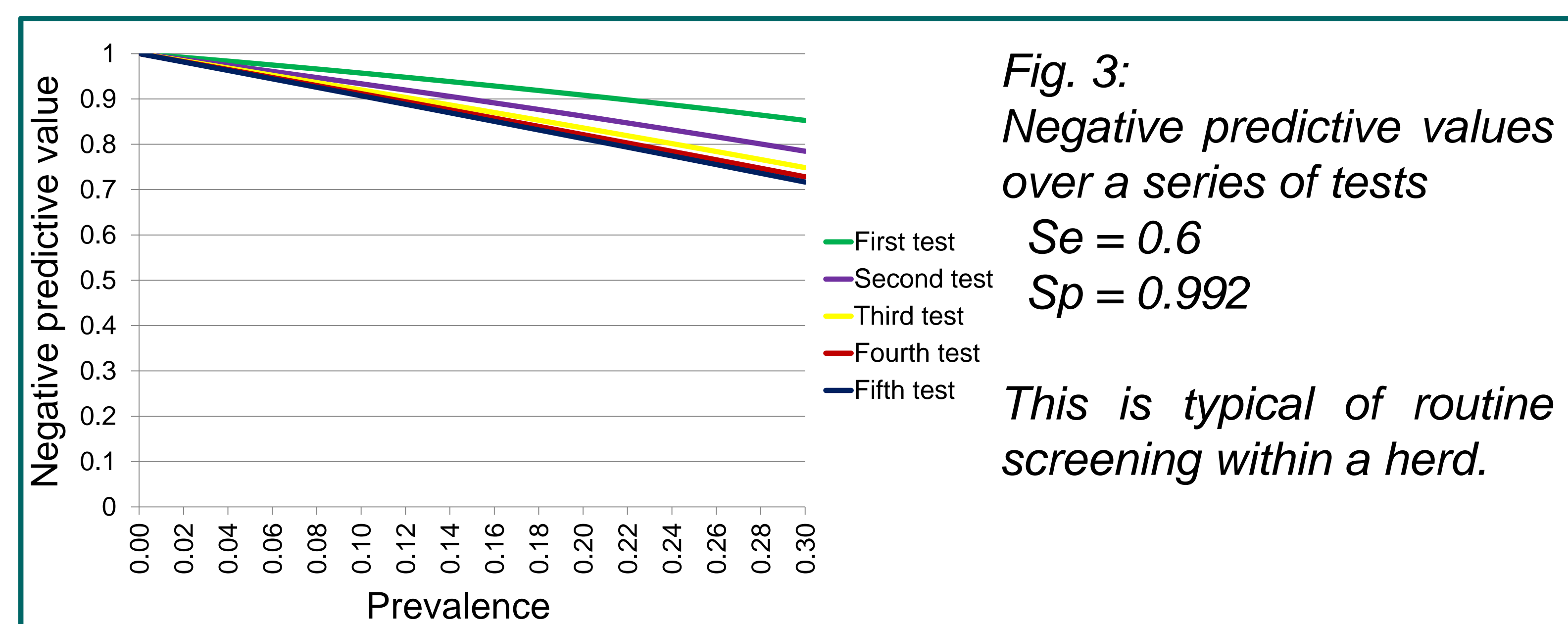

Fig. 3:
Negative predictive values over a series of tests
Se = 0.6
Sp = 0.992

This is typical of routine screening within a herd.

Conclusion

For farms that have made progress in controlling the disease it may not be necessary to remove animals from the herd on the basis of a single positive serology result, though isolation from the main herd could be recommended if facilities are available.
A series of negative serology results may offer little assurance of disease-free status on a farm with a high prevalence.

1 - http://www.idexx.co.uk/view/xhtml/en_us/livestock-poultry/ruminant/map.jsf
2 – Woodbine K,, Schukken Y. et al – Seroprevalence and epidemiological characteristics of *Mycobacterium avium ssp paratuberculosis* on 114 cattle farms in south west England – Preventive Veterinary Medicine Vol 89, Iss 1, Pg 102-109 (2009)