Impact of a pilot NHS-funded sore throat test and treat service in community pharmacies on provision and quality of patient care

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ABSTRACT

Objective A National Health Service (NHS)-funded sore throat test and treat (STTT) service was introduced in selected pharmacies in two local health boards in Wales, as an extension to the national pharmacy common ailment scheme. The aim of this study was to evaluate the impact of STTT on provision and quality of patient care, namely antibiotic use, patient safety and general practitioner (GP) consultation rates.

Methods Secondary analyses of STTT consultation data to describe service outcomes, and routine data to explore changes in antibiotic prescribing and the prevalence of complications. Data were also collected from one GP practice to explore the feasibility of measuring changes in sore throat consultation rates in general practice.

Results Less than 20% of 1725 consultations resulted in antibiotic supply. The availability of STTT was associated with greater reductions in prescriptions for phenoxymethylpenicillin than in areas where STTT was not available (−3.8% and −3.4%, difference 0.4%). When pharmacy supplies were included, the reductions in the supply of the antibiotic were similar. No increase in the monthly number of incidents of quinsy was detected, and patients were appropriately referred to other healthcare professionals during pharmacy consultations. GP consultation rates since introduction of STTT were found to be lower than the equivalent monthly average since 2014.

Conclusions Data from the first 5 months of the STTT service suggest that it may have a role in safely rebalancing uncomplicated sore throat management from general practice to community pharmacies while continuing to promote antibiotic stewardship.

INTRODUCTION

Sore throat is a condition that frequently presents to primary care. An average-sized UK general practice with a list size of 7000, has an estimated 5481 consultations with 3562 antibiotic prescriptions for sore throat over 10 years. Around 60%–78% of sore throat consultations result in an antibiotic prescription. However, most sore throats are caused by a virus and around 80% of people recover without any treatment within 8 days. Some sore throats may be caused by bacteria, most commonly, group A beta-haemolytic streptococcus (GABHS), and antibiotic prescribing where GABHS is suspected is partly driven by a desire to prevent suppurative complications such as peritonsillar abscess (quinsy). Distinguishing between viral and bacterial infections is difficult because the signs and symptoms are similar regardless of cause, and this can lead to unnecessary antibiotic prescribing which contributes to the global public health issue of antimicrobial resistance (AMR).

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several aims; (1) To provide a more accessible, efficient and high-quality clinical pathway for patients with a sore throat. (2) To better use pharmacist skills and free up GP time for more complex and urgent medical issues. (3) To more accurately screen for GABHS and potentially reduce unnecessary antibiotic prescribing.

A previous study found that it is feasible to deliver a community-pharmacy-based screening and treatment service using RADT, but no conclusive evidence could be provided on effectiveness or cost-effectiveness. Additionally, the previous study looked only at provision of a private, commercial service in which patients were required to pay for investigation and treatment. It is not known whether the results of that study would be reproduced in the NHS. The wider available evidence on RADT for sore throats is inconclusive. While randomised trials have suggested no additional benefit over clinical scores alone and the recent NICE guideline did not recommend RADT use, it is recognised there is a lack of robust evidence regarding the role of RADT in community pharmacies and its value in this setting is still unknown. NICE has recommended further research to measure the wider effects of RADT on public health and antimicrobial stewardship in healthcare settings other than general practice.

The implementation of STTT provided a unique opportunity to evaluate such a service, in the NHS and in a real-world setting. While trials are a vital part of evaluating new diagnostic pathways, it is important to understand the role of the STTT service in a health system where patients make their own choices as to how and when to access treatment, which precluded a prospective randomised trial. This study aimed to evaluate whether a pharmacy-led STTT service had an impact on antibiotic use, patient safety, and GP consultation rates.

**PATIENTS AND METHODS**

**STTT pilot service**

The STTT service was available in 56 community pharmacies in two local health boards (LHBs) in Wales, in established CAS sites whereby CAS had been embedded in primary care pathway for more than 6 months. Initially 23 pharmacies in an LHB in central South Wales commenced the service in November 2018. The service was extended to another 33 pharmacies in an LHB in North Wales by December 2018. Pharmacy sites were commissioned within the LHBs based on a balance of population needs and expressions of interest from pharmacy sites that had already been offering CAS for a minimum of 6 months.

The STTT service specification (a document describing the conditions under which commissioned community pharmacies were required to provide the service including any training requirements, and clinical inclusion and exclusion criteria) was developed collaboratively by the LHBs who determined all children under 6 years would be excluded and referred to their GP (online supplementary figure 1). Patients aged 6 years and over presenting with acute sore throat at a participating pharmacy were assessed using either FeverPAIN or CENTOR clinical scoring, validated methods to support identification of bacterial infection. The choice of scoring method was left to the pharmacist’s discretion. Pharmacists received detailed training on throat examination, use of scoring tools and sampling using a throat swab. Patients with FeverPAIN $>$3 or CENTOR$>$2 were offered RADT in the pharmacy, allowing pharmacists to quickly ascertain presence of GABHS. Clinical scoring allows targeted testing of those most likely to have a GABHS infection rather than asymptomatic GABHS carriers. Patients with a positive test were offered antibiotics supplied by the pharmacist under a Patient Group Direction.

Leaflets promoting self-care and providing information about the effectiveness of antibiotic use for sore throats were developed by the Welsh Medicines Information Service, approved by the all Wales Medicines Strategy Group and used in the service. Pharmacists were asked to make a follow-up telephone consultation for all patients accessing the STTT service within 10–14 days of each consultation. This was used to assess treatment success and subsequent health service utilisation (eg, appointments with a GP).

**Study design**

This study involved secondary analyses of data obtained from routine data sources. Data were analysed using Microsoft Excel, IBM SPSS V.23 to obtain descriptive statistics and Stata Statistical Software release V.16 to undertake more detailed statistical comparisons.

**Data collection**

**Service outcomes**

Data from all STTT consultations were collected between November 2018 (service introduction) and end of March 2019, to describe service outcomes. Data were obtained through the Choose Pharmacy system, an IT application supporting delivery of services through community pharmacies in Wales. Data included standardised demographic information derived from matching patients to existing health records in the Welsh Demographic Service, and clinical information in the form of free-text and predefined responses recorded by pharmacists during consultations and follow-up telephone calls.

**Patient safety**

There is currently no routine data linkage of pharmacy data to other primary or secondary care data that would enable us to track patients who have visited pharmacies for STTT. To explore possible impact on patient safety, hospital admissions for quinsy were monitored, as a surrogate for possible complication of untreated GABHS infections. Patient Episode Database for Wales data for coded hospital inpatient stays of quinsy were obtained from the NHS Wales Informatics Service (NWIS) for the period March 2014 to March 2019. Data for a period of 4 full years prior to the service’s introduction were obtained to account for seasonal variation that may have impacted on
quinsy hospital admissions, and would allow us to calculate averages and 95% CIs.

In addition, free-text comments providing clinical information recorded by pharmacists during consultations were analysed using content and deductive thematic analysis for patients who were referred to another healthcare professional, to explore appropriateness of referrals. Data were also analysed for patients who were followed up, to explore possible patient deterioration after an STTT consultation. The number of patients who had further contact with healthcare professionals was calculated and pharmacist comments in relation to patient-reported reasons for seeking further advice were analysed thematically.

GP consultations
Data were also obtained from one GP practice to explore the feasibility of measuring changes in sore throat consultation rates in general practice pre and post STTT service implementation. Audit+ was used as a data source to extract Read-coded GP sore throat related consultations for full 4 years prior to STTT, between March 2014 to March 2019.18 The GP practice selected (list size=10 220) was located adjacent to four community pharmacies in which the STTT service was available (online supplementary table 1).

Antibiotic prescribing
Comparison of antibiotic prescribing was completed using an ecological study design which analysed data at the population rather than individual level to identify any association in total antibiotic supply between intervention (STTT) and non-intervention (non-STTT) areas.20 This design has been used previously to explore the impact of licensing changes on antibiotic (chloramphenicol) supply rates. This approach relied on a linear regression model to predict the number of antibiotic prescriptions at the end of the study period. We determined that in order to make the regression model robust it would be necessary to obtain data for 25 months prior to the intervention. This was in line with previous studies.21 Data were provided by the NHS Wales Shared Services Partnership (NWSSP). Monthly antibiotic prescribing data for the period October 2016 to March 2019 were provided for each primary care cluster, that is, a group of GP practices serving populations of between 50 000 and 100 000 people, within the two LHBs in which the STTT service was available. Clusters were designated as STTT and non-STTT depending on whether or not community pharmacies within their respective areas were providing the STTT service (online supplementary table 2). A retrospective analysis of prescription and pharmacy supply data for phenoxymethylpenicillin in areas in which STTT was available was undertaken. Phenoxymethylpenicillin prescriptions, the recommended antibiotic treatment for sore throat,22 were chosen for analysis. Phenoxymethylpenicillin is not indicated for treatment of any other acute bacterial infection in Wales and as such was assumed to be a good measure of antibiotic prescribing for sore throat. Prescriptions for second line antibiotics (clarithromycin and erythromycin) were excluded because they were only indicated for patients with a known penicillin allergy and had multiple possible indications. Prescribing data for non-STTT clusters were used as a control.

Linear regression was used to generate a cumulative supply equation for phenoxymethylpenicillin prescriptions (r=0.999, p<0.005) and predict the number of supplies (ie, prescriptions and pharmacy supplies) of phenoxymethylpenicillin in STTT clusters at month 30 of the study. The regression model was used to predict prescription numbers at month 30, and was based on NWSSP prescription data for the 25 months immediately preceding the availability of the STTT service (month 1: October 2016). Similar linear regression models were used to predict the number of prescriptions for phenoxymethylpenicillin in non-STTT clusters (r=0.999, p<0.005) and for oral broad-spectrum penicillins (as an indicator of the general trend in antibiotic prescribing within STTT clusters) in STTT clusters (r=0.999, p<0.005). The effect of STTT on antibiotic supplies was estimated using a difference in difference design comparing phenoxymethylpenicillin supplies in STTT and non-STTT clusters, and phenoxymethylpenicillin and broad-spectrum antibiotic prescriptions within STTT clusters.

Ethical considerations
The study was registered with the Research and Development department of both LHBs. There were no identifiers that could link information to an individual in any of the data sets; as such, this study required no ethical approval. The process for obtaining and using Audit+ GP data was approved by the NWIS Data Quality System Governance Board.

Patient involvement
Two members of the Lay Faculty of Cardiff School of Pharmacy and Pharmaceutical Sciences provided patient insight throughout the conceptualisation of the evaluation of the service. Patients were not involved in the design or conduct of this arm of the study.

RESULTS
During the study period 1725 STTT consultations were undertaken in the 56 participating community pharmacies. Table 1 summarises the characteristics of service users, patient alternative action had the service not been available, referral sources to STTT and use of clinical scoring tools during consultations. Of the 1725 patients screened using FeverPAIN or CENTOR, 1259 patients were found to meet the threshold criteria for RADT (72%). Of the 1259 patients having the RADT test, a total of 350 (28.2%) tested positive for GABHS and 340 ((27.4%) were supplied antibiotics. Ten patients did not receive antibiotics, four were referred to their GPs due to feeling systemically unwell or because of a recent recurrent infection and six patients...
Table 1  Descriptive overview of the sore throat test and treat (STTT) service consultations

| Patient demographics | Patients (n=1725) | Patients followed up at 10–14 days (n=537) | Patients not followed-up (n=1188) |
|----------------------|------------------|------------------------------------------|----------------------------------|
| Age at consultation (years) Median | 29.2 | 28.8 | 29.4 |
| IQR | 16–39 | 15–38 | 16–39 |
| Range (SD) | 6–89 (17.4) | 6–79 (17.1) | 6–89 (17.5) |
| Gender (% of total population) | Male | Female |
| | 582 (33.7%) | 1143 (66.3%) |
| | 185 (34.5%) | 352 (65.4%) |
| | 397 (33.4%) | 791 (66.6%) |

Factors related to engagement with STTT

| Referred to the pharmacy by: (% of total population) | General practitioner | Self-referral | Other (OOH/other HCP/ NHS 111/NHS Direct) |
|-----------------------------------------------------|----------------------|--------------|----------------------------------------|
| Visited GP | 991 (57.4%) | 300 (55.9%) | 691 (58.2%) |
| Other (OOH/other HCP/ NHS 111/NHS Direct/accident and emergency) | 667 (38.7%) | 218 (40.6%) | 449 (37.8%) |
| Done nothing | 48 (2.8%) | 15 (2.8%) | 33 (2.8%) |

Missing values | 19 (1.1%) | 4 (0.7%) | 15 (1.3%) |

What would the patient have done if the service had not been available (% of total population)

| Visited GP | 1610 (93.3%) | 503 (93.7%) | 1107 (93.2%) |
| Other (OOH/other HCP/ NHS 111/NHS Direct/accident and emergency) | 56 (3.2%) | 18 (3.4%) | 38 (3.2%) |
| Done nothing | 25 (1.4%) | 7 (1.3%) | 18 (1.5%) |
| Bought medication from the pharmacy | 27 (1.6%) | 8 (1.5%) | 19 (1.6%) |

Missing values | 7 (0.4%) | 1 (0.2%) | 6 (0.5%) |

Presenting features

| Clinical scoring tool (consultations) | CENTOR | FeverPAIN |
|--------------------------------------|--------|-----------|
| Patients | 133 (7.7%) | 1592 (92.3%) |
| Patients followed up at 10–14 days | 56 (10.4%) | 481 (89.6%) |
| Patients not followed-up | 77 (6.5%) | 1111 (93.5%) |

decreed antibiotics in favour of self-care. In total, antibiotics were supplied in 19.7% of STTT consultations (340/1,725) (figure 1). The number and percentage of antibiotic supplies by age group are presented in online supplementary figure 2.

In 59 (3.4%) consultations patients had an RADT test despite not meeting the required clinical criteria. Free-text notes made by pharmacists provided an insight into the reasons for these tests, which included: patients presenting with a referral for RADT from their GP; patients’ insistence related to recurrent infections or for reassurance in cases where the pharmacist used their professional discretion when faced with a distressed patient. Four of these patients, two of whom had been encouraged to take a test by their GP because they were children with recurrent infections, were supplied an antibiotic.

In addition to the 340 antibiotics supplied, 528 patients received 804 analgesic items (ibuprofen n=402 and paracetamol n=402). In total, 89 patients (5.2%) received both an antibiotic and analgesic and 943 patients (54.7%) were not supplied any medication.

Numbers of GP prescriptions for penicillin were lower than predicted for March 2019 in STTT clusters (figure 2). A reduction in penicillin prescriptions was also observed in non-STTT clusters but the reduction was smaller than those in which STTT was available (−3.4% vs −3.8%, difference 0.4%). When pharmacy supplies were included, no difference was observed between the reduction in penicillin supplies in STTT and non-STTT clusters (−3.4% vs −3.4%). In STTT clusters numbers of prescriptions for oral broad-spectrum penicillins also reduced but the reduction was smaller than that for penicillin (−2.5% vs −3.4%, difference 0.9%) (online supplementary figures 3 and 4).

Pharmacists referred 170 patients (9.9%) to other healthcare professionals; 167 referrals were made to GPs and three to dentists (table 2—most common reasons for referring). Two patients were diagnosed with epiglottitis during the clinical examination and were referred urgently to secondary care, whereby both diagnoses were confirmed and patients treated; these incidents were reported to the LHBs and information for these patients was not entered in Choose Pharmacy (L. Sayce, NWIS, personal communication).

In total 896 patients (51.9%) consented to a follow-up phone call and 537 follow-up phone calls were completed...
within the study period (59.9% of those who gave consent). The characteristics of patients participating in follow-up phone calls were compared and found similar to the overall study population (table 1). Of those patients for whom follow-up was completed, 492 (91.6%) reported feeling completely or mostly better after using the STTT service; 81 (15.1%) reported contacting a healthcare professional after the STTT consultation. Table 3 provides a breakdown of the information from patients’ further contact with healthcare professionals after their STTT consultation (n=81 out of 537 who were followed up), recorded by pharmacists during follow-up phone calls. Patients have been categorised by the patients’ need for a RADT as indicated by their clinical score, RADT result (positive or negative) and whether an antibiotic was supplied during the STTT consultation.

Follow-up was unsuccessful in 359 cases. The most commonly recorded reasons for unsuccessful follow-up included patients not answering despite multiple attempts (n=97, 27.5%), patients not returning phone calls or voice messages (n=49, 13.6%), and incorrect phone number (n=12, 3.3% of unsuccessful follow-ups).

No increase in the monthly number of incidents of quinsy was detected (figure 3). It was feasible to extract sore throat consultation data from GP practice prescribing system using Audit+. Monthly sore throat consultation numbers were used to estimate the average consultation rate per month for the study practice before the introduction of STTT. Sore throat consultation rates decreased from 0.71 per 1000 patients in March 2018 (prior to STTT) to 0.36 per 1000 patients in March 2019 (4 months after STTT). Data suggested GP consultation rates were lower during the study period than in the same season in all previous years although this was not tested statistically (figure 4).

**DISCUSSION**

This study triangulated data derived from a range of national databases providing pharmacy, GP, prescribing and secondary care data, to evaluate whether a pilot of an NHS-funded pharmacy STTT service had an impact on antibiotic provision, patient safety and GP consultation rates.

Data from the first 5 months of the STTT service suggest that it may have a role in promoting antibiotic stewardship as a coordinated approach towards sore throat management. Prior to the availability of RADT, screening of patients was liable to identification of asymptomatic GABHS carriers leading to inappropriate antibiotic prescribing. The overall percentage of STTT consultations resulting in antibiotic supply at <20%, was significantly lower than rates reported from consultations with GPs, where RADT is not routinely used. Findings suggest that RADT in addition to clinical scoring systems increases diagnostic confidence of suspected GABHS infection rather than carriage of the bacteria. The availability of STTT was associated with greater reductions in the prescribing of phenoxymethylpenicillin than in areas where STTT was not available although there was no overall difference when pharmacy supplies were included; and greater reductions in antibiotic prescribing for sore throat when compared with antibiotic prescribing for other common infections.

The antibiotic supply rate in the STTT service at 19.7 per 100 consultations is double that reported in the only other test and treat service researched in the UK.
a private service offered to patients 12 years and older. The current study found both the percentage of patients with a clinical score above the threshold for RADT, and the percentage of patients provided antibiotics following RADT, were higher than in the private service. This suggests that patients in the current study, largely referred by the GP after presentation at the surgery or following triage over the phone, and by implication patients presenting to NHS services, were more likely to have a bacterial infection than those accessing a private service. This finding could be explained by different demographics of patients in the studies, for example, in this study the STTT service was available to children aged 6 years or over (rather than 12 years or over), and children aged between 6 years and 12 years received 15% of the overall antibiotic supply; or by differences arising from use of FeverPAIN rather than CENTOR scoring. It is also possible the difference could be attributed to differences in health-seeking behaviours among users of pharmacies including a tendency for pharmacy services to be accessed by the ‘worried well’, described previously.

No safety concerns were evident in the operation of the STT service. There was no observed increase in episodes of quinsy in secondary care, and patients were appropriately referred to other healthcare professionals during pharmacy consultations. A total of 4.5% of patients in
Table 3  Patients’ further contact with healthcare professionals after their sore throat test and treat (STTT) consultation, by rapid antigen detection testing (RADT) outcome and antibiotic supply

| STTT consultation                        | Healthcare professional contacted (number of patients) (reasons for contact where noted) | Antibiotic provided after STTT (n) | Total patients |
|------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------|----------------|
| RadT needed—result negative and no antibiotic supplied | GP: 23 (Gastro-oesophageal disease (GORD), anxiety, glandular fever, suspected hand foot and mouth, further blood tests to identify issue) | 12                               | 30             |
|                                          | Hospital: 2 (Repetitive strain of vocal cords)                                           |                                   |                |
|                                          | Dentist: 1 (Referral to dental hospital)                                                 |                                   |                |
|                                          | Nurse: 1                                                                                 |                                   |                |
|                                          | OOH: 3                                                                                   |                                   |                |
| RadT Needed—result positive and antibiotic supplied | GP: 29 (allergy to antibiotic supplied, glandular fever, ulcer in throat, referral to ENT) | 13                               | 36             |
|                                          | Hospital: 2 (Quinsy, drained tonsils)                                                    |                                   |                |
|                                          | Dentist: 0                                                                               |                                   |                |
|                                          | Nurse: 0                                                                                |                                   |                |
|                                          | OOH: 5                                                                                  |                                   |                |
| RadT not needed and no antibiotic supplied | GP: 14 (Referral to ENT, mild chest infection, GORD; GPs not seen three patients and referred back to pharmacist) | 3                                | 15             |
|                                          | Hospital: 1                                                                             |                                   |                |
|                                          | Dentist: 0                                                                              |                                   |                |
|                                          | Nurse: 0                                                                               |                                   |                |
|                                          | OOH: 3                                                                                  |                                   |                |
| Total                                    | 66                                                                                      | 4                                 | 28             |

ENT, Ear, Nose and Throat; GP, general practitioner; OOH, out of hours.

The benefits of the STTT rely on a collaborative approach between community pharmacies and GP surgeries and appropriate substitution of GP services by pharmacists. Results suggest a high degree of collaboration with 57.4% of all consultations taking place following referral by the patient’s GP (n=991). A summary of each consultation was sent to each patient’s GP with the aim of integrating the service and encouraging GPs to refer appropriate patients in future; whether GP referrals to the STTT service changed over time and in response to...

Figure 3  Incidents of quinsy in the two local health boards whereby sore throat test and treat (STTT) was introduced in middle November 2018, by time, with a 95% confidence band for the average number per month between March 2014 and October 2018.

Figure 4  Rates for recorded sore throat consultations for patients age 6 years and over, in one general practitioner (GP) surgery within the vicinity of four sore throat test and treat (STTT) pilot sites, with a 95% confidence band for the average rate per month between March 2014 and October 2018.
feedback is worthy of further research. We found it was feasible to collect sore throat consultation data from GP practices and use this to assess the impact of the STTT service on GP consultation rates. Data suggest the service may have potential to relieve pressure on GPs. The vast majority of patients using the STTT service reported they would have visited their GP or other health service had STTT not been available. This finding is supported by follow-up data where only 12.3% of patients (66/537) reported contacting their GP after using the pharmacy service; many of the reasons for contacting their GP subsequently were unrelated to sore throat. A further 2.7% of patients (15/537) subsequently contacted a hospital, out of hours, dentist or a nurse; one patient who was later diagnosed with quinsy had commenced antibiotic therapy supplied by a pharmacy.

STTT is an NHS service, hence there were no ethical issues in relation to financial conflicts for pharmacists that could be associated with the private service in England. The service is part of CAS, so other treatments were offered if the pharmacist determined that they were more appropriate. Patient education regarding the appropriateness of antibiotic treatment for viral infections and of the self-limiting nature of many bacterial ones was an integral part of the service. The role of self-care in management of common ailments in general was promoted, with self-care leaflets provided as part of service. A small number of patients chose to self-care instead of taking antibiotics despite having tested positive for RADT; of these none reported a subsequent need for antibiotic treatment. Results suggest that the STTT service is using the skills of pharmacists more effectively than pharmacists that could be associated with private service. The selection of non-STTT clusters may have taken account of some of these, it is plausible the baseline reduction for phenoxymethylpenicillin in non-STTT clusters and prescribing for other infections could be attributed to other stewardship initiatives such as national targets, prescribing indicators and local initiatives.

Coding limitations in GP consultation data were assumed to be consistent throughout the study period within the individual GP practice. Not enough data are available yet to run an interrupted time series that looks at the trend of quinsy rates and sore throat consultation rates before and after implementation of STTT. Pharmacists were not chosen in a way to allow for STTT and non-STTT clusters to be comparable, so it was not possible to adjust for baseline starting point and examine between-group differences (difference in differences approach).

Future work evaluating the STTT service will include exploring patient, pharmacist, GP and GP practice staff’s views and experiences of the service, an economic evaluation, and changes in pattern of use as the service becomes normalised.

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Contributors EM, AE, RC-J, HA and NH developed the methodology; EM supervised the study, was responsible for project administration, and managing the study, coordinated data collection and led the initial manuscript preparation and final submission. EM, AE and RC-J completed the data analysis. NR and RH reviewed the data under the lens of public health.
All authors were involved in data triangulation and interpretation and reviewing versions of the manuscript.

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**Data availability statement** De-identified original data can be shared upon reasonable request.

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**REFERENCES**

1. Gulliford MC, Moore MV, Little P, et al. Safety of reduced antibiotic prescribing for self limiting respiratory tract infections in primary care: cohort study using electronic health records. BMJ 2016;354:i3410.

2. Gulliford MC, Dregan A, Moore MV, et al. Continued high rates of antibiotic prescribing to adults with respiratory tract infection: survey of 588 UK general practices. BMJ Open 2014;4:e000624.

3. Spinks A, Glasziou PP, Del Mar CB. Antibiotics for sore throat. Cochrane Database Syst Rev 2013;CD000023.

4. Kumar S, Little P, Britten N. Why do general practitioners prescribe antibiotics for sore throat? Grounded theory interview study. BMJ 2003;326:138.

5. Worrall GJ. Acute sore throat. Can Fam Physician 2007;53:1961–2.

6. Chatterjee A, Modarai M, Naylor NR, et al. Quantifying drivers of antibiotic resistance in humans: a systematic review. Lancet Infect Dis 2018;18:e368–78.

7. National Institute for Health and Care Excellence. Clinical Knowledge Summaries. Sore throat - acute. Available: https://cks.nice.org.uk/sore-throat-acute

8. Walijee H, Patel C, Brahmabhatt P, et al. Tonsillitis. InnovAiT 2017;10:577–84.

9. National Institute for Health and Care Excellence. NICE Diagnostics Guidance [DG38]. Rapid tests for group A streptococcal infections in people with a sore throat, 2019. Available: https://www.nice.org.uk/guidance/dg38

10. McNulty C, Joshi P, Butler CC, et al. Have the public’s expectations for antibiotics for acute uncomplicated respiratory tract infections changed since the H1N1 influenza pandemic? A qualitative interview and quantitative questionnaire study. BMJ Open 2012;2:e000674.

11. National Institute for Health and Care Excellence. NICE Guidance [NG84]. Sore throat (acute): antimicrobial prescribing, 2018. Available: https://www.nice.org.uk/guidance/ng84

12. Thornley T, Marshall G, Howard P, et al. A feasibility service evaluation of screening and treatment of group A streptococcal pharyngitis in community pharmacies. J Antimicrob Chemother 2016;71:3293–9.

13. Sore throat test and treat – a £34 million question? Drug Ther Bull 2017;55:1.

14. Goyder C, Verbakel J, Hayward G, et al. The sore throat test and treat service: speed should not substitute science. Br J Gen Pract 2017;67:110–110.

15. Little P, Hobbs FDR, Moore M, et al. Clinical score and rapid antigen detection test to guide antibiotic use for sore throats: randomised controlled trial of prism (primary care streptococcal management). BMJ 2013;347:f5806.

16. Little P, Hobbs FDR, Moore M, et al. Primary care streptococcal management (PiSM) study: in vitro study, diagnostic cohorts and a pragmatic adaptive randomised controlled trial with nested qualitative study and cost-effectiveness study. Health Technol Assess 2014;18:1–102. vii-xxv.

17. All Wales Medicines Strategy Group. Common Ailments Formulary Patient Information Leaflets. Sore Throat and Tonsillitis. Available: http://awmsg.org/docs/awmsg/medman/CAPFil/Sore%20Throat%20and%20Tonsillitis.pdf

18. NHS Digital. National clinical coding standards ICD-10 5th edition (2017). International classification of diseases. Available: https://hcsc.kahootz.com/gf2.ti/762498/27838213.1/PDF/-/NCCSICD102017.pdf

19. NHS Digital. Read codes. Available: https://digital.nhs.uk/services/terminology-and-classifications/read-codes

20. Cogggon D, Rose G, Barker DJP. Chapter 6: Ecological studies. In: Epidemiology for the uninitiated. London: BMJ Books, 2003.

21. Walker R, Hinchcliffe A. Prescribing and sale of ophthalmic chloramphenicol following reclassification to over-the-counter availability. Int J Pharm Pract 2010;18:269–74.

22. All Wales Medicines Strategy Group. All Wales Antimicrobial Guidance Group. Primary Care Antimicrobial Guidelines, September 2015 (Updated July 2018). Formulary Choice for Acute Sore Throat. Available: http://www.awmsg.org/docs/awmsg/medman/Primary%20Care%20Antimicrobial%20Guidelines.pdf

23. Miller D, Acton TM, Hedge B. The worried well: their identification and management. J R Coll Physicians Lond 1988;22:158–65.

24. Cohen JF, Bertille N, Cohen R, et al. Rapid antigen detection test for group A Streptococcus in children with pharyngitis. Cochrane Database Syst Rev 2016;7:CD010502.

25. Jones LF, Owens R, Sallis A, et al. Qualitative study using interviews and focus groups to explore the current potential for antimicrobial stewardship in community pharmacy informed by the theoretical domains framework. BMJ Open 2018;8:e025101.

26. Buss VH, Deeks LS, Shield A, et al. Analytical quality and effectiveness of point-of-care testing in community pharmacies: a systematic literature review. Res Social Adm Pharm 2019;15:483–95.