NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Health Technology Evaluation

Artificial intelligence (AI) technologies to assist histopathology for breast cancer diagnosis

Final scope

Remit and evaluation objective

To appraise the clinical and cost effectiveness of artificial intelligence (AI) technologies used to assist the diagnosis of breast cancer in NHS symptomatic breast services, within their indications for use.

Background

Breast cancer starts in the tissues of the ducts or lobules of the breast. It is the most common cancer in women in the UK, and accounts for 15% of all new cancer diagnoses. Approximately 59,400 new cases of breast cancer are diagnosed each year in the UK (Cancer Research UK, 2026). It is predominantly found in women, but 1% of diagnoses are in men (NICE Clinical Knowledge Summary, 2025).

Survival is linked to the stage of the disease at diagnosis. Stages 1 to 3 are called early and locally advanced breast cancer. Early breast cancers (stages 1 and 2) are diagnosed when it is restricted to the breast, adjacent lymph nodes or both. Locally advanced breast cancer (stage 3) is diagnosed when the cancer has spread from the breast to the lymph nodes close to the breast, to the skin of the breast or to the chest wall. Stage 4, or advanced cancer, is diagnosed when it has spread to other parts of the body. The five-year survival rate in England between 2016 and 2020 was almost 100% in women diagnosed with stage 1 breast cancer, 90% with stage 2, 70% with stage 3 and 25% with stage 4 (Cancer Research UK).

There are several types of breast cancer. Most often, breast cancer starts in the milk ducts (ductal carcinoma). Sometimes it starts in the milk-producing glands, or lobules of the breast (lobular carcinoma). Invasive breast cancer means that the cancer cells have grown through the lining of the ducts or lobules into the surrounding breast tissue. Invasive cancer (no special type) is the most common type of breast cancer, accounting for about 70 to 80% of all breast cancer diagnoses in the UK (Cancer Research UK). Ductal carcinoma in situ (DCIS) means that some cells have started to turn into cancer, but these cells are all contained inside the ducts. If left untreated DCIS could become invasive. Around 7,300 women are diagnosed with DCIS in the UK each year (Cancer Research UK). There are also a number of rarer types of breast cancer, which are often called special type breast cancers.

A glossary of terms is included at the end of the document.

Initial histopathological diagnosis and biomarker analysis of breast cancer

Clinical examination and medical imaging are used to identify areas suspicious for breast cancer. But, definitive diagnosis can only be done with histopathology analysis. For initial diagnosis and biomarker analysis, this involves microscopic examination of a small sample of tissue (biopsy). What type of biopsy is done depends on the appearance, size and location of the suspicious region. Core needle and vacuum assisted biopsies (VAB) are most commonly done for initial diagnosis and biomarker analysis. About 65,000 breast biopsies were histologically tested for breast cancer between 2023 and 2024 (estimate derived from the National Disease Registration Service procedure activity extracts and National Cost Collection activity). The Royal College of Pathologists Guidelines for non-operative diagnostic procedures and reporting in breast cancer screening (2021) outline a minimum dataset that should be reported for initial histopathological diagnosis and biomarker analysis of core biopsies and VAB in breast cancer. Key information that should be reported includes:

- Overall histological categorisation, rated B1 (normal) to B5 (malignant). Lesions with a B5 rating should be specified whether they are in situ or invasive carcinoma. In situ carcinoma should be identified as ductal or lobular, and invasive carcinoma type should be identified.
- Histological grade is reported when any carcinoma is identified. DCIS is graded as high, intermediate or low based on how abnormal the cells look. Invasive carcinoma is graded using the Elston and Ellis method, also known as Nottingham Grading.
- Biomarker status is reported when invasive carcinoma is detected. It is used for treatment planning and decisions on further genetic testing. The NICE guideline for early and locally advanced breast cancer: diagnosis and management recommends oestrogen receptor (ER), progesterone receptor (PR) and human epidermal growth factor receptor 2 (HER2) status should be reported quantitatively for all invasive breast cancers at the time of initial histopathological diagnosis. If HER2 status is inconclusive from immunohistochemistry (IHC) staining, a type of genetic test called in situ hybridisation (FISH/ISH) may be done to determine this.
- When a biopsy is taken to investigate a calcification, it should be reported if a calcification was histologically identified. This is to inform whether the biopsy likely includes the mammographically identified target lesion and is suitable for diagnostic assessment.
- Cytology and nodal biopsy findings are reported if available, but these are not always present for initial diagnosis. The proliferation marker Ki-67 is also assessed as part of breast cancer histopathology in some NHS centres. This is not routine practice as currently there is no standardised methodology.

Currently, a minimum of haematoxylin and eosin (H&E) staining is done for suspected breast cancer. IHC staining for biomarker analysis must also be done when invasive cancer is detected.

Patient pathways for initial diagnosis of breast cancer

Initial diagnosis of breast cancer in the NHS can be via the NHS Breast Screening Programme (NHS BSP) or NHS symptomatic services.

NHS symptomatic breast services do diagnostic investigations for people who have a suspicious finding detected during surveillance for breast cancer outside of the NHS BSP, and people who go to their GP or A&E with symptoms of breast cancer. Recommended conditions and schedules for surveillance are outlined in NICE's guideline on early and locally advanced breast cancer and NICE's guideline on familial breast cancer. NICE's guideline on suspected cancer: recognition and referral defines criteria for urgent referral for people who have symptoms of breast cancer. A GIRFT report on breast surgery from 2021 estimated that 60% of cancers are diagnosed following GP referrals, 4 to 5% from emergency services and 30% as a result of the NHS BSP. About 30,000 of an estimated 65,000 biopsies were histologically tested outside of the NHS BSP between 2023 and 2024.

NHS England's faster diagnostic pathway applies to NHS symptomatic breast services when breast cancer is suspected. Key points for histopathology in the faster diagnosis timeline for breast cancer are:

- by day 10, people should be seen in a 'one stop clinic' with same-day access to clinical examination, mammography, ultrasound and biopsy
- by day 17, histopathology results including ER, PR and HER2 findings should be available for multidisciplinary team (MDT) discussion
- by day 24, when relevant, additional histopathology results for FISH should be available for MDT discussion
- by day 28, the person should be informed of diagnosis or cancer ruled out, and treatment options discussed.

MDTs include breast and plastic surgeons, oncologists, specialist nurses, radiologists and pathologists.

Royal College of Pathologist standards and datasets for reporting cancers state that they expect 80% of cases to be reported, confirmed and authorised within 7 calendar days of the biopsy procedure, and 90% within 10 days.

Treatment

NICE's guideline on early and locally advanced breast cancer and NICE's guideline on advanced breast cancer (both last updated in 2025) give recommendations for breast cancer management. Treatment options depend on multiple clinical factors and patient choice. Clinical factors include tumour type, location, size, grade, receptor status, whether it has spread, and characteristics of the person with breast cancer. The MDT discusses treatment options, considering all available information and patient preferences.

Unmet need

Breast cancer is the most common cancer in women in the UK. Early and accurate diagnosis leads to better patient outcomes. Waiting for a diagnosis can cause anxiety and frustration. NHS Faster Diagnosis Standards aim to give people a confirmed diagnosis or have cancer ruled out within 28 days of referral for investigation. The standards recognise the need to reduce unwarranted variation between services in the time taken to reach diagnosis.

Existing laboratory practices mean histopathologists often need to do multiple reviews of slides on different days to complete a report. All processed tissue samples are routinely stained with H&E to detect regions of tumour and calcification, and for grading when cancer is found. Usually, IHC staining to determine biomarker status (ER, PR and HER2) is not ordered until a histopathologist has reviewed H&E-stained slides and confirmed presence of invasive cancer. The delay between H&E and IHC slide review for the same person with suspected invasive cancer can be several days. If HER2 status is inconclusive and ISH/FISH testing is needed, more delays are incurred before a histopathology report can be finalised. In addition, interpretation of some technically challenging histopathology tests may sometimes need a second opinion from another histopathologist for quality assurance.

Pathology departments in the country vary in their set up, including differences in subspecialisation for different conditions, digital adoption and use of AI, which may all contribute to variability in review procedures, review times and the quality of reporting. Also, the demand for pathology services is growing rapidly, both in volume and complexity, while trained pathologist workforce is shrinking, putting pressure on service delivery and subsequent patient safety. A Royal College of Pathologists 2025 workforce census found that 47% of pathologists are aged 50 and over and 60% of consultant pathologists in the UK are typically working beyond their contracted hours each week. Most pathologists do not believe current staffing levels are adequate to ensure long-term stability of pathology services and to meet growing demand.

In response to workforce shortages, the Royal College of Pathologists 2025 to 2028 workforce strategy aims to transform current models of working for pathology. This includes developing best practice recommendations on automation, digital and AI to improve the efficacy and efficiency of workflows. The Royal College of Pathologists position statement on the use of digital pathology and AI states that there is an increasing body of research and interest in use of AI for assisting pathologists in diagnosis, and potential to transform working models which could improve healthcare. The statement highlights the potential for AI to free highly trained pathologists from more routine and repetitive work, and to improve accuracy and consistency in pathology diagnosis. A GIRFT 2025 summary of diagnostics findings and recommendations supported innovation in AI for pathology. This aligns with the broader NHS long term plan (2025) commitment to introducing AI to increase efficiency in NHS services, including those committed to faster diagnosis of disease.

Technologies that can support accurate, efficient and timely results from histopathology for the diagnosis of breast cancer could support laboratories to meet the Faster Diagnosis Standard 28-day target, and quality standards in the face of increasing demand and workforce shortages.

The technologies

Technologies that use artificial intelligence (AI) for histopathology analyse digitised images of tissue samples, called whole slide images (WSI). They can automate a range of analyses that are usually done manually by one or more consultant histopathologists. The technologies are intended to support pathologist review and should not be used for final decision-making without pathologist oversight.

This assessment will focus on AI technologies that assist analysis for the initial histopathological diagnosis and biomarker analysis of breast cancer. This is the point at which the highest volume of histopathology analyses is done in the pathway, so it is where the technologies could demonstrate the most impact on the unmet need.

Clinical experts indicated that most benefit would be gained from technologies that can enable initial diagnosis and biomarker analysis for relevant cases to happen in a single histopathologist review session. Currently, it is common for biomarker analysis to happen in a separate histopathologist session to diagnostic assessment because IHC staining is only ordered after invasive cancer is detected from H&E-stained slides. To be included in the assessment, technologies must be able to identify and distinguish DCIS from invasive breast cancer on H&E stained-slides. This minimum functionality could enable laboratories to pre-order IHC staining ready for the first histopathologist review, and triage cases for priority review.

Clinical experts indicated that additional benefit could come from technologies that support other proforma reporting requirements for initial diagnosis and biomarker analysis. The assessment will consider other functionalities supported by the included technologies that assist the completion of the histopathology report faster and more accurately. In order of priority, the following functions may be considered where relevant:

- ER, PR and HER2 status: clinicians stated that identifying low and ultra-low HER2 status is technically challenging. If a histopathologist reports equivocal HER2 status (2+) this must be followed up with ISH/FISH testing. These tests are expensive and add further delays to the histopathology reporting timeline. Additional MDT discussion is sometimes needed if ISH/FISH tests are not done in time. People with low ER or PR positivity may also benefit if AI improves accuracy in these groups.
- Grading and mitotic count: Nottingham Grading consists of multiple subtasks including mitotic count.
- Other functionality may include detection of calcifications and subtyping.

All technologies included for assessment must have appropriate regulatory approval or be in the process of obtaining this. They must also be available to the NHS or be in the process of preparing to enter the UK market.

NICE is aware of other AI technologies for histopathology of biopsies for suspected breast cancer that do analyses that are not always done for initial diagnosis, or that do not do diagnostic analyses. These include:

- analysis of lymph node biopsies
- analysis of excisions and resections
- risk stratification and prediction of response to treatment
- streamlining of laboratory workflow
- pre-analytical tests including quality assurance in slide preparation.

Technologies that only do these analyses will be excluded from this assessment. Most people do not have a lymph node biopsy done for initial diagnosis, so the effects of technologies that do lymph node analysis will not be assessed. Technologies that are not specifically designed and indicated for use in breast cancer diagnosis will be excluded from this assessment.

Digital pathology is a pre-requisite for AI technologies used to assist histopathological diagnosis of breast cancer. The clinical and cost-effectiveness of technologies used for digital pathology alone will not be examined during this assessment.

Key functions of technologies included in this assessment are summarised in Table 1.

Appendix B

Table 1. Technologies included in the assessment

Technology name (Company)	Indications for use and staining	Deployment options	Tumour detection and typing	Grading	Biomarker analysis	Regulatory approval	Current NHS use
Aiforia Breast Cancer Suite (Aiforia Technologies Plc)	FFPE core needle biopsies (all modules) and surgical resections (non-grading modules) from human breast tissue H&E for grading module; IHC for biomarker analysis	Cloud-based or on-site	Grading module: identifies invasive carcinoma and DCIS	Grading module: Nottingham Grading with component level findings	ER, PR and HER2 modules	Grading: CE-IVDR ER: CE-IVDD (pending CE-IVDR approval) PR: CE-IVDD (pending CE-IVDR approval) HER2: CE-IVDR	Yes
AIRABreast (AIRA Matrix Private Limited)	FFPE core needle biopsies, lumpectomies, and mastectomy specimens of normal and neoplastic breast tissue from women H&E for tumour region detection algorithms; IHC for biomarker analysis	Cloud-based or on-site	Identifies DCIS and invasive tumour regions and quantifies tumour burden	Grading is supported	Percent positivity and intensity scoring for ER and PR HER2 classification Heterogeneous staining patterns are highlighted	Pending CE-IVDR approval	No

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Technology name (Company)	Indications for use and staining	Deployment options	Tumour detection and typing	Grading	Biomarker analysis	Regulatory approval	Current NHS use
Ibex Breast, Ibex Breast IHC (Ibex Medical Analytics)	FFPE core needle biopsy, VAB and excision samples Ibex Breast is indicated for use in women only H&E and hematoxylin-eosin-saffron (HES) staining for Ibex Breast; IHC for Ibex Breast IHC	Cloud-based	Ibex Breast: categorises slides as benign or suspicious for cancer; predicts biopsy or excision-level cancer classification. Detects invasive and in-situ tumours and pre-cancerous and suspicious lesions. Subtypes invasive cancer.	Ibex Breast: nuclear grading for in situ cancer.	Ibex Breast IHC: scores ER, PR, HER2 stained slides.	Ibex Breast and HER2 diagnostic testing: CE-IVDR ER and PR algorithms: pending CE-IVDR approval.	Yes
Mindpeak Breast Suite (Mindpeak GmbH)	FFPE core needle biopsies or resections of breast tissue from adult women Biomarker modules are only intended for use on primary invasive breast	Cloud-based or on-site	H&E module: detects invasive carcinoma and in situ lesions without pathologist identification of RoI	Not supported	ER/PR module: detection, classification and counting of stained or not stained tumour cells. The pathologist does	H&E: pending CE-IVDR approval. ER/PR: CE-IVD HER2 RoI: CE-IVD	No

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Technology name (Company)	Indications for use and staining	Deployment options	Tumour detection and typing	Grading	Biomarker analysis	Regulatory approval	Current NHS use
	cancer lesions with no previous therapy H&E staining used for detection module; IHC staining used for biomarker analysis				not need to identify a RoI. HER2 RoI: HER2 score is based on staining within the RoI. HER2: HER2 score calculated automatically from the WSI. The pathologist does not need to identify a RoI.	HER2: pending CE-IVDR approval.	
Cleo Breast (Primaa)	Biopsy and excision samples of breast tissue from adult women; not intended for use on people who have had neoadjuvant therapy H&E or HES staining	Cloud-based or on-site	Detects and measures in situ and invasive carcinoma, and calcifications	Mitosis hotspots are highlighted and counted	Not supported	CE-IVDR marked	No

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Technology name (Company)	Indications for use and staining	Deployment options	Tumour detection and typing	Grading	Biomarker analysis	Regulatory approval	Current NHS use
Paige Breast Suite (Tempus)	Breast biopsies and excision specimens H&E staining	Cloud-based or on-site	Paige Breast Detect: identifies and classifies foci suspicious for cancer, and can distinguish invasive from pre-cancerous	Paige Breast Mitosis: detects mitotic figures and quantifies mitotic activity	Not supported	CE-IVD; pending CE-IVDR approval.	No
Insight (Visiopharm A/S)	FFPE biopsy and resection samples of normal and neoplastic breast tissue. H&E staining used for detection, IHC staining used for biomarker analysis	Cloud-based or on-site	Tumour detection algorithm identifies invasive and DCIS regions of interest and quantifies tumour burden	Not supported	ER/PR/HER2 APP, Breast Cancer	ER/PR/HER2 app: CE-IVDR Tumour detection algorithm: pending CE-IVDR approval	Yes

Place of the technology in the pathway

This assessment will evaluate the impact of included technologies for analysis on biopsies of breast tissue done for initial diagnosis and tumour profiling. Technologies should be used in a digital pathology workflow, analysing whole slide images (WSI) of formalin-fixed paraffin-embedded (FFPE) breast specimens.

AI technologies in scope are intended for use as diagnostic support systems. Responsibility for the final interpretation remains with the pathologist. But, centres may use AI in different ways depending on analysis type and individual laboratory practices, laboratory size and subspecialisation of staff (for example, as triage, first or second read). The assessment will consider these alternatives where appropriate.

If surgery is done, additional histopathology on resected or excised tissues from the breast and lymph nodes will be done, but this does not form part of initial diagnosis and tumour profiling. Costs and effects of technologies on post-surgical histopathology will not be evaluated in this assessment.

Intervention(s)	AI technologies that assist histopathological detection of breast cancer in WSI of core or vacuum assisted biopsies for initial diagnosis, including: • Aiforia Breast Cancer Suite (Aiforia Technologies Plc) • AIRABreast (AIRA Matrix Private Limited) • Ibex Breast, Ibex Breast IHC (Ibex Medical Analytics) • Mindpeak Breast Suite (Mindpeak GmbH) • Cleo Breast (Primaa) • Paige Breast Suite (Tempus) • Insight (Visiopharm A/S)
Population(s)	Adults who have had core needle or vacuum assisted biopsy and are awaiting initial diagnosis for suspected breast cancer outside of the NHS BSP pathway. Adults who have previously been treated for breast cancer and did not have any tumour present when discharged from that episode are included.
Subgroups	People who have had systemic treatment (like chemotherapy or endocrine therapy) or radiotherapy for a previous breast cancer episode that may have affected the region from which the biopsy was taken.

Comparators	Histopathologist review of breast core needle or vacuum assisted biopsies for initial diagnosis of breast cancer without AI assistance. Reference standard for test accuracy will be determined by the evidence.
Outcomes	The outcome measures to be considered include: **Clinical outcomes** • time to disease-free status • overall survival • breast cancer-specific mortality • progression free survival, disease-free survival, distant disease-free survival • adverse effects including under or overtreatment **Patient reported outcomes** • health-related quality of life • service user and carer acceptability and views **Other intermediate outcomes** • diagnostic accuracy (sensitivity, specificity, positive predictive value and negative predictive value) • case review time/ turnaround time (slide review time/number of cases reviewed per session, time to produce report for MDT) • time to diagnosis (referral to diagnosis, biopsy to MDT) • time to initiate treatment (referral to treatment, MDT to treatment) • concordance between AI and pathologist review • need for or use of additional tests (repeat biopsies, repeat IHC, genetic testing) • need for second pathologist read • proportion of slides not appropriate for AI review/ repeat slide scanning, and reason for it • technical failure • effect of WSI quality and acquisition methods on accuracy • impact on clinical decision-making including staging and treatment selection **Other outcomes** • ease of use or user acceptability **Resource use**

	• cost of technology, considering:
	  ○ procurement
	  ○ implementation
	  ○ ongoing running costs
	  ○ IT set-up
	  ○ updates
	  ○ data storage
	  ○ training
	• costs of additional tests (for example, for IHCs or ISH/FISH)
	• cost of second reads
	• cost of repeat procedures (repeat biopsies, repeat slide scanning, repeat IHC)
	• cost of managing cancer, related to missed cancers or overdiagnosis
	• total volume of cases through per session.

Setting	NHS histopathology services that do breast cancer diagnosis, outside of the NHS BSP.
Economic analysis	The NICE reference case stipulates that the cost effectiveness of treatments should be expressed in terms of incremental cost per quality-adjusted life year. The NICE reference case stipulates that the time horizon for estimating clinical and cost effectiveness should be sufficiently long to reflect any differences in costs or outcomes between the technologies being compared. Costs will be considered from an NHS and Personal Social Services perspective. The availability of any commercial arrangements for the intervention, comparator and subsequent treatment technologies will be taken into account.
Other considerations	Guidance will only be issued in accordance with the CE or UKCA marking. **Groups with high inter-rater variability** Accuracy is particularly important for people with borderline biomarker status, because this information is needed to optimise treatment planning. The technologies may have additional benefits for the following groups if they increase accuracy, so evidence will be considered when available for: • people with low ER or PR positivity • people with borderline HER2 (2+) status.

	Digital infrastructure Infrastructure for digital pathology is a pre-requisite of AI for histopathology. In line with national priorities for diagnostic and cancer services, centralised investment and rollout are supporting uptake of digital pathology nationally. Current adoption data indicates: 25 of 27 pathology networks have begun digital reporting, approximately 80% of acute and specialist trusts are using digital images for primary diagnosis and about 51 trusts are digitally reporting more than 50% of cases. Level of digital adoption underpins the implementation of AI technologies included in the assessment. NHS IT and laboratory information management system compatibility and capacity issues may be a barrier to the implementation of AI software. Data security is essential when deploying AI technologies for histopathology as they require access to patient data. There may be challenges around storage and infrastructure requirements, confidentiality, integrity, and governance of data stored. Issues relating to data ownership and custodianship, risks of re-identification of depersonalised data, unauthorised access and system vulnerabilities, and consent and data sharing should be considered. The location of data storage and processing (e.g., on-site or cloud-based), and the security measures employed are key to these concerns. **Technology validity for the assessment population:** The validity of AI algorithms depends on the data on which they are trained. Experts reported they were not aware of any reasons for differences in diagnostic accuracy across different sexes or ethnic groups. However, it was acknowledged that it was important to understand the representativeness of training data used to inform the algorithms to ensure diagnostic accuracy is maintained across patient groups. Information about the representativeness of sex, ethnicity and rare tumour morphologies in training and validation datasets will be sought. When groups are not represented, the assessment will consider the potential to exacerbate or introduce new health inequalities. **AI acceptability and implementation** Work by the Academy of Medical Sciences suggests that patients strongly support the use of AI in healthcare provided it improves quality and frees up time. The Royal College of Pathologists (2023) advise there is a need for more engagement with patients about the potential use of AI in their healthcare in order to maintain broad public support. From a user perspective, optimal integration with existing workflows is key to both successful deployment and accessing the benefits of AI in laboratory workflows.

	Transparency and explainability of outputs may be important to develop confidence in the technologies. The benefits seen from adoption of AI technologies may vary depending on the laboratory it is used in. Factors may include the scale of the laboratory, accreditation, sub-specialisation, integration with existing digital infrastructure, use of the technology as a triage tool and first or second reads. Technologies vary as to whether they offer on-site or cloud-based deployment options, or both. Flexibility may facilitate uptake and implementation in smaller district general hospitals. **Quality assurance** Cases with significant artefacts may reduce performance and affect interpretation of outputs from AI technologies. AI-assisted biopsy analysis should be audited as part of laboratory practice (Royal College of Pathologists, 2023). Performance monitoring and post-deployment validation is necessary to ensure diagnostic performance remains consistent across institutions and patient populations. **Patient pathways** Some trusts have implemented a system where radiologists can flag cases with a high suspicion of invasive cancer so that laboratories can pre-order IHC staining. Recommendations for histopathological analyses made within the NHS Breast Screening Programme are within the remit of the National Screening Committee (NSC). NICE does not make recommendations for people within NSC programmes. But, evidence from screening populations will be considered where appropriate. Criteria for urgent referral are different in Scotland than in England, Wales and Northern Ireland (Cancer Research UK). **Training** Workforce training is required for the safe and optimal use of AI technologies in this pathway. Most technologies report that they provide training packages alongside user guides and support services, which should be used in conjunction with local competency sign-offs. Existing histopathology training focuses on analysis using glass slides and does not include review of WSI using digital pathology. The benefits of AI may differ depending on histopathologist experience, which will be considered where appropriate.

	Sustainability AI-assisted workflows claim to increase efficiency and reduce waste associated with laboratory processes.
Equality and health inequality issues and considerations	Equality and health inequality issues and considerations are reported in the equality and health inequality impact assessment document. **Equality issues** Some technologies are not indicated for use in men, or after treatment. People with cancer are protected under the Equality Act 2010 from the point of diagnosis. Men with breast cancer often present later and with more advanced disease. **Equality and health inequality considerations** **Usability:** Accessibility and compatibility of technologies with assistive technologies for users with disabilities affecting vision or digital interaction should be considered. **Equity of access and service quality:** There is significant variation between histopathology services across the country due to differences in setup, workload, workforce capacity and subspecialisation, and the rate of digital adoption. It is known that outcomes in the north of England are worse than the south. Cancer death rates are nearly 60% higher for those living in the most deprived areas of the UK compared with the least deprived. If AI technologies can improve review turnaround times, the accuracy and consistency of diagnostic reporting, and reduce variability across laboratories, this would improve equity of access to services with timely diagnosis and management.
Related NICE recommendations	**Related HealthTech guidance:** Tumour profiling tests to guide adjuvant chemotherapy decisions in early breast cancer (2024) NICE HealthTech guidance 719 **Related technology appraisals:** There are 44 published Technology Appraisals on breast cancer and 23 in development Technology Appraisals on breast cancer. Many of these are indicated for breast cancers with specific biomarker status, so may rely on the contribution of outputs from technologies included in this assessment. **Related NICE guidelines:** Early and locally advanced breast cancer: diagnosis and management (2018) NICE guideline 101 Last updated: 14 April 2025

	Suspected cancer: recognition and referral (2015) NICE guideline 12 Last updated: 12 January 2026 Familial breast cancer: classification, care and managing breast cancer and related risks in people with a family history of breast cancer (2013) NICE guideline CG164. Last updated 14 November 2023 Advanced breast cancer: diagnosis and treatment (2009) NICE guideline 81 Last updated: 19 February 2025 **Related NICE guidelines in development:** Suspected Cancer: recognition and referral (update). NICE guideline. Publication expected March 2026 Advanced breast cancer: diagnosis and management (Partial update). NICE guideline. Publication expected 29 May 2026 Familial Breast Cancer: initial assessment and genetic testing (update). NICE guideline. Publication expected April 2027 **Related quality standards:** Suspected cancer (2016) Quality standard 124 Last updated: 05 December 2017 Breast cancer (2011) Quality standard 12 Last updated: 16 June 2016 **Related clinical knowledge summaries:** Breast cancer - recognition and referral (2025) NICE clinical knowledge summary Breast cancer - managing FH (2024) NICE clinical knowledge summary Breast screening (2022) NICE clinical knowledge summary

Glossary of terms

Biopsy
A sample of tissue from the body to assist in diagnosis of disease

Calcification
Small spots of calcium in the breast that do not cause symptoms. Macrocalcifications are benign and not linked to cancer. Microcalcifications can be a sign of pre-cancerous changes or early breast cancer, if found in a cluster.

Core biopsy reporting categories
Biopsies are rated B1 (normal) to B5 (malignant) in the Royal College of Pathologists reporting proformas. B2 indicates a benign lesion, B3 indicates an atypia with uncertain malignant potential and B4 indicates a lesion suspicious for malignancy.

Digital pathology
Digital pathology includes the acquisition, management, sharing and interpretation of pathology information, including WSI, in a digital environment. WSI are captured with a scanning device. The device produces a high-resolution image that can be viewed on a computer screen or mobile device.

Ductal carcinoma in situ (DCIS)
DCIS is an early breast cancer. It is diagnosed when some cells in the lining of the ducts of the breast tissue have started to turn into cancer cells. The cancer cells are contained inside the ducts and have not spread.

Fluorescence in situ hybridisation (FISH/ISH)
If HER2 status is inconclusive from IHC, in situ hybridisation (ISH) or fluorescence in situ hybridisation (FISH) may be done to determine HER2 status. They are both genetic tests that count the number of HER2 gene copies in cancer cells. In FISH, a

Histological grade
Histological grade is reported when carcinoma is identified. DCIS is graded as high, intermediate or low based on how abnormal the cells look. Invasive carcinoma is graded using the Elston and Ellis method, also known as Nottingham Grading. A score between 3 and 9 is reached by considering the percentage of the tumour that forms tubular gland (scored 1 to 3), how much the cancer cell nuclei differ from normal cells (scored 1 to 3), and mitotic count which is the frequency of dividing cells in the most active part of the tumour (scored 1 to 3). Total scores of 3 to 5 points indicates grade 1 tumour (low grade), 6 to 7 points indicates grade 2 tumour (intermediate grade) and 8 or 9 is grade 3 (high grade).

Haematoxylin and eosin (H&E) and haematoxylin, eosin and saffron (HES) staining
H&E is a routine histological stain used to show the structure and morphology of cells and tissues. It helps pathologists assess how normal or abnormal a tissue looks.

Haematoxylin stains cell nuclei, eosin stains cytoplasm and extracellular matrix. Sometimes, HES is used. The addition of saffron staining can distinguish connective tissue from muscle.

Histopathology
The microscopic examination of biological tissues to study, diagnose, and understand the manifestations of disease

Human epidermal growth factor 2 (HER2)
Some breast cancers have large amounts of a protein called HER2. Testing breast cancer cells for the HER2 protein can help to show whether targeted drugs might work. Targeted cancer drugs are treatments that change the way cells work and help the body control the growth of cancer. The drugs attach to the HER2 protein and stop the cells from growing and dividing. Breast cancers that have large amounts of HER2 are called HER2 positive breast cancers.

Immunohistochemistry (IHC) testing
IHC is the recommended method for assessing receptor status in breast cancer. It uses antibodies that bind to specific proteins (ER, PR and HER2) in tumour tissue. The antibodies stain the tissue and show if and how much of the receptor is present.

Mitotic count
Mitotic count is the frequency of dividing cells in the most active part of the tumour. This information is used to grade the tumour.

NHS Breast Screening Programme
The NHS BSP invites all women aged between 50 and 70 for breast screening mammography every 3 years. Women aged over 70 can self-refer to this service. The NHS BSP also outlines eligibility criteria and screening protocols for women at very high risk for breast cancer. If mammography or ultrasound screening identifies suspicious lesions, further tests that may include a biopsy will be done at an assessment clinic.

Oestrogen receptor (ER) status
Most breast cancers have proteins (receptors) for oestrogen (ER). They are called ER positive breast cancer. Breast cancers that have less than 1% ER are called ER negative breast cancers. This is determined at initial diagnosis because hormone therapy is only likely to work for cancers that are ER positive. This is because hormone therapies work by stopping oestrogen from stimulating the cancer cells to grow and divide.

Progesterone receptor (PR) status
PR status indicates if breast cancer cells contain receptors for the hormone progesterone. Unlike ER, PR is not a predictive factor for response to adjuvant endocrine therapy but it does give prognostic information for people with ER-positive tumours. It may also act as a quality control marker because ER-negative, PR-

positive tumours are very rare. If tests show this combination of hormone receptors the quality of ER-stained sections should be reviewed.