

Antimicrobial Stewardship within the Digital Setting: A Quality Improvement Study – Interventions and Outcomes within a Digital-First General Practice in the UK



QUALITY
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STUDY

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ABSTRACT

Antimicrobial resistance is a local, national and global health priority. With the emergence of new infections as demonstrated by the COVID-19 pandemic, our ability to conserve the effectiveness of antimicrobials is crucial. Public Health England's (PHE) UK 20-year vision for antimicrobial stewardship states that one of the key objectives over the next 20 years is to demonstrate the optimal use of antimicrobials.

A digital approach to the delivery of primary care services provides significant advantages regarding accessibility and patient satisfaction. This is beneficial for patients in obtaining medical care at the point of need. However, there are concerns that such accessibility may provide an opportunity for increased and inappropriate antimicrobial prescribing.

As a digital GP practice with over 100,000 registered NHS patients and a multi-disciplinary workforce of approximately 300 clinicians comprising of General Practitioners (GPs), Prescribing Pharmacists (PPs) and Advanced Nurse Prescribers (ANPs), it is essential that appropriate systems and processes are in place to support good antimicrobial stewardship.

Monitoring of prescribing is a significant aspect of antimicrobial stewardship. At Babylon, we review our antibiotic prescribing across our private and NHS services in the UK. The results from monthly broad-spectrum antibiotic prescribing audits between April 2020 – October 2020 showed an average appropriate prescribing rate of 76.4%. It was identified that further improvements could be made by incorporating regular feedback to prescribers as part of the interventions used to support prescribing. A quality improvement study was undertaken to review the impact of prescriber feedback on appropriate prescribing of broad-spectrum antibiotics and audit results observed within the practice.

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1 INTRODUCTION

Antimicrobial resistance (AMR) is an ongoing threat to public health, impacting development and food security across the globe [1]. The significance of this threat has increased over the years and antimicrobial stewardship has been seen as the approach to use to reduce antimicrobial resistance [1]. Antimicrobial stewardship (AMS) comprises a variety of interventions, systems and processes all aimed at promoting appropriate antimicrobial usage and sustaining the effectiveness of this class of medicines [2].

1.1 NATIONAL APPROACH TO ANTIMICROBIAL STEWARDSHIP IN THE UK

In the United Kingdom (UK), the importance of AMS has increased over time and evolved across the primary, secondary and veterinary health settings. In 2013, a nationwide strategy outlined the actions to reduce infection rates, resistance and improve prescribing practice across primary and secondary care, alongside reviewing the use of antimicrobials in agriculture and farming [3]. To further increase prioritisation within UK healthcare, the demonstration of appropriate infection control practices as part of antimicrobial stewardship became a legal requirement [4]. In 2019 a revised national action plan was developed which drew on the progress made and highlighted further improvements [5]. This was subsequently incorporated into the 20-year vision on antimicrobial stewardship, setting out the long-term objectives and the desired position that the UK should be in 2040 [6].

Alongside the national strategy, several policies have been developed, addressing good practice recommendations for effective antimicrobial use [2, 7–9]. Several national guidelines have been developed. This includes prescribing guidelines and toolkits, infection prevention and control and education and training materials [10–13]. All the policies and guidelines form part of a collection of resources available for healthcare professionals across the different sectors to use [14].

To monitor antimicrobial usage and resistance, the English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) was established. Since 2014, ESPAUR has published yearly reports providing objective evidence of the progress of AMS activities across primary and secondary care coupled with valuable information on prescribing, microbiological and antibiotic resistance data of key pathogens [15]. This high-level surveillance provides the intelligence required to facilitate the appropriate allocation of resources to improve AMS.

1.2 ANTIMICROBIAL STEWARDSHIP WITHIN PRIMARY CARE

The UK antimicrobial stewardship strategy and relevant national policies were developed to be adopted across

secondary and primary care, providing details on the vision for antimicrobial stewardship and overarching principles that should be considered in any AMS program [6]. However, in recognition of the differences between the acute and primary care setting, targeted interventions for each setting were developed. The ESPAUR report from 2020–2021 stated that 72.7% of total antibiotics were prescribed within general practice highlighting the importance of having appropriate interventions in place to optimise antimicrobial usage within this sector [15]. Within primary care, these interventions have been based on clinician feedback and patient education.

The Treat Antibiotics Responsibly, Guidance, Education and Tools (TARGET) toolkit provides a suite of resources to support clinicians with AMS within primary care [16–18]. This includes clinical scoring tools that have been developed to support decision making and reduce inappropriate prescribing for sore throat presentations [18].

Several antimicrobial stewardship interventions focus on changing behaviour to optimise prescribing and redefine expectations. Most interventions focussing on changing behaviour have been directed towards the healthcare professional however, public campaigns and promotion are also required to ensure the highest level of engagement and success [19]. National campaigns run in the UK have increased the awareness of antimicrobial resistance amongst the public [20–24].

A study by Borek et al in 2020 [25] provided information on the extent to which certain antimicrobial stewardship interventions have an effect on prescriber behaviour and sought to identify possible ways to optimise antimicrobial stewardship interventions in primary care [25]. The interventions identified as being the most effective were direct prescriber feedback, use of the FeverPAIN scoring tool, electronic decision support tools and point of care diagnostics, accessible evidence-based guidelines and antibiotic prescribing workshops [25].

1.3 ANTIMICROBIAL STEWARDSHIP WITHIN THE DIGITAL SETTING

Prior to the emergence of COVID-19, the opportunities that technological innovations could bring to healthcare delivery were recognised in the UK [26]. This was formally addressed and reviewed by national policymakers and stakeholders by the development of The Topol review [26]. This outlines key recommendations to enable the NHS to meet the expanding demands on the service and develop a workforce that is empowered and capable of utilising digital technologies to provide the best quality of care and service to patients [26].

The COVID-19 pandemic has had a significant impact on the pace of integration of digital technologies to healthcare delivery. The implementation of measures to prevent and limit the spread of COVID-19 virus such as social distancing and limitations to the number of

patients allowed in clinic has led to changes in the modality of care to patients. NHS primary care services that delivered care through the traditional route of face-to-face consultations have had to implement ways to consult with patients remotely.

A digital approach to the delivery of primary care services provides significant advantages regarding accessibility and patient satisfaction. A digital approach can be delivered by using suitable technology such as a mobile app or a system to provide secure video or telephone consultations. This overcomes the barrier of accessibility that the restrictions have created and is beneficial for patients in obtaining medical care at the point of need. However, there are concerns that such accessibility may provide an opportunity for increased and inappropriate antimicrobial prescribing [27].

As a digital-first GP practice in the UK, Babylon, have applied the learnings gained from antimicrobial stewardship in primary care to deliver antimicrobial stewardship within the digital setting. These learnings have led to the following interventions to promote appropriate prescribing being adopted – incorporating digital prescribing tools to support appropriate prescribing, auditing to identify improvement opportunities and creating an organisational culture that motivates clinicians' performance [8, 19, 25, 28–31].

1.3.1 Digital prescribing tools to support appropriate broad-spectrum antibiotic prescribing

The use of a process whereby prescriptions for broad-spectrum antibiotics are reviewed and approved prior to being given to a patient is a strategy that has been shown to improve appropriate prescribing and unnecessary costs associated with inappropriate prescribing [32]. This has been successfully implemented in many secondary care trusts where the organisational structure and resource allows for timely reviews of these prescriptions without a negative impact on patient care [32].

Typically, this strategy is not used by GP practices in the UK as the digital systems and resources to do so in a timely manner are not available. As a GP practice that has technology at the centre of its operation, digital tools have been developed to embed a similar approval process to broad-spectrum antibiotic prescriptions issued for patients seen through the private healthcare service we provide.

The internal prescribing system that is used identifies prescriptions for broad-spectrum antibiotics and funnels these to a designated mailbox for further review. After a prescriber has completed a consultation and written a prescription for a broad-spectrum antibiotic, the system generates an automated request to review the prescription to a specified online mailbox. The requests are reviewed on the system by one of the head office pharmacists or GPs to ensure appropriateness. In instances where an

alternative antibiotic is required a cancellation message is sent to the original prescriber with the rationale of the decision. The patient is contacted and alternative treatment and advice are provided. The efficiency of this process has been demonstrated by internal audits which have shown that patients' accessibility to timely treatment is not impacted.

At Babylon, services are provided to both public and private healthcare through two separate operations – GP at Hand and Babylon respectively. As a result of the large patient cohort within the NHS public operation, it is not possible to embed this process for broad-spectrum antibiotic prescriptions issued for patients within our public healthcare service.

The prescribing system also provides pre-populated prescription templates upon input of certain diagnostic codes including many common infections seen in primary care. This supports prescribing with the appropriate dose and duration already completed for the selected antibiotic and diagnosis.

1.4 PROBLEM IDENTIFIED

Broad-spectrum antibiotics are an effective group of antibiotics, however, inappropriate and widespread use can lead to antibiotic resistance and healthcare-associated infections such as *Clostridium Difficile* [1, 3, 33]. As a result, a key aim of antimicrobial stewardship interventions is to ensure the appropriate prescribing of broad-spectrum antibiotics [1, 3, 5]. At Babylon, audits are carried out monthly to monitor the usage of broad-spectrum antibiotics by looking into separate aspects of prescribing.

The first aspect was to ensure that broad-spectrum antibiotics are prescribed where a need for antibiotic treatment is required. This was to ensure that antibiotics were not prescribed for viral indications where antibiotic treatment is not required.

The second aspect was to ensure that in instances where antibiotics were prescribed in clinical situations and indications deemed appropriate, the prescription was reviewed to determine if the choice of a broad-spectrum antibiotic were appropriate.

The third aspect was to ensure that in instances where the correct choice of broad-spectrum antibiotic was made, the correct duration was prescribed according to the indication documented.

Within the audits, inappropriate broad-spectrum antibiotic prescribing was defined as prescriptions that did not meet any of the below criteria:

- Broad-spectrum antibiotic prescribed in line with the National Institute for Health and Care Excellence (NICE) and Public Health England (PHE) summary of antimicrobial prescribing guidance – managing common infections [34]

- Broad-spectrum antibiotic prescribed in line with Appropriate recognised society guidelines e.g. British Association of Sexual Health and HIV (BASHH)
- According to appropriate culture and sensitivity results
- According to consultant microbiologist or appropriate specialist advice
- Determined to be appropriate by Antimicrobial Stewardship lead Pharmacist

Results from the monthly audits carried out between April 2020 to October 2020 showed inappropriate prescribing of a broad-spectrum antibiotic in 21.4% of the total number of prescriptions audited. This is in line with studies that have shown inappropriate antibiotic prescribing rates in primary care to range between 8% to 24% however, it was identified that further improvement could be made [33, 35].

Providing clinician feedback has been recognised as a positive tool in improving antibiotic prescribing [19, 25, 29, 30]. Between April 2020 and October 2020, providing individual prescriber feedback was not part of the interventions in place. This, coupled with the results achieved presented an opportunity to observe the potential impact that providing prescriber feedback could have on appropriate broad-spectrum antibiotic prescribing. A quality improvement method was chosen to do so with the aim of improving appropriate broad-spectrum antibiotic prescribing by providing direct prescriber feedback alongside maintaining the established antimicrobial stewardship interventions in place.

2 METHODOLOGY

At Babylon, services are provided to both public and private healthcare through two separate operations – GP at Hand and Babylon respectively.

A retrospective audit of broad-spectrum antibiotic prescribing was carried out monthly between May 2021 – October 2021 by a Pharmacist within the team. Between October 2020 and April 2021, due to the ongoing COVID-19 pandemic, the provision of services to the increasing numbers of patients was prioritised and monthly audits restarted in May 2021.

All patients' records are stored electronically across two integrated systems used for prescribing and documentation with each consultation. An internal data analysis system uses information from the prescribing and consultation platforms to create dashboards which can be manipulated to provide quantitative information about all completed consultations such as clinical diagnosis and prescription data. These dashboards can be used to obtain a random sample of consultations according to set parameters.

On a monthly basis, a random sample of 80 broad-spectrum antibiotic prescriptions (40 private and 40 NHS) issued during the previous month is obtained. In months when the number of private prescriptions of broad-spectrum antibiotics issued was less than 40, all prescriptions were included within the sample. This data is downloaded in the form of an electronic spreadsheet and transferred to the data collection spreadsheet.

To complete the data collection sheet, each patient's electronic consultation notes are reviewed to determine the prescription's indication and rationale. All broad-spectrum antibiotic prescriptions in the sample are reviewed to determine if it was appropriate in terms of choice against national guidelines, relevant microbiological results or specialist recommendations and duration.

The data collection was completed by a pharmacy technician and the antimicrobial lead pharmacist.

The pharmacy technician was able to complete the data collection form for the prescriptions that were according to national guidelines. All broad-spectrum antibiotic prescriptions prescribed outside of national guidelines, or for an indication not listed in the guidelines were highlighted on the data collection spreadsheet for the antimicrobial lead pharmacist to review.

The antimicrobial stewardship lead pharmacist reviewed all entries made on the data collection form and completed an analysis to determine percentage compliance for each of the standards.

The analysis was carried out using a summary table developed using relevant formulas and pivot tables.

Clinicians identified as inappropriately prescribing a broad-spectrum antibiotic without clear clinical rationale were provided feedback through email. This was sent within 1-2 weeks of the analysis of the data. Each email included a summary of the consultation, details of the appropriate antibiotic to prescribe alongside the rationale and a request for the prescriber to share their rationale for prescribing a broad-spectrum antibiotic. Where common themes of inappropriate prescribing were identified, this was shared with all prescribers by email through the weekly clinicians' newsletter.

To observe the impact of individual prescriber feedback on appropriate prescribing a run chart was created and updated monthly. The percentage of appropriate broad-spectrum antibiotic prescribing was plotted against each month and the points at which email feedback was provided were highlighted along the timeline. This was compared to the results obtained between April 2020 and September 2020 and statistical analysis was carried out to identify significant differences.

This Quality Improvement Study was conducted using SQUIRE standards [36].

3 RESULTS

Between May and October 2021, 65 feedback emails were sent to clinicians identified as inappropriately prescribing a broad-spectrum antibiotic (Table 1). The highest proportion of feedback emails was sent to General Practitioners (GPs) (52.3%) followed by Advanced Nurse Practitioners (ANPs) (35.4%) and pharmacists (12.3%).

The highest percentage of inappropriate prescribing was observed in April 2020 (36.1%). Between April 2020 and September 2020 there is an overall decrease in inappropriate prescribing with the lowest rate seen in July 2020 (19.6%). However, lower results than this are seen in the period during 2021.

Between May and October 2021 there is a decreasing trend in the level of inappropriate prescribing as shown in Figure 1. The highest level of inappropriate prescribing was seen in May 2021 (27.6%) prior to providing individual feedback. The lowest level of inappropriate prescribing

was seen in September 2021 (8.9%), after five cycles of feedback had been provided.

Between May 2021 – October 2021, a total of 452 (241 NHS prescriptions and 227 Private prescriptions) broad-spectrum antibiotic prescriptions were audited.

Inappropriate broad-spectrum antibiotic prescribing was observed in 12.6% of audited prescriptions. Upon review of NHS and private prescriptions separately, inappropriate prescribing occurred in 17.6% and 7.4% of prescriptions respectively.

Comparatively, between April 2020 – September 2020, a total of 441 broad-spectrum antibiotic prescriptions were audited and inappropriate prescribing was seen in 21.4% of prescriptions. Reviewing NHS and private prescriptions separately, inappropriate prescribing was 20.7% and 22% respectively.

Statistical analysis was carried out by modelling the audit observations as a series of Bernoulli trials, where we regard a failure as a case where a broad-

MONTH (2021)	MAY	JUNE	JULY	AUGUST	SEPTEMBER	CLINICIAN TOTAL
GP	3	4	5	11	11	34
ANP	3	6	8	2	4	23
Pharmacist	0	0	5	1	2	8
Month Total	6	10	18	14	17	65

Table 1 Number of feedback emails sent to clinicians following the audit of each month between May 2021 – Sept. General Practitioner (GP), Advances nurse practitioner (ANP).

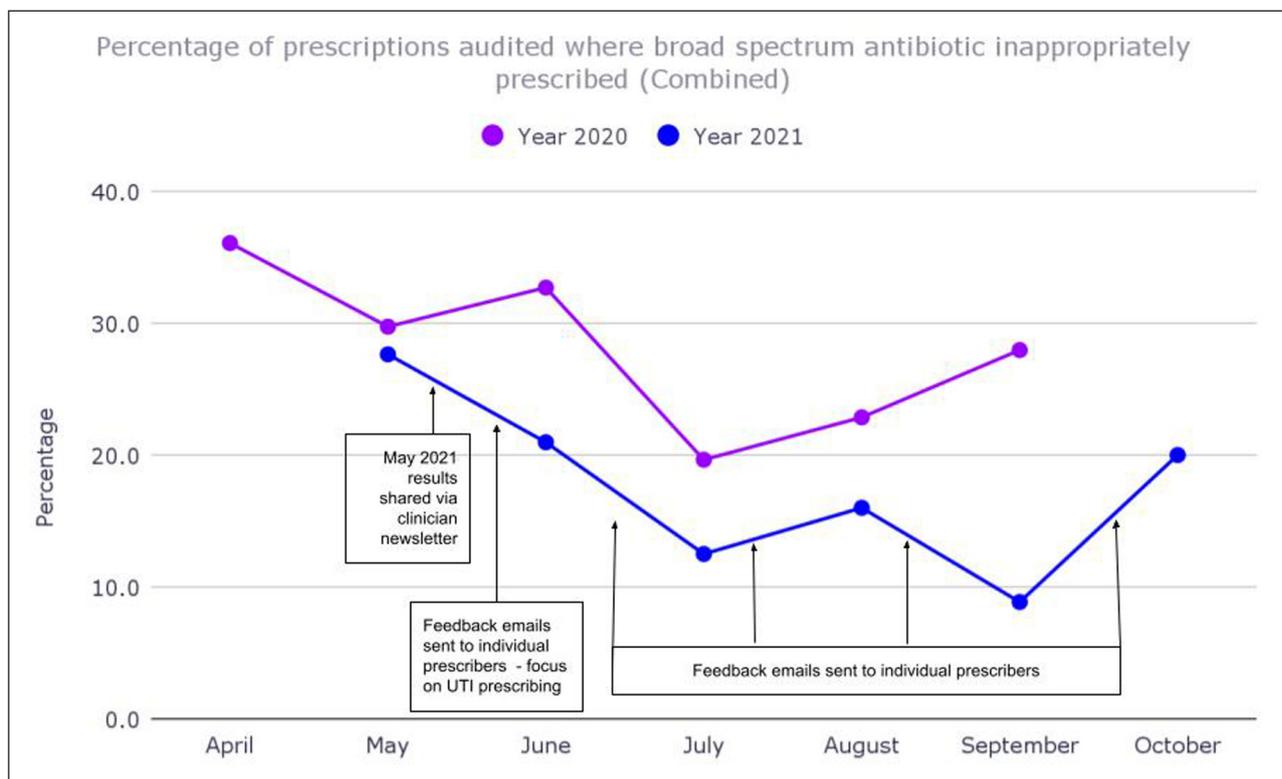


Figure 1 Percentage of prescriptions where inappropriate broad-spectrum antibiotic prescribing observed, April–September 2020 vs May–October 2021. Weighted average used from NHS and Private prescriptions analysed.

spectrum antibiotic is judged to have been prescribed inappropriately, and a success as a case where narrow-spectrum prescribed or broad-spectrum appropriately prescribed. A normal approximation for the binomial distribution was used and a two-tailed two-proportion pooled z-test was applied.

A statistically significant reduction in inappropriate prescribing during the intervention period was observed when all prescriptions were reviewed (May–October 2021 12.6% versus April–September 2020 21.4%, 95% confidence). This was also seen when private prescriptions were analysed (May–October 2021 7.4% versus April–September 2020 22%, 95% confidence) however this was not observed for NHS prescribing (May–October 2021 17.6% versus April–September 2020 20.7%, 95% confidence).

4 DISCUSSION

This analysis has demonstrated that prescriber feedback can significantly contribute to improving appropriate antibiotic prescribing. It is in line with results seen in previous studies that have shown that prescriber feedback is an effective tool in changing antimicrobial prescribing behaviour [19, 25, 29, 30, 37, 38]. To maximise the effect of providing feedback on improving prescribing, an open and transparent environment that enables clinicians to review and reflect on their practices alongside processes that ensure consistency and quality is essential [31].

Developing a workforce capable of utilising digital tools was highlighted as a key pillar to the successful integration of technology and innovation within the NHS [26, 27]. At Babylon, the skills and expertise of healthcare professionals such as prescribing pharmacists have been recognised and championed, demonstrated by the relatively large number of prescribing pharmacists that are within the core workforce. By integrating prescribing pharmacists within the core workforce in a digital setting we demonstrate the ability to develop skills required to consult in the digital workforce and showcase the positive impact that utilising prescribing pharmacists can have on primary care delivery.

Within the organisation, a multi-disciplinary approach is integral to the delivery of services with the expertise and skills of prescribing pharmacists, ANPs and GPs utilised. This quality improvement project was led by the antimicrobial stewardship lead who is a prescribing pharmacist within the senior pharmacy team. All feedback emails were written and sent by the antimicrobial stewardship lead and received by all clinician groups. The results achieved showcase the benefits that this level of multi-disciplinary collaboration can have on prescribing quality and patient care.

The delivery of healthcare services within the digital setting relies upon appropriate governance to provide

safety and quality to patients. The results from this quality improvement study demonstrate that it is possible to achieve good governance within the digital setting. The outcome of this study is positive and provides assurance that the quality of care that patients receive through video or telephone consultations relating to infections, is not compromised using a digital mode of delivery.

On reviewing the results for prescriptions issued by the private (Babylon) and NHS (GP at Hand) services separately, statistical significance was observed between inappropriate prescribing rates pre and post prescriber feedback for private prescriptions and not for NHS prescriptions audited. This is due to the difference in the process of prescribing broad-spectrum antibiotics between the two services.

Due to the risks associated with prescribing in the digital and private setting such as restriction to access to medical records, appropriate processes are required to ensure safe prescribing [39]. At Babylon, a formulary has been created to support prescribers to prescribe safely. Alongside the formulary, for medicines identified as carrying an increased risk when prescribed such as controlled drugs, specialist only medication and broad-spectrum antibiotics, an additional safeguard in the form of an approval process has been added [27]. In this process, all prescriptions for broad spectrum antibiotics are reviewed by a senior team clinician (a pharmacist or GP) to ensure clinical appropriateness. The prescription is released to the patient if approved or changed to a suitable antibiotic if considered inappropriate. This process does not occur within the NHS service as the resources required to embed such a process within such a large service would impact the cost-effective delivery of the service.

5 LIMITATIONS

The numbers of non-medical prescribers such as prescribing pharmacists and nurses are continually expanding within the UK and pharmacists prescribers are recognised as an increasingly important part of the healthcare team in the UK [40]. This project was led by the antimicrobial stewardship lead who is a pharmacist prescriber. This level of autonomy and independent practice by pharmacists is not mirrored in several countries. This could present a limitation having a pharmacist leading on and providing feedback to GPs. Adopting a multi-disciplinary approach where a medical professional supports the delivery of feedback to peers would be effective in overcoming this limitation.

Before the quality improvement project began, there were pre-existing processes in place to promote appropriate antibiotic prescribing. These were prescribing updates communicated to clinicians through a newsletter, an approval process for prescribing broad-spectrum antibiotics in private patients and prescription

templates embedded within the prescribing system. During the intervention period, these interventions were continued to ensure that any observed effects can be attributed to the intervention.

Within Babylon, consultations are provided by a multi-disciplinary workforce comprising of Pharmacists, Advanced nurse practitioners (ANPs) and General Practitioners (GPs). All types of clinicians may encounter patients presenting with acute infections and potentially prescribe antibiotics. The range of clinical conditions that can be effectively managed by Pharmacists and ANPs is continually expanding. However, most patients presenting with acute infections are seen by GPs resulting in the largest proportion of prescriptions to be written by GPs. In this project, 67.7% of the 452 prescriptions audited, were written by GPs followed by ANPs (22.1%) and pharmacists (10.2%).

Despite most feedback emails being sent to the majority prescriber group, the weighted impact of providing feedback to the different clinicians is not clear. A further study exploring the relative impact on improving appropriate antimicrobial prescribing when providing feedback to different clinician groups would be useful to further optimise this tool in antimicrobial stewardship.

6 CONCLUSIONS

The results from this project demonstrate that in conjunction with other antimicrobial stewardship tools providing feedback is an effective tool in changing prescribing patterns and behaviours to improve antibiotic prescribing. The project demonstrates that antimicrobial stewardship can be delivered on a digital basis through the appropriate adaptation of the antimicrobial stewardship tools established for use in the traditional face to face GP practice. The digital platform is a sustainable and effective platform to disseminate information quickly, implement and review changes and continually improve.

This project focussed on broad-spectrum antibiotic prescribing which makes up approximately 5% of total antibiotic prescribing within the organisation. This group of antibiotics are significant due to the consequential effects that misuse of these antibiotics can have. However, to gain an understanding of the impact of current antimicrobial stewardship interventions on antibiotic prescribing more generally, further audits are required on different classes with potential quality improvement projects on improving prescribing for particular infections.

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COMPETING INTERESTS

All listed authors are employees of Babylon and possess share options in Babylon.

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Yvonne Iroegbu: Conceptualization, formal analysis, Writing – Original draft

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