Technoleg Iechyd Cymru
Health Technology Wales

Evidence Appraisal Report [1]

Rapid antigen detection tests for group A streptococcal infections to treat people with a sore throat in the community pharmacy setting

Appraisal summary

Why did Health Technology Wales (HTW) appraise this topic?

Sore throat is most often caused by viral infections, while bacterial infections are less common. The most common bacterial cause of sore throat is group A beta-haemolytic streptococcus (GAS). Antibiotic treatment of GAS sore throat can prevent complications, reduce the duration of symptoms and spread of infection. However, distinguishing between GAS sore throat and viral sore throat can be difficult due to the similarity of symptoms. This means that antibiotics may be prescribed inappropriately, potentially contributing to antimicrobial resistance (AMR) which is recognised as a global threat to human health. The reference standard for GAS diagnosis is microbiological culture of throat swabs. This needs to be conducted by specialist laboratories, which means there is typically a 48-hour delay before results are available. Rapid antigen detection tests (RADT) were developed to provide an immediate, point-of-care indication about the presence or absence of GAS in the throat. These tests are intended to be used to confirm the need for antibiotics where clinical scoring tools (such as FeverPAIN or Centor) indicate that someone is likely to benefit from them.

In Wales, a national Sore Throat Test and Treat Service (STTT) was introduced in November 2018. The STTT is a screening and treatment service that involves assessing and treating sore throat in a community pharmacy setting rather than in GP practices. Pharmacists conduct a structured clinical assessment by screening people who present to the service for GAS sore throat, using either FeverPAIN or Centor scoring tools. RADTs for GAS sore throat are offered to people with a FeverPAIN score of 2 or more or Centor score of 3 or more, indicating that they might, or are most likely to, benefit from an antibiotic. People with a positive RADT are offered antibiotics by the pharmacist in line with NICE guidance.

In 2020, an HTW appraisal (EAR020) of the clinical and cost effectiveness of RADTs for GAS sore throat in the community pharmacy setting recommended the accumulation of more evidence. This report is a re-assessment of the clinical and cost effectiveness of RADTs for GAS sore throat in the community pharmacy setting. The aim of updated guidance is to enable a final decision to be taken regarding the use of RADT as part of the STTT service.

[1] Cyfieithu dogfennau HTW wedi'u cyhoeddi o'r Saesneg i'r Gymraeg
Translation of published technical HTW documents from English into Welsh

What evidence did HTW find?

We included studies that described diagnosis and management of GAS sore throat in the community pharmacy setting and studies that investigated diagnostic accuracy of RADTs for GAS sore throat in any setting. We identified one systematic review and 13 further primary studies published after this review.

We identified three retrospective, observational primary studies that examined diagnosis and management of GAS sore throat in the STTT where FeverPAIN/Centor clinical scoring and point-of-care RADT was used. The three studies obtained data from large primary care databases. Two studies were ecological studies using data from the STTT where confirmatory RADT was used compared with 1) a community pharmacy service in England where people with a FeverPAIN score of 4 or more were prescribed antibiotics, or 2) with the STTT during a time where antibiotic prescribing decisions were based on FeverPAIN/Centor scores alone, without the need for confirmatory RADT. One study was a longitudinal cohort study and compared antibiotic prescribing rates and GP re-consultations for participants who had an initial consultation with the STTT with those who had an initial consultation at a GP practice. Outcomes were reported on the initial date and within 28 days of the initial date.

- Antibiotic prescribing rates were reported as being 36 to 43 percentage points (%pts) lower for the STTT where confirmatory RADT was used after FeverPAIN/Centor scoring compared to community pharmacy services using FeverPAIN/Centor scoring alone.
- Restricting analysis to STTT participants with a FeverPAIN score of 4 or more, antibiotic prescribing rates were 13%pts lower compared with rates in the community pharmacy service in England where all participants with a FeverPAIN score of 4 or more were prescribed antibiotics.
- Antibiotic prescribing rates were reported as being 14%pts lower on the initial day for people who attended the STTT compared with people who attended a GP practice with a sore throat.
- Antibiotic prescribing rates were reported as being 12%pts lower within 28 days from the initial day for people who attended the STTT compared with people who attended a GP practice with a sore throat.
- GP re-consultations were reported as being 14%pts higher for participants who attended the STTT as initial consultation compared with those who attended a GP practice.
- The use of aggregated data in ecological studies means there may have been differences between groups in health status, deprivation, illness severity, and other unknown confounders that could not be controlled for.
- The longitudinal cohort study did not have FeverPAIN/Centor scores for participants with an initial GP consultation which meant illness severity could not be accounted for.
- There were limitations in coding for sore-throat in data obtained from GP practices which introduced uncertainty in the results for GP re-consultations. In addition, it was not possible to assess rate of re-consultation or provision of additional medication with a pharmacist for sore throat within 28 days of the initial consultation.

We identified one systematic review that examined diagnostic accuracy of RADTs for GAS sore throat in any setting. The review included 22 full-text peer-reviewed studies, three conference abstracts, two non-peer reviewed studies from manufacturers, and two Food and Drug Administration (FDA) reports. We identified an additional ten articles describing diagnostic accuracy studies published since the review. Evidence was found on a total of 16 different RADTs. Only two studies were identified that reported diagnostic accuracy in people with a high clinical score. Studies were conducted in primary and secondary care, but no studies that reported on diagnostic accuracy of RADTs for GAS sore throat specifically in community pharmacies were identified.

- Three meta-analyses of primary studies for tests known to be used in the STTT estimated sensitivities ranging from 83% to 92% and specificities from 93% to 96%.
- In two studies conducted in adults in primary care, sensitivity ranged from 92% to 95% and specificity from 94% to 96%. All participants had a Centor score of 3 or more.
- The criteria for participant selection was often unclear, it wasn't clear whether participants were selected consecutively, studies often used the same swab for the RADT and microbiological culture, not all studies stated that laboratory staff were blinded to the results of the RADT, and some studies included participants who had taken antibiotics within the previous few weeks.

Two studies were included in the economic review, as well as the economic analysis developed as part of the previous HTW appraisal on this topic (EAR020). All took the perspective of the UK NHS and compared the use of RADT in a pharmacy consultation to a standard GP consultation, for people presenting with a sore throat. One study estimated national savings of £263 million annually, via the prevention of unnecessary GP visits. However, this cost analysis was associated with uncertainties and potential bias due to the study design. Another study updated the original HTW cost-utility analysis with data on GP referrals and re-consultations from a retrospective comparative observational study and estimated the STTT was dominant for adults and cost-effective for children. Minor limitations were identified due to assumptions and heterogeneity in diagnostic accuracy inputs used to inform the accuracy of RADT and clinical risk scoring. However, economic conclusions did not change when these inputs were explored in sensitivity analysis.

As the economic review identified a recent cost-utility model incorporating the latest evidence available on clinical management, we did not develop a new model for this re-assessment. To complement the existing economic evidence, we conducted a simple cost analysis using the evidence identified on antibiotic prescribing comparing pharmacy STTT with RADT to other strategies. In all comparisons, STTT with RADT reduced antibiotic prescribing. Estimated costs were lower for STTT with RADT compared with either GP consultations or England's Acute Sore Throat Pharmacy First (ASTPF) service. This difference was driven by lower consultation costs for the STTT. Costs were estimated to be higher for STTT with RADT compared with STTT without routine RADT. When considered alongside the results of previous cost-utility analyses, this suggests STTT with RADT is likely to be cost effective compared with GP consultation or ASTPF. However, cost effectiveness remains uncertain compared with STTT without routine RADT. Our results were sensitive to variation in costs applied to STTT patient registrations, STTT training and GP consultations and should be interpreted with caution. Our analysis did not capture all relevant costs and outcomes, including the downstream effects of reduced antibiotic prescribing, and only gives an indication of cost effectiveness based on existing economic evidence.

A patient, carer and family considerations (PPI) review was conducted. Eight studies were included. The PPI review looked at three areas of interest to patients and the public: patient experiences with RADT and other point of care tests (POCT); patient acceptance and trust of pharmacy led services; and patient and public understanding of antibiotic resistance and overprescription and efforts taken to address this. The evidence shows that overall, patients have positive experiences with RADT and other POCT, which they perceive as easy to administer, well tolerated, and provide results that offer reassurance. Patients are willing to visit pharmacies instead of their GP and generally have positive experiences with pharmacist prescribing. Public understanding of the proper use for antibiotics is varied, but support is present for methods to address overprescribing of antibiotics, including acceptance of tests that show that antibiotics are not needed. While some concerns remain regarding the migration of services from GP to pharmacist, patients and the public understand the challenges of facing NHS services and are willing to support efforts to address these.

What was the outcome of HTW's appraisal?

HTW is a national body working to improve quality of care in Wales. We collaborate with partners across health, social care, and industry to issue independent guidance that informs commissioning within Wales health and social care. We are supported by an Assessment Group, who ensure our work adheres to high standards of methodological and scientific rigour, and an Appraisal Panel, who consider evidence within the Welsh context and produce HTW guidance.

More details on our appraisal process, the assessment group, and the appraisal panel can be found on the HTW website.

In this case, the HTW Assessment Group considered the evidence presented in this Evidence Appraisal Report (EAR020-2) and concluded there was sufficient evidence for the development of guidance. Please refer to the HTW website for full guidance details. EAR020-2 follows below and provides full details for this topic. More comprehensive details of the HTW Guidance and HTW Appraisal Panel considerations can be found on the HTW website.

1. Purpose of the Evidence Appraisal Report

This report aims to identify and summarise evidence that addresses the following question: What is the clinical and cost effectiveness of rapid antigen detection tests for diagnosing and managing suspected group A streptococcal sore throat infection in the community pharmacy setting?

Evidence Appraisal Reports are based on rapid systematic literature searches, with the aim of identifying the best published evidence on the effectiveness and cost-effectiveness of health and social care technologies and models of care and support. Researchers critically evaluate this evidence. The draft Evidence Appraisal Report is reviewed by experts and by Health Technology Wales multidisciplinary advisory groups before publication.

2. Context

Sore throat describes the symptom of pain at the back of the mouth (NICE 2019). Clinical descriptions of acute sore throat include pharyngitis and tonsillitis. Symptoms of a sore throat include pain in the throat, fever and a headache. Other symptoms can also include nausea, vomiting, abdominal pain, muscle pain and rashes (NICE 2019). Sore throat is most often caused by viral infections, while bacterial infections and non-infectious causes, such as hay fever and chronic exposure to cigarette smoke, are less common. However, distinguishing between bacterial and viral infections, and hence the likely effectiveness of antibiotics, can be difficult due to the similarity of symptoms. The most common bacterial cause of sore throat is group A beta-haemolytic streptococcus (GAS). Complications of GAS sore throat are rare but can include scarlet fever, suppurative complications including otitis media, acute sinusitis and peri-tonsillar abscess (quinsy), or non-suppurative complications such as rheumatic fever and acute glomerulonephritis, although the latter are very rare in developed countries (NICE 2018).

NICE recommends that people with an acute sore throat should be advised that it is a self-limiting condition that, for most people, gets better without treatment (NICE 2018, NICE 2019). People should be advised that sore throats can last for around one week and given advice on how to best manage symptoms with self-care, such as oral analgesia, medicated lozenges and appropriate fluid intake. People are advised to seek medical help if symptoms worsen rapidly or they become very unwell. Antibiotic treatment of GAS sore throat can prevent complications, reduce the duration of symptoms and spread of infection but there is concern that antibiotics may be prescribed inappropriately (Cohen et al. 2020). Inappropriate prescribing of antibiotics may cause side effects and contribute to antimicrobial resistance (AMR) which is recognised as a global threat to human health. NICE recommends antimicrobial stewardship programmes to optimise antibiotic use and limit the development of AMR, to help preserve the effectiveness of antimicrobial treatments (NICE 2015). Tackling unnecessary prescribing of antibiotics forms part of the UK government action plan to reduce AMR (Committee of Public Accounts 2025). The likelihood of GAS sore throat is assessed by clinical examination with or without the use of clinical scoring systems, specifically Centor or FeverPAIN (Table 1). Unless the patient is systemically very unwell, has symptoms and signs of a more serious illness, or is at high risk of complications, antibiotic prescribing for sore throat is typically guided by these clinical scoring systems (Table 2). In both children and adults, the first-choice antibiotic for acute sore throat is phenoxymethylpenicillin. If the patient is allergic or intolerant to penicillin, alternative first choice antibiotics include either clarithromycin or erythromycin. Dosage and course length vary, depending on age and, for clarithromycin use in children, weight (NICE 2018).

Table 1 – Clinical scoring system criteria recommended by NICE (NICE 2018)

Centor criteria	FeverPAIN criteria
Tonsillar exudate	Fever > 38° C (during previous 24 hours)
Tender anterior cervical lymphadenopathy or lymphadenitis	Purulence (pus on tonsils)
History of fever (over 38°C)	Attend rapidly (within three days after onset of symptoms)
Absence of cough	Severely inflamed tonsils
	No cough or coryza (inflammation of mucus membranes in the nose)
Each of the Centor criteria score 1 point (maximum score of 4). A score of 0, 1 or 2 is thought to be associated with a 3 to 17% likelihood of isolating streptococcus. A score of 3 or 4 is thought to be associated with a 32 to 56% likelihood of isolating streptococcus.	Each of the FeverPAIN criteria score 1 point (maximum score of 5). Higher scores suggest more severe symptoms and likely bacterial cause. A score of 0 or 1 is thought to be associated with a 13 to 18% likelihood of isolating streptococcus. A score of 2 or 3 is thought to be associated with a 34 to 40% likelihood of isolating streptococcus. A score of 4 or 5 is thought to be associated with a 62 to 65% likelihood of isolating streptococcus.

Table 2 – Antibiotic prescribing

Antibiotic prescribing	Centor/FeverPAIN scoring	Suggested treatment
Unlikely to benefit from an antibiotic	FeverPAIN score of 1 or less, or a Centor score of 2 or less	Offer advice on self-care without an antibiotic prescription
Might benefit from an antibiotic	FeverPAIN score of 2 or more	Offer advice on self-care or a back-up antibiotic prescription (to use if symptoms do not start to improve within 3 to 5 days or worsen rapidly or significantly at any time)
Most likely to benefit from an antibiotic	FeverPAIN score of 4 or more, or a Centor score of 3 or more	Either an immediate or a back-up antibiotic prescription should be considered. This should take into account the risk of possible complications of untreated group A streptococcus infections and of possible adverse effects of antibiotics

The global burden of sore throat is unclear. A systematic review of 26 community surveillance studies reported that the pooled incidence rate for children was 82.2 episodes per 100 child-years for sore throat and 22.1 episodes per 100 child years for GAS sore throat (Miller et al. 2022). However, over half the studies were conducted in Australia or India, with none from the UK, and there was considerable differences in methodology between studies. The review estimated the number of GAS pharyngitis cases in children worldwide as 289 million per year. The Centres for Disease Control report that experts think GAS accounts for 20% to 30% of cases of pharyngitis in children, and 5% to 15% of pharyngitis cases in adults (Donowotz 2024).

Not everyone with a sore throat will attend their general practitioner (GP). Up-to-date figures are difficult to obtain, but in 2005 a Scottish survey found 31% of adults reported a severe sore throat in the previous year, with 38% of these people visiting their GP (Hannaford et al. 2005). NICE (2026) reports that for a typical GP practice, around 78 visits per 1,000 patients per year, are due to sore throat while recurrent sore throat has an annual incidence of 1 in 10 in UK general practice, but the origins of these figures are unclear. Incidence of GAS throat infections is highest in winter and early spring. Specifically, colonisation with GAS peaks in school-aged children during the

winter months (Donowotz 2024). In 2022, GAS sore throat infections increased across the UK and notifications of scarlet fever quadrupled, returning to more normal levels for the 2023/24 season (Morgan et al. 2024).

3. Health technology

The reference standard for GAS sore throat diagnosis is microbiological culture of throat swabs. This method can detect the presence of GAS in the throat with high sensitivity, but swabs need to be sent to specialist laboratories and there is typically a 48-hour delay before results are available (Cohen et al. 2020). Rapid antigen detection tests (RADT) were developed to provide an immediate, point-of-care indication about the presence or absence of GAS in the throat. These tests are intended for people who are identified as more or most likely to benefit from antibiotics by clinical scoring tools, to confirm the need for antibiotics. Limitations of RADTs are that they are unable to detect non-GAS bacteria that may also cause sore throat, for example, group C or F non-haemolytic streptococci (Cohen et al. 2020) and are unable to differentiate between a GAS carrier and true GAS infection. The predictive value of the tests relate to the probability of GAS being present in the throat, and do not relate to whether or not someone is ill from GAS.

A 2016 systematic review of paediatric studies reported that RADT for GAS was about 85% sensitive, and 95% specific compared with throat culture (Cohen et al. 2016). A number of factors may affect the accuracy of a RADT, including type of test kit used, expertise of the healthcare practitioner performing the test, method of specimen collection, severity of the disease and GAS prevalence. In clinical practice, a positive test in the absence of symptoms is considered to represent colonisation and is not clinically relevant (Donowotz 2024). Many RADTs that measure presence or absence of GAS in the throat have been developed (a sample are detailed in Appendix 7) and manufacturers typically cite figures for sensitivity and specificity of over 95%.

NICE guidance (HTG531, formerly DG38) examined use of RADTs for GAS sore throat in 2019 (NICE 2019). The tests were not recommended as it was concluded that they were unlikely to improve antimicrobial prescribing and patient outcomes compared with clinical scoring tools alone and were unlikely to be cost effective. Evidence was drawn from studies conducted in primary and secondary care, but no studies reported on use of RADT for GAS sore throat in the pharmacy setting. In comparison, US guidelines recommend selective testing for GAS if indicated by a clinical scoring tool, using either microbiological culture of throat swabs or a RADT, before antibiotics are prescribed. French guidelines published in 2011 recommend that all children, between ages three to fifteen, with a sore throat should be tested with a RADT as a stand-alone test, without the use of a clinical scoring tool (Cohen et al. 2024).

4. Wales Sore Throat Test and Treat Service

In Wales, a national Sore Throat Test and Treat Service (STTT) was introduced in November 2018. The STTT is a screening and treatment service that assesses and treats sore throat in a community pharmacy setting rather than in GP practices. On set up, the aims of the service were to increase accessibility of care for people with a sore throat, to better use pharmacist skills, reduce the need for people to attend their GP practice, and to more accurately screen for GAS and reduce unnecessary antibiotic prescribing (Mantzourani et al. 2020). People aged six and over with an acute sore throat are encouraged to attend a participating community pharmacy rather than their GP practice. Pharmacists conduct a structured clinical assessment by screening people who present to the service for GAS using either FeverPAIN or Centor scoring tools. RADTs for GAS are offered to people with a FeverPAIN score of 2 or more or Centor score of 3 or more, indicating that they might, or are most likely to, benefit from an antibiotic (Mantzourani et al. 2022). People with a positive RADT are offered antibiotics by the pharmacist in line with NICE guidance (NICE 2018).

A pilot conducted in 56 community pharmacies across two health boards in Wales evaluated the feasibility and effectiveness of the STTT (Mantzourani et al. 2020). The pilot used data from all STTT consultations conducted between November 2018 to March 2019 and reported that the availability of STTT was associated with a small reduction in antibiotic prescribing in primary care clusters where STTT was offered in community pharmacies and those where it wasn't (-3.8% versus -3.4%, respectively). The average sore throat consultation rate in one practice before and after the introduction of the service decreased from 0.71 per 1,000 patients to 0.36 per 1,000 patients (Mantzourani et al. 2020). An HTW appraisal (EAR020) of clinical and cost effectiveness of RADTs for GAS sore throat in the community pharmacy setting recommended the accumulation of more evidence (HTW 2020) and the pilot was extended and expanded to other community pharmacies. In 2024-25, over 50,000 STTT consultations took place in pharmacies in Wales (StatsWales 2026). In June 2025, the decision was taken to roll out the STTT to all eligible pharmacies. Between around 3,000 to 7,000 STTT consultations a month now take place, with the higher numbers occurring in the winter months.

This report is intended to support a re-assessment of HTW's 2020 Guidance on RADT. RADTs are currently used in the STTT, using tests with a minimum of 96% sensitivity and specificity. STTT suggests OSOM Strep A Test (Sekisui Diagnostics), Alere Testpack Plus with OBC Strep A (Abbott), NADAL Strep A Test (BHR Pharmaceuticals) and BD Veritor Plus System for Group A Strep (Becton Dickinson) as specific examples of suitable tests. The first three are provided as strips or cassettes whereas the BD Veritor Plus System requires an additional reader device. In 2024-25 over 40,000 RADTs were conducted in STTT pharmacies (StatsWales 2026). The use of the RADTs adds time, complexity and costs to consultations which need to be outweighed by benefits from increased diagnostic certainty and reduced use of antibiotics. The aim of updated guidance is to enable a final decision to be taken regarding the use of RADT as part of the STTT service.

5. Effectiveness

HTW researchers searched for evidence that could be used to answer the review question: What is the clinical and cost effectiveness of rapid antigen detection tests for diagnosing and managing suspected group A streptococcal infection in the community pharmacy setting?

We included studies in people who presented with symptoms of sore throat in whom GAS was suspected. Diagnosis and management using clinical scoring systems such as Centor or FeverPAIN (Table 1) and point-of-care RADT in the community pharmacy setting was compared to diagnosis and management using clinical scoring systems or clinical judgement alone in any setting. In addition, we included evidence evaluating the diagnostic accuracy of RADT in detecting GAS sore throat in people of any age, with or without the use of clinical scoring systems, in any setting. For diagnostic accuracy studies, microbiological culture from throat swabs was the reference standard.

The previous appraisal (EAR020) was used to identify relevant evidence up to 2020 (HTW 2020). A new literature search was undertaken to identify evidence published since this date. For full details on the methodology used to identify evidence for this report, refer to Appendix 1.

5.1 Overview

Table 3 shows the outcomes we included, the sources of evidence identified for each outcome and a summary of data synthesis. In total, we identified one systematic review (Fraser et al. 2020) and 13 primary studies published after this review (Alhaddad et al. 2023, Armitage et al. 2025, Benboujida et al. 2025, Bulut et al. 2026, Bulut et al. 2020, Gumus et al. 2019, Kim et al. 2019, Mantzourani et al. 2025a, Mantzourani et al. 2022, Matuluko et al. 2025, Sølvik et al. 2021, Wi & Choi 2021, Zaki et al. 2021). Details of study characteristics are available in Appendix 6.

Table 3 – Summary of outcomes

Outcome	Sources of evidence and details of synthesis	Section
Clinical management outcomes		
Rates of antimicrobial prescribing	Narrative synthesis: 2 retrospective ecological studies 1 retrospective longitudinal cohort	5.2.1
Rates of re-consultation	1 retrospective longitudinal cohort	5.2.2
Morbidity (hospital admissions for quinsy)	1 retrospective longitudinal cohort	5.2.3
Patient satisfaction	No comparative evidence found. Narrative synthesis: 2 qualitative studies (semi-structured interviews) 2 cross-sectional surveys	8
Time to treatment decision	No evidence found	NA
Health-related quality of life	No evidence found	NA
Diagnostic accuracy (tests considered separately)		
Alere Testpack Plus Strep A (Abbott)	Meta-analysis: 10 studies Subgroups Meta-analysis in primary care: 4 studies	5.3.1

Outcome	Sources of evidence and details of synthesis	Section
	Meta-analysis in secondary care: 6 studies	
OSOM Strep A Test (Sekisui Diagnostics)	Meta-analysis: 6 studies Subgroups Meta-analysis in primary care: 4 studies Meta-analysis in secondary care: 2 studies	5.3.2
BD Veritor Plus System for Group A Strep (Becton Dickinson)	Meta-analysis: 4 studies	5.3.3
NADAL Strep A Test (BHR Pharmaceuticals)	1 manufacturer study	5.3.4
Diagnostic accuracy stratified by clinical score	Alere Testpack Plus Strep A: 1 study OSOM Strep A Test: 1 study	5.3.5

Abbreviation: NA, not applicable

[1]Patient satisfaction was reported in studies identified by an additional literature search of patient experiences with point-of-care testing.

5.1.1 Overview of observational studies with clinical management outcomes

Three studies evaluated the STTT (Mantzourani et al. 2025a, Mantzourani et al. 2022, Matuluko et al. 2025). All the studies were retrospective comparative observational studies and used data obtained from national primary care NHS databases. In all studies, STTT pharmacists conducted a structured clinical assessment using either FeverPAIN or Centor clinical scoring systems to screen people with a sore throat. If FeverPAIN was 2 or more, or Centor 3 or more, a point-of-care RADT was routinely advised. Antibiotics were supplied if the RADT was positive, in line with NICE guidance (NICE 2018). Outcomes from the STTT where RADT was routinely advised were compared with outcomes from a service where RADTs were not routinely offered. Data for STTT consultations were obtained from Choose Pharmacy, which is a national IT platform used in 98% of community pharmacies in Wales to record consultations. None of the studies named the RADTs that were used.

Mantzourani et al. (2025a) conducted a longitudinal cohort study with a 28 day follow up after an index consultation for sore throat. Outcomes included:

- antibiotic prescribing rates at the index consultation and within the follow up period
- rates of GP referrals and re-consultations
- hospital admissions for quinsy.

Data were obtained from people who consulted with the STTT service in two health boards in Wales from November 2018 to February 2020. Data were pseudonymised and individually linked to GP and hospital admission records. Outcomes were compared with Wales Longitudinal GP data from people who consulted with a health care professional in a GP practice in the same two health boards and who did not have an STTT record. The STTT service was delivered as described above. No details were given about the structure of the index GP consultation and whether a clinical scoring system or RADT point-of-care test was used. A total of 72,736 index consultations were recorded, of which 6,495 (6,024 unique individuals) were index STTT consultations and 66,241 (56,554 unique individuals) were index GP consultations. Median age at index consultation was 26 years for the STTT and 28 years for GPs. Around 65% were female in both groups. It was reported that in the STTT group, some participants had a GP consultation on the same day, and it was not possible to distinguish which was the index consultation. It was suggested that the entries could represent 1) an administrative entry by the GP that the patient had consulted the STTT and this was not a re-consultation 2) people were referred to the GP by

the STTT in line with the clinical pathway 3) a consultation with the GP despite assessment by the STTT. For the purposes of the GP re-consultation outcome, three scenarios were explored from "no index GP consultations were re-consultations" to "all index GP consultations were re-consultations".

Matuluko et al. (2025) examined antibiotic prescribing rates in people who had consulted with the STTT in Wales compared with people who had consulted the Acute Sore Throat Pharmacy First (ASTPF) service in England using data from February 2024 to July 2024. This period covered the first six months of the ASTPF service whereas the STTT was more established. Aggregated antibiotic prescribing data from the ASTPF for people aged 5 years and above were obtained from the NHS Business Service Authority (NHSBSA) and anonymised individual level data were obtained from the STTT. In the ASTPF service, community pharmacists assess people presenting with a sore throat using FeverPAIN. People with a FeverPAIN score of 4 or above are offered antibiotics without the need for a confirmatory point-of-care RADT. The STTT service was delivered as described above. During the study period, 27,684 STTT and 317,864 ASTPF consultations were conducted. This was equivalent to 874.9 consultations per 100,000 population in Wales and 551.0 consultations per 100,000 people in England. Individual patient data was not available for the ASTPF and so no demographic data were reported for this study.

Mantzourani et al. (2022) conducted an ecological study examining antibiotic prescribing rates in the STTT from November 2018 to end September 2020 in the pilot community pharmacies compared with antibiotic prescribing rates in the STTT from November 2020 to end May 2021. During the first time period, the STTT was delivered as described above. During the second time period, the STTT delivered mainly remote consultations due to the Covid-19 pandemic. During this period antibiotics could be considered for people with FeverPAIN of 4 or more, or Centor 3 or more, without the need for a confirmatory RADT. A total of 4,468 STTT consultations occurred in 56 pharmacies across two health boards during the first time period and 199 consultations in 25 of the original 56 pharmacies during the second time period. No demographic data were reported in this study.

5.1.2 Overview of diagnostic accuracy studies

Fraser et al. (2020) conducted a systematic review and meta-analysis, commissioned by the National Institute of Health and Care Research on behalf of NICE. This review provided the evidence for NICE's guidance on rapid tests for GAS sore throat in people aged 5 years or older with a sore throat (NICE 2019). The review examined 17 RADTs and considered diagnostic accuracy, clinical outcomes and cost effectiveness. Studies were conducted in primary and secondary care, but the review did not include any clinical studies with comparative outcomes that were conducted in a community pharmacy setting.

Fraser et al. (2020) identified 22 full-text peer-reviewed studies, three conference abstracts, two non-peer reviewed studies from manufacturers, and two Food and Drug Administration (FDA) documents that examined diagnostic accuracy. Not all of the 17 RADTs included data for diagnostic accuracy. The peer-reviewed studies included 7,632 participants and were conducted in children and adults, but the exact proportions were not reported in about half of the studies. No information was given about which countries the studies were conducted in. Only two of the included studies (Humair et al. 2006, Llor et al. 2009) reported diagnostic accuracy of the RADT in participants with a Centor score of 3 or more. The other studies either did not use a clinical scoring system to screen participants or used a lower cut-off. Separate meta-analyses of peer-reviewed studies were conducted for each test where possible, including for three of the tests named by the STTT: BD Veritor Plus System, OSOM Strep A and Alere Test Pack Plus. Only manufacturer's data was available for NADAL Strep A tests.

We identified ten additional papers describing 13 primary diagnostic accuracy studies that were published since the review by Fraser et al. (2020). Four studies, reported in two papers, were conducted in the Republic of Korea (Kim et al. 2019, Wi & Choi 2021), three in Türkiye (Bulut et al. 2026, Bulut et al. 2020, Gumus et al. 2019) and two studies, reported in one paper, in Sweden (Sølvik et al. 2021). One study was conducted in Saudi Arabia (Alhaddad et al. 2023), one in The Gambia (Armitage et al. 2025), one in Belgium (Benboujida et al. 2025) and one in Malaysia (Zaki et al. 2021). Five studies were conducted in primary care (Armitage et al. 2025, Benboujida et al. 2025, Sølvik et al. 2021, Zaki et al. 2021) and eight in secondary care (Alhaddad et al. 2023, Bulut et al. 2026, Bulut et al. 2020, Gumus et al. 2019, Kim et al. 2019, Wi & Choi 2021). A total of 20,961 participants were included. Eight studies, reported in six papers, were conducted in children and involved 1,614 participants under the age of 17 years (Alhaddad et al. 2023, Armitage et al. 2025, Gumus et al. 2019, Kim et al. 2019, Wi & Choi 2021, Zaki et al. 2021). The remaining studies were conducted in children and adults, although the two largest of these reported that 9,276 (75%) and 5,418 (88%) participants were recruited from paediatric clinics (Bulut et al. 2020, Bulut et al. 2026). Sølvik et al. (2021) included two studies that screened participants using the Centor scoring system, with participants with a score of 2 or more receiving a RADT. Other studies selected participants for RADT using clinical judgement, predefined clinical criteria other than a formal clinical scoring system, or did not report how screening was done. Three studies used the RADT at point-of-care (Armitage et al. 2025, Sølvik et al. 2021, Zaki et al. 2021), the remainder were unknown (Bulut et al. 2020, Wi & Choi 2021) or the throat swab was sent to the same laboratory that conducted the microbiological culture and the RADT performed in the laboratory. In four studies (Alhaddad et al. 2023, Benboujida et al. 2025, Gumus et al. 2019, Zaki et al. 2021) the same throat swab was used for both the RADT and the microbiological culture. Ten RADTs were evaluated, of which three appear to have been developed since HTW's previous appraisal (HTW 2020). Two new studies evaluated BD Veritor Plus (Bulut et al. 2020, Kim et al. 2019), and one new study evaluated OSOM Strep A (Benboujida et al. 2025), allowing us to update the meta-analyses conducted by Fraser et al. (2020). A total of 16 RADTs with data for diagnostic accuracy were identified although some of these exist as both test strips and cassettes. Further details of the RADTs are available in Appendix 7.

5.2 Clinical management outcomes

Table 4 shows an overview of clinical management outcomes from studies evaluating the use of RADTs for diagnosing and managing suspected GAS sore throat infection in the community pharmacy setting,

5.2.1 Rates of antibiotic prescribing for sore throat

Mantzourani et al. (2025a) compared participants with sore throat who had attended the STTT with participants who had attended a GP. The study examined antibiotic prescribing at the initial consultation and antibiotic prescribing within 28 days of the initial consultation. An additional 188 participants who attended the STTT were recorded as receiving antibiotics from a GP on the initial date. To account for these people, all antibiotic prescribing on the date of the initial consultation was examined.

Antibiotic prescribing rates at the initial consultation were 17 percentage points (%pts) lower for the STTT (21% for STTT vs 39% for GP; adjusted odds ratio [AOR] 0.30, $p<0.001$).

Antibiotic prescribing rates on the initial consultation date were 14%pts lower for the STTT (24% for STTT vs 39% for GP; AOR 0.36, $p<0.001$).

Antibiotic prescribing rates within 28 days of the initial consultation were 12%pts lower for the STTT (28% for STTT vs 40% for GP; AOR 0.44, p<0.001).

Two studies compared rates of antibiotic prescribing in the STTT, where RADT was routinely used to confirm GAS after clinical scoring, with community pharmacy services where confirmatory RADT was not routinely required.

Matuluko et al. (2025) compared participants with sore throat who had attended the STTT with participants attending the ASTPF service in England. In the ASTPF service, community pharmacists assess people presenting with a sore throat using FeverPAIN. People with a FeverPAIN score of 4 or above are offered antibiotics without the need for a confirmatory point-of-care RADT. The study compared antibiotic prescribing in the ASTPF service with STTT participants assessed with FeverPAIN (to improve comparability), in STTT participants with FeverPAIN scores of 2 or 3 and in STTT participants with FeverPAIN scores of 4 or more.

Antibiotic prescribing rates in STTT participants assessed with FeverPAIN were 43%pts lower for the STTT compared with rates in all ASTPF participants (30% for STTT vs 73% for ASTPF).

In STTT participants with a FeverPAIN score of 2 and 3, antibiotic prescribing rates were 49%pts lower compared with rates in all ASTPF participants (24% for STTT vs 73% for ASTPF).

In STTT participants with a FeverPAIN score of 4 or more, antibiotic prescribing rates were 13%pts lower compared with rates in all ASTPF participants (60% for STTT vs 73% for ASTPF).

Mantzourani et al. (2022) compared participants with sore throat who attended the STTT during two time periods. During time period 1, after clinical scoring, confirmatory RADT was required before antibiotics were prescribed. During time 2 antibiotics could be considered for people with FeverPAIN score of 4 or more, or Centor score of 3 or more without the need for a confirmatory RADT.

Antibiotic prescribing rates were 27%pts lower during time 1 compared to time 2 in all participants (21% during time 1 vs 48% during time 2).

Antibiotic prescribing rates were 47%pts lower in participants with a FeverPAIN of 4 or more, or Centor 3 score of 3 or more during time 1 compared to time 2 (44% during time 1 vs 91% during time 2).

5.2.2 Rates of GP re-consultations

Mantzourani et al. (2025a) examined rates of re-consultation with a GP up to 28 days after initial consultation for a sore throat. People who had attended the STTT for the initial consultation were compared with those who attended a GP for initial consultation.

For days 1 to 28 after the initial consultation, 752 (12%) participants who attended the STTT as initial consultation had a re-consultation with a GP compared with 4,916 (7.4%) of those who attended a GP for the initial consultation. Rates of GP re-consultations for days 1 to 28 were 4.2%pts higher for participants who attended the STTT as initial consultation.

However, 174 participants with an initial STTT consultation also had a GP consultation where antibiotics were prescribed on the initial date. These were assumed to be people who had been referred to the GP by the STTT due to pharmacist concern over symptoms, or desire for further reassurance from the patient. A further 1,075 participants with an initial STTT consultation also had a consultation with a GP recorded on the same day without antibiotic prescription. Of these, 612 consultations were coded as 'seen in pharmacy' and could have been referred to the STTT by

the GP practice and were not re-consultations. Ultimately it was not possible to distinguish which was the initial consultation and which were re-consultations so three scenarios were examined.

Scenario one included the 174 consultations where antibiotics were prescribed and assumed that none of the 1,075 consultations were re-consultations. Under this scenario, 926 (14%) participants who attended the STTT for the initial consultation had a re-consultation with a GP within 28 days. For scenario one, rates of GP re-consultations were 6.8%pts higher for participants who attended the STTT as initial consultation (AOR 2.3, p<0.001).

Scenario two assumed that some of the 1,075 consultations were re-consultations (those not coded 'seen in pharmacy'). Under this scenario, 1,389 (21%) participants who attended the STTT for the initial consultation had a re-consultation with a GP within 28 days. For scenario 2 rates of GP re-consultations were 14%pts higher for participants who attended the STTT as initial consultation (AOR 3.8, p<0.001).

Scenario three assumed that all of the 1,075 consultations were re-consultations. Under this scenario, 2,001 (31%) participants who attended the STTT for the initial consultation had a re-consultation with a GP within 28 days. For scenario 3, rates of GP re-consultations were 23%pts higher for participants who attended the STTT as initial consultation (AOR 6.7, p<0.001).

The study authors considered scenario two most likely but, for all scenarios, it was reported that rates of re-consultation with a GP within 28 days of initial consultation were higher for people who had initially attended the STTT compared with those who had initially attended a GP.

5.2.3 Hospital admissions for quinsy

Mantzourani et al. (2025a) reported on hospital admissions for quinsy in people who had attended the STTT for the initial consultation compared with those who attended a GP for initial consultation.

Overall rates were low (STTT participants 0.31% vs GP participants 0.41%), and there was no evidence for a difference between the groups (AOR 0.68, p=0.104).

5.2.4 Patient satisfaction

No comparative evidence was found for this outcome. Patient experiences, including patient satisfaction, with point-of-care testing (POCT) from two single arm cross-sectional surveys and two qualitative studies, are reported in Section 8.

5.2.5 Health related quality of life

No evidence was found for this outcome.

5.2.6 Time to treatment decision

No evidence was found for this outcome.

5.3 Diagnostic accuracy outcomes

The following RADTs had diagnostic accuracy evidence available and are known to be used by the STTT:

- Alere Testpack Plus Strep A (Abbott)
- OSOM Strep A Test (Sekisui Diagnostics)
- BD Veritor Plus System for Group A Strep (Becton Dickinson)
- NADAL Strep A Test (BHR Pharmaceuticals)

Diagnostic accuracy outcomes for these RADTs are reported in the main text of this EAR. Sensitivity and specificity for other RADTs are available in Appendix 7. In common with Fraser et al. (2020), we have not pooled outcomes across different RADTs.

Table 5 shows an overview of diagnostic accuracy outcomes for RADTs for detecting GAS in any setting.

5.3.1 Alere Testpack Plus Strep A (Abbott)

Fraser et al. (2020) conducted a meta-analysis of 10 studies investigating diagnostic accuracy for Alere Testpack Plus Strep A involving 3,770 participants. The summary estimates were sensitivity of 85% and specificity of 96%.

Positive predictive values (PPV) ranged from 80% (35.9% prevalence) to 100% (40.1% prevalence). Negative predictive values (NPV) ranged from 86% (35.9% prevalence) to 98% (40.1% prevalence).

Four studies, involving 1,609 participants, were conducted in primary care and six studies, involving 2,161 participants were conducted in secondary care. Meta-analyses were undertaken to indirectly examine sensitivity and specificity in primary and secondary care settings. For studies conducted in primary care, the summary estimates were sensitivity of 90% and specificity of 95%. For those conducted in secondary care, the summary estimates were sensitivity of 80% and specificity of 97%.

5.3.2 OSOM Strep A Test (Sekisui Diagnostics)

We conducted a meta-analysis of seven studies for OSOM Strep A Test involving 1,087 participants. Six studies had previously been included in Fraser et al. (2020) and one (Benboujida et al. 2025) was published since the review. The summary estimates were sensitivity of 92% and specificity of 95%.

PPV ranged from 76% (17.9% prevalence) to 100% (23.0% prevalence) and NPV from 93% (38.1% prevalence) to 99% (22.7% prevalence).

4 studies, involving 699 participants were conducted in primary care and 2 studies, involving 388 participants were conducted in secondary care. Both studies conducted in secondary care were in children alone. Meta-analyses were undertaken to indirectly examine sensitivity and specificity in primary and secondary care settings.

For studies conducted in primary care, the summary estimates were sensitivity of 91% and specificity of 93%. For those conducted in secondary care, the summary estimates were sensitivity of 95% and specificity of 97%.

5.3.3 BD Veritor Plus System for Group A Strep (Becton Dickinson)

We conducted a meta-analysis of four studies for BD Veritor Plus System for Group A Strep involving 12,961 participants. Two studies had previously been included in Fraser et al. (2020) and two (Bulut et al. 2020, Kim et al. 2019) were published since the review. The summary estimates were sensitivity of 83% and specificity of 93%.

PPV ranged from 56% (25% prevalence) to 91% (18.5% prevalence) and NPV from 90.2% (26% prevalence) to 98.7% (18.5% prevalence).

All studies were conducted in secondary care.

Fraser et al. (2020) also included results from an FDA report. Sensitivity was reported as 97% and specificity 96%.

5.3.4 NADAL Strep A Test (BHR Pharmaceuticals)

The only data for NADAL Strep A Test was from a non-peer reviewed study conducted in secondary care by the manufacturer (Fraser et al. 2020). Sensitivity was reported as 98% and specificity as 98%.

5.3.5 Diagnostic accuracy stratified by clinical score

Only two studies, both identified by Fraser et al. (2020), reported diagnostic accuracy in people with a high clinical score. Both studies were conducted in adults in a primary care setting and both used the Centor clinical score. Diagnostic accuracy in people with a score of below 3 and those with a score of 3 or more was reported separately.

Humair et al. (2006) examined diagnostic accuracy of Alere TestPack Plus in 244 adults who had a Centor score of 3 or more. Sensitivity was reported as 95% and specificity as 94%. In 148 participants with a Centor score of 2, sensitivity was 80% and specificity 96%.

Llor et al. (2011) examined diagnostic accuracy of OSOM Strep A Strip in 166 adults who had a Centor score of 3 or more. Sensitivity was reported as 92% and specificity of 96%. In 160 participants with a Centor score of 1 or 2, sensitivity was 85% and specificity 93%.

Table 4 – Clinical management outcomes

Outcome	Evidence source(s)	Study design / participants	Results	Effect Interpretation	Comments on reliability
Rates of antibiotic prescribing at index consultation	Mantzourani et al. (2025a)	Retrospective longitudinal cohort, 62,578 participants STTT: n=6,024 (6,495 consultations) Index GP: n=56,554 (66,241 consultations)	STTT vs index GP (n, %) Antibiotic prescriptions at index consultation: 1,382 (21%) vs 25,506 (39%) Antibiotic prescriptions on index date: 1,570 (24%) vs 25,506 (39%)	Absolute difference (STTT-GP) Antibiotic prescriptions at index consultation: -17% (95% CI: -18% to -16%) AOR[1]: 0.30 (95% CI: 0.27 to 0.32), p<0.001 Antibiotic prescriptions on index date: -14% (95% CI: -15% to -13%) AOR[1]: 0.36 (95% CI, 0.34 to 0.40), p<0.001 **Favours STTT**	Limitations in coding for sore-throat in primary care may introduce inaccuracies in the data. No data available on FeverPAIN/Centor scores for people assessed in GP practices, making it impossible to account for differences in illness severity. An additional 174 STTT participants received antibiotics from a GP on the index date without further re-consultation.
	Matuluko et al. (2025)	Retrospective ecological study, 345,548 participants STTT: n=27,684 STTT assessed with FeverPAIN: n= 25,002 FeverPAIN score of 2 and 3: n= 13,439 High risk[2]: n=6,784 ASTPF: n=317,864 All assessed with FeverPAIN Scores NA	STTT vs ASTPF Rates for STTT participants assessed with FeverPAIN: 29.5% (95% CI: 29.0% to 30.1%) 72.7% (95% CI: 72.5% to 72.8%) All STTT participants 29.9% (95% CI: 29.4% to 30.5%) vs 72.7% (95% CI: 72.5% to 72.8%) Rates for STTT high risk[2] participants: 59.7% (95% CI: 58.5% to 60.8%) 72.7% (95% CI: 72.5% to 72.8%)	Absolute difference (STTT-ASTPF) For STTT participants assessed with FeverPAIN: -43.2% (95% CI: -42.6% to -43.8%), p<0.001 All STTT participants: -42.8% (95% CI: -42.2% to -43.8%), p<0.001 For STTT high risk[2] participants: -13.0% (95% CI: -11.9% to -14.1%), p<0.001 For STTT participants with FeverPAIN score of 2 and 3:	Anonymised individual level data from STTT compared with anonymised aggregated data from ASTPF. Lack of individual level data for ASTPF makes it impossible to adjust for differences in covariates, such as comorbidities, illness severity, age, deprivation or smoking status. Data entry for STTT and ASTPF is completed during the consultation and linked to reimbursement, so data quality and completeness are high. Differences in skills between STTT pharmacies and ASTPF pharmacies may exist.

Outcome	Evidence source(s)	Study design / participants	Results	Effect Interpretation	Comments on reliability
			Rates for STTT participants with FeverPAIN score of 2 and 3: 24.0% (95% CI: 23.3% to 24.8%) 72.7% (95% CI: 72.5% to 72.8%)	-48.7% (95% CI: -47.9% to -49.5%), p<0.001 **Favours STTT**	Only FeverPAIN is used by the ASTPF. Rates for STTT participants with FeverPAIN scores were reported for comparability.
	Mantzourani et al. (2022)	Retrospective ecological study, 4,667 participants STTT during time 1 (with routine RADT): n=4468 High risk[2]: n=1154 STTT during time 2 (no routine RADT): n=199 High risk[2]: n=86	Time 1 vs time 2 All participants Consultations where antibiotics supplied (n): 940 vs 95 Rate: 21% (95% CI: 20% to 22%) vs 48% (95% CI: 41% to 55%) High risk[2] Consultations where antibiotics supplied (n): 508 vs 78 Rate: 44% (95% CI: 41% to 47%) vs 91% (95% CI: 83% to 95%)	Absolute difference (time 1 – time 2) All participants: -27% (95% CI: -20% to -33%), p<0.001 High risk[2] participants: -47% (95% CI: -38% to -52%) **Favours STTT**	Lack of individual level data makes it impossible to adjust for differences in covariates, such as comorbidities, illness severity, age, deprivation or smoking status. Data entry for STTT is completed during the consultation and linked to reimbursement, so data quality and completeness are high.
Rates of antibiotic prescribing within 28 days of index consultation (inclusive of index)	Mantzourani et al. (2025a)	Retrospective longitudinal cohort, 62,578 participants STTT: n=6,024 (6,495 consultations) Index GP: n=56,554 (66,241 consultations)	STTT vs index GP (n, %) 1,820 (28%) vs 26,369 (40%)	Absolute difference (STTT-GP) -12% (95% CI: -13% to -11%) AOR[1]: 0.44 (95% CI: 0.41 to 0.47) **Favours STTT**	It was not possible to assess an outcome measure for re-consultation with a pharmacist within 28 days of the index date for a sore throat–related reason and associated medication supply in either group.

Outcome	Evidence source(s)	Study design / participants	Results	Effect Interpretation	Comments on reliability
Rates of GP re-consultations	Mantzourani et al. (2025a)	Retrospective longitudinal cohort, 62,578 participants STTT: n=6,024 (6,495 consultations) Index GP: n=56,554 (66,241 consultations)	STTT vs index GP (n, %) Days 1 to 28 after index date 752 (12.0%) vs 4,916 (7.4%) Within 28 days of index consultation (including index date). Scenarios[3] 1) 926 (14%) vs 4,916 (7.4%) 2) 1,389 (21%) vs 4,916 (7.4%) 3) 2001 (31%) vs 4,916 (7.4%)	Absolute difference (STTT-GP) Days 1 to 28 after index date 4.2% (95% CI: 3.4% to 5.0%) Within 28 days of index consultation (including index date). Scenarios[3] 1) 6.8% (95% CI: 6.0% to 7.7%) AOR[1]: 2.3 (95% CI: 2.1 to 2.5), <0.001 2) 14% (95% CI: 13% to 15%) AOR[1]: 3.8 (95% CI: 3.5 to 4.1), p<0.001 3) 23% (95% CI: 22% to 25%) AOR[1]: 6.7 (95% CI: 6.1 to 7.2), <0.001 **Favours index GP consultation**	Limitations in coding for sore-throat in primary care may introduce inaccuracies in the data. No data available on FeverPAIN/Centor scores for people assessed in GP practices, making it impossible to account for differences in illness severity. In the STTT index consultations, 174 people also had a GP consultation where an antibiotic was prescribed, these were assumed to be referrals to the GP from the STTT according to protocol and are included in scenario 1[3]. In the STTT index consultations, 1075 sore throat consultations with a GP were also recorded on the same day, and it was not possible to distinguish which was the index consultation and which were re-consultations. Three scenarios[3] were tested. It was not possible to assess re-consultations with a pharmacist during the study period for either group.
Hospital admissions for quinsy	Mantzourani et al. (2025a)	Retrospective longitudinal cohort, 62,578 participants STTT: n=6,024 (6,495 consultations) Index GP: n=56,554 (66,241 consultations)	STTT vs index GP (n, %) 20 (0.31%) vs 274 (0.41%)	Absolute difference (STTT-GP): -0.10% (95% CI: -0.23% to 0.07%) AOR[1]: 0.68 (95% CI: 0.43 to 1.1), p=0.104 **No evidence for a difference**	Authors warn that low rates of hospitalisation for quinsy mean that it may not be possible to detect a difference.

Outcome	Evidence source(s)	Study design / participants	Results	Effect Interpretation	Comments on reliability
Abbreviations: AOR, Adjusted odds ratio; ASTPF, Acute Sore Throat Pharmacy First service; CI, confidence interval; GP, general practitioner: n, number; RADT, rapid antigen detection test; STTT, sore throat, test and treat service Notes: [1]Adjusted for baseline rates of sore throat consultations, hospital admissions, and all-cause antibiotic prescriptions in the 12 months before the index consultation. Also adjusted for health board, age, sex, deprivation, rural/urban location, smoking status, and the presence or absence of several comorbidities. [2]High risk = FeverPAIN score of 4 or more/Centor score of 3 or more. [3] For STTT index consultations, 1075 sore throat consultations with a GP were also recorded. Scenario 1 assumes none of these were re-consultations; scenario 2 that 612 of these consultations coded 'seen in pharmacy' could be assumed to be referred into the STTT by the GP and not re-consultations and the remaining 463 consultations were assumed to be re-consultations; scenario 3 assumes that all of these were re-consultations.					

Table 5 – Diagnostic accuracy outcomes for rapid antigen detection tests used in the Welsh Sore Throat Test and Treat Service

Outcome	Evidence source	Number and type of studies	Number of participants	Results	Comments
Alere Testpack Plus Strep A (Abbott)					
Sensitivity (%)	Fraser et al. (2020)	Meta-analysis (10 primary studies)	3,770	85% (95% CI: 79% to 90%)	Primary care: 1 in adults, 3 mixed population Secondary care: 4 in children, 2 mixed population Prevalence GAS from 25.4% to 40.1% Heterogeneity was assessed using I^2 Sensitivity I^2: 83% (high) Specificity I^2: 76% (high)
Specificity (%)	Fraser et al. (2020)	Meta-analysis (10 primary studies)	3,770	96% (95% CI: 94% to 98%)	
PPV (%)	Fraser et al. (2020)	11 primary studies	Range: 49 to 1,002	80% (95% CI: 72% to 86%) to 100% (90% to 100%)	
NPV (%)	Fraser et al. (2020)	11 primary studies	Range: 49 to 1,002	86% (95% CI: 78% to 92%) to 98% (95% CI: 94% to 99%)	
Alere Testpack Plus Strep A (Abbott) – indirect comparison primary vs secondary care					
Sensitivity (%)	Fraser et al. (2020)	Meta-analyses (4 primary care; 6 secondary care)	Primary: 1,609 Secondary: 2,161	Primary: 90% (95% CI: 83% to 96%) Secondary: 80% (95% CI: 71% to 88%)	Primary care: 1 in adults, 3 mixed population Secondary care: 4 in children, 2 mixed population
Specificity (%)	Fraser et al. (2020)	Meta-analyses (4 primary care; 6 secondary care)	Primary: 1,609 Secondary: 2,161	Primary: 95% (95% CI: 88% to 99%) Secondary: 97% (95% CI: 94% to 99%)	
OSOM Strep A Test (Sekisui Diagnostics)					
Sensitivity (%)	Fraser et al. (2020) Benboujida et al. (2025)	Meta-analysis (6 primary studies)	1,087	92% (95% CI: 87% to 95%)	Primary care: 4 studies (3 in adults, 1 in mixed population) Secondary care: 2 studies (2 in children) Prevalence GAS from 17.8% to 38.1% Meta-analysis updated by HTW using data extracted from Fraser et al. 2020 (5 studies) and Benboujida et al. (2025) Visual assessment of ROC curve suggests low heterogeneity (Appendix 8)
Specificity (%)	Fraser et al. (2020) Benboujida et al. (2025)	Meta-analysis (6 primary studies)	1,087	95% (95% CI: 91% to 98%)	
PPV (%)	Fraser et al. (2020) Benboujida et al. (2025)	6 primary studies	Range: 100 to 276	76% (95% CI: 65% to 84%) to 100%	
NPV (%)	Fraser et al. (2020) Benboujida et al. (2025)	6 primary studies	Range: 100 to 276	93% (95% CI: 85% to 97%) to 99% (95% CI: 92% to 100%)	

Outcome	Evidence source	Number and type of studies	Number of participants	Results	Comments
OSOM Strep A Test (Sekisui Diagnostics) – indirect comparison primary and secondary care					
Sensitivity (%)	Fraser et al. (2020) Benboujida et al. (2025)	Meta-analysis (4 primary care, 2 secondary care)	Primary: 699 Secondary: 388	Primary: 91% (95% CI: 85% to 95%) Secondary: 95% (95% CI: 90% to 98%)	Primary care: 4 studies (3 in adults, 1 in mixed population) Secondary care: 2 studies (2 in children) Primary: Prevalence GAS ranged from 17.8% to 24.8% Secondary: Prevalence GAS ranged from 28.9% to 38.1% Primary care subgroup analysis updated by HTW using data extracted from Fraser et al. 2020 (5 studies) and Benboujida et al. (2025)
Specificity (%)	Fraser et al. (2020) Benboujida et al. (2025)	Meta-analysis (4 primary care, 2 secondary care)	Primary: 699 Secondary: 388	Primary: 93% (95% CI: 91% to 95%) Secondary: 97% (95% CI: 95% to 99%)	
BD Veritor Plus System for Group A Strep (Becton Dickinson)					
Sensitivity (%)	Fraser et al. (2020) Bulut et al. (2020) Kim et al. (2019)	Meta-analysis (4 primary studies)	12,961	83% (95% CI: 67% to 92%)	Primary care: 0 Secondary care: 4 studies (2 in children, 1 in mixed population, 1 NR) Prevalence GAS ranged from 18.5% to 26% Meta-analysis updated by HTW using data extracted from Fraser et al. 2020 (2 studies) and Bulut et al. (2020) and Kim et al. (2019) Visual assessment of ROC curve suggests some heterogeneity (Appendix 8)
Specificity (%)	Fraser et al. (2020) Bulut et al. (2020) Kim et al. (2019)	Meta-analysis (4 primary studies)	12,961	93% (95% CI: 83% to 97%)	
PPV (%)	Fraser et al. (2020) Bulut et al. (2020) Kim et al. (2019)	4 primary studies	Range 100 to 12,391	56% (95% CI: 38% to 72%) to 91.0%	
NPV (%)	Fraser et al. (2020) Bulut et al. (2020) Kim et al. (2019)	4 primary studies	Range 100 to 12,391	90% (95% CI: 86% to 93%) to 99%	
BD Veritor Plus System for Group A Strep (Becton Dickinson) FDA report (not peer reviewed)					
Sensitivity (%)	Fraser et al. (2020)	1 FDA report	796	97% (95% CI: 92% to 99%)	Setting NR (mixed population) Not included in meta-analysis.
Specificity (%)	Fraser et al. (2020)	1 FDA report	796	96% (95% CI: 94% to 97%)	
PPV (%)	Fraser et al. (2020)	1 FDA report	796	83% (95% CI: 77% to 88%)	

Outcome	Evidence source	Number and type of studies	Number of participants	Results	Comments
NPV (%)	Fraser et al. (2020)	1 FDA report	796	99% (95% CI: 98% to 100%)	Prevalence GAS: 18.7%
NADAL Strep A Test (BHR Pharmaceuticals) manufacturer's study (not peer reviewed)					
Sensitivity (%)	Fraser et al. (2020)	1 manufacturer study	244	98% (95% CI: 91% to 100%)	Secondary care (mixed population) Prevalence GAS: 34.4%
Specificity (%)	Fraser et al. (2020)	1 manufacturer study	244	98% (95% CI: 93% to 99%)	
PPV (%)	Fraser et al. (2020)	1 manufacturer study	244	95% (95% CI: 88% to 99%)	
NPV (%)	Fraser et al. (2020)	1 manufacturer study	244	99% (95% CI: 95% to 100%)	
In people with a Centor score of 3 or more[1] (Alere Tespack Plus Strep A and OSOM Strep A test)					
Sensitivity (%)	Humair et al. (2006) Llor et al. (2011)	2 primary studies	244 and 166	95% (95% CI: 89% to 98%) 92% (95% CI: 76% to 98%)	Primary care (adults) Prevalence GAS: 46.9% and 31.0%
Specificity (%)	Humair et al. (2006) Llor et al. (2011)	2 primary studies	244 and 166	94% (95% CI: 88% to 98%) 96% (95% CI: 89% to 99%)	
PPV (%)	Humair et al. (2006) Llor et al. (2011)	2 primary studies	244 and 166	93% (95% CI: 87% to 97%) 92% (95% CI: 78% to 97%)	
NPV (%)	Humair et al. (2006) Llor et al. (2011)	2 primary studies	244 and 166	96% (95% CI: 90% to 98%) 96% (95% CI: 90% to 99%)	

Abbreviations: CI, confidence interval; FDA, Food and Drug Administration; GAS, group A beta-haemolytic streptococcus; NPV, negative predictive value; NR, not reported; PPV, positive predictive values; RADT, rapid antigen detection test; ROC, receiver operating curve

Notes:
[1]Date extracted from Fraser et al. (2020)

5.4 Ongoing studies

No eligible ongoing studies were identified.

5.5 Certainty of the evidence

5.5.1 Clinical management

- We only identified observational studies that examined use of rapid antigen detection tests for diagnosing and managing suspected GAS in the community pharmacy setting.
- The studies examining antibiotic prescribing, rates of re-consultation with a GP and hospital admissions for quinsy were all retrospective studies using large primary care databases to obtain data (Mantzourani et al. 2025a, Mantzourani et al. 2022, Matuluko et al. 2025). It was noted that data for the STTT and ASTPF is entered at the time of consultation and is linked to reimbursement, so the quality and completeness is high.
- Mantzourani et al. (2025a) was the only study to use individual-level data for both groups, the other two used aggregated data for one or both groups. This meant that there may have been differences between groups in health status, deprivation, illness severity, and other unknown confounders that could not be controlled for.
- Mantzourani et al. (2025a) obtained STTT data for FeverPAIN / Centor scores but this data was not available for participants with an initial GP consultation which meant illness severity could not be accounted for.
- Mantzourani et al. (2025a) reported that there were limitations in coding for sore-throat in primary care which introduced uncertainty in the results for GP re-consultations. To try to take account of these limitations three scenarios were explored. The exact reasons for GP re-consultations were not reported for the majority of people, but 19% were referred directly to the GP by the pharmacists and it was thought likely that a proportion of other re-consultations were due to appropriate pharmacist safety-netting due to deterioration of symptoms or development of complications. In addition, it was not possible to assess rate of re-consultation or provision of additional medication with a pharmacist for sore throat within 28 days of the initial consultation.
- Hospital admissions for quinsy were reported by one study (Mantzourani et al. 2025a) and were very low in both groups. The small numbers means that it may not have been possible to detect a difference between groups.
- One expert we consulted commented that there is a complex relationship between primary care prescribing and hospital admissions for tonsillitis, quinsy and deep neck space infections and therefore there are some uncertainties in this metric and how it applies in assessing the impact of the STTT.
- Matuluko et al. (2025) examined differences in antibiotic prescribing in the ASTPF in England and STTT in Wales. They noted that there may be differences in skills between STTT pharmacies and ASTPF. The STTT was introduced in stages, with an initial evaluated pilot in 56 community pharmacies, training of pharmacists and collaboration with GPs. The ASTPF was introduced nationally with no formal accreditation required to implement the service.
- No studies were identified that examined patient satisfaction with the STTT in comparison with a service where a confirmatory RADT was not used, or in comparison with a GP consultation.

- Experts commented that there was a lack of data available to measure the additional impacts of reduced antibiotic prescribing, particularly the impact on AMR, but also on disposal of unused medication, side effects, and on hospitalisations for quinsy, tonsillitis or deep neck infections.
- One expert commented that it is assumed that clinical scoring rules using FeverPAIN or Centor are equally applicable for children and adults, but this is unclear, and it is not clear what the correct cut-off for FeverPAIN is.

5.5.2 Diagnostic accuracy

- We identified one systematic review of 22 studies and ten additional primary papers reporting diagnostic accuracy, but only two studies were identified that reported on diagnostic accuracy in participants with a Centor score of 3 or more, which was the population of interest for this appraisal (Humair et al. 2006, Llor et al. 2011).
- No studies were identified that reported on diagnostic accuracy of RADTs in community pharmacies. There was some evidence from two different RADTs that there was a difference in diagnostic accuracy when tests were conducted in primary and secondary care settings, but the studies were observational, and no direct comparison was made. Consequently, there may have been other differences in study design, population, and the way the tests were undertaken that were not accounted for.
- We asked experts whether there are clear reasons why diagnostic accuracy of RADTs and clinical risk scoring conducted in community pharmacies would be significantly different from other settings. One expert thought that PPV and NPV would likely differ between care settings, because differences in illness severity across patient populations could impact the underlying prevalence of GAS sore throat, but they did not suggest differences in diagnostic sensitivity and specificity. Another expert added that earlier illness severity and protocol-driven patient selection in pharmacies could influence pre-test probability (sometimes described as prevalence) and bacterial load, while factors such as throat swab technique and the high-throughput nature of pharmacy consultations may affect diagnostic sensitivity. Several experts suggested there would be no difference in diagnostic accuracy if training was received, and it was noted that pharmacists delivering the STTT receive training on how to perform RADTs (including swabbing technique) and undertake Centor and FeverPAIN risk scoring. One expert commented that if the STTT service is effective at reducing antibiotic prescription rate and is safe, even if a study were to show that RADTs performed in pharmacies have lower accuracy, but patient outcomes are better, then, pragmatically, RADTs should be used in community pharmacy settings.
- In the identified systematic review (Fraser et al. 2020), it was reported that the criteria for participant selection was often unclear, it wasn't clear whether participants were selected consecutively, studies often used the same swab for the RADT and microbiological culture, not all studies stated that laboratory staff were blinded to the results of the RADT, and some studies included participants who had taken antibiotics within the previous few weeks. Similar issues were found in the additional diagnostic accuracy primary studies that we identified since the review.
- Diagnostic accuracy for NADAL Strep A Test was only reported in a non-peer reviewed study supplied by the manufacturer to Fraser et al. (2020). There was evidence from the review that manufacturer supplied studies reported better diagnostic accuracy than independent peer-reviewed primary studies.

- No studies were identified that compared diagnostic accuracy for BD Veritor Plus System, OSOM Strep A, Alere Test Pack Plus and NADAL Strep A Test with each other. Overall, there was not enough evidence to allow us to identify which RADT is the most accurate.

6. Cost effectiveness

6.1 Economic literature review

In the previous HTW appraisal, EAR020 (HTW 2020), two economic studies were included in the economic review, and a new economic model was developed.

Both studies included in the previous economic review were only partially applicable to NHS Wales because they considered healthcare systems in the US and Canada. One study (Klepser et al. 2012) included a US cost-utility analysis and found pharmacist-use of RADTs was cost saving with equal or better effectiveness when compared to RADT-use in walk-in clinics, physician observation only, physician with empiric therapy and physician with RADT-use. Pharmacist-use of RADTs was deemed cost saving but not cost effective when compared to strategies where a physician used a throat culture. Another study (Lathia et al. 2018) included a Canadian cost-minimisation analysis which estimated cost savings for point-of-care strep throat testing in a pharmacy setting, in comparison to physician-based usual care in a family physician's office, a walk-in clinic or an emergency room. These studies were selectively excluded from the current economic review because more relevant economic evidence was available.

This re-assessment identified two additional studies. Both considered the UK NHS perspective and were directly applicable to the research question. Mantzourani et al. (2025a) included a cost-utility analysis and Edokpayi et al. (2025) included a cost analysis extrapolated to a national level. These UK studies, as well as the original HTW analysis from EAR020, were included in the current economic review and are summarised in Table 6.

6.1.1 Cost-utility analyses

In the previous HTW appraisal (HTW 2020), a new economic model was developed to estimate the cost effectiveness of using RADT as part of the pharmacy-led STTT for suspected GAS infection, in comparison to standard GP assessment. The analysis took the perspective of the UK NHS and personal social services (PSS). The model utilised a decision tree approach with outcomes evaluated over a one-year time horizon for separate hypothetical cohorts of children and adults. The modelling approach was based on the economic analysis conducted as part of NICE HTG531 (previously DG38) on 'Rapid tests for group A streptococcal infections in people with a sore throat' (NICE 2019). The model assumed pharmacists would be able to carry out the RADT testing with the same level of effectiveness as a physician.

Base case results found the pharmacy-led STTT using RADT to be less costly than GP consultation in both adult and child populations. Similar quality-adjusted life years (QALYs) were estimated for both strategies. For adults, STTT with RADT was slightly more effective and therefore a dominant strategy. Conversely, as children were estimated to have a higher disease prevalence, the STTT with RADT strategy was estimated to be slightly less effective than GP consultation for this population. The incremental cost-effectiveness ratio (ICER) result for the child population was over £13.5 million per QALY. This is above the commonly accepted cost-effectiveness threshold of £20,000 per QALY and considered cost effective in this context, because cost savings outweigh the reduction in health outcomes.

All scenarios explored in deterministic sensitivity analysis (DSA) resulted in dominant or cost-effective economic conclusions, at a threshold of £20,000 per QALY. A threshold analysis investigating the cost of training found that conclusions remain cost effective if total training costs (accounting for training fee and pharmacist time) did not exceed £1,337 and £1,326, for adult and child populations, respectively. In probabilistic sensitivity analysis (PSA), the

pharmacy-led STTT using RADT was found to have a 100% probability of being cost effective. The probability reduced to 91% when training costs were incorporated.

Minor limitations of this model were identified. The model incorporates average diagnostic sensitivity and specificity estimates for RADTs from peer-reviewed publications reported in NICE HTG531 (NICE 2019), for adults and children separately. However, there is considerable heterogeneity in the studies included in NICE HTG531 (NICE 2019), where disease severity differs across included studies. Most studies did not consider clinical scoring or used thresholds lower than those used in UK practice. Additionally, diagnostic accuracy estimates of RADTs and clinical risk scoring are based on its use in secondary and/or primary healthcare settings and are assumed transferable to a pharmacy setting. Despite uncertainty around the modelled RADT diagnostic accuracy parameters, economic conclusions remained unchanged when these inputs were explored in sensitivity analysis. Expert feedback on whether the diagnostic accuracy of RADTs and clinical risk scoring is expected to differ between community pharmacies and other settings is summarised in Section 5.5.2. Further limitations are described in Table 6. A full description of the original HTW analysis is provided in Appendix 9.

Mantzourani et al. (2025a) aimed to address evidence gaps for longer term outcomes for patients with acute sore throat, comparing presentation at the Wales pharmacy-led STTT using RADT to standard GP assessment (described in Section 5). Cost-effectiveness was explored using the cost-utility model developed by HTW in EAR020 (HTW 2020) with inputs adjusted to reflect the clinical findings of the study. This included the probability of patients being directly referred to general practice from pharmacy, and the probability of re-consultation with a GP. These adjustments impact the antibiotic prescribing rates modelled. The 'worst-case' definition of re-consultation was applied in the base case, representing a conservative approach. Cost inputs were updated to reflect 2021/22 costs. All other inputs were consistent with the values used in the original HTW model from EAR020.

Mantzourani et al. (2025a) reported conclusions consistent with the HTW cost-utility analysis (EAR020). For adults and children, STTT with RADT was a cost-effective strategy, with the strategy being dominant (i.e. less costly and more effective) in the adult population. The ICER result for the child population was over £5 million per QALY and deemed cost effective at the £20,000 per QALY threshold. The intervention strategy was estimated to be dominant or cost effective in all DSA and scenario analyses explored. Their PSA estimated the intervention to have a 94% and 92% probability of being cost effective in adults and children, respectively.

Limitations of clinical findings of this study (described in Section 5), introduce uncertainty to the economic analysis. Limitations of the original HTW model from EAR020 are also transferable to this analysis and are described above and in Table 6.

6.1.2 Cost analysis

Edokpayi et al. (2025) reported a cross-sectional study across pharmacies in England using RADT, where the national economic impact of preventing unnecessary GP visits was estimated based on patient survey results.

Data from NHS Digital (2019) and published literature were used to estimate the annual number of GP consultations for a sore throat infection at a national level. The cost of GP and pharmacy consultations were sourced from unit costs reported in the 2018 PSS Research Unit (PSSRU) report (Curtis & Burns 2018). It was assumed that 10 minutes would be required by an advanced pharmacist practitioner for a pharmacy consultation. The cost of an OSOM Strep A RADT was provided by the manufacturer. The cost saving of replacing a GP visit with a pharmacist consultation using RADT was estimated to be £21.51 per patient, in 2018/19 prices.

A total of 59 patients presenting with a sore throat participated in the study, with 36 patients deemed suitable for RADT based on FeverPAIN score or clinical judgement. Survey results indicated that 34 of the 36 patients who received a RADT would have visited their GP if the pharmacy-led diagnostic service had not been available. Of these 34 patients, 23 tested negative for GAS, implying 67% of GP visits would be unnecessary. At a national level, the study estimated this could equate to the prevention of over 10 million GP visits for a sore throat annually, corresponding to over £263 million in total cost savings. Cost savings were estimated in all scenario analyses exploring alternative pharmacist consultation times and wages.

Potentially serious limitations of this study were identified. The economic analysis did not include costs related to treatment, RADT training for pharmacists, follow-up consultations or downstream complications. Clinical estimates feeding into the analysis were associated with uncertainty because they were based on a small sample size (n=34). Additionally, positive RADT results were assumed to be followed by GP referral, which may not represent clinical practice in settings where pharmacists can supply antibiotics. Therefore, cost savings could be underestimated for prescribing pharmacists. Further limitations are detailed in Table 6.

Table 6 – Summary of included economic studies: Original HTW appraisal (EAR020), Mantzourani et al. (2025a), Edokpayi et al. (2025)

Study details	Study population and design	Data sources	Results	Quality assessment
Author and year: Original HTW appraisal, EAR020 (HTW 2020) **Country:** UK **Type of economic analysis:** Cost-utility analysis **Perspective:** UK NHS **Currency:** UK pounds **Price year:** 2019 **Time horizon:** One year **Discounting:** NA **Potential conflict of interest:** None declared	**Population:** Adults and children presenting with GAS infection. **Intervention:** STTT with RADT: Clinical scoring in a pharmacy setting, with RADT if Centor score greater than 2 or FeverPAIN score greater than 1, and antibiotics offered if RADT positive. **Comparator:** Standard assessment: Clinical scoring in a GP setting, with antibiotics offered if Centor score greater than 2 or FeverPAIN score greater than 3. **Study design:** A new economic model was developed based on the economic analysis conducted in NICE (2019). A decision tree captured the outcomes of alternative assessment strategies, including the prescription of antibiotics, repeat visits and incidence of complications.	**Source of baseline and effectiveness data:** Prevalence estimates of GAS in patients presenting with a sore throat were derived by NICE (2019), based on a UK study for adults and three non-UK studies for children. Diagnostic accuracy of RADT was based on the average sensitivity and specificity reported from peer reviewed publications in NICE (2019), for adults and children separately. Diagnostic accuracy of clinical scoring was based on Centor risk scoring presented in NICE (2019), based on meta-analysis of 12 studies reported by Aalbers et al. (2011). Delayed antibiotic prescription and prescription usage were informed by NICE (2019), who used GP prescribing behaviour from the PRISM trial (Little et al. 2013). This data also informed assumptions for repeat consultations. Further GP contact after pharmacist assessment was based on Mantzourani et al. (2020). Assumed RADT use based on clinical judgement among patients with a Centor score less than 2 was informed by Mantzourani et al. (2020).	**Base case results** **Total costs (per person):** Adult population Intervention: £32.09 Comparator: £47.68 Incremental: -£15.59 Child population Intervention: £34.19 Comparator: £49.69 Incremental: -£15.50 **Total QALYs (per person):** Adult population Intervention: 0.86283 Comparator: 0.86282 Incremental: 0.000003 Child population Intervention: 0.86277 Comparator: 0.86277 Incremental: -0.000001 **ICER:** Adult population: Dominant Child population: £13,580,065 **Sensitivity analysis:** The intervention was cost effective or dominant throughout DSA. Conclusions were insensitive to variations in inputs including diagnostic accuracy, disease prevalence, disease severity, costs of testing and complications, complication rates and utility weights.	**Applicability** Directly applicable **Limitations** Minor limitations were identified: • Uncertainty exists in the diagnostic accuracy inputs used for RADT due to heterogeneity in the evidence base reported in NICE (2019). Disease severity differs across studies, with most not considering clinical scoring or using thresholds lower than UK practice. • As the diagnostic accuracy estimates of RADT include studies which do not consider clinical scoring, it may be implied that the accuracy of RADT is assumed independent of clinical scoring in the model, which may add uncertainty to cost effectiveness conclusions. • Diagnostic accuracy estimates of RADT are based on its use in primary and secondary care and are assumed transferable to a pharmacy setting. • Diagnostic accuracy estimates of clinical scoring are based on its use in primary care and are assumed transferable to a pharmacy setting.

Study details	Study population and design	Data sources	Results	Quality assessment
		Complication rates came from NICE (2019). Complications of GAS infection were based on Little et al. (2013), with assumptions made for complications that are non-suppurative. Penicillin-induced complications were based on a previous economic evaluation of diagnostic and treatment strategies for adults with streptococcal pharyngitis (Neuner et al. 2003). **Source of resource use and costs:** The unit cost of a GP consultation was sourced from the Personal Social Services Research Unit (PSSRU) (Curtis & Burns 2017). STTT pharmacy consultation costs were estimated from the fee listed in the service specification. Equipment and consumable costs were informed by the lead researcher in Mantzourani et al. (2020). RADT costs, including confirmatory swab culture for patients with a negative RADT result, were informed by NICE (2019). Antibiotic costs were estimated from the British National Formulary (BNF). Costs of complications were based on NICE (2019). **Source of quality of life data:** As in NICE (2019), baseline utilities were based on the general UK population (Kind et al. 1998) and utility decrements were informed by a previous economic analysis (Neuner et al. 2003).	Training costs were considered in sensitivity analysis only, whereby assumptions on training fees and the reimbursement of pharmacist time were explored. The intervention remained cost effective in all scenarios tested. A threshold analysis found that conclusions would remain cost effective if training costs did not exceed £1,337 and £1,326, for adult and child populations, respectively. PSA estimated the intervention to have a 100% probability of being cost effective at £20,000 per QALY in both adults and children. When the PSA was re-run with training costs incorporated, the intervention was found to have a 91% probability of being cost effective in both adults and children.	• For the diagnostic accuracy of clinical scoring, only Centor risk scoring is considered due to limitations in the evidence base for the accuracy of FeverPAIN risk scoring. • The prevalence of GAS for adults is based on a 2013 study which may not reflect current prevalence estimates. • The prevalence of GAS for children is based on non-UK studies. • The analysis does not capture benefits of reduced antibiotic use in terms of AMR. • Training costs were not considered in the base case analysis due to the uncertainty in cost and the potential for the analysis to be distorted by a 'one-off' cost in the set-up of the service. However, these are not expected to be a driver of results. • Antibiotic prescribing was modelled based on diagnostic accuracy and GAS prevalence, which might not reflect real world prescribing behaviour. It is unclear how this would impact cost-effectiveness conclusions.

Study details	Study population and design	Data sources	Results	Quality assessment
Author and year: Mantzourani et al. (2025a) **Country:** Wales **Type of economic analysis:** Cost-utility analysis **Perspective:** UK NHS **Currency:** UK pounds **Price year:** 2021/22 **Time horizon:** One year **Discounting:** NA **Potential conflict of interest:** None declared	**Population:** Adults and children presenting with acute sore throat. **Intervention:** STTT: Clinical scoring in a pharmacy setting, with RADT if Centor score greater than 2 or FeverPAIN score greater than 1, and antibiotics offered if RADT positive. **Comparator:** Standard assessment: Clinical scoring in a GP setting, with antibiotics offered if Centor score greater than 2 or FeverPAIN score greater than 3. **Study design:** A cost-utility analysis using the findings of a retrospective, longitudinal cohort study of sore throat consultations in Wales with either the pharmacy-led STTT or a healthcare professional at a GP practice. The study used an updated version of the HTW model from EAR020.	**Source of baseline and effectiveness data:** The probability of patients being directly referred to a GP from pharmacy and the probability of re-consultation with a GP are incorporated from the clinical findings of this study. All other sources of baseline and effectiveness data used are aligned to the original HTW model from EAR020 described above. **Source of resource use and costs:** The sources of resource use and cost data used are aligned to the original HTW model from EAR020 described above, updated to reflect 2021/22 prices. **Source of quality of life data:** The sources of quality of life data are aligned to the original HTW model from EAR020 described above.	**Base case results** **Total costs (per person):** <u>Adult population</u> Intervention: £51.86 Comparator: £56.99 Incremental: -£5.13 <u>Child population</u> Intervention: £55.44 Comparator: £60.42 Incremental: -£4.98 **Total QALYs (per person):** <u>Adult population</u> Intervention: 0.86282 Comparator: 0.86282 Incremental: 0.0000027 <u>Child population</u> Intervention: 0.86277 Comparator: 0.86277 Incremental: -0.0000009 **ICER:** Adult population: Dominant Child population: £5,274,887 **Sensitivity analysis:** The intervention was cost effective or dominant throughout DSA. Conclusions were insensitive to plausible variations in inputs including diagnostic accuracy, disease prevalence, test costs, complication costs and utility weights.	**Applicability** Directly applicable **Limitations** Minor limitations were identified: • Limitations related to the clinical evidence of this retrospective study (Section 5) also apply to the economics. • Limitations related to the HTW model from EAR020 also apply to this analysis and are described above.

Study details	Study population and design	Data sources	Results	Quality assessment
			PSA estimated the intervention to have a 94% and 92% probability of being cost effective at £20,000 per QALY in adults and children, respectively. Further sensitivity analyses were run to explore the uncertainty around the re-consultation rate. Alternative re-consultation definitions were explored, and the intervention was found to be cost-effective or dominant for all definitions considered.	
Author and year: Edokpayi et al. (2025) **Country:** UK **Type of economic analysis:** Cost analysis extrapolated to a national level **Perspective:** UK NHS **Currency:** UK pounds **Price year:** 2023/24 **Time horizon:** One year	**Population:** People aged 16 or older who visited the pharmacist with signs of a viral sore throat infection. **Intervention:** Pharmacist consultation with RADT: Clinical scoring using FeverPAIN followed by RADT if score was greater than 3 in a pharmacy setting. **Comparator:** GP consultation **Study design:** A cross-sectional study across pharmacies in England using RADT was conducted, and participants completed a questionnaire on treatment choice if the diagnostic service	**Source of baseline and effectiveness data:** The proportion of GP consultations avoided was estimated based on the observed incidence of negative RADT results and a survey asking participants what they would have done if the service was not available. Annual GP appointments for upper respiratory infection (URI) was estimated from NHS Digital (2019). The proportion of URIs which were sore throats was sourced from a UK study investigating antibiotic prescribing for adults with URI (Gulliford et al. 2014). **Source of resource use and costs:** Original source costs were based on 2018/19 prices and inflated to 2023/24 prices using the CCEMG – EPPI Centre Cost Converter (EPPI 2024).	**Base case results** Total cost savings from avoided GP visits for sore throat (national level): £263,211,361 **Sensitivity analysis:** Consultation time was varied from 5 to 15 minutes. Pharmacist wage was varied from £35 to £50 per hour. All scenarios explored resulted in cost saving outcomes.	**Applicability** Directly applicable **Limitations** Some potentially serious limitations were identified: • The cross-sectional study had a small sample (n=59), from a single pharmacy chain with voluntary participation. This might limit generalisability of results to the wider population. • The study did not include a comparator group, limiting direct comparability in the economic analysis. • Positive RADT results were assumed to lead to GP referral, which may not represent clinical practice in settings where pharmacists can supply antibiotics.

Study details	Study population and design	Data sources	Results	Quality assessment
Discounting: NA **Potential conflict of interest:** Funded by Reckitt Health, a consumer health company, who were involved in study design and interpretation.	was unavailable. The cost difference between a pharmacist consultation with RADT and a GP consultation was estimated using publicly available sources. Cost differences were extrapolated to a national level using the outcomes of this study and publicly available sources.	The cost of GP and pharmacy consultations were sourced from unit costs reported in the 2018 PSSRU report (Curtis & Burns 2018). It was assumed 10 minutes would be required by an advanced pharmacist practitioner for a pharmacy consultation. The cost of an OSOM Strep A RADT was provided by the manufacture.		• The economic analysis did not include costs related to treatment, RADT training, follow-up consultations or downstream complications. • Authors noted some pharmacists exercised clinical discretion which deviated from the protocol. This introduces heterogeneity in testing decisions which may have influenced diagnostic outcomes. • The study excluded those aged 15 years or less, limiting the applicability to paediatric populations. • Patients included in this study may differ in health-seeking behaviour compared to those consulting GPs, potentially introducing bias. • Authors noted that pharmacists' experience in throat swabbing could impact test results. • The study collected data during a period that included peak URIs, and season fluctuations in sore throat incidence and antibiotic prescribing patterns may impact generalisability of results.

Study details	Study population and design	Data sources	Results	Quality assessment
				• PSA not conducted and DSA not fully explored. • It was unclear whether national results related to the UK or England. • GP avoidance estimates were based on non-mutually exclusive survey responses, which could inflate the estimate and introduce uncertainty. • There is a lack of transparency in the analysis of survey results used to estimate GP visits avoided, and exploration to a national level adds further uncertainty.

Abbreviations: AMR, antimicrobial resistance; DSA, deterministic sensitivity analysis; GAS, group A beta-haemolytic streptococcus; GP, general practitioner; ICER, incremental cost-effectiveness ratio; NA, not applicable; PSA, probabilistic sensitivity analysis; PSSRU, Personal Social Services Research Unit; QALY: quality-adjusted life year; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service; URI, upper respiratory infection

6.2 HTW cost analysis

We did not develop a new cost-utility analysis for this re-assessment. This was because the economic evaluation reported by Mantzourani et al. (2025a) was directly applicable, used an updated version of HTW's model and the latest evidence available on clinical management which could be incorporated into the model framework (i.e. GP referrals and re-consultations). We could not make any further updates to this analysis based on the effectiveness evidence described in Section 5.

The cost-effectiveness conclusions of previous cost-utility analyses were driven by costs, with very similar QALYs estimated for both strategies. Mantzourani et al. (2025a) estimated a gain of 1.4 minutes of perfect life for adults and a loss of 0.5 minutes for children. Similarly, NICE HTG531 (NICE 2019) estimated differences of -2.1 minutes to 2.0 minutes for RADTs used for adults in primary care, compared with no RADT.

Both models incorporated evidence for the diagnostic accuracy of clinical risk scoring and RADTs to determine the number of people with and without GAS infection who are prescribed antibiotics. The risks of GAS-related and penicillin-induced complications were then applied to estimate QALY differences between strategies.

This re-assessment identified direct evidence on antibiotic prescribing (Section 5). However, this evidence cannot be incorporated into the cost-utility models, because it is not broken down for people correctly or incorrectly identified with GAS infection. Consequently, the incidence of GAS-related and penicillin-induced complications cannot be estimated, nor can their impact on costs and QALYs.

To complement the existing cost-effectiveness evidence, a simple cost analysis was conducted using the evidence identified on antibiotic prescribing and clinical management, under the Wales STTT and other strategies. This is not a comprehensive evaluation of costs, and QALYs were not estimated in this analysis. However, the plausibility of cost effectiveness was considered alongside the findings of the previous cost-utility studies.

6.2.1 Methods

A simple cost analysis was developed in Microsoft Excel to compare the cost of diagnostic strategies for suspected GAS infection. Our analysis captured clinical outcomes, including RADT use, antibiotic prescribing and re-consultations, and associated costs were applied from the perspective of the UK NHS and PSS. A time horizon of one month was considered, reflecting the maximum period over which outcomes are likely to differ between the strategies. Discounting of future costs and benefits was not needed because of the short time horizon.

We considered a population of people presenting with a sore throat and the diagnostic strategies are described in Table 7. The analysis reflects the population of the STTT (aged six years and over). However, comparative evidence versus the ASTPF service included people aged five years and over.

Experts contacted by HTW suggested that GP assessment using RADT is a relevant comparator strategy. However, this was not included in our cost analysis because this is not usual care in Wales, and no evidence was identified comparing pharmacy STTT using RADT against this strategy. One expert also stated that, in their experience, people presenting with sore throats at GP surgeries are rarely seen by GPs and are more commonly seen by allied healthcare professionals. Though no effectiveness evidence was identified for this comparator, we explored this in scenario analysis for the GP assessment comparator.

Table 7 – Diagnostic strategies compared in HTW cost analysis

No.	Diagnostic strategy	Description
Intervention		
1.	Pharmacy STTT using RADT	Pharmacist assessment using a clinical risk score (Centor or FeverPAIN), followed by a RADT if the patient meets the risk score threshold (Centor score >2 or FeverPAIN score >1), or if deemed necessary following clinical judgement of the pharmacist. Antibiotics are prescribed if the RADT result is positive.
Comparator		
1.	GP assessment	GP assessment using a clinical risk score (Centor or FeverPAIN) with immediate antibiotics prescribed if the patient meets the risk score threshold (Centor score >2 or FeverPAIN score >3). Otherwise, a delayed antibiotic prescription may be provided if deemed necessary by the GP.
2.	Pharmacy STTT without routine RADT	Pharmacist assessment using a clinical risk score (Centor or FeverPAIN), with immediate antibiotics prescribed if the patient meets the risk score threshold (Centor score >2 or FeverPAIN score >3).
3.	Pharmacy ASTPF service	Pharmacist assessment using a clinical risk score (FeverPAIN), with immediate antibiotics prescribed if the patient meets the risk score threshold (FeverPAIN score >3).

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; GAS, group A beta-haemolytic streptococcus; GP, general practitioner; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service.

6.2.1.1 Clinical inputs

We performed pairwise comparisons of pharmacy STTT using RADT against each of the listed comparators. Each comparison is described below, with clinical inputs presented in Table 8.

6.2.1.1.1 Comparison 1: Pharmacy STTT using RADT vs GP assessment

Antibiotic prescribing for each strategy was informed by Mantzourani et al. (2025a), a retrospective comparative observational study using data collected from November 2018 to February 2020 and obtained from national primary care NHS databases (described in Section 5). We used the rates of antibiotic prescribing within 28 days of index consultation (inclusive of index) from this study to capture total antibiotic prescribing from initial assessments and re-consultations with a GP. The rates of GP re-consultations, for both strategies, have also been informed by Mantzourani et al. (2025a). We applied estimates based on the most conservative definition of GP re-consultations, as used in their economic modelling (as described in Section 6.1).

RADT use was informed by Mantzourani et al. (2023), a cross-sectional study using routine data sources from November 2018 to February 2020, reporting the percentage of STTT consultations provided with a RADT. This input was varied in sensitivity and scenario analysis. No RADT use was modelled for the comparator strategy.

Re-consultation with a pharmacist was not captured in our cost analysis as it was not possible to capture this outcome measure in Mantzourani et al. (2025a). Additionally, rates of RADT use in re-consultation with a pharmacist is not known. This was explored in scenario analysis.

6.2.1.1.2 Comparison 2: Pharmacy STTT using RADT vs Pharmacy STTT without routine RADT

Antibiotic prescribing for each strategy was informed by Mantzourani et al. (2022), a retrospective observational study using data obtained from national primary care NHS databases which compared participants with a sore throat who attended the STTT during two time periods (described in Section 5).

We estimated that 75.4% (95% confidence interval [CI]: 74.1% to 76.7%) of people presenting during the routine RADT period of Mantzourani et al. (2022) were eligible for RADT based on clinical risk scoring (3,369 of 4,468). This is similar to RADT use from Mantzourani et al. (2023), where the 95% CIs across both studies overlap. For consistency across analyses, we modelled the same level of RADT use in the intervention strategy for each pairwise comparison. This input was varied in sensitivity and scenario analysis.

Although the comparator strategy did not include the routine use of RADT, its use could be considered to inform treatment decisions. No data was available on the use of RADT in the comparator arm of Mantzourani et al. (2022). We conservatively assumed that no RADTs were used in this strategy. However, this assumption was tested in sensitivity analysis.

Re-consultation with a pharmacist or GP was not captured in this comparison because no data were available comparing these outcomes between the two strategies. Re-consultation with a pharmacist was explored in scenario analysis.

6.2.1.1.3 Comparison 3: Pharmacy STTT using RADT vs Pharmacy ASTPF service

Antibiotic prescribing for each strategy was informed by Matuluko et al. (2025), a retrospective ecological study using data obtained from national primary care NHS databases to compare outcomes for the STTT in Wales with the ASTPF service in England (described in Section 5).

We estimated that 80.9% (95% CI: 80.4% to 81.4%) of people evaluated with FeverPAIN under the STTT in Matuluko et al. (2025) were eligible for RADT based on clinical risk scoring (20,223 of 25,002). This estimate does not include those evaluated with Centor risk scoring, in which RADT use was not reported. For consistency across analyses, we modelled RADT use in the intervention strategy informed by Mantzourani et al. (2023) and varied this value in sensitivity and scenario analysis. No RADT use was modelled for the comparator strategy.

Re-consultation with a pharmacist or GP was not captured in this comparison because no data were available comparing these outcomes between the two strategies. Re-consultation with a pharmacist was explored in scenario analysis.

Table 8 – Clinical inputs used in HTW cost analysis

Clinical input	Mean (%, 95% CI)	Source
Comparison 1: Pharmacy STTT using RADT vs GP assessment		
Antibiotic prescribing: comparator	39.8 (39.4 to 40.2)[a]	Mantzourani et al. (2025a)
Antibiotic prescribing: intervention	28.0 (26.9 to 29.1)[a]	Mantzourani et al. (2025a)
RADT use in intervention strategy	76.7 (75.9 to 77.4)[a]	Mantzourani et al. (2023)
GP re-consultation: comparator	7.4 (7.2 to 7.6)[a]	Mantzourani et al. (2025a)
GP re-consultation: intervention	30.8 (29.7 to 31.9)[a]	Mantzourani et al. (2025a)
Comparison 2: Pharmacy STTT using RADT vs Pharmacy STTT without routine RADT		
Antibiotic prescribing: comparator	47.7 (40.8 to 54.7)	Mantzourani et al. (2022)

Clinical input	Mean (%, 95% CI)	Source
Antibiotic prescribing: intervention	21.0 (19.8 to 22.2)	Mantzourani et al. (2022)
RADT use in intervention strategy	76.7 (75.9 to 77.4)[a]	Mantzourani et al. (2023)
Comparison 3: Pharmacy STTT using RADT vs Pharmacy ASTPF service		
Antibiotic prescribing: comparator	72.7 (72.5 to 72.8)	Matuluko et al. (2025)
Antibiotic prescribing: intervention	29.9 (29.4 to 30.5)	Matuluko et al. (2025)
RADT use in intervention strategy	76.7 (75.9 to 77.4)[a]	Mantzourani et al. (2023)

All inputs independently sampled from a beta distribution.
[a] 95% CI not reported in study. The 95% CI has been estimated by HTW by calculating the SE and then using a normal approximation.

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; CI: confidence interval; GP, general practitioner; NR, not reported; RADT, rapid antigen detection test; SE, standard error; STTT, Sore Throat Test and Treat Service.

6.2.1.2 Costs and resource use

We applied the most recent costs available at the time of analysis. Most costs related to a 2025/2026 price year. However, unit costs of health and social care and the NHS cost inflation index were only available up to 2023/2024 (Jones et al. 2025). Cost inputs are presented in Table 9.

The cost of an STTT pharmacist consultation was informed by the March 2026 issue of the NHS electronic drug tariff (NHS Drug Tariff 2026), which reports the fees and allowances of the common ailment service (CAS), including the STTT. We applied a cost of £13.02 per patient, accounting for the fee per STTT consultation (£12.12) and the fee of consumables used per consultation (£0.90). The cost of a RADT used within an STTT consultation was also informed by NHS Drug Tariff (2026), where the additional fee for each RADT used is £2.47.

Under the CAS, pharmacies receive an annual registration fee from the NHS, which is paid in monthly instalments based on the number of patients registered. This is a pharmacy-level fee which relates to multiple services, including the STTT, and depends on patient bandings. Patients may already be registered when they present to the STTT and patient transfers between pharmacies adds further complexity when apportioning registration fees to STTT consultations. We did not include registration fees in our base case analysis because of difficulty in robustly estimating an average cost per STTT consultation. However, this was explored in scenario analyses.

Aligned with the base case in the cost-utility analysis previously developed for EAR020, training costs were not considered due to uncertainty in costs and the potential for the analysis to be distorted by a 'one-off' cost. However, this was explored in scenario analyses.

The cost of a GP consultation was sourced from unit cost estimates in the 2024 PSSRU report (Jones et al. 2025). The report states a GP consultation lasting 10 minutes costs £45 (including direct care staff costs and qualification costs). In scenario analysis, we applied the cost of a 15-minute consultation with an advanced nurse practitioner instead of a standard GP consultation.

The cost of an ASTPF pharmacist consultation was sourced from the Community Pharmacy Contractual Framework: 2024 to 2025 and 2025 to 2026 (Department of Health and Social Care 2025). We applied a cost of £17.00 per patient, aligning to the 2025/26 fee for Pharmacy First minor illness and clinical pathways consultations.

The cost associated with the prescription of antibiotics was estimated using costs from the basic price reported in NHS Drug Tariff (2026), and dosing from the British National Formulary

(BNF) (Joint Formulary Committee 2026). The dose of phenoxymethylpenicillin for acute sore throat is 250 mg four times a day for children aged 6 to 11 years, and 500 mg four times a day for children aged 12 to 17 years and adults. We assumed a course length of five days, based on feedback from expert consultation. The cost of each regimen was estimated based upon a price of £0.91 for a 28 pack of 250 mg tablets. An average of the two regimens was calculated, resulting in an estimated cost of £0.98.

Table 9 – Cost inputs used in HTW cost analysis

Input	Mean (£)	Source
Costs (£)		
STTT pharmacist consultation	12.12	NHS Drug Tariff (2026)
STTT pharmacist consumables	0.90	NHS Drug Tariff (2026)
STTT pharmacist RADT	2.47	NHS Drug Tariff (2026)
GP consultation	45.00	Jones et al. (2025)
ASTPF pharmacist consultation	17.00	Department of Health and Social Care (2025)
Antibiotic (phenoxymethylpenicillin)[a]	0.98	NHS Drug Tariff (2026), BNF (Joint Formulary Committee 2026) and expert feedback.

Sampled from a gamma distribution where the SE is assumed 10% of the mean value.
[a] Assumed 250 mg and 500 mg doses, four times each day for five days, are equally likely.

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; BNF, British National Formulary; GP, general practitioner; NR, not reported; RADT, rapid antigen detection test; SE, standard error; STTT, Sore Throat Test and Treat Service.

6.2.1.3 Wider health economic benefits of reducing antibiotic prescribing

This analysis did not capture wider health economic benefits associated with reduced antibiotic prescribing, including impacts on AMR. AMR is a global problem and antimicrobial stewardship programmes aim to reduce indiscriminate use of antibiotics, minimise AMR and preserve the future effectiveness of treatments. The benefits of reduced antibiotic prescribing occur at a population level, over extended time horizons, and are therefore beyond the scope of our analysis. Complex dynamics and evidence requirements make the incorporation of AMR into cost-effectiveness models challenging. None of the studies included in our economic review considered AMR within their analyses.

Previous studies have explored ways to assess these wider benefits. One study (Shrestha et al. 2018) estimated a cost per antibiotic consumed using population level associations between antibiotic use, resistance and downstream costs. They concluded that the economic costs of AMR per antibiotic consumed were considerable; however, these estimates were based on uncertain relationships and were not indication or pathogen specific. Another study (Nayyar et al. 2026) conducting a scoping review of antimicrobial stewardship programmes found limited economic evidence, and noted the implementation challenges of such economic evaluations.

Several experts contacted by HTW researchers emphasised the importance of reducing antibiotic prescribing for AMR. Like previous economic studies, our analysis is likely to underestimate the health economic value of strategies that reduce unnecessary antibiotic prescribing because we did not model a link between prescribing and AMR.

6.2.1.4 Plausibility of cost effectiveness

We considered whether it was possible for the pharmacy STTT with RADT strategy to be cost effective based on the incremental costs from each pairwise comparison. If the intervention strategy was estimated to increase costs, we estimated the minimum QALY gains that would be needed to justify this additional expenditure versus the comparator. Conversely, if cost savings were estimated, we estimated the maximum QALY losses that could be justified by these savings. We used a cost-effectiveness threshold of £20,000 per QALY gained to estimate these values.

We used the findings of previous cost-utility studies to give an indication of whether QALY differences were likely to fall in the range needed for cost effectiveness. For strategies with and without RADT, cost-utility analyses have reported QALY differences equivalent to a gain or loss of around two minutes of perfect life (Mantzourani et al. 2025a, NICE 2019). We therefore concluded that cost effectiveness was likely if estimated cost savings were large enough to justify small QALY losses. If QALY gains were needed to justify cost increases, we concluded that cost effectiveness remained uncertain because neither our analysis or the cost-utility analyses captured the potential health benefits of reduced antibiotic prescribing relating to AMR.

This analysis is presented as context for our cost estimates and is only intended to give an indication of cost effectiveness. The results should be interpreted with caution because not all relevant costs can be included in our analysis. Our results should be considered alongside the results of previous cost-utility analyses.

6.2.1.5 Assumptions and limitations

Key limitations and assumptions of the cost analysis are described in Table 10.

Table 10 – Key assumptions and limitations of the HTW cost analysis

Component	Description
RADT use (Intervention)	We assumed that the same level of RADT use was applicable to the intervention strategy in all comparisons. Modelled RADT use was informed by the percentage of STTT consultations provided with a RADT in a cross-sectional study of routine data from November 2018 to February 2020 Mantzourani et al. (2023). The findings of this study are similar to the percentage of people presenting during the routine RADT period of Mantzourani et al. (2022) who were eligible for RADT based on clinical risk scoring. This value is explored in scenario and sensitivity analysis.
RADT use (Comparator 2)	We assumed that no RADTs were used in comparator 2, because the extent of its use was not reported for this strategy. This assumption is likely to bias our base case analysis in favour of the comparator, because we will underestimate the cost of RADT for this strategy. This has been explored in scenario analysis.
CAS registration fee	A CAS registration fee has not been included in our base case analysis due to the complexities in robustly attributing it to an STTT consultation, which might underestimate the cost of the STTT. We explore inclusion of a registration fee in scenario analysis.
Antibiotic dosing	BNF reports the dosing of phenoxymethylpenicillin for acute sore throat is 250mg four times a day for children aged 6 to 11 years, and 500mg four times a day for children aged 12 to 17 years and adults. To estimate an average cost, we assumed 250mg and 500mg doses are equally likely, based on the assumptions made from the economic model in the previous appraisal (EAR020).

Component	Description
Antibiotic course length	We assumed a course length of five days for phenoxymethylpenicillin, based on expert feedback.
Pain relief	Based on feedback from experts, we assumed no prescription for pain relief is made. Scenario analysis explores the prescription of paracetamol (32-tablet pack, 500mg) for people who do not receive an antibiotic prescription.
Training costs	We assumed the NHS does not incur significant training costs for STTT or comparator strategies. The cost of training was not considered due to uncertainty in costs and the potential for the analysis to be distorted by a 'one-off' cost. This aligns to the base case in the previous cost-utility analysis developed for EAR020. This assumption could bias our base case analysis in favour of the intervention strategy and is explored in scenario analysis.
Diagnostic accuracy	This analysis does not capture the accuracy of clinical risk scoring and RADTs because the available antibiotic prescribing evidence does not break down results for people correctly or incorrectly identified with GAS infection.
Complications	This analysis does not capture the incidence of complications associated with infection or treatment, or their impact on quality of life and costs. We could not model these outcomes because the available antibiotic prescribing evidence does not break down results for people correctly or incorrectly identified with GAS infection. This limitation is likely to bias cost estimates in favour of the comparator strategies, because the previous cost-utility analysis showed overall cost savings related to complications for pharmacy RADT use.
Antibiotic prescribing	It is unknown whether the available antibiotic prescribing evidence strictly follows the criteria defined for each strategy. For example, when RADT was routinely used in Mantzourani et al. (2022), a total of 940 people were prescribed antibiotics, despite only 922 people receiving antibiotics as indicated by RADT following clinical scoring.
Staff assessing sore throats at GP practices (Comparator 1)	Heterogeneity may exist in general practices where sore throats can be assessed by allied healthcare professionals, such as advanced nurse practitioners, as well as GPs. We explore the cost of an advanced nurse practitioner consultation applied instead of a standard GP consultation in scenario analysis.
Re-consultation at a pharmacy	Re-consultation at a pharmacy was not captured as this evidence was not captured in the studies used to inform this cost analysis. We explore this in scenario analysis.
GP re-consultation (Comparison 2 and 3)	Re-consultation with a GP was not captured for comparison 2 or 3 as this evidence was not captured in the studies used to inform this cost analysis in these comparisons.
Quality of life	This analysis does not capture quality of life or estimate QALYs for each strategy. Previous cost-utility analyses suggest the difference in QALYs between strategies is likely to be very small. However, where STTT is estimated to be less costly and less effective than comparators, QALY estimates are needed to assess cost effectiveness.
Benefits of reducing antibiotic use	This analysis does not capture the potential wider benefits of reducing antibiotic use in relation to AMR. It is difficult to robustly quantify these benefits as they occur at a wider population level over extended time horizons.

Abbreviations: AMR, antimicrobial resistance; ASTPF, Acute Sore Throat Pharmacy First; BNF, British National Formulary; CAS, common ailment service; GAS, group A beta-haemolytic streptococcus; GP, general practitioner; PSSRU, Personal Social Services Research Unit; QALY, quality-adjusted life year; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service.

6.2.2 Results

Base case results are presented in Table 11, alongside the evidence identified on antibiotic prescribing.

In all comparisons, the evidence shows lower antibiotic prescribing for pharmacy STTT using RADT. The largest reduction was in the comparison to the pharmacy ASTPF service, where absolute antibiotic prescribing reduced by 42.8%. Reductions of 11.8% and 26.7% were demonstrated in comparisons to GP assessment and the pharmacy STTT without routine RADT, respectively.

Cost savings were estimated in the comparisons to GP assessment and the ASTPF service, where the pharmacy STTT using RADT strategy saved £19.67 and £2.50 per patient, respectively. These savings were largely driven by lower consultation costs of the STTT. Conversely, additional costs of £1.63 per patient were estimated in the comparison to the pharmacy STTT without routine RADT, driven by differences in RADT use and antibiotic prescribing.

Table 11 – Base case results (per-patient)

Strategy	Costs		Antibiotic prescribing	
	Total	Incremental	Total	Incremental
Comparison 1				
Pharmacy STTT using RADT	£29.05	-	28.0%	-
GP assessment	£48.72	-£19.67	39.8%	-11.8%
Comparison 2				
Pharmacy STTT using RADT	£15.12	-	21.0%	-
Pharmacy STTT without routine RADT	£13.49	£1.63	47.7%	-26.7%
Comparison 3				
Pharmacy STTT using RADT	£15.21	-	29.9%	-
Pharmacy ASTPF service	£17.71	-£2.50	72.7%	-42.8%

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; GP, general practitioner; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service.

Table 12 summarises our estimation of QALYs needed/supported by the incremental costs estimated in our base case analysis and implications for cost effectiveness

When compared to GP assessment (comparison 1) and the pharmacy ASTPF service (comparison 3), the pharmacy STTT using RADT strategy will remain cost effective if no more than 8.6 hours and 1.1 hours of perfect health is lost, respectively. These losses are much larger than estimates from existing cost-utility analyses. Therefore, pharmacy STTT using RADT is likely to be cost effective compared with GP assessment and the ASTPF service. The comparison to GP assessment is consistent with the conclusions of the existing cost-utility analysis.

In comparison to pharmacy STTT without routine RADT (comparison 2), gains of at least 42.9 minutes of perfect life are required for the pharmacy STTT using RADT strategy to be cost effective. These required gains are much larger than estimates from existing cost-utility analyses. However, as potential health benefits related to reducing antibiotic prescribing are not captured in our analysis, cost-effectiveness conclusions of this comparison remain uncertain.

Table 12 – Base case consideration of cost effectiveness for STTT using RADT

Comparison	Maximum QALY losses to be cost effective	Minimum QALY gains to be cost effective	Interpretation	Plausible cost-effectiveness conclusion[a]
1: v GP assessment	0.0010	-	Pharmacy STTT using RADT cost effective if no more than 8 hours 37 minutes of perfect life is lost.	Likely
2: v Pharmacy STTT without routine RADT	-	0.0001	Pharmacy STTT using RADT cost effective if at least 43 minutes of perfect life is gained.	Uncertain
3: v Pharmacy ASTPF service	0.0001	-	Pharmacy STTT using RADT cost effective if no more than 1 hour 6 minutes of perfect life is lost.	Likely

Key: green = cost effectiveness likely, amber = cost effectiveness uncertain
Cost effectiveness is based on the commonly used threshold of £20,000 per QALY.

[a] Cost-effectiveness conclusions consider quality of life differences ranging from -2.1 minutes to 2.0 minutes of perfect life, as reported in previous cost utility studies (Mantzourani et al. 2025a, NICE 2019) comparing strategies with and without RADT use. However, analyses did not capture benefits of reduced antibiotic prescribing for AMR.

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; QALY, quality-adjusted life year; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service; v, versus.

When input parameters were sampled across 10,000 PSA runs, the conclusions of the analysis were consistent with the base case. The probability of the pharmacy STTT using RADT being cost saving was 100.0% and 88.5% when compared to GP assessment and the pharmacy ASTPF service, respectively. However, in comparison to the pharmacy STTT without routine RADT, the probability of the pharmacy STTT using RADT being cost saving was 0.0%.

Uncertainty was further explored in DSA, whereby each input parameter was varied one at a time and the health economic outcome was recorded. Where available, inputs were varied within 95% CIs; otherwise, input parameters were adjusted by 20% above and below the mean value. The indicative cost effectiveness conclusions were consistent in the majority of DSA results. Conclusions only changed in comparison 3, where the base case cost of an ASTPF pharmacist consultation was lowered by 20% (£13.60) which resulted in the STTT with RADT being cost incurring by £0.90 per patient, leading to uncertainty in cost effectiveness. For comparisons 1 and 3, consultation costs were identified as key drivers of incremental costs. For comparison 2, RADT and antibiotic costs were identified as key drivers, as well as antibiotic prescribing.

Scenario analyses explored a range of alternative assumptions relating to GP and ASTPF consultations, antibiotic prescribing, antibiotic dose and course length, pain relief, RADT use, STTT training costs and pharmacy re-consultations. All scenario analysis results are presented in Table 13. The indicative cost effectiveness conclusions remained consistent in the majority of scenarios explored. Conclusions changed in one scenario explored for comparison 1, where the cost of a 15 minute advanced nurse practitioner (band 7) consultation was applied instead of a standard GP consultation. For comparison 3, conclusions changed in scenarios incorporating STTT training costs, in one scenario incorporating a CAS registration fee for all STTT patients and in one scenario where an ASTPF consultation fee was assumed equal to the STTT consultation fee. These scenarios resulted in the STTT with RADT being cost incurring with uncertainty in cost effectiveness. It should be noted that in scenarios where training costs are incorporated, we conservatively apply no training costs with the ASTPF service.

Table 13 – Scenario analysis results: incremental costs and plausible cost-effectiveness conclusions for STTT using RADT

Modelled scenario	1: v GP assessment		2: v Pharmacy STTT without routine RADT		3: v Pharmacy ASTPF service	
	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]
Base case	**-£19.67**	**Likely**	**£1.63**	**Uncertain**	**-£2.50**	**Likely**
The cost of a 15 minute advanced nurse practitioner (band 7) consultation (Jones et al. 2025) instead of a standard GP consultation is applied in comparison 1 (£18.75)	£0.44	Uncertain	-	-	-	-
GP re-consultations using alternative definition in Mantzourani et al. (2025a), described in Section 5.2.2 as scenario one (14%)	-£27.23	Likely	-	-	-	-
GP re-consultations using alternative definition in Mantzourani et al. (2025a), described in Section 5.2.2 as scenario two (21%)	-£24.08	Likely	-	-	-	-
5% RADT use in comparison 2 for the STTT where RADT is not use routinely	-	-	£1.51	Uncertain	-	-
10% RADT use in comparison 2 for the STTT where RADT is not use routinely	-	-	£1.39	Uncertain	-	-
50% RADT use in comparison 2 for the STTT where RADT is not use routinely	-	-	£0.40	Uncertain	-	-
Antibiotic prescribing for STTT in comparison 3 based on those assessed with FeverPAIN in Matuluko et al. (2025) (29.5%)	-	-	-	-	-£2.51	Likely
Antibiotic prescribing for STTT in comparison 3 based on those assessed with FeverPAIN in Matuluko et al. (2025) (29.5%), and RADT use based on those assessed with FeverPAIN who were eligible for a RADT from Matuluko et al. (2025) (80.9%)	-	-	-	-	-£2.41	Likely
Antibiotic prescribing for STTT in comparison 3 based on high risk patients (FeverPAIN 4 or more) in Matuluko et al. (2025) (59.7%)	-	-	-	-	-£2.21	Likely
Antibiotic prescribing for the STTT in comparison 3 based on high risk patients (FeverPAIN 4 or more) in Matuluko et al. (2025) (59.7%), and RADT use reported for high risk patients (FeverPAIN 4 or more) from Matuluko et al. (2025) (96.8%)	-	-	-	-	-£1.72	Likely
ASTPF consultation fee assumed equal to STTT consultation fee (£13.02)	-	-	-	-	£1.48	Uncertain
Antibiotic course length of 10 days	-£19.79	Likely	£1.37	Uncertain	-£2.92	Likely
Antibiotic dose for children aged 6 to 11 years (250mg four times a day) applied only, for a course length of five days (£0.65 per course)	-£19.63	Likely	£1.72	Uncertain	-£2.36	Likely

Modelled scenario	1: v GP assessment		2: v Pharmacy STTT without routine RADT		3: v Pharmacy ASTPF service	
	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]
Antibiotic dose for children aged 12 to 17 years and adults (500mg four times a day) applied only, for a course length of 10 days (£2.60 per course)	-£19.86	Likely	£1.20	Uncertain	-£3.20	Likely
Pain relief given to those who do not receive antibiotics (NHS Drug Tariff 2026, NICE 2019) (£0.64, 32-tablet pack of paracetamol 500mg)	-£19.60	Likely	£1.80	Uncertain	-£2.23	Likely
RADT use based those presenting during the routine RADT period of Mantzourani et al. (2022) who were eligible for RADT based on clinical risk scoring (75.4%)	-£19.70	Likely	£1.60	Uncertain	-£2.54	Likely
RADT use based on those assessed with FeverPAIN who were eligible for a RADT from Matuluko et al. (2025) (80.9%)	-£19.57	Likely	£1.74	Uncertain	-£2.40	Likely
RADT use based on Mantzourani et al. (2024) (75.7%)	-£19.70	Likely	£1.61	Uncertain	-£2.53	Likely
STTT training costs applied, aligned to training costs explored in EAR020, based on reimbursement of pharmacist time using PSSRU 2023/24 (Jones et al. 2025) (£4.71 per STTT consultation)[b]	-£14.96	Likely	£1.63	Uncertain	£2.21	Uncertain
STTT training costs applied, aligned to training costs explored in EAR020, based on a training fee of £250 per pharmacist (£2.51 per STTT consultation)[b]	-£17.16	Likely	£1.63	Uncertain	£0.01	Uncertain
STTT training costs applied, aligned to training costs explored in EAR020, based on reimbursement of pharmacist time using PSSRU 2023/24 (Jones et al. 2025) and a training fee of £250 per pharmacist (£7.23 per STTT consultation)[b]	-£12.44	Likely	£1.63	Uncertain	£4.73	Uncertain
25% of patients initially assessed at a pharmacy have a pharmacy re-consultation[c]	-£15.94	Likely	£2.11	Uncertain	-£3.03	Likely
50% of patients initially assessed at a pharmacy have a pharmacy re-consultation[c]	-£12.21	Likely	£2.58	Uncertain	-£3.55	Likely
75% of patients initially assessed at a pharmacy have a pharmacy re-consultation[c]	-£8.49	Likely	£3.05	Uncertain	-£4.07	Likely
100% of patients initially assessed at a pharmacy have a pharmacy re-consultation[c]	-£4.76	Likely	£3.53	Uncertain	-£4.59	Likely
CAS registration fee included (estimated as £2.47 per patient per month, NHS Drug Tariff (2026))[d] where 25% of STTT patients are new registrations	-£19.05	Likely	£1.63	Uncertain	-£1.89	Likely

Modelled scenario	1: v GP assessment		2: v Pharmacy STTT without routine RADT		3: v Pharmacy ASTPF service	
	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]	Incremental cost	Plausible CE[a]
CAS registration fee included (estimated as £2.47 per patient per month, NHS Drug Tariff (2026))[d] where 50% of STTT patients are new registrations	-£18.44	Likely	£1.63	Uncertain	-£1.27	Likely
CAS registration fee included (estimated as £2.47 per patient per month, NHS Drug Tariff (2026))[d] where 75% of STTT patients are new registrations	-£17.82	Likely	£1.63	Uncertain	-£0.65	Likely
CAS registration fee included (estimated as £2.47 per patient per month, NHS Drug Tariff (2026))[d] where 100% of STTT patients are new registrations	-£17.20	Likely	£1.63	Uncertain	-£0.04	Uncertain

Key: green = CE likely, amber = CE uncertain
Cost effectiveness is based on a threshold of £20,000 per QALY.

[a] Cost-effectiveness conclusions consider quality of life differences ranging from -2.1 minutes to 2.0 minutes of perfect life, as reported in previous cost utility studies (Mantzourani et al. 2025a, NICE 2019) comparing strategies with and without RADT use.
[b] STTT training costs explored include a fixed fee per pharmacist and/or reimbursement of pharmacist time for one day of training, based on the average cost of a band 6 or band 7 scientific or professional staff worker in the community setting. It was assumed a pharmacist would be involved with the STTT for three years and approximately 33 STTT consultations would be undertaken annually per pharmacist based on pilot data from Mantzourani et al. (2020) (1,725 consultations in 56 pharmacies over five months) and the estimated medium number of community pharmacists per pharmacy from the International Pharmaceutical Federation (2017) (2.23 pharmacists per pharmacy from high-income countries). This allowed us to estimate the training cost per STTT consultation by dividing the fixed training fee per pharmacist and/or reimbursement of pharmacist time by the total number of STTT consultations estimated to be undertaken per pharmacist (approximately 99 STTT consultations). Training cost related to the ASTPF was not considered in any scenarios as a conservative assumption.
[c] The cost of a pharmacy re-consultation was assumed equivalent to an initial pharmacy consultation under each strategy. For the intervention strategy, the rate of RADT use at re-consultations was assumed equal to initial assessments. Antibiotic prescribing is not impacted in this scenario.
[d] Annual fee for CAS registration bandings up to 700 patients are approximately £29.07 per patient (subject to bandings) which increase to £30.24 per patient for registrations over 700 patients. We estimated an average registration fee of £2.47 per patient per month.

Abbreviations: ASTPF, Acute Sore Throat Pharmacy First; CAS: common ailment service; CE, cost effectiveness; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat Service; v, versus.

7. Organisational considerations

It is not clear how introduction of the STTT changed patient behaviour. It may be that more people sought medical attention for a sore throat more quickly instead of practicing self-care. However, evidence from the pilot STTT indicated that over 90% of patients who consulted with the service said that they would have contacted their GP if the STTT had not been available (Mantzourani et al. 2023). We asked experts whether the availability of the STTT across Wales impacts healthcare utilisation or patient behaviours. Most experts thought that it would be easier for people to use a pharmacy-led service for sore throat, which could result in an increase in absolute numbers visiting the pharmacy. Some experts thought that there could be increased attendance amongst people with milder symptoms who might otherwise have self-managed, although others commented that fewer people present to GPs or Accident and Emergency for sore throats. Data from the STTT was cited to support that there is a reduction in GP presentations and that the majority of patients are only visiting the pharmacy once for STTT in a typical one-year epidemiological cycle. In addition, experts commented that a major element of STTT is patient education and self-care advice, although at present it is difficult to say whether this advice on future management of similar episodes will have an impact on attendance.

The STTT is now an established service in Wales in community pharmacies, and already uses RADTs in people presenting with sore throat who have high clinical scores to guide antibiotic prescribing. If this re-assessment recommends routine adoption of RADTs there would be no change to the existing service. If routine adoption is not recommended, the requirement for confirmatory RADT within the STTT would be removed and community pharmacists would base antibiotic prescribing decisions on the FeverPAIN or Centor scores, similar to the ASTPF in England. There would be a need for clear communication as to the reasons for withdrawal of the RADT both for community pharmacists and for patients who may previously have presented at the STTT and now expect a confirmatory RADT. The impact on GPs would need to be evaluated to examine whether more people seek a consultation with a GP for reassurance.

Experts considered that RADT offers reassurance to people and health care professionals that the most appropriate decision is being made given the results. Experts felt that withdrawal of RADT would reduce confidence in the STTT and community pharmacists, increase antibiotic prescriptions and represent a backward step for AMR.

One expert consulted by HTW commented that basing antibiotic decisions solely on clinical scores may not be optimal for children given the higher risk of GAS in that age group.

8. Patient, carer and family considerations

HTW conducted a literature search for qualitative evidence on patient experiences with RADT for sore throat, POCT for other conditions, patient acceptance and trust in pharmacy led diagnosis and treatment, and understanding of antibiotic resistance and efforts taken to reduce this. Nine studies were identified for inclusion (Boiko et al. 2020, Clarke et al. 2025, Courtenay et al. 2017, Daniels et al. 2024, Gilham et al. 2025, Gilham et al. 2023, Mantzourani et al. 2021, Mantzourani et al. 2025b, McNulty et al. 2022).

Not all the studies looking at POCT were on RADT specifically, but the insights from patients found within them are relevant, as the experience of having a point-of-care swab-test is the same from the patients' perspective, despite the differences in reagents. Details of study characteristics are available in Table A4.

8.1 Patient experiences with POCT for sore throat and other conditions

Three studies were identified: two on POCT for sore throat in the UK (Daniels et al. 2024, Mantzourani et al. 2021), and one on POCT for patients with respiratory conditions (Clarke et al. 2025).

Mantzourani et al. (2021) conducted a survey that included free-text responses, to explore patient experiences with the STTT service at select pharmacies in Wales, where a point-of-care RADT for the detection of Strep A was used alongside clinical scoring tools to determine antibiotic treatment. 510 participants (18% response rate) completed the survey. When asked about their experience of the swab-test, most patients (99.8%) said that they were happy with the way the swab was taken, and 93% found that the results of the test were reassuring. Eventual provision of the antibiotics did not overly influence patient satisfaction with the RADT. Patients who did not receive antibiotics were more likely to report dissatisfaction with the service, but numbers were very small (0% of those receiving antibiotics vs 2.3% of those who did not). Test results were shown to increase confidence in the treatment outcome. Patients also commented that the test allowed them the opportunity to learn the difference between a bacterial and a viral infection, although this distinction proved difficult for a small number.

Daniels et al. (2024) considered if the addition of POCT alters antibiotic prescribing for patients with sore throat in the UK. The test involved was a molecular point-of-care test delivered at GP surgeries. Semi-structured interviews were conducted.

Patients were wholly accepting of, and valued, having POCT available at a primary health care setting, describing it as 'excellent'. 90% of these patients found it 'reassuring' to get a correct diagnosis during the consultation with their GP, rather than being referred and waiting for tests, and 80% of them felt that patient care was improved.

> *"As my daughter has strep throat and glandular fever last May, it was important that she was tested for strep throat, otherwise she could of fallen ill again. It was so quick and easy to go the swab test at the GP surgery, we waited 5 min for the results. And it put our minds at rest"*
>
> *"Great service, great to be able to have test done there and then speed, accuracy, reassurance and quick correct treatment as result"*
>
> *"Excellent service. Quick results resulting in no need for antibiotics which is always the best outcome if possible"*
>
> Patient quotes (Daniels et al. 2024)

Similarly, Clarke et al. (2025) looked at patient perceptions of POCT for respiratory conditions at primary care settings in the UK using semi-structured interviews. They saw that most patients viewed the testing positively. Performing swabs was described as 'not that invasive' and they were generally considered quick and easy. Familiarity with swab testing from the COVID-19 pandemic is thought to have contributed to the acceptability of such testing. While not all patients find swab testing comfortable, the benefits are understood to outweigh any disadvantages or negative experiences. Patients viewed the tests as reliable ways to indicate if antibiotics were needed, and this was particularly reassuring for parents of children, who pointed out that it can be difficult to try and understand what symptoms their children have. Test results were trusted, and results that suggested antibiotics were unnecessary provided peace of mind and encouraged patients to believe that they could recover without treatment at home. Some patients felt that the addition of POCT to a consultation with a clinician meant that they had extra evidence that they did not need antibiotics, and that this would influence their decision to re-present at a later stage if symptoms persisted.

> *"Otherwise you come away and you think, okay, I'll give it another couple of days and maybe I'll see another doctor and they'll tell me something different. It just takes away all of that doubt.*
>
> Patient quote (Clarke et al. 2025)

Consultation remains an important element for patients, as this is where they feel most heard by healthcare professionals, and provides extra reassurance. Patients value the 'face-to-face' interaction and see this as their opportunity to understand their symptoms properly, ask questions, and learn how to manage themselves or a loved one at home. As a result, there was some concern amongst patients that POCT may lead to a reduction in clinical judgment and time spent with a clinician. There were also concerns that POCT could lead to a failure to adequately explore compounding factors, such as co-morbidities.

> *"Does that mean that a 10- minute appointment gets forced as a five- minute appointment and then you lose that interaction ability?"*
>
> Patient quote (Clarke et al. 2025)

8.2 Patient acceptance of pharmacy led testing and treatments

Clarke et al. (2025), Daniels et al. (2024) and Mantzourani et al. (2021) considered patient acceptance of pharmacy led testing. An additional relevant paper, examining pharmacy led testing for UTIs in Wales, was also identified (Mantzourani et al. 2025b).

8.2.1 Pharmacy and sore throat

Clarke et al. (2025) saw that most patients were unconcerned by who was leading their POCT, but a few retained the perspective that a GP was preferable to a pharmacist. This was seen to be based on the patients understanding of different clinical roles.

"I want it to be a GP, rather than going to the pharmacist [...] what doctors do is completely different, wildly different to what pharmacists do which is literally symptoms and associated drugs, and drugs and interactions with other drugs."

Patient quote (Clarke et al. 2025)

They also saw that there is high awareness amongst patients of the pressures on the NHS and GP services, and that patients in general are supportive of measures taken to address these pressures. There was a sense of guilt and of 'being a nuisance' to services from patients concerned with attending unnecessarily. However, this was seen as at the expense of the level of care patients consider the most appropriate, such as patient-centred care with consultation. POCT was viewed as something that could address these concerns, as patients would take up less time with a clinician.

"I'd rather obviously keep going to pick one of those tests up and then do the test, rather than waste the doctor's time for something that you've literally just got to sort through."

"I guess maybe that would change me in terms of actually I might go to the doctors a bit sooner as opposed to... to kind of toughing it out or not."

Patient quotes (Clarke et al. 2025)

Similarly, Mantzourani et al. (2021) also saw that most patients felt that pharmacists explained the aims of the STTT service well and were satisfied with how the pharmacist checked whether they needed a throat swab. . Overall, 98% of participants were satisfied with the STTT and 98% of patients surveyed said that they would go to the pharmacy instead of trying to see the GP in the future for throat related symptoms. Patients viewed the opening hours of a pharmacy, and not needing to book an appointment before going, as positives. The professionalism of pharmacists was commended, and this helped patients feel at ease and to have confidence. However, some challenges around access persisted, such as finding a pharmacy that offered the test and who the test could be administered to, such as restrictions to children under 3 years of age.

''It was so convenient to call and consult with the pharmacy without having to make an appointment"

Patient quote (Mantzourani et al. 2021)

On the whole, there was support from patients on the migration of services from the GP to the pharmacy, with patients identifying such benefits as faster access to treatments and relieving pressures on GP services.

''I think this [service] is a great idea, no inconvenience to the patient and eases pressure on the GP. Informative and friendly service by the pharmacist."

"For the past 6 months it is so hard to get into the doctors you can never get in. Pharmacist always happy to see if he can help me and I found he actually helped me out.''

Patient quotes (Mantzourani et al. 2021)

Some patients expressed concerns about the additional pressure provision of POCT may place on the pharmacy, particularly those that are understaffed.

8.2.2 Pharmacy and other conditions

Mantzourani et al. (2025b) considered the experiences of patients with UTIs accessing treatment from pharmacies in Wales through online surveys. They saw that acceptance of pharmacy-led testing and treatment was high and independent of whether antibiotics were prescribed. Pharmacist communication was rated highly, and patients advised they felt consulted, listened to, and involved with decisions, and that they had the opportunity to ask questions. Most patients were happy with the advice the pharmacist provided on how to look after themselves following the appointment. Only 1.6% of patients disagreed with the pharmacist on their need for antibiotics, and most agreed that they would recommend pharmacy services to others.

> *"Great service provided by the local pharmacist, after two failed attempts to contact my GP from 8 am I was told I was on a call back list for 6 pm. Due to my worsening symptoms I chose to access support from my nearest pharmacy they were professional and very efficient."*
>
> *"Pharmacist explained why I don't need antibiotics today, thanks for reassuring me"*
>
> Patient quotes (Mantzourani et al. 2025b)

8.2.3 Public attitudes in the UK

HTW looked for studies on public attitudes in the UK toward pharmacy led services and prescribing to see if there is public support. All the studies found were conducted pre COVID-19 pandemic and were therefore excluded as public attitudes have altered significantly as a result of the pandemic.

8.3 Patient expectations of antibiotic provision and understanding of antibiotic overprescription

Four additional studies (Boiko et al. 2020, Courtenay et al. 2017, Gilham et al. 2025, McNulty et al. 2022) looking at the attitudes of patients towards antibiotic prescribing, understanding of over prescription of antibiotics, and efforts taken to reduce this, were found.

8.3.1 Expectations of antibiotic prescription and impacts of overprescription

Clarke et al. (2025) saw that patient understanding of antibiotics varies greatly, with conflicting views as patients want easy access to early antibiotic treatment to feel better, but at the same time are concerned with overprescription and antibiotic resistance. For most patients, POCT was seen as a way of reducing unnecessary prescribing of antibiotics. Patients who had negative POCT results, and as such did not get antibiotics, saw the experience as educating them on the difference between feeling poorly and requiring treatment, and felt that this would influence their decision making in the future.

> *"This experience has shown me that I didn't have antibiotics, I felt really ropey, but I got over it without antibiotics. So, it's obviously not the be all and end all, is it? Looking after yourself, rest, hydration, that obviously can do the trick as well.*
>
> Patient quote (Clarke et al. 2025)

Clarke et al (2025) saw that patient expectation of antibiotic provision is linked to previous illness experiences. Patients believe that antibiotics are necessary when dealing with symptoms similar to those on previous occasions when antibiotics were prescribed. However, the belief in the use of antibiotics as a preventative measure persisted, with patients viewing them as a way to prevent more complicated or longer-term illnesses.

Courtenay et al. (2017) considered patient experiences with pharmacist and nurse prescription services for acute respiratory infections but did not compare them. They found that patient expectations of a consultation are more than just the provision of antibiotics, but also include seeking information, seeking reassurance, physical examination and pain relief. They also saw that antibiotic expectation is linked to previous illnesses where antibiotics were prescribed, and that this is more prevalent in older populations. Antibiotics are also viewed as a 'quick fix', with the view that patients would be able to return to work and other activities quicker than 'waiting it out'.

McNulty et al. (2022) considered the public's knowledge on antibiotic use and resistance in England during 2020. The study conducted surveys during January and February 2020, and as such capture pre COVID-19 pandemic attitudes. They saw that there was general support for avoiding unnecessary antibiotic use, with most people surveyed indicating that they would accept, and welcome, their GPs advice that they or their child did not need antibiotics, and showing concern about antibiotic resistance. Those who reported taking antibiotics in the past were significantly more likely to believe that antibiotics would 'speed up' recovery. Most participants agreed that they would trust a doctor, nurse, or pharmacist about antibiotics. About one third of participants incorrectly stated antibiotics effectively treat viral or fungal infections.

Boiko et al. (2020) considered attitudes towards antibiotic prescription across two centres in England (one rural and one city based). Surveys were run at each centre independently. They saw the belief that antibiotics should be prescribed and taken only when necessary. Patients' concerns were about 'finding the right one for what infection you have at the time and making sure that you're going to be safe'. Expectations around antibiotics were varied, with those patients who had conditions such as frequent infections expecting treatment with antibiotics based on experience, whereas others preferred to wait for the decision of a healthcare professional. Approximately one quarter of the patients interviewed spoke about their experience of AMR. There was a sense of frustration and confusion because antibiotics had not worked. This was especially true for patients who had frequent infections. Side effects were also discussed, with the most common being nausea, stomach upset, vomiting and thrush. Patients spoke about compensating with probiotics to resolve digestive side-effects but continuing with antibiotics. If antibiotics were discontinued, this was because of more significant side-effects such as liver derangement, shortness of breath or anaphylactic shock.

8.3.1.1 Impact of the COVID-19 pandemic

Gilham et al. (2025) considered public understanding of antibiotic use in England pre and post COVID-19 pandemic. Online surveys were conducted each year from 2019 to 2024 and results compared. They saw that public knowledge of correct antibiotic use and AMR increased during the initial post pandemic period, as did the public belief that individuals and society have a role

in combatting antibiotic resistance (62% to 67% of people surveyed). However, they noted a decrease in these beliefs following the second-year post pandemic, with numbers returning to pre pandemic levels and more people stating they are uncertain if they can do anything to combat antibiotic resistance. The one exception to this pattern was the belief that antibiotics should be taken 'just in case', with the number of people reporting they do not believe this increasing year on year. However, those who do still account for more than half of people surveyed. Trust in pharmacist prescribing of antibiotics was 70% or higher during and post pandemic, with the same pattern of increasing and then declining numbers before returning to pre pandemic numbers.

8.4 Equality, diversity and inclusion considerations

There were many equality, diversity and inclusion factors found within the literature to influence patient acceptance of POCT and patient expectations around antibiotics, as well as implications for wider societal concerns around the introduction of POCT in antibiotic prescribing. One additional paper (Gilham et al. 2023) has been included in this section for findings relevant to equality, diversity and inclusion (ED&I).

8.4.1 ED&I factors influencing POCT acceptance

Clarke et al. (2025) saw that factors such as age, perceived immune system weakness, chronic health conditions and virus outbreaks in schools increase concern about symptoms and, as a result, entitlement towards antibiotic provision. While POCT was viewed as a way to mitigate this, some vulnerable patient populations retained the concern that they would be 'shut out' from getting the antibiotics that they view they need.

> *"I've got an autoimmune condition, so sometimes when I get illnesses, it makes it a lot worse [...] So, for me, it's really helpful to find out straight away that I can have the tablets, rather than having to just potentially deal with it getting worse."*
>
> *"I'm a bit scared because it's your lungs, isn't it, and I'm an old woman [...] I think I might get pneumonia and die."*
>
> Patient quote (Clarke et al. 2025)

There was some suggestion from patients that younger people may be more trusting of POCT than older people. It was also highlighted by patients in this study that while POCT may bring many benefits, contact with a healthcare professional is still important, particularly from a safeguarding perspective.

> *"They can spot any number of illnesses or maybe signs of social issues like sexual abuse and things like that, so... I wouldn't necessarily say you want to take off the face- to- face entirely."*
>
> Patient quote (Clarke et al. 2025)

8.4.2 Societal implications on the introduction of POCT for antibiotic prescribing

Clarke et al. (2025) also saw that POCT may provide additional benefits to parents with sick children, as tests were viewed as a way of providing evidence of a child's sickness to institutions such as schools, where absences come with penalties unless they are proven necessary.

8.4.3 ED&I considerations within knowledge about antibiotics

Gilham et al. (2025) saw that post-pandemic reported antibiotic use was higher in younger adults aged 16 to 34-years (44%), respondents from ethnic minority backgrounds (42%), those with a disability (44%), and in the lowest Index of Multiple Deprivation (https://data.geods.ac.uk/dataset/index-of-multiple-deprivation-imd) (37%). Differences in antibiotic knowledge were seen among populations with factors associated with health inequalities.

Gilham et al. (2023) also noted that antibiotic understanding is higher in men than it is in women.

McNulty et al. (2022) saw a general trend for higher levels of comprehension around antibiotic use and resistance for higher social classes, more trust in GP decisions and less challenge in white vs ethnic minorities, older people vs younger people and those who had recent antibiotic use. Trust in pharmacist prescribing was also lower for participants from ethnic minority groups.

9. Conclusions

This evidence review summarised published evidence on the effectiveness and cost effectiveness of rapid antigen detection tests for diagnosing and managing suspected GAS sore throat infection in the community pharmacy setting.

This review has also summarised the available literature related to patient experience of POCTs in the community pharmacy setting and public awareness of antibiotic over-prescribing.

Overall, there was evidence from two ecological studies suggesting that antibiotic prescribing rates were lower for a community pharmacy service using confirmatory point-of-care RADTs than for a community pharmacy service that did not. A reduction in antibiotic prescribing rates was observed in all patients presenting to the service, and also in patients with FeverPAIN scores of 4 or more. There was also evidence from a longitudinal cohort study that antibiotic prescribing rates were lower for a community pharmacy service using confirmatory point-of-care RADTs than for initial consultations conducted at GP practices, both on the initial date and within 28 days of presentation. There was evidence from the same longitudinal cohort that rates of GP re-consultation were higher for the community pharmacy service, compared to initial GP consultations. A patient satisfaction survey conducted in the same community pharmacy service reported high levels of satisfaction with the service. No evidence was found for health related quality of life.

We found evidence on the diagnostic accuracy of RADTs in primary and secondary care settings, but no studies examined diagnostic accuracy for RADTs in community pharmacies. Overall, diagnostic accuracy was variable for the different RADTs, and it was not possible to identify which RADT was most accurate. There was indirect evidence that there may be differences in diagnostic accuracy when tests are conducted in primary and secondary care settings, but differences in study design and population make this observation uncertain. There was evidence from two studies that sensitivity was higher in participants with a Centor score of 3 or more.

Two UK studies were included in the economic review, as well as the economic analysis developed as part of the previous HTW appraisal on this topic (EAR020). One study estimated £263 million in annual cost savings via the prevention of unnecessary GP visits. However, this analysis was associated with uncertainties and potential biases due to the study design. Another study updated HTW's model with new clinical findings and estimated the use of RADT in pharmacy consultations (via the STTT) was a dominant or cost-effective strategy compared with GP consultations.

To complement the existing economic evidence, we conducted a simple cost analysis using the evidence identified on antibiotic prescribing comparing pharmacy STTT with RADT to other strategies. In all comparisons, STTT with RADT reduced antibiotic prescribing. When compared to GP consultations and England's ASTPF service, STTT with RADT was estimated to be cost saving and is likely to be cost effective when the existing economic evidence is considered alongside our results. In comparison to STTT without routine RADT, STTT with RADT was estimated to be cost incurring. Cost effectiveness remains uncertain for this comparison because potential health benefits related to reducing antibiotic prescribing could not be captured in our analysis. Economic conclusions were consistent in most sensitivity and scenario analyses explored. There was uncertainty in the comparison to the ASTPF service when lower ASTPF consultation fees were applied, a CAS registration fee was applied to all STTT patients, and STTT training costs were incorporated. There was also uncertainty in cost effectiveness conclusions in the comparison to a GP consultation in the scenario where costs were applied for an advanced nurse practitioner instead of a GP. Our cost analysis only provides an indication of cost effectiveness based on existing economic evidence and results should be interpreted with caution because not all relevant costs and benefits could be considered.

The patient evidence shows that, overall, patients tolerate RADT and other forms of swab-testing and are accepting of both pharmacy-led services and of measures taken to reduce overprescription of antibiotics. However, some concerns were expressed: some patients are concerned that they may not get access to antibiotics they view as necessary for their health, and others are concerned about unintended consequences of moving services from GP clinics to pharmacies, such as missed safeguarding opportunities.

10. Contributors

This topic was proposed by Andrew Evans, Chief Pharmaceutical Officer, Welsh Government

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The HTW Assessment Group advised on methodology throughout the scoping and development of the report.

We are grateful to the following subject experts, who also contributed to this re-assessment:

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Subject experts contributed to this re-assessment by commenting on a draft of this report, and in some cases providing other advice to HTW's staff and decision-making groups. All contributions from reviewers were considered by HTW's Assessment Group and actioned accordingly. However, subject experts had no role in authorship or editorial control, and the views expressed are those of Health Technology Wales.

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Appendix 1 – Evidence review methods

We searched for evidence that could be used to answer the review question: What is the clinical and cost effectiveness of rapid antigen detection tests for diagnosing and managing suspected group A streptococcal infection in the community pharmacy setting?

The criteria used to select evidence for the re-assessment are outlined in Appendix 2. These criteria were developed following comments from the Health Technology Wales (HTW) Assessment Group and UK experts.

The systematic search followed HTW's standard rapid review methodology. A search was undertaken of Medline, Embase, CINAHL, KSR Evidence, Cochrane Library, and the International Network of Agencies for Health Technology Assessment (INAHTA) HTA database. Additionally, searches were conducted of key websites and clinical trials registries. The searches were carried out from 1 to 4 December 2025, with an update search of Medline, Embase, CINAHL, KSR Evidence, Cochrane Library, and INAHTA HTA database conducted on 8 April 2026.

The search was limited to evidence published after January 2020. The original EAR020 was used as a source of evidence before this date (HTW 2020). Appendix 3 gives details of the search strategy used for Medline. Search strategies for other databases are available on request. Appendix 4 summarises the selection of articles for inclusion in the review.

We updated previous meta-analyses of diagnostic test accuracy for OSOM Strep A Test and BD Veritor Plus. Data were extracted from Fraser et al. (2020) and from the relevant new primary studies to create 2 x 2 tables. Meta-analyses were conducted by fitting the bivariate model to sensitivity/specificity points using a linear mixed model using the reitsma() function in the *mada* package in R version 4.5.1. Heterogeneity was assessed visually by looking at the receiver operating curve (ROC) plot of sensitivity and specificity (see Appendix 8).

An additional literature search for qualitative evidence on patient experiences (PPI literature) was run between 4 to 6 February 2026. The search strategy used for the main rapid review search was the basis for this search, but the population was widened to include rapid testing of any kind in the community pharmacy setting. An additional search on the concepts of public awareness of antibiotic overprescribing and the impact of pharmacist prescribing was developed. These changes and additions were decided through consultation with the PPI Manager. The search followed HTW's standard systematic search methodology for PPI literature. A search was undertaken of Medline, PsycINFO, CINAHL, Health Management Information Consortium (HMIC) & TripPro. Additionally, searches were conducted of key websites.

Appendix 5 summarises the selection of articles for inclusion in the patient-related literature review. The full search report is available on request.

Appendix 2 – Inclusion and exclusion criteria for evidence included in the review

	Inclusion criteria	Exclusion criteria
Population	People presenting with symptoms of an acute sore throat in whom group A streptococcal infection is suspected	
Intervention	Diagnosis and management using clinical scoring tools and point-of-care RADT carried out in the community pharmacy setting	Point-of-care nucleic acid amplification tests (NAATs) / molecular tests
Comparison/ Comparators	Screening and management in any care settings (including community pharmacy) based on clinical scoring tools or clinical judgement alone	
Outcome measures	• Diagnostic accuracy (the reference standard is diagnosis of group A streptococcal infection using microbiological culture of throat swabs) • Time to antimicrobial prescribing decision or other treatment • Changes to antimicrobial prescribing (for example, rates of prescribing) • Rates of re-presentation or need for follow-up consultation • Morbidity, either from infection complications or from antibiotic therapy • Health-related quality of life • Patient satisfaction with test and antimicrobial prescribing decision • Costs effectiveness or other measures of economic impact	
Study design	We will prioritise the following study types, in the order listed: • Systematic reviews of randomised controlled trials. • Randomised controlled trials. • Non-randomised comparative trials. • Single-arm (no control group) trials that report any relevant outcome. We will only include evidence from "lower priority" sources where this is not reported by a "higher priority" source. This could be because higher priority evidence: • Does not cover all relevant populations • Does not compare the technology of interest to all relevant comparators • Does not cover all outcomes of interest • Reports over short-term follow up periods and longer follow up data is required to facilitate decision making.	

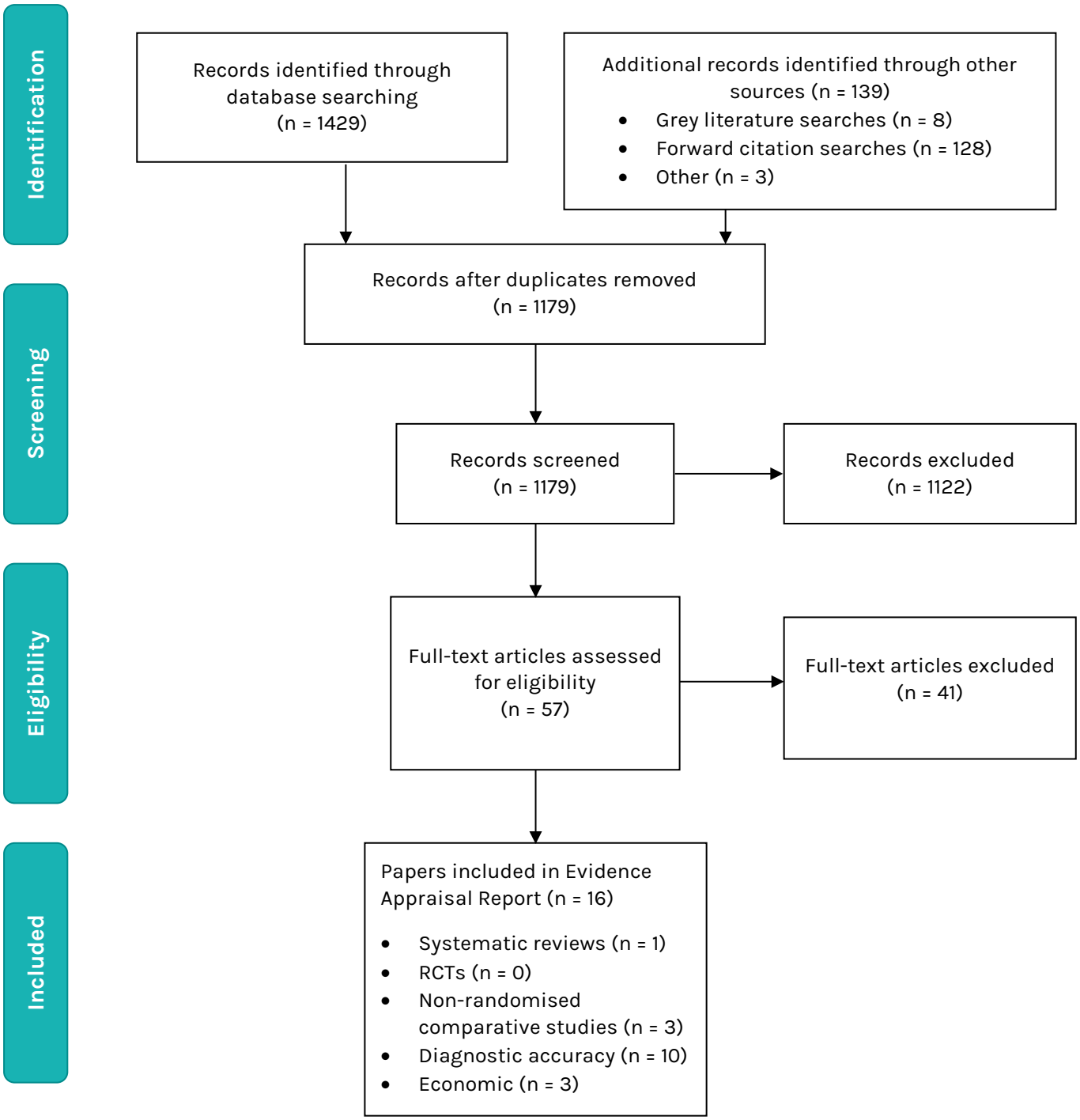
	Inclusion criteria	Exclusion criteria
	Where relevant and well-conducted systematic reviews exist we will use these by: • Reporting or adapting their reported outcome measures where these are fully relevant to the scope of our review, and appropriate synthesis methods have been used • Using these reviews as a source of potentially relevant studies where the review cannot be used as a source of outcome data We will prioritise systematic reviews in terms of the sources of evidence they include, using the order described above.	
Search date limits	From January 2020. We will use our original EAR as a source of evidence before this date.	
Language limits	English language only	
Publication status	We will include evidence from studies that are published in full. We will include details of any ongoing trials that have a planned completion or reporting date within 24 months of the date searches are carried out. We will only include trials of a design that is likely to add to the existing evidence in terms of certainty; for example, if we report evidence from randomised controlled trials in the EAR, we will only report details of ongoing trials if they also use a randomised design.	

Appendix 3 – Medline strategy

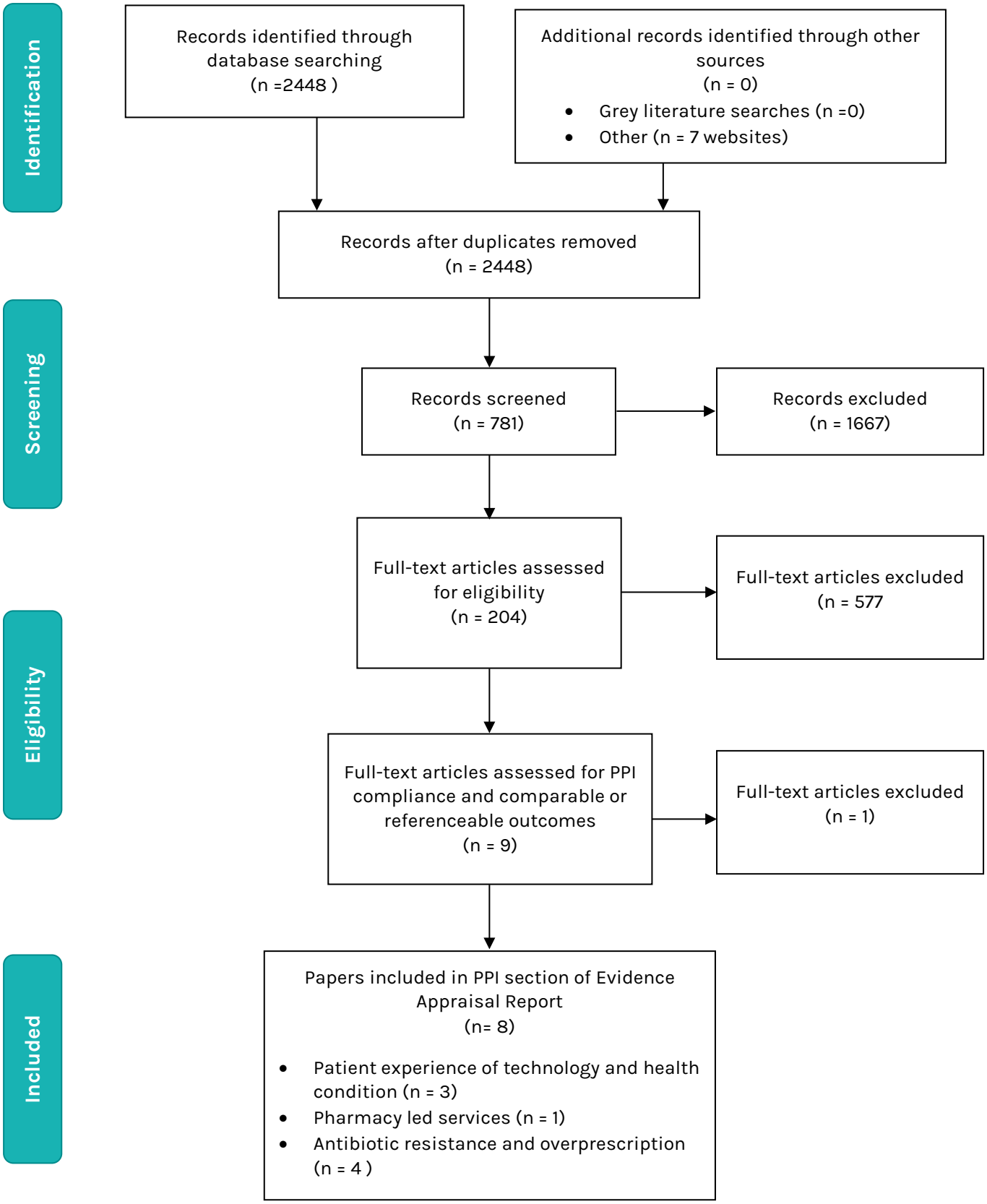
Ovid MEDLINE(R) ALL <1946 to April 07, 2026>		
Sore throat terms		
1	exp Pharyngitis/	17388
2	Respiratory Tract Infections/	46454
3	((sore adj1 throat$) or pharyngit$).tw,kf.	15288
4	(nasophyryngit$ or rhinopharyngit$ or epipharyngit$).tw,kf.	231
5	(tonsillit$ or tonsilit$ or tonsillopharyngit$).tw,kf.	7292
6	((sore or pain$ or ache$ or aching or inflam$ or infect$ or swab$) adj3 (pharyn$ or throat$ or tonsil$ or nasopharyn$ or rhinopharyn$ or epipharyn$)).tw,kf.	28465
7	or/1-6	89503
Strep A terms		
8	Streptococcus pyogenes/	15114
9	Streptococcal Infections/	36793
10	("group A" adj5 streptococc$).tw,kf.	11882
11	("strep A" or "streptococcal A" or "streptococcus A" or "streptococci A").tw,kf.	819
12	(((beta-h?emolyt$ or betah?emolyt$) adj3 streptococc$) and "group A").tw,kf.	2416
13	gabhs.tw,kf.	435
14	or/8-13	47568
Strep throat		
15	7 and 14	6708
16	(strep$ adj3 (throat$ or pharyngit$)).tw,kf.	2646
17	15 or 16	7303
RADT terms		
18	rapid diagnostic tests/	304
19	("rapid antigen test$" or "rapid antigen detect$").tw,kf.	2175
20	((rapid antigen or rapid antigen detection or rapid strep$ or rapid diagnos$) adj3 test$).tw,kf.	9178
21	(radt or radts or rdt or rdts or sartd).tw,kf.	4335
22	((antigen$1 or rapid) adj6 (test or tests or testing or tested or detect$ or diagnos$ or screen$ or kit or kits or assay$ or immunoassay$ or determin$ or identif$)).tw,kf.	297760
23	Point-of-Care Systems/	19332
24	Point-of-Care Testing/	5407
25	("point-of-care" or poc or pocs or poct or pocts).tw,kf.	52888
26	exp Reagent Kits, Diagnostic/	21472
27	or/18-26	363862
RADT & Strep throat		
28	17 and 27	971
Specific tests		
29	(("strep A" or "streptococcal A" or "streptococcus A" or "streptococci A") adj3 (rapid or test$)).tw,kf.	128
30	(sore throat$ adj3 test$).tw,kf.	39
31	(osom$ or alere$ or testpack$ or test-pack$ or bionexia$ or bio-nexia$ or biosynex$ or veritor$ or cobas$ or quikread$ or quik-read$ or NADAL$ or sofia$ or xpert$ or genexpert$ or clearview$ or binaxnow$ or qustick$ or qu-stick$ or quickvue$ or quick-vue$ or diaquick$).tw,kf.	13224
32	(abbott or bec?ton dickinson or biopanda or nal von minden or sekisui or orion diagnostica or roche or cepheid or biomerieux or Quidel or BHR pharmaceuticals or stanbio or sentinel diagnostics or dialab or alltest).tw,kf,in.	68312
33	(newfoundland or prima or rezure or gettested or vivatest or anbio or wondfo or vedalab or ecotest or self-diagnostics or home health or rapidity or cleartest).tw,kf,in.	34441
34	(31 or 32 or 33) and 14	324
35	29 or 30 or 34	425
Set combination		
36	28 or 35	1242
Community pharmacy		
37	Community Pharmacy Services/	6704
38	(communit* adj4 pharmac*).tw,kf.	13965

39	or/37-38	15989
40	(7 or 14 or 16) and 27 and 39	40
Final set & limits		
41	36 or 40	1252
42	limit 41 to english language	1075
43	exp animals/ not humans/	5443529
44	Disease Models, Animal/	452634
45	(baboon*1 or bovine*1 or canine*1 or chimpanzee*1 or cow*1 or dog*1 or feline*1 or goat*1 or hens or macque*1 or mice or monkey*1 or (mouse adj2 model*1) or murine*1 or ovine or pig*1 or porcine or (non-human adj2 primate*1) or sheep or rabbit*1 or rattus or rhesus or rodent*1 or zebrafish).ti.	1344863
46	or/43-45	5899218
47	42 not 46	1029
48	limit 47 to yr="2020 -Current"	258

Appendix 4 – Flow diagram outlining selection of relevant evidence sources



Appendix 5 – Flow diagram outlining selection of relevant evidence sources from the PPI literature search



Appendix 6 – Full sources of evidence and outcome data.

Table A1 – Included systematic reviews: design and characteristics

Review	Design	Eligibility criteria	Study characteristics	Outcome measures	Comments
Fraser et al. (2020)[1]	Systematic review and meta-analysis Searches up to: 19th March 2019	Inclusion: • People aged ≥ 5 years presenting with symptoms of an acute sore throat. • Point-of-care tests for strep A Exclusion: • People without acute sore throat. • People with existing comorbidities. • People with known invasive strep A infection.	17 point-of-care RADTs included • 22 full text primary studies and 3 abstracts investigating diagnostic accuracy for GAS (n=7,632) • 2 manufacturers' data (n=515 patients) • 2 FDA documents (n=1,532 patients) Reference standard: Microbiological culture from throat swab. 4 meta-analyses of primary studies: • BD Veritor Plus System: 2 studies (n=315) • OSOM Strep A Strip: 5 studies (n=987) • Alere Test Pack Plus Cassette: 10 studies (n=3,770) • QuikRead Go Strep A Kit: 2 studies (n=195) 13 RADTs not included in meta-analyses since data was only available from one primary study, from non-peer reviewed manufacturers' data or FDA documents. 12 studies were conducted in primary care, 14 in secondary care, 2 in primary and secondary, and one unknown. Data on countries was not included in the review. Studies were conducted in children and adults, but exact proportions unknown as not reported in about half the included studies. 2 studies conducted in participants with Centor score of 3 or more. Prevalence of GAS: 15.0% to 46.9%	Sensitivity and specificity for each RADT. Pooled subgroup analyses for RADT conducted in primary care and RADT in secondary care.	The review included 12 studies on the use of point-of-care RADT in practice and the impact on prescribing, but no comparative study was conducted in community pharmacies, so data has not been extracted for this re-assessment. Data on 4 point-of-care molecular tests were included in the review but are excluded from this re-assessment.

Abbreviations: FDA, Food and Drug Administration; GAS, group A beta-haemolytic streptococcus; RADT, rapid antigen diagnostic test

Notes: [1]This review was commissioned by the NIHR HTA Programme on behalf of NICE to provide the evidence for NICE HTG531 (previously DG38) (NICE 2019)

Table A2 – Observational studies with clinical outcomes: design and characteristics

Study reference	Methods, setting	Inclusion / exclusion criteria	Participants	Intervention(s)	Outcomes	Comments
Matuluko et al. (2025)	• Retrospective cross-sectional (ecological data linkage study) • England and Wales • Community pharmacies • Number of pharmacies: NR • 1 February to 30 July 2024	Inclusion: • STTT and ASTPF service users aged 5 yrs and older for the study period (anonymised data) Exclusion: • NR	STTT: • N: 27,684 • Clinical screening (n, %) FeverPAIN: 25,002 (90%) Centor: 2,682(10%) FeverPAIN score of 2 or 3 (n, %): 13,439 (53.8%) FeverPAIN score of 4 or 5 (n, %): 6,784 (27%) Centor score: NR Received RADT (n, %) by FeverPAIN score. • FeverPAIN 2 or more: 18,675 (74.5%) ASTPF • N: 317,864 Clinical screening FeverPAIN: 100% FeverPAIN score: NA	Intervention: • Consultation with STTT pharmacy. • STTT pharmacies screen people with suspected GAS with FeverPAIN or Centor clinical scoring systems. • If FeverPAIN 2 or 3, RADT considered if FeverPAIN 4 or 5 or Centor ≥3, RADT advised. • Antibiotics considered if RADT +ve. Comparator: • Consultation with ASTPF pharmacy. • ASTPF pharmacies screen people with suspected GAS with FeverPAIN scoring system. • Antibiotics considered if FeverPAIN ≥4.	Rates of antimicrobial prescribing	Anonymised individual level data from STTT compared with anonymised aggregated data from ASTPF. Data entry for STTT and ASTPF is completed during the consultation and linked to reimbursement, so data quality and completeness are high. There may be differences in unknown confounders such as illness severity, health status and levels of deprivation. Differences in skills between STTT pharmacies and ASTPF may exist. The STTT was introduced in stages, with an initial evaluated pilot in 56 community pharmacies, training of pharmacists and collaboration with GPs. The ASTPF was introduced nationally with no formal accreditation required to implement the service.
Mantzourani et al. (2025a)	• Retrospective longitudinal cohort • Wales • Community pharmacies	Inclusion: • People who consulted with the STTT in a community pharmacy or	• Total N: 62,578 (72,736 consultations) STTT • N: 6,024 (6,495 consultations)	Intervention: • Index consultation with STTT pharmacy. • STTT pharmacies screen people with suspected GAS with FeverPAIN or	Rates of antimicrobial prescribing: • At index date • Within 28 days of index date	Ecological study There are limitations in coding for sore-throat in primary care which may introduce inaccuracies in the data.

Study reference	Methods, setting	Inclusion / exclusion criteria	Participants	Intervention(s)	Outcomes	Comments
	from 2 health boards. • Number of pharmacies: NR • November 2018 to February 2020. • Follow-up for a maximum of 28 days after index consultation.	people who consulted with a HCP in a GP practice without any STTT record. • Welsh residents • Had continuous WLGP data coverage for at least 28 days before their index consultation. Exclusion: • People with a sore throat–related GP event or hospital admission in the 28 days prior to their first index event • Opted out from data sharing.	• Median (IQR) age at index consultation (all patients): 26 (16 to 39) yrs • Age categories (n, %) 6 to 14 yrs: 1,398 (22) 15 + yrs: 5,097 (79) • Sex (n, %) M: 2,043 (32); F: 4,416 (68) Index GP consultation • N: 56,554 (66,241 consultations) • Median (IQR) age at index consultation (all patients): 28 (16 to 48) yrs. • Age categories (n, %) 6 to 14 yrs: 13,358 (22) 15 + yrs: 51, 883 (78) Sex (n, %) M: 23,624 (36); F: 42,617 (64)	Centor clinical scoring systems. • If FeverPAIN 2 or 3, RADT considered if FeverPAIN 4 or 5 or Centor ≥3, RADT advised. • Antibiotics considered if RADT +ve. Comparator: • Index consultation at GP practices. • Tools used for diagnosis NR	Index STTT GP referrals Rates of GP re-consultation. In the STTT groups some participants had a GP consultation on the same day and it was not possible to distinguish which was the index consultation. Three scenarios were explored, from no index GP consultations were re-consultations to all index GP consultations were re-consultations. Hospital admission for quinsy.	There was no data available on FeverPAIN/Centor scores for people assessed in GP practices, making it impossible to account for differences in illness severity.
Mantzourani et al. (2022)	• Retrospective cross-sectional (ecological data linkage study) • Wales	Inclusion: • All STTT service users aged 6 yrs and older for the study periods. Exclusion:	Time 1 • N: 4,468 • Age: NR • Sex NR	Intervention (Time 1): • Pharmacies screen people with suspected GAS with FeverPAIN or Centor clinical scoring systems.	Rates of antimicrobial prescribing.	Ecological study. Requirement for an RADT was suspended during Covid-19 pandemic.

Study reference	Methods, setting	Inclusion / exclusion criteria	Participants	Intervention(s)	Outcomes	Comments
	• Community pharmacies from 2 health boards. • 56 pharmacies • Time 1: November 2018 to September 2019 • Time 2: November 2020 to end May 2021	NR	Time 2 • N: 199 • Age: NR • Sex: NR	• If FeverPAIN ≥2 or Centor ≥3, RADT advised. • Antibiotics considered if RADT +ve. Comparator (Time 2): • Pharmacies screen people with suspected GAS with FeverPAIN or Centor clinical scoring systems. • If FeverPAIN ≥2, RADT considered to support clinical decision making, with antibiotics considered if RADT +ve. If FeverPAIN ≥4 or Centor ≥3 consider RADT to support clinical decision making but consider antibiotics with or without RADT.		Data entry for STTT completed during the consultation and linked to reimbursement, so data quality and completeness are high. There may be differences between participants during time 1 and time 2 in unknown confounders such as illness severity, health status and levels of deprivation.

Abbreviations: +ve, positive; ASTPF, Acute Sore Throat Pharmacy First; F, female; GAS, group A beta-haemolytic streptococcus; GP, general practitioner; N, number; NR, not reported; M, male; RADT, rapid antigen detection test; STTT, Sore Throat Test and Treat; WLGP, Wales Longitudinal GP; yrs, years

Table A3 – Diagnostic accuracy studies: design and characteristics

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
Alhaddad et al. (2023)	• Prospective • Saudi Arabia • Secondary care: paediatric emergency department • Single centre • January to April 2020	Inclusion: • Aged 3–14- years. • Clinical diagnosis of pharyngotonsillitis and at least one of dysphagia, sore throat, or fever and at least one of pharynx or tonsil oedema or erythema, tonsillar exudate, or tender/or swollen anterior or lateral cervical lymph node. • Throat swab for the detection of GAS obtained. Exclusion: • Below 3 years and above 15 years. • Symptoms acute of rhinorrhoea, hoarseness of voice or conjunctivitis.	RADT: Sofia® Strep A + FIA (Quidel Corporation) McIsaac score calculated retrospectively, not used for selection. Swabs collected by nurse.	• N: 246 • Mean age: 7 yrs • Age categories (n, %) 3 to <7 yrs: 127 (51.6) 7 to <11 yrs: 84 (34.1) 11 to <15 yrs 35 (14.2) • Sex (n, %) M: 136 (55); F: 110 (45) • Prevalence GAS (n, %): 65 (26.4) • Clinical scoring (McIsaac) (n, %) 2: 84 (34.1) 3: 94 (38.2) 4: 48 (19.5) 5: 20 (8.1)	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection was based on well described clinical characteristics, but a formal clinical scoring system was not used. 23 participants had recently taken antibiotics Same swab used for RADT and streaking culture. RADT conducted in lab, not at point-of-care. Lab staff were blinded to results of the RADT.
Armitage et al. (2025)	• Prospective • The Gambia • Primary care: health centre • Single centre • June 2021 to September 2022	Inclusion: • Aged under 16 years • Complaining of sore throat in the presence of tonsillopharyngeal erythema. Exclusion: • Children under five were included if non-specific symptoms	RADT: SD Bioline Group A Streptococcal RADT lateral flow test swab (Abbott) Swabs collected by a nurse 5 clinical scores (Centor, FeverPAIN, McIsaac, Cape Town	• N: 376 • Median (IQR) age: 4 (2 to 6) • Age categories (n, %) 0 to 4 yrs: 256 (68·1) 5 to 11 yrs: 101 (26·9) 12 to 15 yrs: 19 (5·1) • Sex (n, %) M: 208 (55); F: 168 (45)	• Sensitivity • Specificity • PPV • NPV	Cases were selected consecutively. Participant selection was based on clinical characteristics, but a formal clinical scoring system was not used. NR if any participants had recently taken antibiotics.

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
		were accompanied by tonsillopharyngeal erythema.	and Smeesters) calculated retrospectively, not used for selection.	• Prevalence GAS (n, %): 37 (9.8) • Clinical scores calculated but not clearly reported.		Different swabs used for RADT and streaking culture. RADT conducted at point-of-care. NR if lab staff were blinded to results of the RADT.
Benboujida et al. (2025)	• Prospective • Belgium • Primary care: lab based study, samples from GPs and community health centres • Not reported • November to December 2025 (12 consecutive weekdays)	Inclusion: • All throat swabs prescribed for GAS testing and received by the lab from ambulatory patients. Exclusion: • NR	RADT: OSOM® Strep A Test (Sekisui Diagnostics) NR who collected swabs.	• N: 100 • Age: NR • Sex: NR • Prevalence GAS (n, %): 23 (23) • No clinical scoring	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection criteria NR. NR if any participants had recently taken antibiotics. Same swab used for RADT and streaking culture. RADT conducted in lab, not at point-of-care. NR if lab staff were blinded to results of the RADT
Bulut et al. (2026)	• Retrospective • Turkey • Secondary care: lab based study, samples from general paediatric clinics (1,241), emergency paediatric clinics (4,177) departments,	Inclusion • Throat samples with a preliminary diagnosis of acute tonsillopharyngitis. Exclusion • NR	RADT: Biogold Strep A Card test (Bioriver) NR who collected swabs	• N: 6188 • Age: NR • Sex: NR • Prevalence GAS (n, %): 1,062 (17%) • No clinical scoring	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection criteria NR. NR if any participants had recently taken antibiotics. Different swab used for RADT and streaking culture. RADT conducted in lab, not at point-of-care.

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
	adult clinics (770). • Not reported • January 2022 to May 2023					NR if lab staff were blinded to results of the RADT
Bulut et al. (2020)[3]	• Prospective • Turkey • Secondary care: lab based study, samples from general paediatric clinics (1,270), emergency paediatric clinics (8,006) and adult clinics (3,115) • Not reported • October 2017 to January 2019	Inclusion: • Throat swabs with the preliminary diagnoses of pharyngitis. Exclusion: • Samples sent for pre-employment examination, general medical examination and routine child health examination.	RADT: BD Veritor ™ System (Becton Dickinson and Company) NR who collected swabs.	• N: 12,391 • Mean (SD) age: 12.1 (10.7) (range: 1 to 80) yrs • Sex (n, %) M: 7,422 (60); F: 4,969 (40) • Prevalence GAS (n, %): 2,291 (18.5) • No clinical scoring	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection criteria NR. NR if any participants had recently taken antibiotics. Different swab used for RADT and streaking culture. NR if RADT conducted at point-of-care. NR if lab staff were blinded to results of the RADT
Gumus et al. (2019)[3]	• Unclear if prospective or retrospective • Turkey • Secondary care: paediatric inpatients • Single centre • January 2015 to March 2016	Inclusion: • Throat swabs from paediatric patients admitted as inpatients for acute tonsillopharyngitis. Exclusion • NR	RADT: Orient Gene Strep A rapid test kit (Zhuhai Encode Medical) NR who collected swabs.	• N: 250 • Mean age: 6.76 (range 1 to 18) yrs • Sex (n, %) M: 152 (60.8); F: 98 (39.2) • Prevalence GAS (n, %): 54 (21.6) • No clinical scoring	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participants selected based on diagnosis, no formal clinical scoring system used. NR if any participants had recently taken antibiotics. Same swab used for RADT and streaking culture. RADT conducted in lab, not at point-of-care.

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
						NR if lab staff were blinded to results of the RADT.
Kim et al. (2019)[3]	• Prospective • South Korea • Secondary care: outpatient clinic • Single centre • September to November 2015	Inclusion: • Aged 4–17 years • Suspected of having streptococcal pharyngitis (defined as the presence of a painful throat and evidence of inflammation of the throat or tonsils on physical examination). Exclusion: • Presented with symptom onset more than 7 days previously or who presented signs of viral respiratory infection.	Three RADTs: • careUS Strep A Plus (Wells bio) • SD Bioline Strep A (Standard Diagnostics/ Abbott) • BD Veritor ™ System (Becton Dickinson and Company) Swabs collected by two physicians.	• N: 255 • Median age: 9.6 (range, 4–17) yrs • Sex (n, %) M: 122 (54.2); F: 103 (45.8) • Prevalence GAS (n, %): 67 (26) • No clinical scoring	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection was based on clinical characteristics, but a formal clinical scoring system was not used. NR if any participants had recently taken antibiotics. Different swabs used for RADT and streaking culture. RADT conducted on stored lab samples not point-of-care . Lab staff were blinded to results of the RADT.
Sølvik et al. (2021)	• Prospective • Sweden • Primary care: health centres • QuickVue: 7 centres February to March 2015 • DIAQUICK: 4 centres February to April 2018	Inclusion: • Consecutive patients with severe symptoms of pharyngitis. • Fulfilled at least two of the Centor criteria. Exclusion: • Antibiotic treatment during the last 14 days.	Two RADTs: • QuickVue Dipstick Strep A test (Quidel) • DIAQUICK Strep A Blue Dipstick (Zafena) Swabs collected by assistant nurses and biomedical lab scientists.	QuickVue • N: 317 (culture 307) • Median age : 17 (range 0.67 to 86) yrs < 10 yrs (n, %): 106 (33) • Sex (n, %) M: 134 (43); F: 183 (57) • Prevalence GAS (n, %): 116 (38%) • DIAQUICK • N: 351 (culture 348) • Median age : 18 (0.67 to 88) yrs	• Sensitivity • Specificity • PPV • NPV	Cases were selected consecutively. Participants selected based on diagnosis and Centor score of ≥2. No participants had recently taken antibiotics. Different swabs used for RADT and streaking culture. RADT conducted at point-of-care. Lab staff were not blinded to results of the RADT.

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
				< 10 yrs (n,%): 129 (37%) • Sex (n, %) M: 154 (44); F: 197 (56) • Prevalence GAS (n, %): 105 (30%) Clinical scoring (Centor): NR		
Wi & Choi (2021)	• Retrospective • South Korea • Secondary care: setting NR • Single centre • July 2016 to September 2018	Inclusion: • Paediatric patients under the age of 15 years with RADT and microbiological culture. Exclusion: • Diagnosed with seasonal influenza. • Received antibiotics before these tests within 2 weeks • Had a comorbidity (congenital heart diseases, chronic lung diseases, or hemato–oncologic malignancy) regardless of the current medical condition	RADT: SD Bioline Strep A (Standard Diagnostics/Abbott) NR who collected swabs. McIsaac score calculated retrospectively, not used for selection.	• N: 377 • Median age: 3.5 (0.4 to 14.9) • Age categories (n, %) < 3 yrs: 171 (45.4) 3 to 14 yrs: 206 (54.6) • Sex (n, %) M: 197 (52.3); F: 180 (47.7) • Prevalence GAS (n, %): 34 (9.5) • Clinical scoring (McIsaac) (n, %) 1: 2 (0.5) 2: 11 (3.0) 3: 91 (24.1) 4: 91 (24.1) 5: 9 (2.4)	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection criteria NR. No participants had recently taken antibiotics. NR if same swab used for RADT and streaking culture. NR if RADT conducted at point-of-care. NR if lab staff were blinded to results of the RADT.
Zaki et al. (2021)	• Prospective • Malaysia • Primary care • Single centre • August 2018 to July 2019	Inclusion: • Aged between 3 and 15 years. • Presented with sore throat or inflamed pharynx or enlarged tonsils. Exclusion:	RADT: BIONEXIA® Strep A Plus (bioMérieux, Marcy-l'Étoile, France) NR who collected swabs.	• N: 110 • Age (n, %) < 7 yrs: 55 (50.0) 7 to 12 yrs: 41 (37.3) 12 to 15 yrs: 14 (12.7) • Sex (n, %) M: 66 (60); F: 44 (40)	• Sensitivity • Specificity • PPV • NPV	NR if cases were selected consecutively. Participant selection was based on clinical characteristics, but a formal clinical scoring system was not used.

Study reference	Methods, Setting	Inclusion/ Exclusion	Interventions[1]	Participants	Outcomes[2]	Comments
		• Refused throat swab to be taken. • Received antibiotic therapy in the previous two weeks.	McIsaac score calculated retrospectively, not used for selection.	• Prevalence GAS (n, %): 6 (5.5%) • Clinical scoring (McIsaac) NR		No participants had recently taken antibiotics. Same swab used for RADT and streaking culture. RADT conducted at point-of-care. NR if lab staff were blinded to results of the RADT.

Abbreviations: F, female; GAS, group A beta-haemolytic streptococcus; M, male; N, number; NPV, negative predictive value; NR, not reported; PPV, positive predictive value; RADT, rapid antigen detection test; yrs, years.

Notes:
[1]Microbiological culture used for reference standard in all studies; [2]NPV and PPV not extracted for RADTs not known to be used in Wales Sore Throat Test and Treat service; [3]Included in the previous appraisal (EAR020).

Table A4 – Design and characteristics of studies describing patient and public experiences

Study reference	Setting	Purpose	Study Design	Participant selection	Participants
Boiko et al. (2020)	• Two regions, one an urban metropolitan area and the other a town in rural England • General practices • Interviews conducted from February to December 2019	To investigate contemporary patient expectations and experiences of antibiotic prescribing in England.	Qualitative study using semi-structured interviews	Patients consulting their GP for infections were recruited via letter invitation.	• N: 31 • Age range: 20 to 99 yrs • Sex (n): M: 7; F: 24 Ethnicity (n): • White British: 25 • White Other: 3 • Black: 2 • Asian: 1 Setting (n): • Urban: 22 • Shire-town: 9
Clarke et al. (2025)	• South West England • Sixteen general practices • Recruitment between November 2022 and May 2024.	To explore patients' and parents' experiences using RM- POCTs for RTIs and their views on how RM- POCTs may influence treatment decisions, symptom management and their future consulting behaviours.	A qualitative study using semi-structured interviews.	Participants were recruited from a multicentre, individually randomised controlled efficacy trial evaluating the use of a multiplex RM- POCT for suspected RTIs in primary care. Patients aged ≥12 months who presented to primary care with a suspected RTI where antibiotics might be necessary were eligible.	Adult patients • N: 21 • Age range: 29 to 77 yrs • Sex (n): M: 10; F: 11 Ethnicity (n): • White British: 19 • Other white background: 1 • Indian: 1 Parents and carers Children • N: 9 • Age range: 1 to 15 yrs • Sex (n): M:4; F:5 Ethnicity (n): • White British: 6 • White Irish: 1 • Any other white background: 1 • White and Asian: 1
Courtenay et al (2017)	• Scotland, England and Wales • One Health Board; one Clinical Commissioning	To explore patients' expectations and experiences of nurse and pharmacist non-medical	Questionnaires and qualitative semi-structured interviews.	Patients presenting to non-medical prescribers with self-limiting respiratory tract infections at participating	• N: 22 • Age range: 25 to 65 yrs • Sex (n): M: 33; F: 55 • Ethnicity NR

Study reference	Setting	Purpose	Study Design	Participant selection	Participants
	Group and Primary Care respectively. • Data collection between August 2014 and November 2015.	prescriber-led management of respiratory tract infections		centres were recruited to complete a questionnaire	
Daniels et al (2024)	• England • Primary care settings in the towns of Seaton, Colyton and Axminster, in Devon. • Between December 2023 and February 2024	To evaluate the impact of point-of- care-testing on the management of acute sore throat in ambulatory patients presenting to primary care services	Online survey (response rate NR)	Patients presenting to the General Practice clinics with acute sore throat were recruited during clinical assessment	• N: 160 • Median age: 17 yrs (range 2 months to 86 yrs) • Sex (n, %): M: 57 (36%); F: 103 (64%)
Gilham et al (2025)	• England • National survey conducted by a market research organisation. • Data from interviews conducted in 2020, 2021, 2022 and 2024	To examine public knowledge and attitudes towards antibiotics in England pre and post Covid-19 pandemic	Repeated cross-sectional structured interviews conducted face-to-face (2020), via computer-aided telephone interviews (2021, 2022) and online (2024) as part of routine surveys across England.	Random location sampling method used to select sample points in each region and interviewer quotas then set for gender, age, working status and region.	N total • 8,385 • Age range: 15 to 65+ yrs, age bands approximately equally distributed at each year (14% to 23%) • Sex: Approximately M: 49%; F: 51% each year. • Ethnicity: Approximately 83% White each year. • SES: Approximately 55 to 60% ABC1 each year and 40% to 55% C2DE
Gilham et al. (2023)	• England • National survey conducted by a market research organisation. • Data from 2017 to 2019	To assess the impact of a national social marketing campaign for antimicrobial resistance on public awareness, attitudes, and behaviour, and as a supportive tool for healthcare professionals, England, 2017 to 2019.	Pre and post campaign surveys in 2017, 2018 and 2019. Interviews with adult members of the public were conducted using a Computer Assisted Web Interviewing approach.	The public samples collected at each campaign wave were weighted for the statistical analysis to ensure the samples were matched and nationally were representative on the demographic variables of age, sex region, and socioeconomic status.	Total across all time points • N: 6,002 • Mean age: 45 to 47 yrs • Sex (%): M: 45%; F: 55% Ethnicity (%): • British: 85% • Other white background: 6% • Asian: 4% • Black African and Caribbean: 1.%

Study reference	Setting	Purpose	Study Design	Participant selection	Participants
					• Other/Mixed: 3% Participants were evenly distributed between the four SES groups (AB to DE).
Mantzourani et al. (2025b)	• Wales • Community pharmacies delivering UTI service. • June 2024 to July 2025	To describe patient-reported experience with the pilot national community pharmacy-based UTI service, which includes a POCT, in Wales.	Online survey (unknown response rate)	Pharmacists invited all patients who had a UTI consultation at a pharmacy to take part in the survey.	• N: 309 Main age categories (n, %) • 18 to 24 yrs: 70 (23%) • 35 to 44 yrs: 63 (20%) • 45 to 54 yrs: 63 (20%) Sex, ethnicity, SES NR
Mantzourani et al (2021)	• Wales • Community pharmacies from 2 health boards. • 56 pharmacies • November 2018 to May 2019	To explore whether a pharmacist delivering consultation for sore throat that included clinical scoring and point-of-care testing was acceptable to patients, and how this might influence future health-seeking behaviour	Study specific cross-sectional survey including free text qualitative responses (18% response rate)	The patient experience survey was distributed to all patients who had completed a consultation between November 2018 and May 2019	• N: 510 Age categories (n, %) • 6 to 12 yrs: 71 (15%) • 13 to 18 yrs: 68 (14%) • 19 to 24 yrs: 73 (15%) • 25 to 34 yrs: 103 (21%) • 35 to 44 yrs: 61 (13%) • 45 to 54 yrs: 37 (8%) • 55 to 64 yrs: 40 (8%) • 65 + yrs: 31 (6%) Sex: M: 120 (29%); F: 289 (71%) Ethnicity, SES: NR
McNulty et al. (2022)	• England • Household survey conducted by market research organisation. • January to February 2020	To describe public attitudes and knowledge around antibiotic activity, resistance and use	Face- to- face household 18 question survey using computer-assisted data collection.	Two- stage random location sampling was used. Interviewers go door- to- door and invite people who are at home, and are over 15 years old, to participate.	• N: 2,022 Age categories (n, %) • 15 to 25 yrs: 406 • 25+ / unknown: 1,616 Sex: NR Ethnicity (n, %) • Black, Asian and minority ethnicity: 521 (30%) • White / unknown: 1,501 (70%) SES NR

Abbreviations: F, female; M, male: N, number; NR, not reported; POTC, point-of-care test; SES, socioeconomic status; UTI, urinary tract infection; yrs, years

Appendix 7 – Summary of rapid antigen detection tests measuring presence or absence of GAS, adapted and amended from NICE guidance (NICE 2019).

This list is not exhaustive.

Product (manufacturer)	Data source	Sensitivity	Specificity	Limit of detection	Time to result (minutes)	Results	Confirmation of negative result?
Known to be used in STTT services (minimum of 96% sensitivity and specificity from manufacturer's data)							
Alere Testpack Plus with OBC Strep A (Abbot)	Fraser et al. (2020)	85% (95% CI: 79% to 90%)	96% (95% CI: 94% to 98%)	Not known	5	Qualitative	Yes (if symptoms persist)
OSOM Strep A test (Sekisui diagnostics)	HTW meta-analysis	92% (95% CI: 87% to 95%)	95% (95% CI: 91% to 98%)	Not known	5	Qualitative	Yes
BD Veritor plus system group A Strep (Becton Dickinson)	HTW meta-analysis FDA (Fraser et al. 2020)	83% (95% CI: 67% to 92%) 97% (95% CI: 92% to 99%)	93% (95% CI: 83% to 97%) 96% (95% CI: 94% to 97%)	1×10^5 to 5×10^4 CFU/ml	5	Qualitative	Yes
NADAL Strep A / Strep A plus / Strep A scan test (nal von minden GmbH)	Fraser et al. (2020) Manufacturer's data	98% (95% CI: 91% to 100%)	98% (95% CI: 93% to 99%)	1.5×10^5 organisms/swab	5	Qualitative	No
Other rapid antigen detection tests							
Clearview exact Strep A dipstick (Abbott)	Fraser et al. (2020)	68% (95% CI: 55% to 81%)	95% (95% CI: 93% to 98%)	5×10^4 organisms/test	5	Qualitative	Yes
Strep A rapid test cassette (Biopanda reagents)	Fraser et al. (2020)	95% (95% CI: 89% to 98%)	98% (95% CI: 96% to 99%)	1E+05 organisms/swab	5	Qualitative	Yes
QuikRead Go Strep A test kit (Orion Diagnostica)	Fraser et al. (2020) Manufacturer's data	87% (95% CI: 78% to 95%) 83% (95% CI: 73% to 90%)	87% (95% CI: 78% to 95%) 97% (95% CI: 93% to 99%)	7×10^4 CFU/swab	Less than 4	Qualitative	Not known
Bionexia Strep A plus (Biomerieux)	Zaki et al. (2021)	100% (95% CI: 54% to 100%)	98% (95% CI: 93% to 100%)	Not known	5	Qualitative	Not known

Product (manufacturer)	Data source	Sensitivity	Specificity	Limit of detection	Time to result (minutes)	Results	Confirmation of negative result?
Bionexia Strep A dipstick (Biomerieux)	Fraser et al. (2020)	85% (95% CI: 74% to 92%)	91% (95% CI: 84% to 95%)	1×10^4 organisms/swab	5	Qualitative	Not know
Sofia Strep A FIA (Quidel)	Fraser et al. (2020) Alhaddad et al. (2023) FDA	85% (95% CI: 81% to 89%) 94% (95% CI: 85% to 98%) 91% (95% CI: 84% to 95%)	95% (95% CI:.93% to 97%) 83% (95% CI: 77% to 88%) 96% (95% CI: 94% to 97%)	1.86×10^4 to 9.24×103 CFU/test	5 to 6	Qualitative	Yes
QuickVue DipStick Strep A test (Quidel)	Sølvik et al. (2021)	92% (95% CI: 87% to 96%)	86% (95% CI: 81% to 90%)	Not known	5	Qualitative	Not known
DIAQUICK Strep A Blue Dipstick (DIALAB GmbH)	Sølvik et al. (2021)	72% (95% CI: 65% to 79%)	98% (95% CI: 96% to 99%)	Not known	5 to 10	Qualitative	Not known
SD Bioline Strep A (Standard diagnostics/Abbott)	Armitage et al. (2025) Kim et al. (2019) Wi & Choi (2021) Manufacturer's data (website)	84% 72% (95% CI: 59% to 82%) 75% (95% CI: 58% to 88%) 87.3%	74% 95% (95% CI: 90% to 98%) 97.9% (95% CI: 96% to 9%) 95.8%	Not known	5 to 10	Qualitative	Yes
Orient Gene Strep A (Zhuhai Encode Medic)	Gumus et al. (2019)	85%	98%	Not known	Not known	Qualitative	Not known
careUS Strep A plus (Wells bio)	Kim et al. (2019)	93% (95% CI: 83% to 96%)	97.% (95% CI: 93% to 99%)	Not known	5 to 15	Qualitative	Not known
Biogold Strep A Card test (Bioriver)	Bulut et al. (2026)	76%	76%	Not known	5	Qualitative	Not known

Abbreviations: CI, confidence interval; FDA, Food and Drug Administration

Appendix 8 – Meta-analyses of clinical outcomes

Updated meta-analyses conducted by HTW only. For results for other tests, including pooled analyses from the existing literature, refer to Table 5.

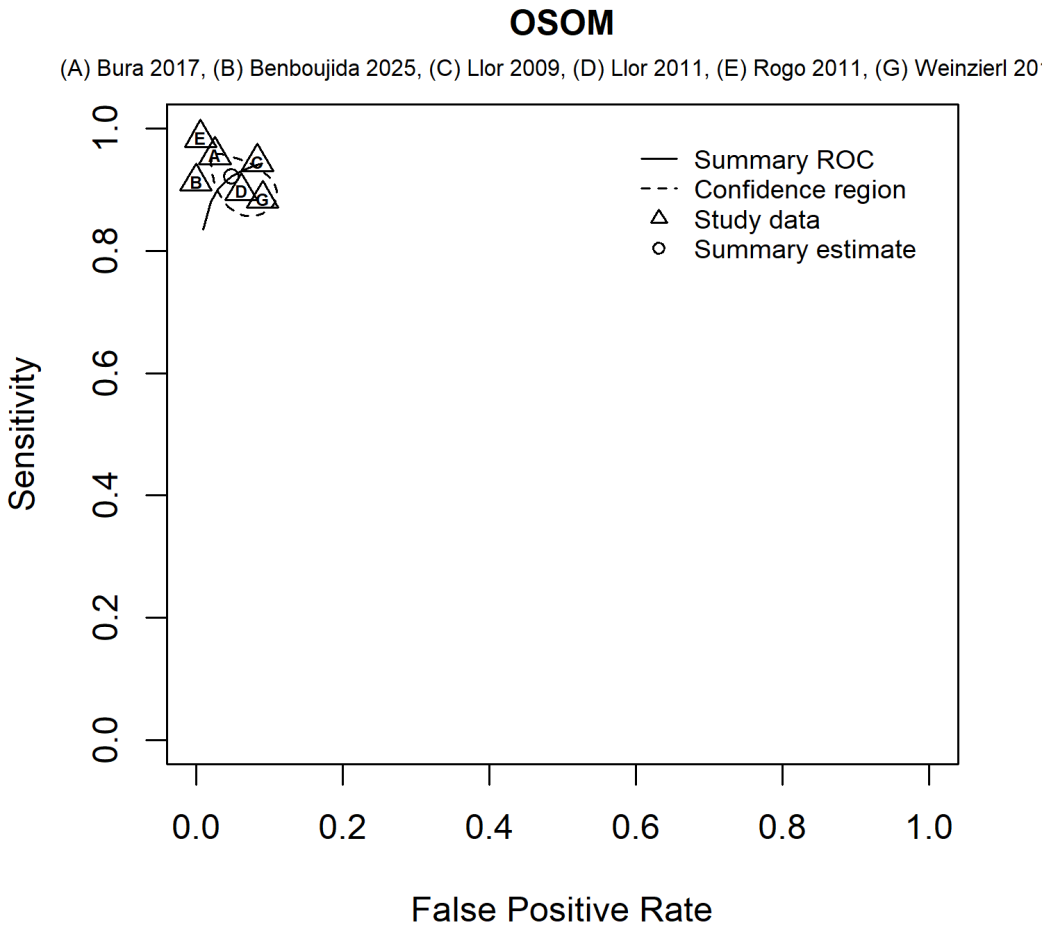


Figure 1 – Summary ROC curve and summary sensitivity and specificity estimates for OSOM Strep A Test

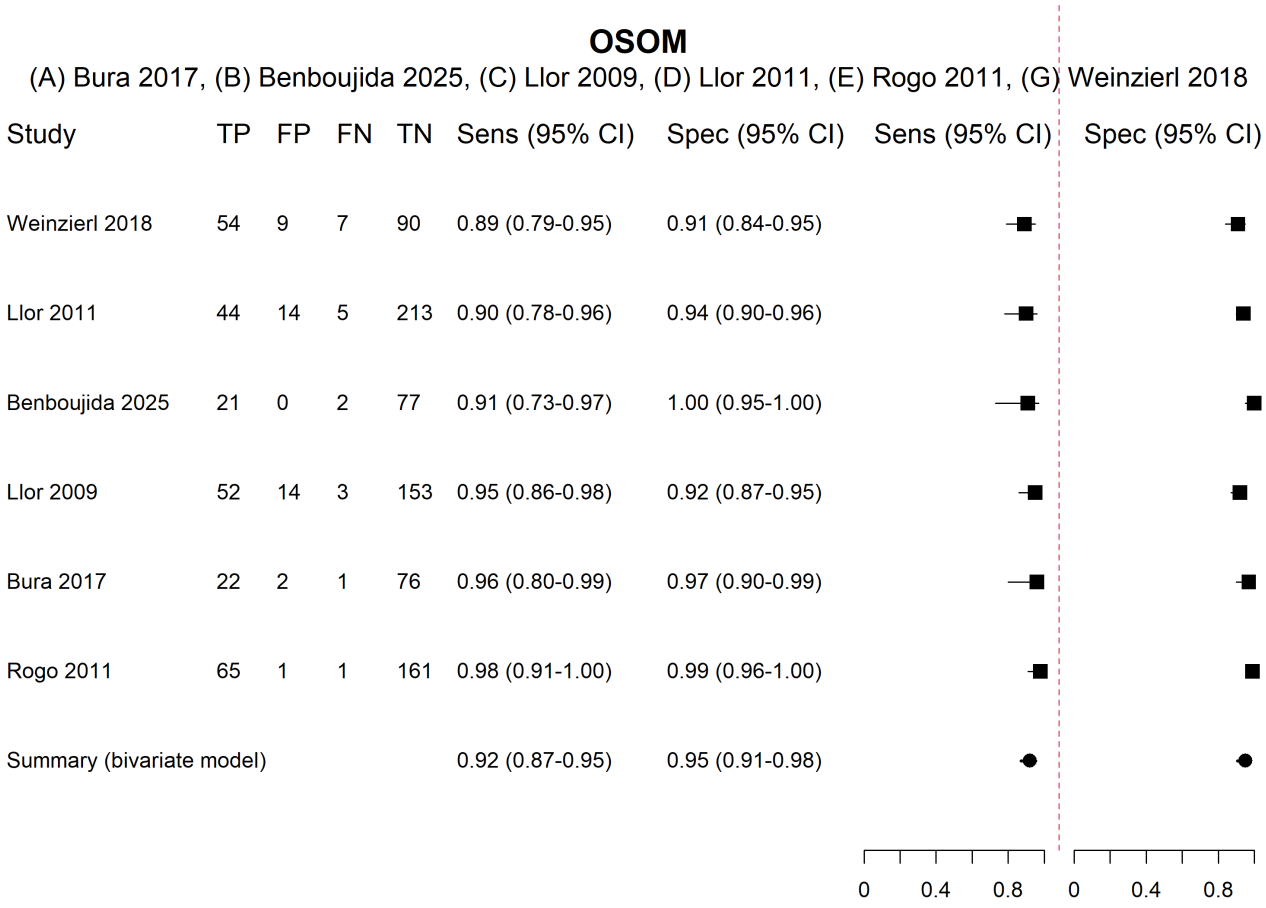


Figure 2 – Sensitivity and specificity, pooled and individual study values

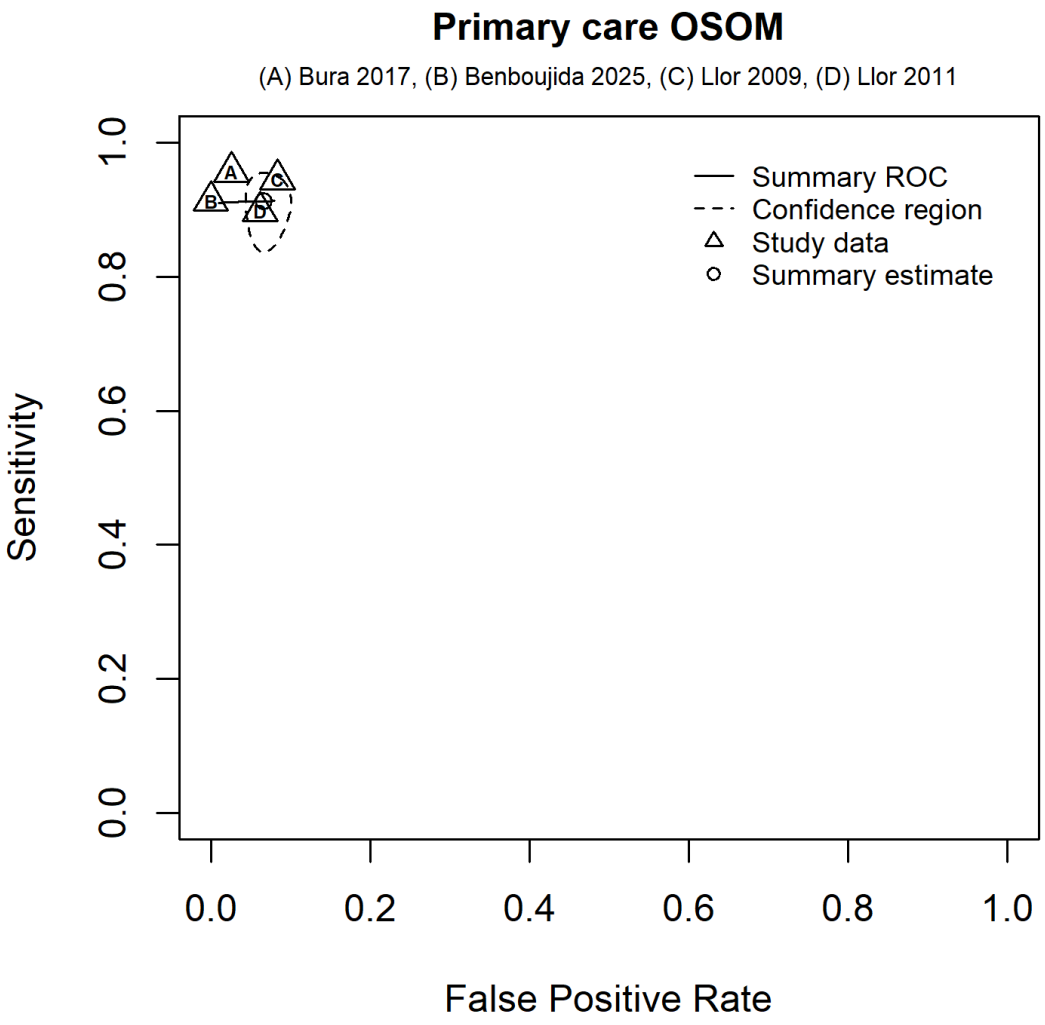


Figure 3 – Summary ROC curve and summary sensitivity and specificity estimates for OSOM Strep A test: studies in primary care only

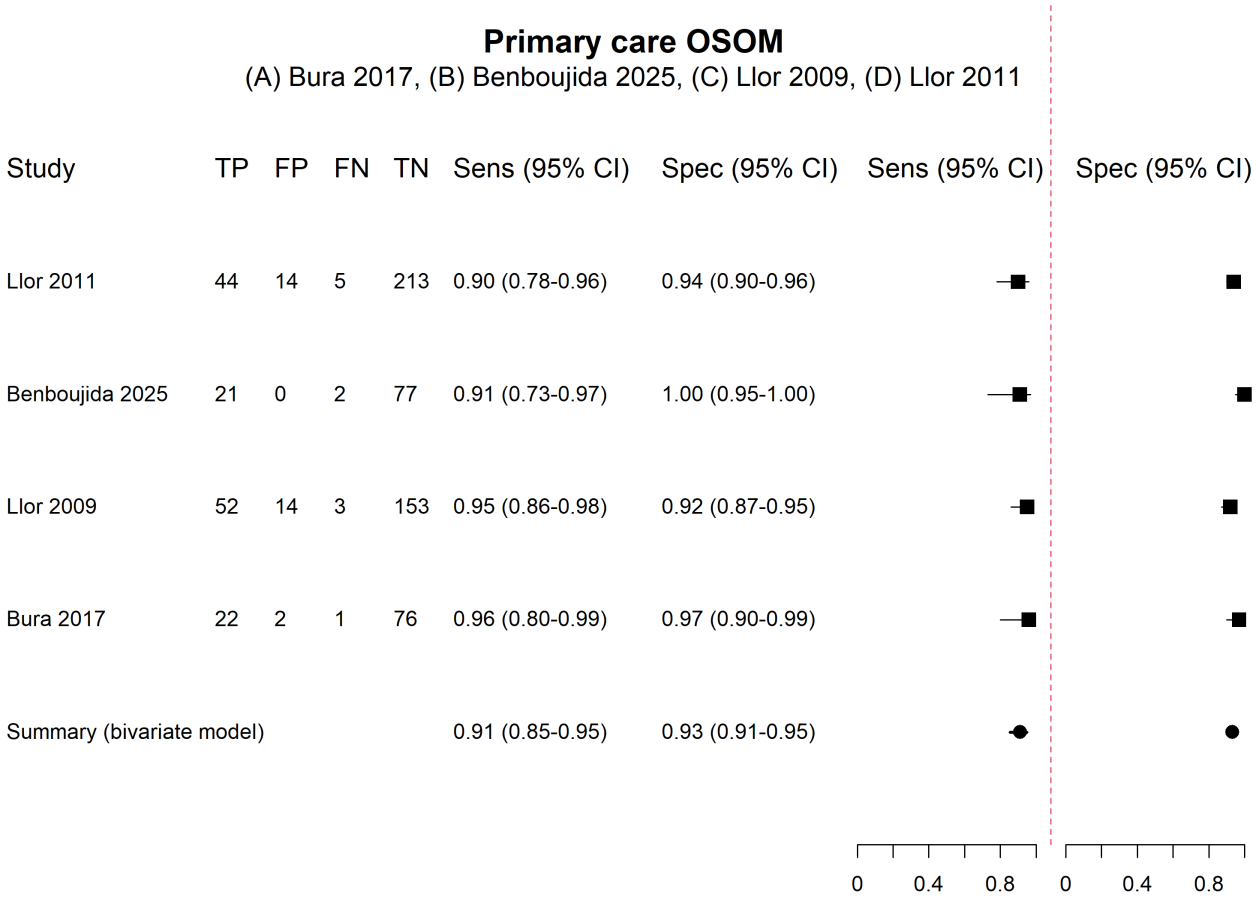


Figure 4 – Sensitivity and specificity, pooled and individual study values for OSOM Strep A test: studies in primary care only

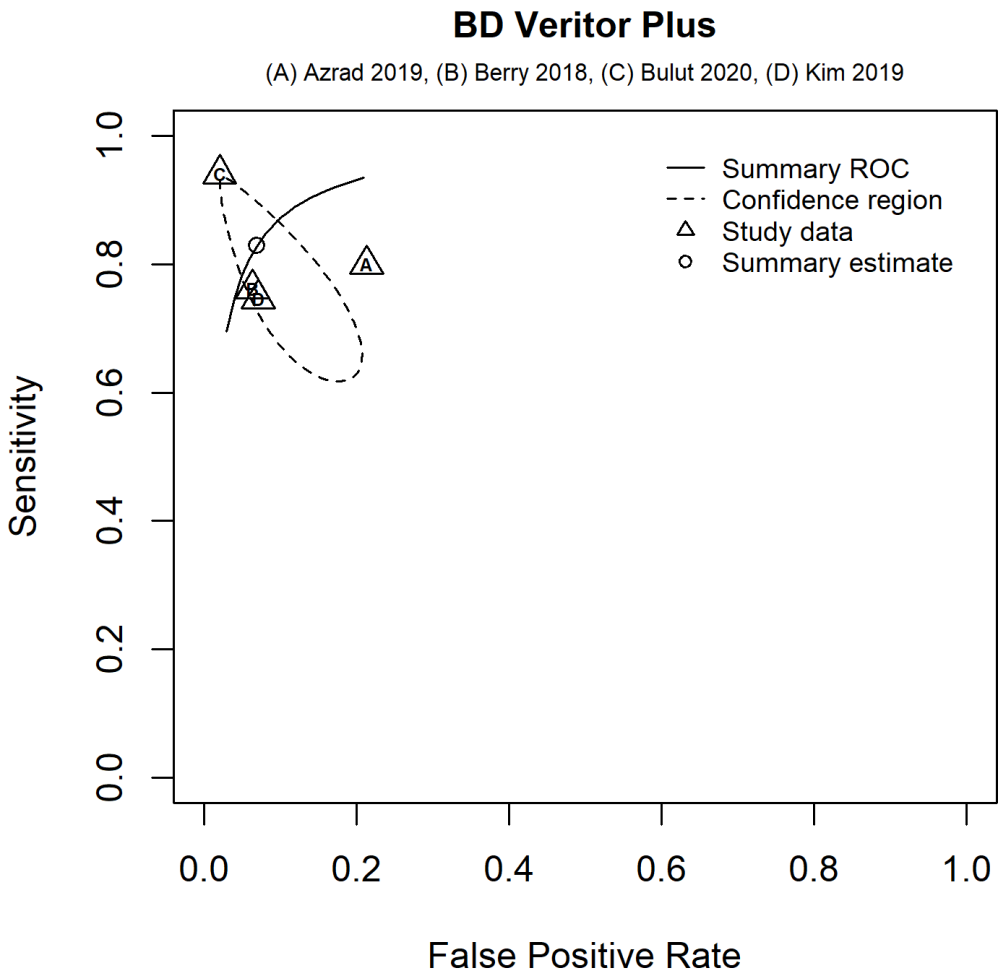


Figure 5 – Summary ROC curve and summary sensitivity and specificity estimates for BD Veritor Plus System for Group A Strep

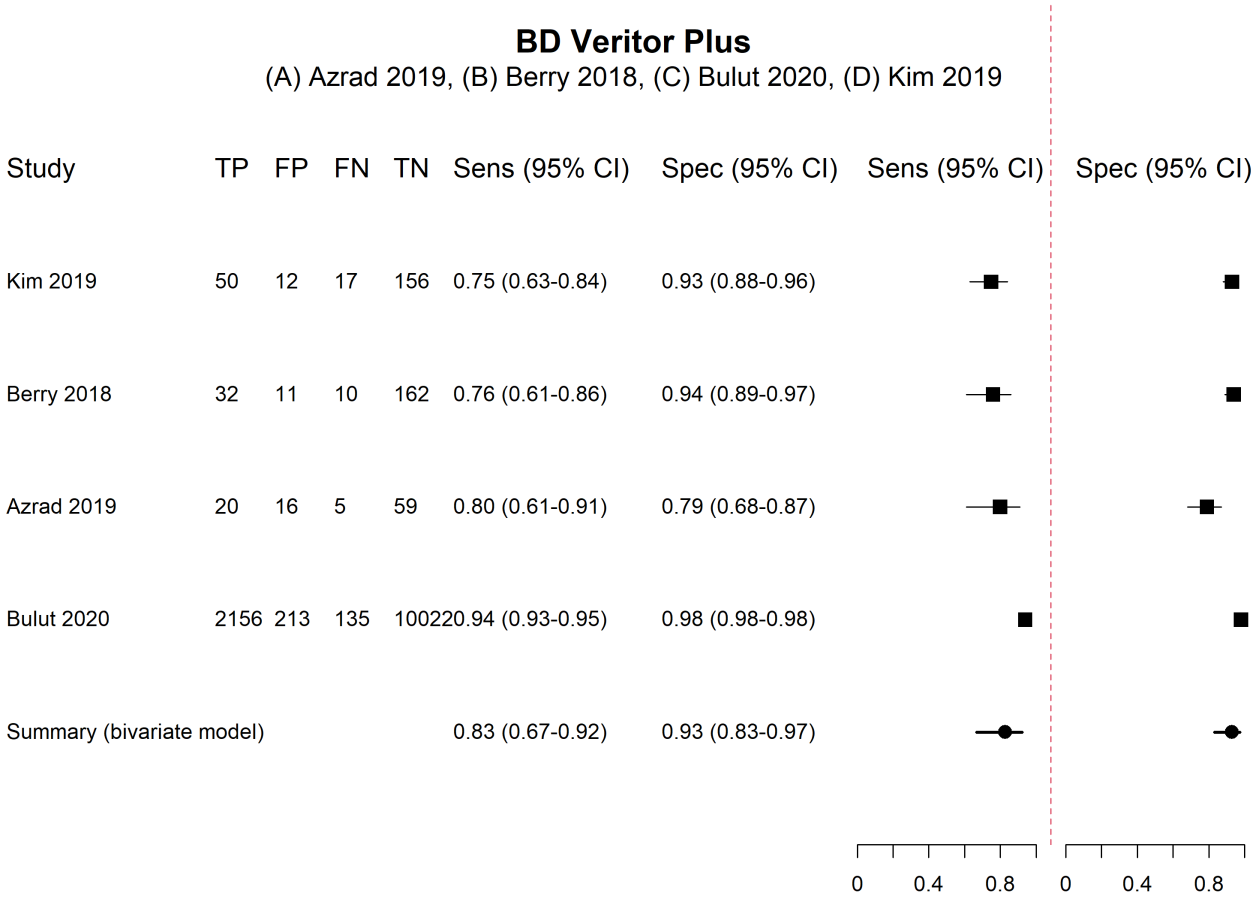


Figure 6 – Sensitivity and specificity, pooled and individual study values for BD Veritor Plus System for Group A Strep

Appendix 9 – HTW cost utility analysis (2020)

1. Background and objective

An economic analysis was developed to estimate the cost effectiveness of using rapid antigen detection tests (RADTs) as part of a pharmacy test-and-treat service for suspected group A streptococcal (GAS) infection in comparison to standard general practitioner (GP) assessment.

The economic analysis was based largely on an economic analysis conducted as part of NICE Diagnostic Guidance 38 (NICE DG38) on 'Rapid tests for group A streptococcal infections in people with a sore throat' (NICE 2019). The NICE analysis considered the use of RADTs in primary and secondary care settings. The analysis was adapted to reflect the use of RADTs as part of an assessment in the community pharmacy setting.

Minor updates to this analysis have been made following the original publication.

2. Methods

2.1 Model structure

A decision tree analysis was developed using Microsoft Excel to compare the cost effectiveness of diagnostic strategies for suspected group A streptococcal infection. The analysis took the perspective of the UK NHS and personal social services (PSS). A time horizon of one year was considered, reflecting the maximum period over which outcomes are likely to differ between the strategies. Discounting of future costs and benefits was not considered due to the short time horizon.

A simplified version of the decision tree is shown in Figure 7 and the two strategies considered in the analysis are briefly described below:

1. Pharmacist test-and-treat service using RADT

   Pharmacist undertakes initial assessment using FeverPain or Centor risk score. If risk score is sufficiently high (Centor score $\geq$ 3 or FeverPAIN score $\geq$ 1), then assessment with RADT will be offered. Patients with a positive RADT result will be offered antibiotics. Patients with a negative RADT result or patients with a clinical risk score below the threshold for testing will not be offered antibiotics. Patients not offered antibiotics are advised to return for re-assessment if symptoms persist or seek medical attention sooner if symptoms worsen rapidly or significantly. Re-assessment at repeat consultations were included in the analysis and were assumed to follow the same system as the original consultation.

2. Standard GP assessment

   GP undertakes initial assessment using FeverPain or Centor risk score. If risk score is sufficiently high (Centor score $\geq$ 3 or FeverPAIN score $\geq$ 4), then patients will be offered antibiotics. Patients with a clinical risk score below the threshold for immediate antibiotic prescription will either not be offered antibiotics or will be offered a delayed prescription of antibiotics to collect after three to five days if symptoms don't improve.

   Some further considerations were incorporated in the analysis based on outcomes from a recent pilot of a pharmacist test-and-treat service using RADT in Wales (Mantzourani et al. 2020). Mantzourani et al. (2020) showed that pharmacists sometimes made judgement calls whereby they would decide to offer RADT even in situations where it is not indicated based on the clinical risk score assessment. In addition, pharmacists referred some patients to see their GP if they were concerned about another condition or if RADT was indicated but it was

not possible to complete. The model structure was adapted to allow for these real-world complexities to be incorporated. The probability of these events occurring are described in the clinical data section below.

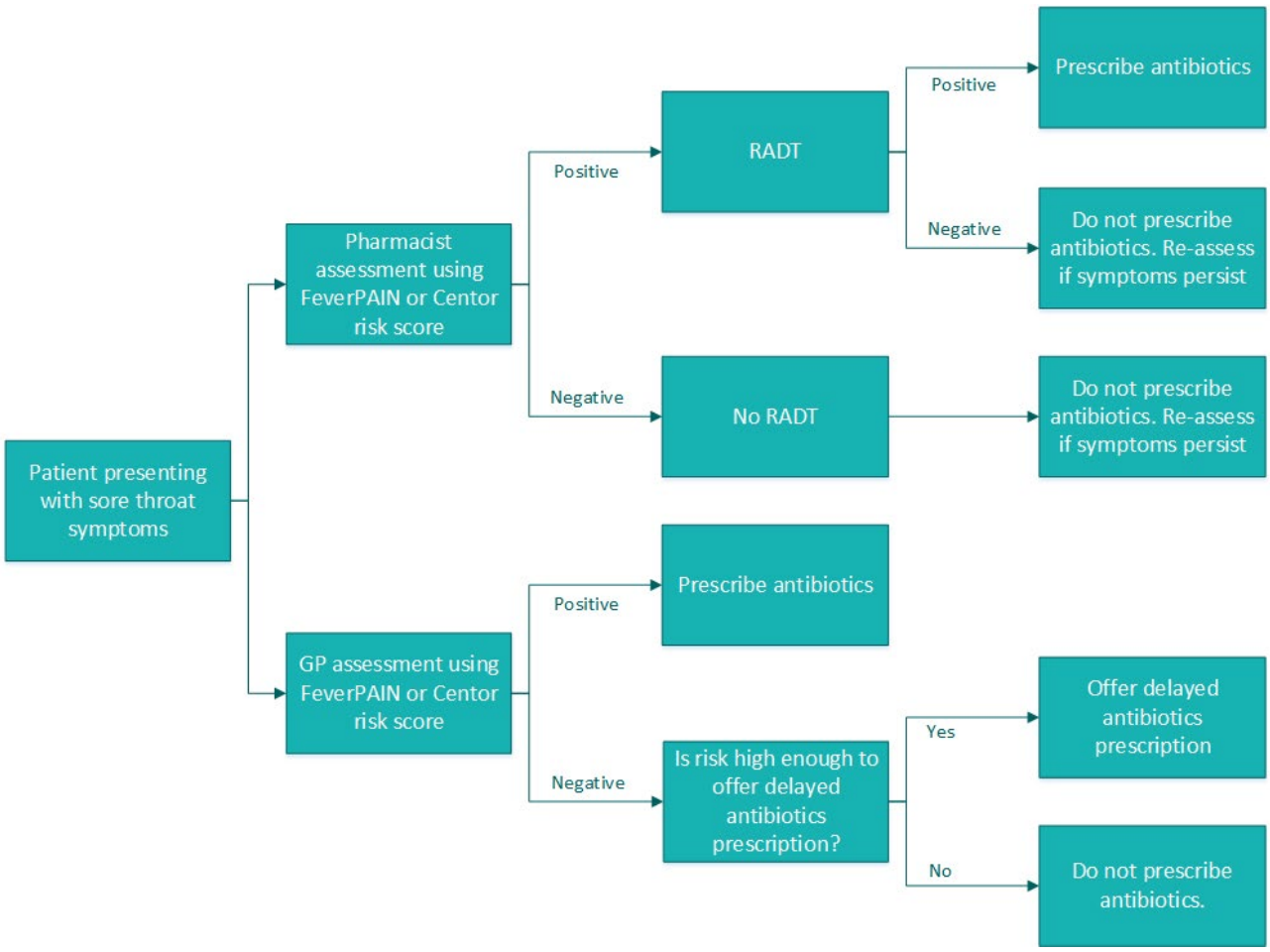


Figure 7 – Modelled decision tree

2.2 Clinical data

2.2.1 Prevalence and accuracy data

The prevalence of group A streptococcal infection in patients presenting with a sore throat was estimated to be 22.8% for adults and 30.2% for children. These estimates were sourced from the economic analysis conducted as part of NICE DG38 (NICE 2019). NICE derived the estimate of 22.8% for adults from Little et al. (2013), which reported 136 cases of group A streptococcal infection amongst 597 patients aged ≥ 5 years old presenting in UK primary care settings. NICE reported that there were no clear UK estimates for prevalence in children and instead estimated a median value of 30.2% from three non-UK studies of children in primary care.

The diagnostic accuracy of GP or pharmacist assessment using a clinical risk score was estimated using the accuracy of the Centor risk score presented in NICE DG38, based on meta-analysis of 12 studies reported by Aalbers et al. (2011). Table A4 shows estimates of the diagnostic accuracy of the Centor risk score for GAS infection at various threshold levels.

Table A5 – Diagnostic accuracy of Centor risk score for GAS infection

Threshold for infection	Sensitivity	Specificity	Source
Centor score ≥ 1	95%	18%	Aalbers et al. (2011)
Centor score ≥ 2	79%	55%	Aalbers et al. (2011)
Centor score ≥ 3	49%	82%	Aalbers et al. (2011)
Centor score = 4	18%	95%	Aalbers et al. (2011)

In the base case analysis, it was assumed that a Centor score threshold of 3 would be used to guide decision making. When used as part of a pharmacy assessment, patients with a Centor score ≥ 3 would be offered RADT testing whereas those with a Centor score < 3 would not be offered antibiotics. When used as part of a GP assessment, patients with a Centor score ≥ 3 would be offered antibiotics, whereas those with a Centor score < 3 would either not be offered antibiotics or be offered a delayed antibiotics prescription. Using a Centor score ≥ 3 as the threshold for infection results in a sensitivity of 49% and a specificity of 82%. Alternative Centor score thresholds were considered in sensitivity analysis.

Note that FeverPAIN could not be considered in the analysis because there are no data available in a format suitable for utilisation in the economic model (i.e. sensitivity and specificity based on FeverPAIN thresholds).

No data were available on the diagnostic accuracy of RADT when undertaken by community pharmacists. Therefore, diagnostic accuracy was sourced from data on the use of RADT in primary or secondary care under the assumption that pharmacists would be able to carry out the RADT testing with the same level of effectiveness as a physician.

The diagnostic accuracy of RADT was estimated based on accuracy data presented for a range of RADTs in NICE DG38 (NICE 2019). Average sensitivity and specificity were estimated for the adult and child population based on accuracy estimates presented in NICE DG38. Estimates were only included in the calculation of the average if they were based on published, peer-reviewed, studies (the NICE report also included accuracy data from abstracts as well as manufacturer submitted data, but these have been excluded from the calculation). An average sensitivity of 84% and specificity of 92% was estimated for the adult population, while an average sensitivity of 80% and specificity of 95% was estimated for the child population.

Table A5 and Table A6 show the diagnostic accuracy data of RADTs for the adult and child population, respectively.

Table A6 – Diagnostic accuracy of RADT for GAS infection in adults

Population	Sensitivity (95% CI)	Specificity (95% CI)	Source
Clearview extract strep A cassette (Abbott)	68% (54% to 80%)	95% (92% to 97%)	1 study included in NICE DG38
Clearview extract strep A dipstick - test strip (Abbott)	68% (54% to 80%)	95% (92% to 97%)	1 study included in NICE DG38
BD Veritor Plus system group A strep Assay cassette (Becton Dickinson)	78% (67% to 87%)	90% (86% to 93%)	2 studies included in NICE DG38
OSOM Strep A test - test strip (Sekisui diagnostics)	92% (76% to 98%)	96% (89% to 99%)	3 studies included in NICE DG38

Population	Sensitivity (95% CI)	Specificity (95% CI)	Source
QuikRead Go Strep A test kit (Oriom Diagnostica)	100% (85% to 100%)	79% (60% to 92%)	1 study included in NICE DG38
Alere TestPack Plys Strep A - cassette (Abbott)	95% (89% to 98%)	94% (88% to 98%)	1 study included in NICE DG38
Sofia Strep A FIA (Quidel)	85% (81% to 89%)	95% (93% to 97%)	1 study included in NICE DG38
Average	**84%**	**92%**	

Note: NICE DG38 includes diagnostic accuracy data for additional tests but these have been excluded from the table as they were based on data submitted by the manufacturer or data from abstracts

Abbreviations: CI: confidence interval; DG: diagnostics guidance: NICE: National Institute for Health and Care Excellence

Table A7 – Diagnostic accuracy of RADT for GAS infection in children

Population	Sensitivity (95% CI)	Specificity (95% CI)	Source
Clearview extract strep A cassette (Abbott)	68% (54% to 80%)	95% (92% to 73%)	1 study included in NICE DG38
Clearview extract strep A dipstick - test strip (Abbott)	68% (54% to 80%)	95% (92% to 97%)	1 study included in NICE DG38
BD Veritor Plus system group A strep Assay cassette (Becton Dickinson)	76% (61% to 88%)	94% (89% to 97%)	1 study included in NICE DG38
OSOM Strep A test - test strip (Sekisui diagnostics)	94% (89% to 98%)	95% (91% to 98%)	1 study included in NICE DG38
QuikRead Go Strep A test kit (Oriom Diagnostica)	80% (56% to 94%)	91% (72% to 99%)	1 study included in NICE DG38
Alere TestPack Plys Strep A - cassette (Abbott)	86% (79% to 91%)	99% (97% to 100%)	1 study included in NICE DG38
Sofia Strep A FIA (Quidel)	85% (81% to 89%)	95% (93% to 97%)	1 study included in NICE DG38
Average	**80%**	**95%**	

Note: NICE DG38 includes diagnostic accuracy data for additional tests but these have been excluded from the table as they were based on data submitted by the manufacturer or data from abstracts

Abbreviations: CI: confidence interval; DG: diagnostics guidance: NICE: National Institute for Health and Care Excellence

While the base case analysis uses average accuracy data across all RADTs, alternative estimates were applied in the sensitivity analysis. This includes a scenario based on accuracy data for the OSOM Strep A test, which is known to be the test used in the recent pilot of a pharmacist test-and treat service using RADT in Wales (Mantzourani et al. 2020).

2.2.2 Delayed prescription and repeat consultations

Some patients undergoing standard assessment via GP consultations were assumed to be offered a delayed prescription of antibiotics. This is an option for patients with a Centor score below the threshold for antibiotic prescription (< 3 in the base case). The proportion of patients that are offered a delayed prescription as well as prescription use was estimated from NICE DG38

(NICE 2019). NICE DG38 estimated proportions based upon prescribing behaviour of GPs reported in the PRISM trial.

The probability of a delayed prescription given a negative clinical score was estimated to be 51.1%, based on 91 out of the 178 patients with a FeverPAIN score < 4 in the in the clinical score arm of the PRISM trial that were offered a delayed prescription (under the assumption that a Centor score < 3 is equivalent to a FeverPAIN score < 4). Of those offered a delayed antibiotic prescription, 45.7% were assumed to use it based on PRISM data showing that 75 out of 164 patients offered a delayed antibiotic prescription went on to use it.

Some of the patients in whom RADT wasn't indicated following pharmacist assessment using a clinical risk tool were assumed to have a re-assessment due to the persistence of symptoms. The proportion of patients that might have a re-assessment was estimated using data on delayed antibiotic prescription in combination with the proportion that go on to use it. This was considered to be a reasonable approximation under the assumption that those that go on to use the prescription were likely to have had persistent symptoms. Therefore, 23.4% of patients that did not require a RADT were assumed to have a re-assessment (estimated as 0.511 multiplied by 0.457).

Similarly, some patients with a negative RADT result were assumed to have a re-assessment due to the persistence of symptoms. The proportion of patients that might have a re-assessment in this case was estimated in a similar manner to the above, except that a different estimate for delayed antibiotic prescription was applied. In the economic analysis conducted as part of NICE DG38, it was estimated that 27.6% of patients with a negative RADT result receive a delayed antibiotic prescription (based on 48 out of 174 patients offered a delayed prescription following a positive clinical score in the PRISM trial). This value was used in combination with the proportion of patients offered a delayed antibiotic prescription that go on to use it (45.7%). Therefore, 12.6% of patients with a negative RADT were assumed to have a re-assessment (estimated as 0.276 multiplied by 0.457).

2.2.3 Clinical judgement and further GP contact

As noted above, some real-world considerations were incorporated in the analysis based on outcomes from a recent pilot of a pharmacist test-and-treat service using RADT in Wales (NICE 2019). It was assumed that RADT would be offered to 10.8% of patients with a Centor score < 3. This was based on evidence from Mantzourani et al. (2020), which showed that pharmacists made a judgement call to offer RADT to 59 of the 545 people (10.8%) in whom RADT was not indicated based on the clinical risk score assessment and/or a direct request by a GP.

In addition, it was assumed that pharmacists would refer 9.7% of people to see their GP. This was based on evidence from Mantzourani et al. (2020), which showed that pharmacists referred 167 of 1,725 patients to GPs (9.7%). A further three patients were referred by pharmacists to dentists, but this was not incorporated in the analysis as it may reflect a referral for a complication (such as an abscess) and this is already incorporated in the analysis. Therefore, it was not included to avoid the risk of doubling counting the cost of a complication.

Further GP contact following the pharmacist assessment was also incorporated in the analysis based on evidence from Mantzourani et al. (2020). It was assumed that 2.6% of patients with a negative RADT and 8.3% of patients with a positive RADT would have a GP consultation, based on a reported 23 out of the 889 people with a negative RADT and 29 out of the 350 people with a positive RADT that went on to see their GP in Mantzourani et al. (2020). It was further assumed that 2.9% of patients that did not undergo a RADT assessment would have a GP consultation,

based on a reported 14 out of the 486 people that did not require a RADT that went on to see their GP in Mantzourani et al. (2020).

2.2.4 Complications

Complications relating to GAS infection were incorporated in the analysis using estimates applied in the economic analysis conducted as part of NICE DG38. The NICE analysis based the complication estimates on data presented in Little et al. (2013), a large cohort study of UK patients presenting in primary care with sore throat. The probability of complications for patients with a treated infection was estimated to be 1.3%, based on 78 complications reported among 5,932 treated patients. The probability of complications for patients with an untreated infection was estimated to be 1.5%, based on 75 complications reported among 4,974 untreated patients.

Little et al. (2013) did not report rates for rare non-suppurative complications such as acute rheumatic fever. Therefore, in-line with an assumption made by the NICE analyst, it was assumed that only 0.01% of complications would be non-suppurative.

The probability of penicillin-induced complications was also based on estimates applied in the economic analysis conducted as part of NICE DG38 as well as a previous economic evaluation of diagnostic and treatment strategies for adults with streptococcal pharyngitis (Neuner et al. 2003). It was therefore assumed that 2% of patients prescribed antibiotics will develop penicillin-induced rash and 0.01% will develop penicillin-induced anaphylaxis or sepsis.

The complication rates applied in the analysis are presented in Table A7.

Table A8 – Complication rates

Complication	Probability	Source
Complications relating to GAS infection		
Probability of complications with treated infection	1.3%	Little et al. (2013)
Probability of complications with untreated infection	1.5%	Little et al. (2013)
Proportion of complications that are non-suppurative	0.01%	Assumption made in NICE (2019)
Penicillin-induced complication		
Probability of developing rash	2%	Neuner et al. (2003)
Probability of anaphylaxis or sepsis	0.01%	Neuner et al. (2003)

2.3 Costs

The costs considered in the model reflect the perspective of the analysis, thus only costs that are relevant to the UK NHS & PSS were included. Where possible, all costs were estimated in 2019 prices.

2.3.1 Consultation costs

The cost of a GP consultation was sourced from unit costs estimates from the Personal Social Services Research Unit (PSSRU). The PSSRU reports that a typical GP consultation lasting 9.22 minutes costs £39.23 (including direct care staff costs and qualification costs).

The cost of a consultation at a community pharmacy test-and-treat service using RADT was estimated based upon the fee listed within the service specification for the Community Pharmacy Sore Throat Test-and-Treat (STTT) Service. The report specifies that an activity payment of £135.83 will be made for every 10 patients managed using the STTT service. For simplicity, this was converted into a per-patient fee for use in the economic analysis (equal to £13.58 per patient).

The service specification states that this fee will be charged in addition to any reimbursement for the cost of any medication prescribed (described in treatment cost section below) as well as the cost of equipment and consumables. Therefore, the cost of equipment and consumables used as part of all consultations (£0.89) was incorporated based on estimates provided by the lead researcher involved in the recent pilot of the pharmacy test and treat service using RADT in Wales (Mantzourani et al. 2020).

2.3.2 Investigation costs

The cost of RADT was estimated based on costs presented in NICE DG38. NICE (2019) presented costs for a range of RADTs from different manufacturers, with costs ranging from £0.64 for the Biopanda's Strep A rapid test strip to £4.34 for QuikRead Go Strep A test kit supplied by Oriom Diagnostica. Test cost estimates were primarily based on costs submitted by the respective manufacturer. The list of NICE costs was supplemented with data provided by the lead researcher involved in the pilot of the pharmacy test and treat service using RADT in Wales (Mantzourani et al. 2020). This data showed that the cost of the test used in the service (OSOM Strep A test) was £1.80 per test.

For the purpose of the base case analysis, an average cost per test was estimated based on all of the RADT cost data in NICE DG38 as well as the cost of the OSOM Strep A test. The resulting average cost per test was £1.86. The cost of additional equipment required to undertake the test, such as the cost of a tongue depressor and disposable apron, was estimated to be £0.27 based on data provided by the lead researcher involved in the pilot of the pharmacy test-and-treat service using RADT in Wales. Thus, the total cost for the test and associated equipment was estimated to be £2.13. Alternative cost estimates were applied in sensitivity analysis, including a scenario where the cost estimate is based only upon OSOM Strep A (in which case, the total cost was £2.07).

The cost of a confirmatory swab culture for patients with a negative RADT result was estimated in-line with NICE DG38. A cost of £7.58 was applied based on the cost associated with microbiology in NHS Reference costs 2018/19.

2.3.3 Treatment costs

The cost associated with the prescription of antibiotics was estimated using costs from the British National Formulary (BNF). It was assumed that a ten-day, four-times-daily course of phenoxymethylpenicillin 250mg or 500mg would be prescribed. The cost of the regimen was estimated based upon a drug tariff price of £1.28 for a 28 pack, which resulted in a cost of £1.83 for the 250mg dose and £3.66 for the 500mg dose. An average of the two regimens was calculated, resulting in an estimated cost of £2.74.

The cost associated with the prescription of paracetamol was also estimated using costs from the BNF. It was assumed that a 32-tablet pack of paracetamol 500mg would be prescribed at a cost of £1.06 (based on drug tariff price listed in the BNF). This is in-line with the assumption made in the economic analysis conducted in NICE DG38.

2.3.4 Complication costs

The cost of managing complications relating to GAS infection were incorporated based on sources and assumptions made in NICE DG38 (NICE 2019). The cost of treating group A streptococcal infection related abscess was estimated at £1,913 based on the cost of a tonsillectomy in people aged 4 years and over (CA60C) reported in NHS Reference Costs 2018/19. The cost of treating acute rheumatic fever was estimated to be £2,346 based on the cost for Other Acquired Cardiac Conditions with CC Score 6 to 8 (EB14C) in NHS Reference Costs 2018/19.

The cost of managing complications relating to the adverse effects of penicillin were incorporated based on sources and assumptions made in NICE DG38. People with a penicillin-induced rash were assumed to require an additional GP consultation (£39.23) and be switched to clarithroymycin 250mg-500mg, twice-daily for five days. The cost of clarithroymycin 250mg twice-daily for five days was estimated to be £1.19 based on a drug tariff price of £1.67 for a pack of 14 tablets from the BNF. The cost of clarithroymycin 500mg twice-daily for five days was estimated to be £1.95 based on a drug tariff price of £2.73 for a pack of 14 tablets from the BNF. An average of the 250mg and 500mg regimens was calculated for the purpose of the analysis, resulting in an average cost of £1.57.

NICE DG38 estimated that the cost of penicillin-induced anaphylaxis or sepsis was £1,744 based on a 2017 study on the cost of sepsis, which estimated that 93,973 adults would need treatment for sepsis in UK hospitals at annual total cost £163,949,055. This value was inflated to 2019 prices, resulting in an estimated cost of £1,810.

2.3.5 Training costs

Pharmacists are likely to receive training before offering the test-and-treat service using RADT. Researchers involved in the pilot of the service in Wales provided estimates of training time (Mantzourani et al. 2020). It was estimated that two half-day training sessions would be required for each pharmacist, with one face-to-face session and another session delivered virtually (webinar). However, the cost of the training sessions is not known and it's also not known whether the cost of the community pharmacist's time would be reimbursed by the NHS.

Training costs were not considered in the base case analysis because of this uncertainty and also the potential for the analysis to be distorted by a 'one-off' cost in the set-up of the service. However, training costs were considered in sensitivity analysis in three scenarios. In one scenario, it was assumed that there would be no training fee but that pharmacist time would be reimbursed at a rate equivalent to that of NHS pharmacists in the community setting. In another scenario, it was assumed that pharmacist time would not be reimbursed but the NHS would pay a fee for the training session (based on an assumed fee of £250). In the third scenario it was assumed that pharmacist time would be reimbursed and the NHS would pay a fee for the training session.

In the scenarios in which it was assumed that pharmacist time was reimbursed, costs were estimated using unit costs from the PSSRU 2019. A cost of £49.50 per hour of pharmacist time was estimated (including oncosts, travel and overheads) based on the average cost of a band 6 or band 7 scientific or professional staff worker based in the community setting. As the training cost is a one-off cost, the cost needs to be spread across all the RADT test and treat service consultations that an individual pharmacist is likely to undertake (to give a training cost per consultation). This was estimated based on data from the pilot, which reported 1,725 consultations in 56 community pharmacies over the five-month period of the (Mantzourani et al. 2020). Based on this, it was estimated that there could be 74 RADT test and treat service consultations per pharmacy per year. The number of community pharmacists per pharmacy was

estimated from a report from the International Pharmaceutical Federation (2017), which estimated a median number of 2.23 community pharmacists per pharmacy in high-income countries. Thus, there could be 33 RADT test and treat service consultations per community pharmacist per year. It was assumed that each pharmacist might be involved in the service for an average of three years. This approximation aims to account for many possibilities, such as pharmacists changing jobs, retiring or receiving refresher training sessions. Spreading the training cost over the likely consultations that a pharmacist may undertake over a three-year period, results in an estimated cost of £3.73 per consultation.

2.4 Health-related quality of life

As recommended in the NICE reference case, the model estimates effectiveness in terms of quality adjusted life years (QALYs). These are estimated by combining life year estimates with quality of life (QoL) values associated with being in a particular health state. Mortality is not considered in this analysis because it is not anticipated that there would be survival differences between the two strategies. Therefore, differences in QALYs will be entirely driven by differences in QoL.

The source and approach taken to the estimation of QoL values was based upon the economic analysis conducted as part of NICE DG38.

Baseline QoL for adults was assumed to be 0.863, which is equal to the mean QoL for the general UK population (Kind et al. 1998). Baseline QoL for children was assumed to be 0.940 which is equal to the mean QoL for the general UK population aged under 25 years old (Kind et al. 1998). Note that this was the lowest age band available in the study. Based on the general trend of lower ages having higher QoL, it is possible that this value underestimates QoL in children. However, this would not be anticipated to have any meaningful influence on the results of the economic analysis as the result is driven by differences in strategies and this value is applied equally in both strategies.

QoL decrements associated with infection and complications were sourced from NICE DG38, which itself sourced values from previously published economic evaluations of diagnostic and management strategies for adults with pharyngitis.

Losses of 0.15 and 0.25 quality-adjusted life days were reported for treated and untreated sore throat infections. These estimates translate into QoL decrements of 0.000411 (0.15/365) for a treated infection and 0.000685 (0.25/365) for an untreated infection. A loss of 5 quality-adjusted life days was reported for peritoncillar abscess, equivalent to a QoL decrement of 0.0037 (5/365). A loss of 76.5 quality-adjusted life days was reported for rheumatic fever, equivalent to a QoL decrement of 0.209 (76.5/365). A loss of nine quality-adjusted life days was reported for penicillin-induced anaphylaxis or sepsis, equivalent to a QoL decrement of 0.025 (9/365). A loss of 0.65 quality-adjusted life days was reported for penicillin-induced rash, equivalent to a QoL decrement of 0.0017 (0.65/365).

QALYs were calculated by subtracting the QoL decrements associated with any events that occur within the modelled from the baseline QoL estimates, with QoL decrements assumed to be additive. For example, the total QALYs associated with an adult with a treated infection without complications would be equal to 0.862589 (calculated as *0.863-0.000411)* whereas the total QALYs associated with an adult with a treated infection with a penicillin induced rash would be equal to 0.860808 (calculated as *0.863-0.000411-0.001781).*

Table A8 presents the QoL values applied in the economic analysis.

Table A9 – Quality of life values

Health state	QoL value	Source
Baseline QoL for adults	0.863	Kind et al. (1998) (UK population norm for adults)
Baseline QoL for children	0.940	Kind et al. (1998) (UK population norm for children)
QoL decrements		
Untreated infection	0.000685	Neuner et al. (2003)
Treated infection	0.000411	Neuner et al. (2003)
Penicillin induced rash	0.001781	Neuner et al. (2003)
Penicillin induced anaphylaxis (sepsis)	0.024658	Neuner et al. (2003)
Abscess	0.013699	Neuner et al. (2003)
Rheumatic fever	0.209589	Neuner et al. (2003)
Abbreviation: QoL: quality of life		

3. Results

3.1 Base case results

The base case results of the analysis are shown in Table A9 and Table A10 for the adult and child population, respectively. The results estimated pharmacy assessment using RADT to be less costly than GP assessment in both populations. For adults, this strategy was slightly more effective and therefore a dominant. For children, the pharmacy RADT strategy was estimated to be slightly less effective and an incremental cost-effectiveness ratio (ICER) over £13.5 million per QALY was estimated. This is above the commonly accepted cost-effectiveness threshold of £20,000 per QALY and considered cost effective in this context, because cost savings outweigh the reduction in health outcomes.

Table A10 – Base case results for the adults (presented on a per-patient basis)

Diagnostic strategy	Cost		QALYs		ICER (cost per QALY)
	Total	Incremental	Total	Incremental	
GP assessment	£47.68	-	0.86282	-	-
Pharmacy assessment using RADT	£32.09	-£15.59	0.86283	0.000003	Dominant
Abbreviations: ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life-year; RADT: rapid antigen detection test					

Table A11 – Base case results for children (presented on a per-patient basis)

Diagnostic strategy	Cost		QALYs		ICER (cost per QALY)
	Total	Incremental	Total	Incremental	
GP assessment	£49.69	-	0.86277	-	-
Pharmacy assessment using RADT	£34.19	-£15.50	0.86277	-0.000001	£13,580,065
Abbreviations: ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life-year; RADT: rapid antigen detection test					

3.2 Deterministic sensitivity analysis results

A series of deterministic sensitivity analyses were conducted, whereby an input parameter is changed, the model is re-run and the new cost-effectiveness result is recorded. This is a useful way of estimating uncertainty and determining the key drivers of the model result. The results of the deterministic sensitivity analyses are presented in Table A11.

It can be seen that the results of the analysis are relatively insensitive to changes in the majority of input parameters. In the majority of scenarios, the conclusion of the base case analysis remains unchanged with pharmacy assessment using RADT found to be less costly and more effective (i.e. dominant) than GP assessment for adults, and cost effective for children. In cases where the intervention is less costly and less effective than the comparator, the interpretation of the ICER represents the amount of money saved for each QALY that is lost and therefore values above £20,000 per QALY can be considered cost effective. In all instances where this scenario occurred, the ICER value was above £20,000 per QALY indicating that pharmacy assessment with RADT can be considered cost effective as the savings outweigh the minor reduction in quality of life.

Table A12 – Deterministic sensitivity analysis results

Modelled scenario	ICER result (cost per QALY)	
	Adults	Children
Base case	Dominant	£13,580,065
Prevalence of GAS infection = 10%	Dominant	Dominant
Prevalence of GAS infection = 20%	Dominant	Dominant
Prevalence of GAS infection = 30%	Dominant	£14,757,943
Prevalence of GAS infection = 40%	£4,412,814	£2,762,318
RADT sensitivity = 70%	£15,100,214	£2,994,445
RADT sensitivity = 80%	Dominant	£16,087,569
RADT specificity = 70%	Dominant	£5,086,842
RADT specificity = 80%	Dominant	£6,767,541
Centor score threshold of ≥1	Dominant	Dominant
Centor score threshold of ≥2	Dominant	Dominant
Centor score threshold of 4	Dominant	£4,643,601
RADT cost based on OSOM Strep A test only	Dominant	£13,598,996
RADT accuracy based on OSOM Strep A test only	Dominant	Dominant
RADT cost and accuracy based on OSOM Strep A test only	Dominant	Dominant
No repeat consultations	Dominant	£3,787,711
No pharmacist judgement calls	Dominant	£4,670,265
No GP contact following pharmacy consultation	Dominant	£23,734,484
Complications related to GAS infection doubled	Dominant	£7,227,774
Penicillin induced complication rates doubled	Dominant	Dominant
All complication rates doubled	Dominant	Dominant
Cost of managing anaphylaxis or sepsis increased by 50%	Dominant	£13,600,887
Cost of managing anaphylaxis or sepsis decreased by 50%	Dominant	£13,559,243

Modelled scenario	ICER result (cost per QALY)	
	Adults	Children
All complication costs increased by 50%	Dominant	£13,544,545
All complication costs decreased by 50%	Dominant	£13,615,585
Training cost based on reimbursement of pharmacist time	Dominant	£9,784,088
Training cost based on training fee of £250 per pharmacist	Dominant	£11,023,852
Training cost based on reimbursement of pharmacy time and training fee of £250 per pharmacist	Dominant	£7,227,875
QoL decrements increased by 50%	Dominant	£9,053,377
QoL decrements rates increased by 100%	Dominant	£27,160,130

Abbreviations: GAS, group A beta-haemolytic streptococcus; GP, general practitioner; RADT, rapid antigen detection test ;QoL: quality of life

3.3 Threshold analysis results

A threshold analysis was conducted to assess the uncertainty around the cost of training. The total training cost (including training fee and pharmacist time) required for pharmacy assessment using RADT to no longer be cost-effective was estimated (using a threshold of £20,000 per QALY). It was found that pharmacy assessment using RADT in adult and child populations was no longer cost-effective if the training cost £1,337 and £1,326 (total per consultation), respectively.

3.4 Probabilistic sensitivity analysis results

Probabilistic sensitivity analysis (PSA) was conducted to assess the combined parameter uncertainty in the model. In this analysis, the mean values that were utilised in the base case were replaced with values drawn from distributions around the mean values. The results of 10,000 runs of the PSA are shown using ICER scatterplots and cost-effectiveness acceptability curves (CEAC). The ICER scatter plots show the incremental costs and QALYs associated with each of the 10,000 runs of the PSA along with the mean result. The CEAC graphs show the probability of each strategy being considered cost effective at the various cost-effectiveness thresholds on the x axis.

Figure 8 and Figure 9 show the ICER scatterplot for the adult and child population, respectively. In both populations, it can be seen that all of the results reside in the bottom half of the graph, indicating that the pharmacy assessment strategy with RADT is always less costly than GP assessment. The results appear to be roughly split in half between those that reside the south-east quadrant (indicating that pharmacy assessment strategy with RADT is less costly and more effective than GP assessment) and those that reside in the south-west quadrant (indicating that pharmacy assessment strategy with RADT is less costly and less effective than GP assessment).

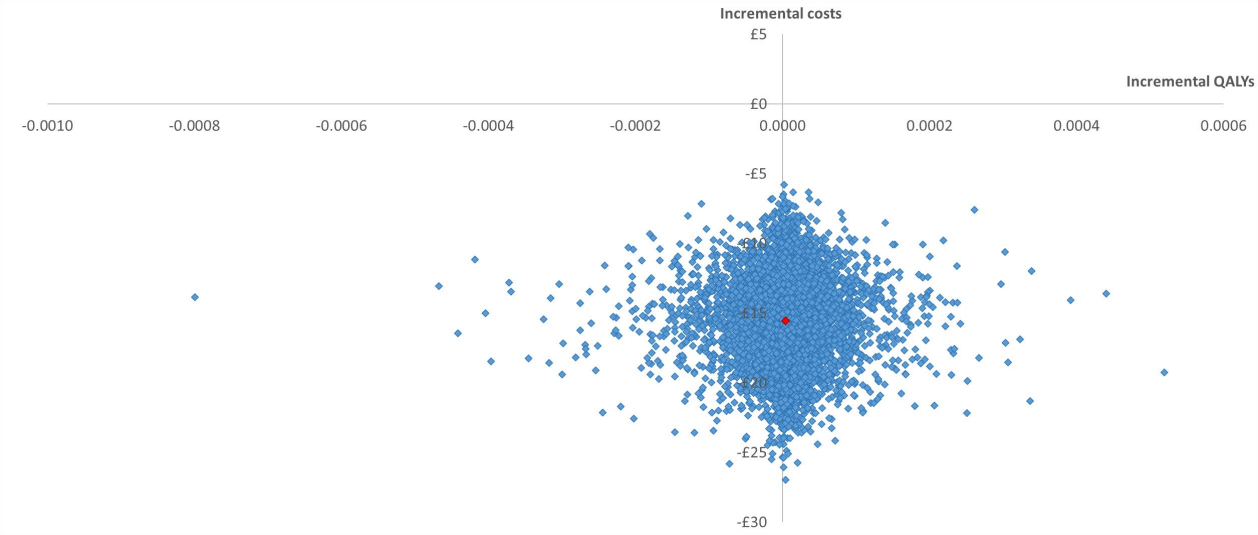


Figure 8 – ICER scatterplot for pharmacy assessment using RADT in comparison to GP assessment in adult population

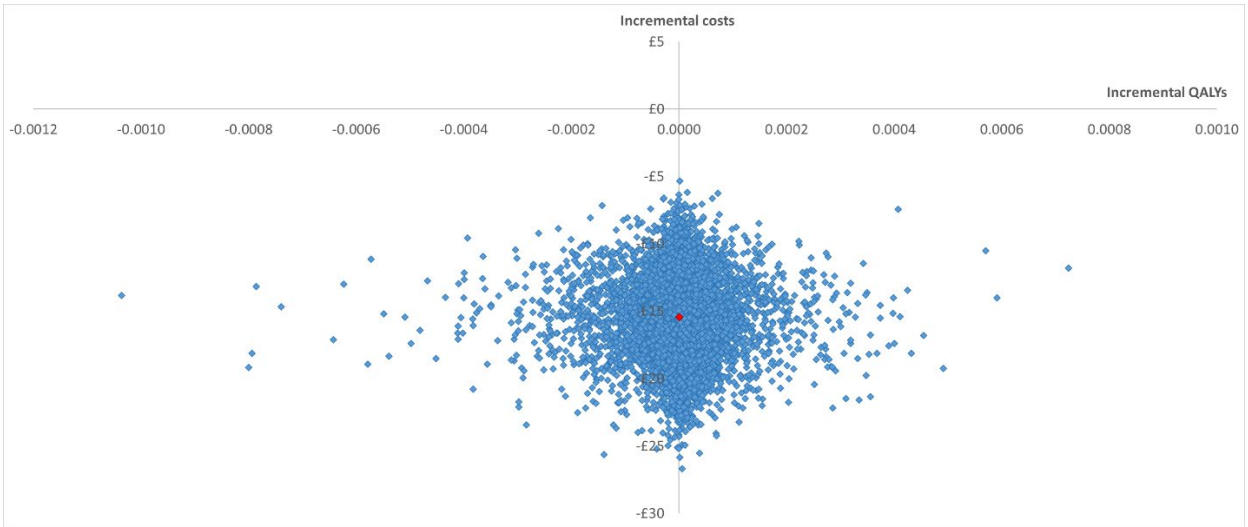


Figure 9 – ICER scatterplot for pharmacy assessment using RADT in comparison to GP assessment in child population

Figure 10 and Figure 11 show the CEACs for the adult and child population, respectively. In both populations, it can be seen that the probability of the pharmacy assessment strategy with RADT being cost effective is high and that it remains high across all cost-effectiveness thresholds. At a threshold of £20,000 per QALY, the pharmacy assessment strategy with RADT was found to have a 100% probability of being cost effective in both adults and children.

To explore the uncertainty around training costs, the probabilistic sensitivity analysis was re-run with training costs incorporated. In this scenario, at a threshold of £20,000 per QALY, the pharmacy assessment strategy with RADT was found to have a 91% probability of being cost-effective in both adults and children.

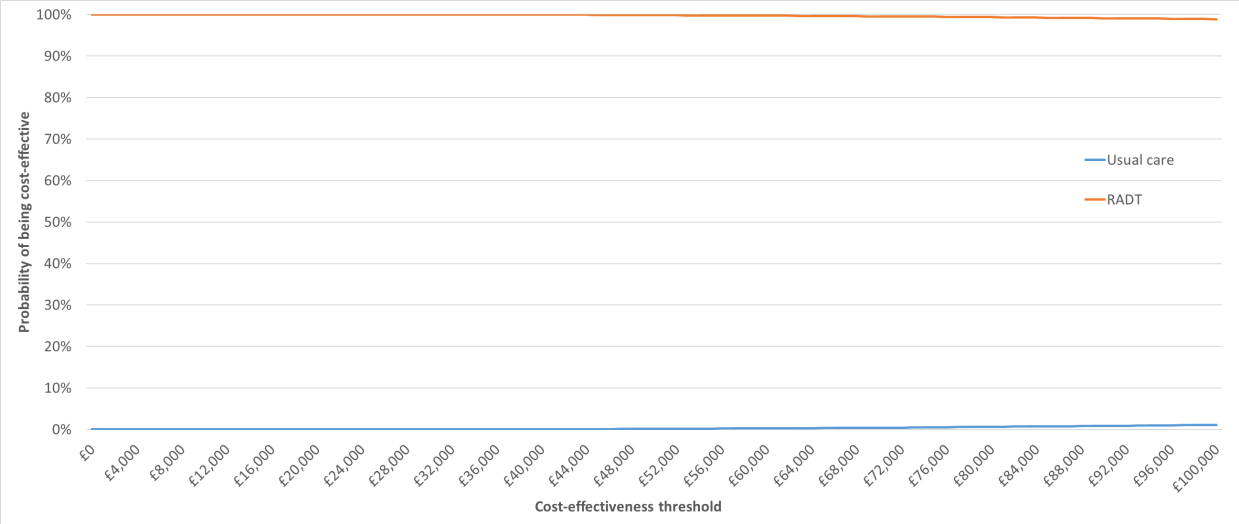


Figure 10 – CEACs for pharmacy assessment using RADT in comparison to GP assessment in adult population

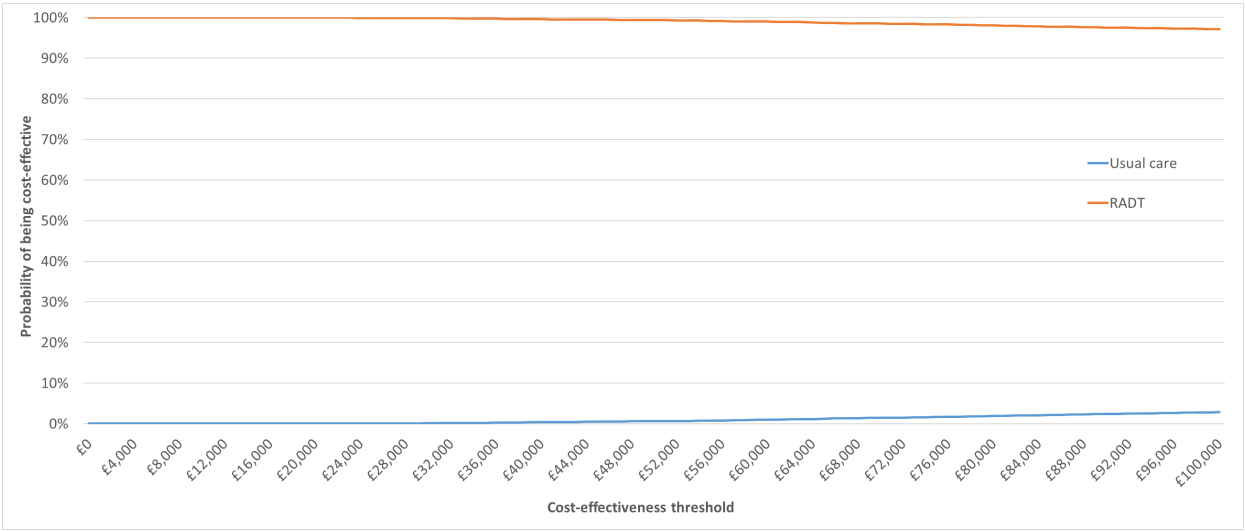


Figure 11 – CEACs for pharmacy assessment using RADT in comparison to GP assessment in child population