# Can a Diagnostic AI Tool to Read Prostate Cancer (PrC) Biopsies Benefit the NHS?

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## INTRODUCTION

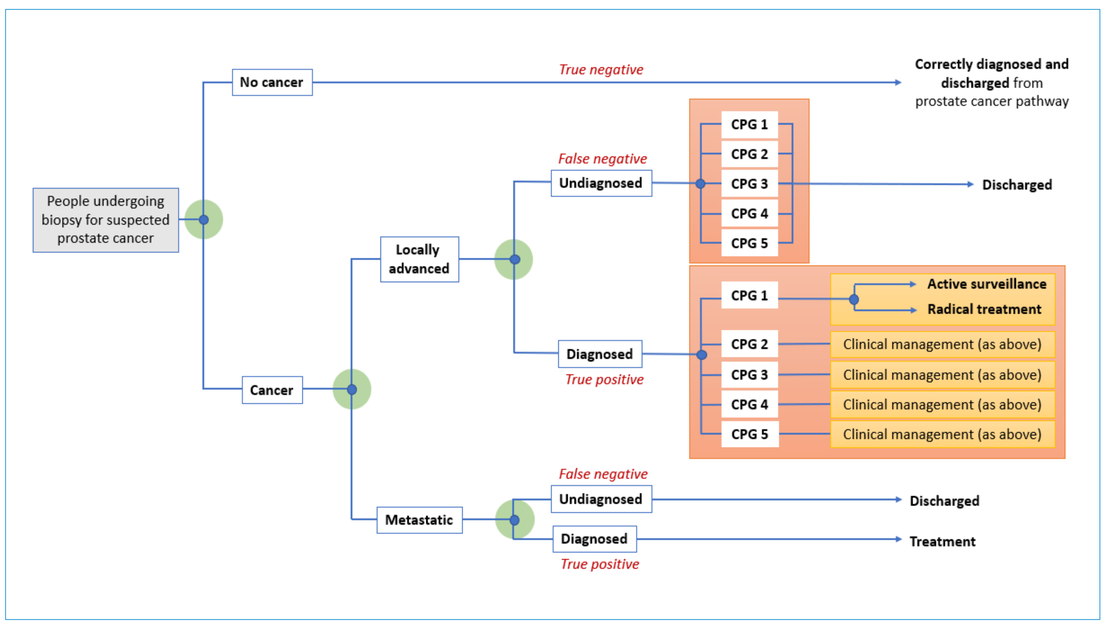
- Prostate cancer (PrC) is the most common cancer in males in the UK, with nearly 48,500 people diagnosed annually.[1]
- Following a biopsy, cases are assigned a Gleason grade (GG) and stratified into Cancer Prognostic Groups (CPGs).
- Variation in diagnostic accuracy, particularly across labs and pathologists, can mean subjectivity in results which risks overtreatment or undertreatment.
- Paige Prostate (PaPr) is an assistive AI biopsy reading tool, designed to support both the identification of PrC as well as the GG assignment of the cancer.

**Objective:** This analysis aimed to estimate the potential economic impact of the use of PaPr in the UK as part of the NHS AI Lab programme, the AI in Health and Care Award.

## METHODS

- A cohort model, combining a decision tree and a Markov structure, was built. The population was people referred for biopsy for suspected PrC.
- The decision tree mapped the diagnostic pathway, from referral to diagnosis, and captured the diagnostic endpoints assigned to the cohort. The decision tree is presented in Figure 1.
- The model included functionality to capture differences in GG scores and, therefore, impact on CPG categorisation and clinical management, between the PaPr supported and pathologist-only arms.
- The cohort then entered a long-term, lifetime Markov model with a cycle length of one year to estimate the costs and quality-adjusted life years (QALYs) associated with clinical management.
- Deterministic sensitivity analysis (DSA) and probabilistic sensitivity analysis (PSA) was also conducted.
- The analysis was informed by the results of an observational study run across three NHS sites as part of the AI Lab programme[2].

### Figure 1: Decision tree model structure




## RESULTS

- The model results suggest that, in the short-term, the use of the PaPr tool is likely to be cost saving (£26 saved per person) with negligible impact on health outcomes. These savings were predominantly due to reduced histopathology tests, though this varied across sites.
- Over a lifetime, the AI tool was estimated to be cost saving but at the expense of health loss when compared with pathologist-alone review.
- DSA indicated that modelling uncertainty was mainly driven by comparator and intervention diagnostic sensitivity. Through PSA it was estimated that PaPr was 88% likely to be cost-saving and 31% likely to be cost-effective at a threshold of £20,000/QALY.

### Table 1: Deterministic results (all sites)

| Summary results | Intervention | Comparator | Incremental |
|---|---|---|---|
| 90-day costs | £29.39 | £55.64 | -£26.25 |
| 90-day QALYs | 0.21 | 0.21 | 0.00 |
| Total costs | £4,256 | £4,314 | -£58 |
| Total QALYs | 8.99 | 9.01 | -0.02 |
| **ICER (at a threshold of £20,000 per QALY)** | | | **Less effective** |
| **Net health benefit** | | | **-0.02** |
| **Net monetary benefit** | | | **-£336** |

**Abbreviations:** ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year.

### Table 2: Deterministic results (between sites)

| Incremental results | Site A | Site B | Site C |
|---|---|---|---|
| 90-day costs | -£25.56 | -£5.88 | -£41.72 |
| 90-day QALYs | 0.00 | 0.00 | 0.00 |
| Total costs | -£56.50 | -£57.78 | -£41.72 |
| Total QALYs | -0.05 | 0.00 | 0.00 |

**Abbreviations:** QALY, quality-adjusted life year.

## DISCUSSION

- The use of the AI tool as an adjunct to pathologist review is estimated to generate cost savings in the short-term. The site-specific pathology set-up will affect the extent of cost savings (e.g. baseline rate of immunohistochemistry tests required and slides per biopsy).
- Long-term results are uncertain due to a lack of data on how short-term diagnostic outcomes influence clinical decision making. While the introduction of PaPr may improve the diagnostic accuracy and impact CPG categorisation, the downstream effect on treatment and patient outcomes are unclear.
- Economic studies of AI healthcare technologies face unique challenges that have not been fully addressed by current regulatory and decision-making frameworks.
- For instance, the iterative learning nature of AI systems, and how this impacts intervention efficacy over time, is often overlooked. Additionally, bias in the data used to train AI algorithms can result in variability in outcomes across populations, potentially leading to equity and generalisability concerns.

## CONCLUSIONS

- We conducted an economic evaluation of the PaPr tool in a population referred for biopsy for suspected PrC.
- In this analysis, it is estimated that the AI tool plus pathologist is likely to be cost-saving in the short term compared with pathologist-alone review. Long-term results are more uncertain due to limited evidence on how short-term diagnostic outcomes impact subsequent clinical management outcomes.
- Further research is required to establish the impact on long-term health outcomes, such as through registry data, to establish whether change in management improves patient outcomes.
- Developing more robust frameworks to address the unique challenges posed by AI technologies will be vital for improving the evaluation of AI's impact and value in healthcare.

## REFERENCES

**1.** National Health Service. Prostate cancer (PrC): Diagnosis. 2021 [online]. **2.** ISRCTN. Examining the impacts of pathologists using the assistance of computer technology (artificial intelligence software) on the diagnosis of prostate cancer biopsies [online].

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