

Original Research

C-reactive protein point of care testing in community pharmacy: Observational study of a Northern Ireland pilot

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Abstract

Background: Whether or not to prescribe an antibiotic is a key issue for clinicians treating respiratory tract infection (RTI) in the community. Measurement of C-reactive protein (CRP) in community pharmacy may help to differentiate viral and self-limiting infections from more serious bacterial infections. **Objective:** To pilot POC CRP testing for suspected RTI within community pharmacy in Northern Ireland (NI). **Methods:** POC CRP testing was piloted in 17 community pharmacies linked to 9 general practitioner (GP) practices in NI. The service was available to adults presenting to their community pharmacy with signs and symptoms of RTI. The pilot (between October 2019 and March 2020) was stopped early due to Coronavirus-19 (COVID-19). **Results:** During the pilot period, 328 patients from 9 GP practices completed a consultation. The majority (60%) were referred to the pharmacy from their GP and presented with <3 symptoms (55%) which had a duration of up to 1 week (36%). Most patients (72%) had a CRP result of <20mg/L. A larger proportion of patients with a CRP test result between 20mg/L and 100mg/L and >100mg/L, were referred to the GP when compared to patients with a CRP test result of <20mg/L. Antimicrobial prescribing rates were studied in a subgroup (n=30) from 1 practice. Whilst the majority (22/30; 73%) had a CRP test result of <20mg/L, 50%, (15/30) of patients had contact with the GP in relation to their acute cough and 43% (13/30) had an antibiotic prescribed within 5 days. The stakeholder and patient survey reported positive experiences. **Conclusion:** This pilot was successful in introducing POC CRP testing in keeping with National Institute of Health and Care Excellence (NICE) recommendations for the assessment of non-pneumonic lower RTIs and both stakeholders and patients reported positive experiences. A larger proportion of patients with a possible or likely bacterial infection as measured by CRP were referred to the GP, compared to patients with a normal CRP test result. Although stopped early due to COVID-19, the outcomes provide an insight and learning for the implementation, scale up and optimization of POC CRP testing in community pharmacy in NI.

Keywords: point of care testing; c-reactive protein; community pharmacy; Northern Ireland

INTRODUCTION

Northern Ireland (NI) has the highest prescription rates of antibiotics of all the United Kingdom (UK) nations. In 2017, over 1.76 million prescriptions were issued for an antibiotic, approximately 1 course of antibiotics per head of population.¹ The Department of Health Changing the Culture 2019-2024: One Health strategy for tackling antimicrobial resistance in NI is aiming for a 15% reduction in antibiotic prescribing in primary care by 2023/24.² Reducing the use of antibiotics where they

are not necessary is essential to prevent the development of antibiotic resistance.

In the period 2001 - 2010, approximately 13 people per million died from acute lower respiratory tract infections (LRTI) each year in the UK.³ Upper and lower RTI account for about half of all oral antibiotics prescribed in the UK. Given the global concerns about antibiotic resistance, antimicrobial stewardship is essential to preserve the future effectiveness of antibiotics.⁴⁻⁶ Whether or not to prescribe an antibiotic is a key issue for clinicians treating RTI in the community. C-reactive protein is a marker of a host's response to a microbe which can become elevated in response to viral infections, but generally rises to higher levels in bacterial infections, especially severe bacterial infections.⁷ Measurement of CRP in people presenting in community pharmacy with suspected LRTI may help to differentiate viral and self-limiting infections from more serious bacterial infections.⁸ Indeed, an overwhelming number of studies have demonstrated that the use of CRP tests in patients presenting with RTI symptoms reduces the index of antibacterial prescribing.⁹ As a result, POC testing for CRP is incorporated into NICE (National Institute for Health and Care Excellence) guidelines for the diagnosis of pneumonia; facilitating the provision of results in time to inform treatment.¹⁰ POC testing, is defined as any medical device and/or system that enables diagnosis, monitoring or screening of patients at the time and place of care. These tests have the potential to shift care from general practitioner (GP)

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to community pharmacies helping to reinforce and support self-care for minor self-limiting infections.¹¹ Policymakers have identified community pharmacies as appropriate locations for extended healthcare delivery, not least due to the accessibility of community pharmacy (opening hours, locations and no need for appointments) meaning access to healthcare is easier.

In a systematic review and meta-analysis, Albasri *et al* explored the impact of various POC tests in community pharmacies. The review concluded that whilst a few studies suggested some promise in the use of pharmacy-based POC testing in particular areas (i.e. antimalarial dispensing in low-resource settings and in the control of blood lipids), results required cautious interpretation given the heterogeneity of results observed and lack of evidence on clinically relevant outcomes.¹² Further evidence for POC tests is required, particularly in areas such as RTIs. Extending the role of pharmacists to delivering POC testing may require further assessment before large-scale roll-out. Recent national guidance from NHS England on the implementation of POC testing in community pharmacies, highlight that there is still work to do to establish and expand the use of POC testing in primary care to conserve the use of antibiotics. This guidance emphasises the importance of these types of service in aiding recovery from the impact of COVID-19 by developing community pharmacy services thereby supporting the communities they serve.¹³

AIM

To pilot POC CRP testing as part of assessment for suspected RTI within community pharmacy in NI.

OBJECTIVES

To introduce CRP testing, in keeping with NICE recommendations for the assessment of non-pneumonic LRTIs.

To evaluate the impact of CRP testing by community pharmacy on antimicrobial prescribing rates.

To evaluate patient and pharmacist feedback on experiences of POC CRP testing in community pharmacy.

METHODS

Design

A pilot of the new POC CRP testing service was carried out in community pharmacies in the Northern and Western LCG (Local Commissioning Group) areas in NI. The pilot was to introduce and evaluate the implementation of a recommended standard care; therefore, research ethics approval was not applicable. An observational study of the service was completed.

Materials

Pharmacies were enabled with CRP analyser equipment; (Alere Afinion or QuikRead GO). Both systems had NICE Medtech Innovation Briefings (MIB) to support their use. Pharmacists

underwent training in using the equipment as well as testing and quality control training (provided by the equipment provider and the Health and Social Care Board [HSCB]).

Study population

The service was available to any person over the age of 18 and under the age of 65 registered with one of the 7 GP practice pilot sites with signs and symptoms indicative of RTI. No sample size calculation was carried out and a convenience sample was collected. Appendix 1 details the assessment and treatment process.

Data collection

Following patient referral, the pharmacist assessed the patient's symptoms in order to determine the severity of the ailment. Prior to performing the CRP test, the pharmacist ruled out any red flags, signs suggestive of serious illness and or any other complications, and performed a CRP test if appropriate. Based on the CRP test result, the pharmacist followed pre-defined consultation steps:

CRP test result < 20mg/L: bacterial infection unlikely, advice on self-care.

CRP test result between 20-100mg/L; possible bacterial infection, watch and wait with advice on self-care.

CRP test result >100mg/L: bacterial infection likely, refer to GP as appropriate.

The CRP test results were shared with the patient and their GP. Patients were provided with a personalised "treating your RTI" patient information leaflet (PIL) (Appendix 1) and advice on the course of action required including:

- the symptoms to expect
- the expected duration
- advice on self-care and over the counter (OTC) preparation to try alleviate symptoms
- any requirement for follow up if no improvement
- advice if ailment reoccurs
- advice on prevention
- referral to GP/Out of hours if applicable

Local arrangements were in place for dealing appropriately with individuals requiring onward referral to the GP. This was supported with written or verbal referral requests. Individuals could also be advised to refer themselves to their GP where, despite treatment, their ailment did not improve.

Outcome measures

A number of outcomes were explored:

Consultation outcome

Reasons for GP referral

Antimicrobial prescribing rates

Pharmacist perspectives and satisfaction: All pharmacists using the service were invited to complete an electronic survey via Citizen Space



Patient perspectives and satisfaction: All patients using the service were invited to complete a paper survey.

Data analysis

Data was collated using Microsoft Excel 2016. Descriptive statistics were used to summarize patient, community pharmacy and practice characteristics and activity. Descriptive summaries and proportions were used to summarize quantitative outcomes. A theming approach was used to summarize qualitative feedback. Discussion points emerging from the analysis were summarized.

RESULTS

A total of 9 GP practices and 17 community pharmacies from the Northern and Western LCG areas took part. The pilot study ran between 31st October 2019 and 11th March 2020. Given the emergence of COVID-19 in NI during early March 2020, the pilot was stopped early.

Patient and practice characteristics

During the pilot period, 328 patients from the 9 practices in the Northern and the Western LCG's areas completed a consultation for suspected RTI. One community pharmacy practice withdrew due to the lack of available trained pharmacists.

Patient, community pharmacy and practice characteristics are described in table 1.

In summary, the majority of patients were based in the Western area (72%), more than half of the patients were females (56%) with a mean age of 45 years. Over a third of patients (38%) had a pre-existing condition and 10% had multiple comorbidities. The majority (60%) of patients were referred to the pharmacy from their GP and presented with < 3 symptoms (55%) which had a duration of ≤1 week (36%). The most commonly reported symptoms were cough (72%) and other (56%). Nearly two thirds of patients (69%) had tried a previous treatment with some patients trying more than 1 treatment. Most patients (72%) had a CRP result in the lowest category of less than 20mg/L.

Consultation outcome according to CRP test results

Figure 1 presents the pharmacist consultation outcome according to patient CRP results. The bar chart represents the proportion of patients receiving the consultation outcome in each of the CRP test result categories.

Approximately equal proportions of patients were reported to have received verbal advice and received a patient information leaflet, regardless of the CRP test result. The proportion of patients reported to have purchased an additional OTC medicine was largest in patients with a CRP test result between 20mg/L and 100mg/L. In alignment with the project aim, a

Table 1. Patients, GP practices and community pharmacies characteristics	
Sample characteristics N=328 patients; N=9 GP practices and n=17 community pharmacies	
N (%) F	183 (56%)
N (%) M	113 (34%)
N (%) not reported	32 (10%)
Mean (SD) age (years)	45 (15)
N (%) with existing medical condition*	117 (36%)
N (%) with comorbidities (i.e. > 1 existing condition)	32 (10%)
Patients with a red flag:	
N (%) yes	1 (0.3%)
N (%) no	325 (99.1%)
N (%) not reported	2 (0.6%)
Referral source:	
N (%) referred to pharmacy from GP	198 (60%)
N (%) patients presented to pharmacy	124 (38%)
N (%) not reported	6 (2%)
Symptoms of RTI recorded:	
N (%) patients reporting cough	236 (72%)
N (%) patients reporting other**	185 (56%)
N (%) patients reporting discoloured and/or increased sputum production (phlegm)	124 (38%)
N (%) patients reporting feeling unwell	93 (28%)
N (%) patients reporting fever > 38° (temperature)	42 (13%)
N (%) patients reporting respiratory distress (difficulty breathing)	26 (8%)
N (%) patients reporting runny nose	6 (2%)
N (%) of patients reporting < 3 symptoms	181 (55%)
N (%) of patients reporting 3 or more symptoms	147 (45%)
Duration of symptoms:	
N (%) ≤1 week	118 (36%)
N (%) 1-2 weeks	61 (19%)
N (%) 2-3 weeks	47 (14%)
N (%) > 3 weeks	25 (8%)
N (%) not reported	77 (23%)



Any previous treatment tried: N (%) of patients that tried previous treatment N (%) of patients no previous treatment tried	228 (69%) 100 (31%)
Type of previous treatment tried: N (%) patients tried other*** N (%) patients tried paracetamol N (%) patients tried cough preparation N (%) patients tried ibuprofen	 138 (42%) 108 (33%) 95 (29%) 15 (5%)
Median (range) CRP (mg/L) ****	9 (1-200)
CRP test result parameter category: N (%) less than 20mg/L N (%) between 20mg/L and 100mg/L N (%) greater than 100mg/L N (%) not reported	237 (72%) 85 (26%) 4 (1.2%) 2 (0.6%)
93 (28%) Northern LCG: 235 (72%) Western LCG Northern LCG's: N (%) practice 1 N (%) practice 2 N (%) practice 3 N (%) practice 4 N (%) practice 5 Western LCG's: N (%) practice 6 N (%) not reported N (%) practice 7 N (%) practice 8 N (%) practice 9	 36 (11.0%) 25 (7.6%) 13 (4.0%) 15 (4.6%) 4 (1.2%) 225 (68.6%) 5 (1.5%) 3 (0.9%) 1 (0.3%) 1 (0.3%)

* Breakdown of primary existing medical condition reported in appendix 2

** Breakdown of other symptoms reported in appendix 3

*** Breakdown of other treatment tried presented in appendix 4

****n=324 (n=4 no value reported)

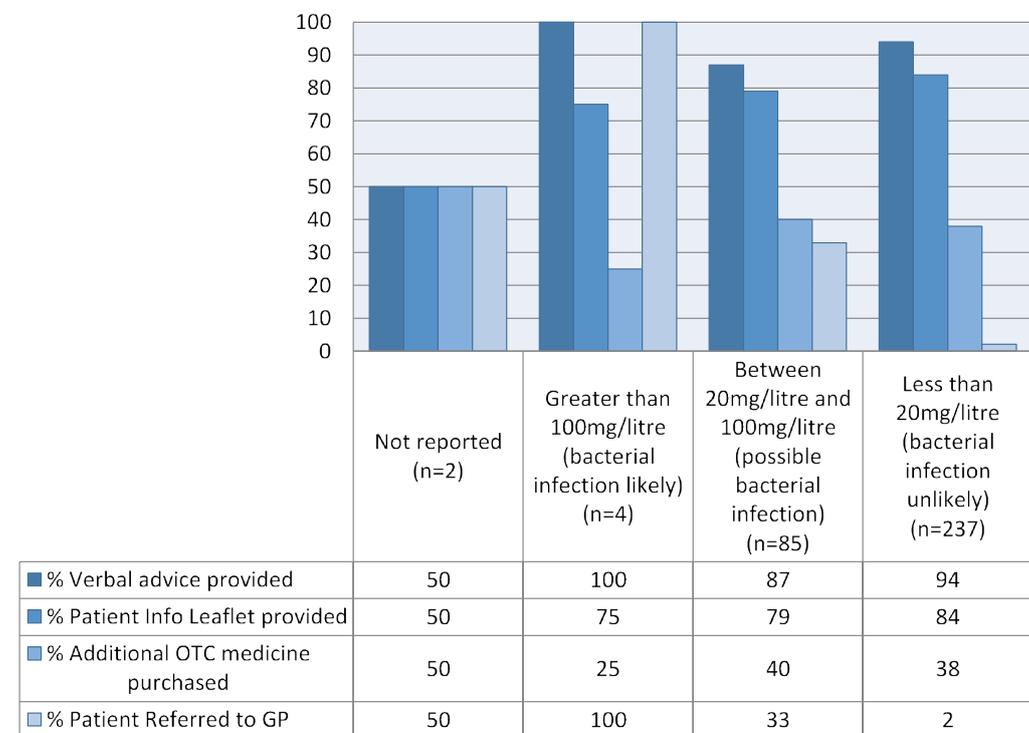


Figure 1. Pharmacist consultation outcome according to CRP test results (n=328 patients)

larger proportion of patients with a CRP test result between 20mg/L and 100mg/L and greater than 100mg/L, were referred to the GP compared to patients with a CRP test result of less than 20mg/L.

In terms of the overall cohort of 328 patients, 38 (12%) of patients were referred onwards to the GP. The reasons for GP referral are presented in figure 2.

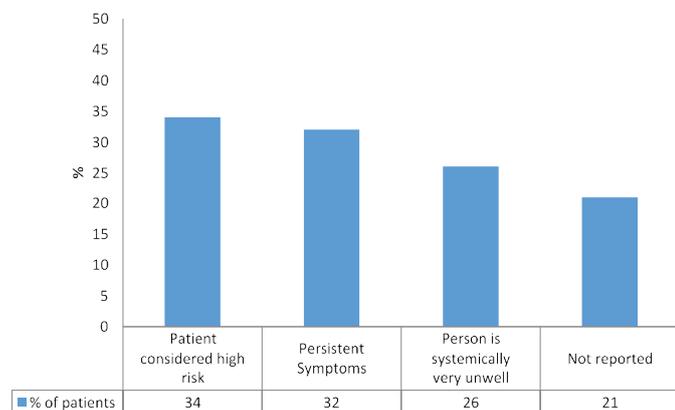


Figure 2. Reasons for GP onward referral (n=328 patients)

It was noted that approximately equal proportions of patients were referred due to being considered high risk or having persistent symptoms.

Impact of POC CRP testing by community pharmacy on antimicrobial prescribing rates

Due to the project stopping early and subsequent disruption in pharmacy and GP practices caused by COVID-19, data on antimicrobial prescribing rates could only be retrospectively collected in a subgroup of patients (n=30) from 1 practice. The practice recorded the GP activity on 30 patients who had received a pharmacy consultation between 29/11/2019 and 14/02/2020.

As shown in figure 3, 50% (15/30) of patients had future contact with the GP practice in relation to their acute cough and 43% (13/30) had an antibiotic prescribed within 5 days of the consultation with the community pharmacist.

Of note, only 20% (6/30) of patients had a copy of the community consultation recorded in their GP record.

The original CRP test result from the community pharmacist for the majority of these patients (22/30; 73%) was less than 20mg/L (Figure 4).

Pharmacist perspectives and satisfaction

An online pharmacist evaluation questionnaire was opened via Citizen Space on 09/06/2021 and all participating sites in Western and Northern LCG areas were invited to submit a response. By 15th October 2021, 3 pharmacists from practices participating in the pilot had submitted a response. As highlighted, administration of this survey was delayed significantly due to the COVID-19 pandemic. As a result, the response rates were low.

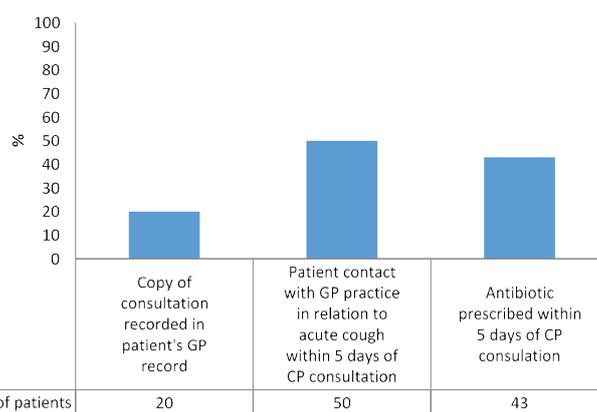


Figure 3. GP activity (n=30 patients)

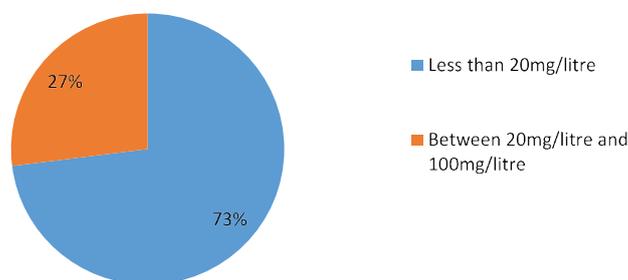


Figure 4. CRP test result in patients prescribed antibiotic within 5 days of consultant pharmacist consultation (n=30)

Usability and feasibility: Practical aspects of POC CRP testing

All respondents opted to use the Affinion 2 (Abbott) CRP analyser during the pilot and both reported that they received adequate training in the use of the machine. All 3 practices responding to the questionnaire located their machine in the consultation room and stored cartridges in the fridge. One of the practices highlighted some problems ordering replacement cartridges, which were eventually resolved.

The practices used testing as patients presented and all pharmacists commented on how the CRP test fitted into the patient consultation:

“Worthwhile education for (the) patient but time consuming for the pharmacist”

“CRP test fitted in well to consultation. Patients generally liked getting a test to show if antibiotics were required”

“I feel that it was a very useful service as majority felt they needed an antibiotic but when they were able to see the test results for themselves and that it was viral this made patient counselling easier and in turn meant that antibiotics were only prescribed to those who needed”

The pharmacists reported that the CRP test only took on average, an extra 5-10 minutes of time with the patient. Two of the pharmacists reported that the use of the test did impact on patient flow in their pharmacy. One site commented: “All extra

work has a certain impact. It always works best when there are two pharmacists on site.”

Pharmacist perceptions on benefits of POC CRP testing

Respondents reported that the main reason for using the CRP test was to reassure the patient that antibiotics were unlikely to be needed. Two pharmacies also reported that it was used to assist the diagnostic process. They were “satisfied” with the service overall, would continue to use the test if cartridges were funded by the HSCB and would recommend the CRP testing service to other pharmacies. However, only 1 would continue to use the test if the pharmacy had to fund the cartridges.

Pharmacist perceptions of the impact on the patient

The pharmacies reported that the general feedback on the CRP testing service from patients was positive overall. They reported that patients found out about the service through referral from their GP practice and 2 also reported that patients were aware of the service through word of mouth. In general, they reported that patients understood why the test was being done, were content to wait for the test result and that the test reassured the patients about their cough.

Finally, they believed that the availability of CRP testing changed patient’s expectations about needing or wanting an antibiotic for their complaint.

Patient perspectives and satisfaction

Eighty-nine patients’ responses were received for analysis. This represented 27% (89/328) of the patients seen during the pilot.

Understanding of the service

The majority (66%) of patients found out about the service through referral by their GP practice. The other sources of referral to the service are displayed in figure 5.

Ninety-nine percent of patients understood why the test was being done. The majority (88%) also reported that the test reassured them about their cough (4% reported “not sure” and 8% did not respond).

Almost all (99%) of patients were “very satisfied” or “satisfied” with the service overall. All patients agreed that the pharmacist



Figure 5. Patient questionnaire: How did you find out about this service? (n=89)

provided advice on the management of their symptoms and 98% found the advice helpful. The majority of patients (96%) were “very likely” or “likely” to use the service again. In addition, the majority (97%) were “very likely” or “likely” to recommend the service to friends or family.

Impact of the service

When asked would you feel more confident to manage these symptoms yourself in the future, the majority (79%) responded “yes”, however 12% responded “not sure” and 9% responded “no”. When patients were asked “If this service had not been available, what would you have done”, the majority (69%) responded that they would have contacted their GP practice, demonstrating how the CRP POC testing in community appropriately managed acute cough at this time, whilst reducing pressure in primary care. Figure 6 summarises all patient responses to this question.

Thirteen patients provided further feedback when asked to suggest how to improve the service. The majority of these comments were under the theme of “positive patient feedback”. Table 2 summarises the themes and associated responses.



Figure 6. Patient questionnaire: If this service had not been available, what would you have done? (n=89)

DISCUSSION

Although stopped early due to COVID-19, this descriptive summary of a pilot of CRP POC testing provides key learning points for the scaling up, refinement and optimization of the service in community pharmacy in NI.

This pilot was successful in introducing CRP testing in community pharmacies in NI, in keeping with NICE recommendations and both stakeholders and patients reported positive experiences.¹⁰ In line with project aims, a larger proportion of patients with a possible or likely bacterial infection as measured by CRP were referred to the GP, compared to patients with a CRP test result within the normal range. This highlights the success of the training in aiding delivery and interpretation of the POC testing, a key aspect outlined in the recent NHS guidance.¹¹ The provision of verbal advice and written information by community pharmacy is considered standard management and the results from this pilot demonstrate that this is being achieved for patients presenting with RTI symptoms.



Table 2. Do you have any other feedback or suggestions to improve the service? n=89 patients	
Theme	Direct extract
Positive patient feedback	Good idea! Very useful.
	Very helpful
	Very helpful and eased my mind
	Just a great service
	It's great keep it going
	I think this (is) great
	I think that this service being provided by the pharmacist is excellent and a great innovation
	Very helpful, great advice
	Fairly good idea. Saves sitting in Doctors surgery
	Very happy.
Future funding	This is a brilliant system.
	The funding needed
Clear explanations of procedures	Good explanations of the procedure

We can also draw some inferences on the impact of CRP testing by community pharmacy on antimicrobial prescribing rates. In the subgroup analysis from 1 practice, whilst the majority of patients (73%) had a CRP test that indicated bacterial infection was unlikely, half still went on to have contact with their GP practice and 43% had an antibiotic prescribed within 5 days of the consultation with the community pharmacist. Although only from a subgroup, this result is not in alignment with an overwhelming number of studies demonstrating that the use of CRP tests in patients presenting with RTI symptoms, reduces the index of antibacterial prescribing.¹⁴⁻¹⁶ However, there may be a number of factors in addition to CRP POC test results that influence GP antibiotic prescribing for LRTIs. Fletcher-Lartey *et al* interviewed GPs to understand and quantify the various factors influencing GP antibiotic prescribing for LRTIs and found that patient expectations—were a major influencing factor in antibiotic prescribing. Limited time, poor doctor–patient communication and diagnostic uncertainty also play a part.¹⁷ The finding of antibiotics being prescribed despite a normal CRP POC test result indicates that there may be additional work to do to consider these other factors and the impact they have on such a service in primary care in NI.

Results from the stakeholder and patient surveys results provide valuable feedback on the utility and feasibility of the CRP POC testing service. Stakeholders specifically highlighted how funding (of cartridges) and consideration of extra time required to deliver the service, was essential for sustainability. A recent review has highlighted that although there is significant evidence of the benefits of CRP POC testing, financial constraints and lack of incentive for clinicians, continue to be a major barrier in the adoption of this new diagnostic process in primary care.⁹ This emphasises that clarity on these issues is essential in the successful implementation of this service regionally. Findings from this study surveying 89 patients, also echo the findings from other studies of POC testing in community pharmacies in UK and other countries, with high

levels of patient satisfaction.¹⁸⁻²¹ This finding supports further scale up and roll out of this service, supporting a potential shift in health-seeking behaviour towards a pharmacist-led service. Interestingly, results from the patient questionnaire also show that the majority were referred by the GP, assuming they went there initially for advice. Other studies have reported that a lack of service publicity can limit patient engagement, underlining the importance of awareness and promotion strategies to encourage service uptake.¹⁸ This indicates that raising awareness of any future community pharmacy POC testing services is needed to ensure services achieved their aim to reduce GP workload.

The NHS England guidelines for POC testing in community pharmacies outline the multiple factors which can influence POC testing adoption and implementation including the service commissioners, technology and equipment selection, operational service delivery, governance and assurance. This guideline will be useful in informing practices, guiding commissioners and informing community pharmacies on the consistent standards required to ensure delivery of an effective POC clinical service. Importantly, the guidance also highlights the importance of record keeping and regular audit to ensure adherence to correct procedures for an effective POC testing service.¹¹

There are limitations to this study. The pilot was purely observational and did not include a comparator group. The antimicrobial prescribing rates analysis was based on a small random subgroup from a single site as some sites were unable to collect the follow up data due to the impact of COVID-19 on staffing levels. There may be unknown confounding factors in the subgroup analysis, which could affect the generalizability of the results. Stakeholder surveys results were also based on very small numbers and may not be representative of all practices involved in the pilot.

Results must also be interpreted in the context of restrictions



introduced as a result of the COVID-19 pandemic and provides key learning points on how such a service would be impacted in these circumstances. Given the emergence of COVID-19 in NI during March 2020, the pilot was stopped early limiting the practices and patients that could take part. Furthermore, the impact of COVID-19 on staffing and working environments led to delays in retrieving data and in conducting the stakeholder survey during the evaluation process. Importantly the impact of COVID-19 on the community pharmacy workplace and the management of patients with RTI symptoms meant that the model used in this pilot was not a feasible working model during the pandemic when restrictions were in place.

CONCLUSION

Given the global antimicrobial resistance crisis, pharmacists have an important role in minimising the inappropriate use of antimicrobials. This pilot was successful in introducing POC CRP testing in keeping with NICE recommendations for the assessment of non-pneumonic LRTIs and both stakeholders and patients reported positive experiences. In line with project aims, a larger proportion of patients with a possible or likely bacterial infection as measured by CRP were referred to the GP, compared to patients with a CRP test result within the normal range.

Although stopped early due to COVID-19, this descriptive summary of the outcomes and experiences of this pilot provides an insight on the implementation of CRP POC testing and key learning points for the scaling up, refinement and optimisation of the service in community pharmacy in NI.

CONFLICTS OF INTEREST STATEMENT

There are no conflicts of interest.

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AUTHORS CONTRIBUTIONS

Prof Mike Scott: Analysis of data, interpretation of data, drafting the work, revising drafts critically for important intellectual content, final approval of the version submitted for publication.

Dr Glenda Fleming: Analysis of data, interpretation of data, drafting the work, revising drafts critically for important intellectual content, final approval of the version submitted for publication.

Dr Katherine O'Neill: Analysis of data, interpretation of data, drafting the work, revising drafts critically for important intellectual content, final approval of the version submitted for publication.

Gillian Plant: Conception or design of the work, acquisition of data, interpretation of data, drafting the work, revising drafts critically for important intellectual content, final approval of the version submitted for publication.

Sam Varma: Conception or design of the work, acquisition of data, interpretation of data, drafting the work, revising drafts critically for important intellectual content, final approval of the version submitted for publication.

References

- <https://www.health-ni.gov.uk/news/nis-chief-medical-officer-warns-dangers-antibiotic-resistance>
- <https://www.daera-ni.gov.uk/publications/changing-culture-2019-2024-one-health>
- [Acute lower respiratory tract infections \(acute LRTI\) statistics | British Lung Foundation \(blf.org.uk\)](https://www.blf.org.uk/acute-lower-respiratory-tract-infections-statistics)
- World Health Organization. Global Action Plan on Antimicrobial Resistance, 2015. <https://www.who.int/publications/i/item/9789241509763>
- Hay AD. Point-of-care tests to inform antibiotic prescribing. *BMJ*. 2021;374:n2253. <https://doi.org/10.1136/bmj.n2253>
- NICE. Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use, 2015. <https://www.nice.org.uk/guidance/ng15>.
- Sproston NR, Ashworth JJ. Role of C-Reactive Protein at Sites of Inflammation and Infection. *Front Immunol*. 2018;9:754. <https://doi.org/10.3389/fimmu.2018.00754>
- Huddy JR, Ni MZ, Barlow J, et al. Point-of-care C reactive protein for the diagnosis of lower respiratory tract infection in NHS primary care: a qualitative study of barriers and facilitators to adoption. *BMJ Open*. 2016;6:e009959. <https://doi.org/10.1136/bmjopen-2015-009959>
- Cooke J, Llor C, Hopstaken R, et al. Respiratory tract infections (RTIs) in primary care: narrative review of C reactive protein (CRP) point-of-care testing (POCT) and antibacterial use in patients who present with symptoms of RTI. *BMJ Open Respiratory Research*. 2020;7:e000624. <https://doi.org/10.1136/bmjresp-2020-000624>
- <https://www.nice.org.uk/guidance/cg191>
- <https://www.england.nhs.uk/wp-content/uploads/2022/01/B0722-Point-of-Care-Testing-in-Community-Pharmacies-Guide-January-2022.pdf>
- Albasri A, Van den Bruel A, Hayward G, et al. Impact of point-of-care tests in community pharmacies: a systematic review and meta-analysis. *BMJ Open*. 2020;10:e034298. <https://doi.org/10.1136/bmjopen-2019-034298>
- <https://www.england.nhs.uk/primary-care/pharmacy/community-pharmacy-contractual-framework/>
- Dixon S, Fanshawe TR, Mwandigha L, et al. The Impact of Point-of-Care Blood C-Reactive Protein Testing on Prescribing

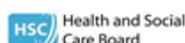


Antibiotics in Out-of-Hours Primary Care: A Mixed Methods Evaluation. *Antibiotics* (Basel). 2022;11(8):1008. <https://doi.org/10.3390/antibiotics11081008>

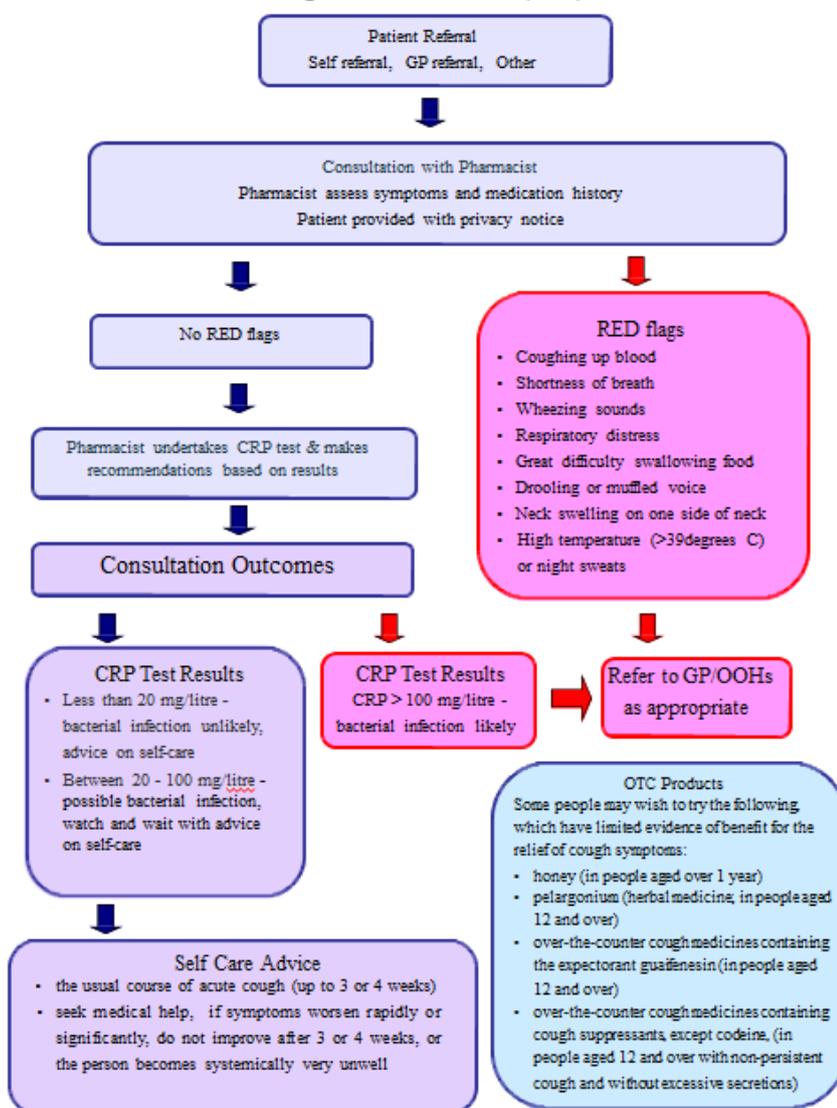
15. Boere TM, van Buul LW, Hopstaken RM, et al. Effect of C reactive protein point-of-care testing on antibiotic prescribing for lower respiratory tract infections in nursing home residents: cluster randomised controlled trial [published correction appears in *BMJ*. 2021 Nov 29;375:n2894]. *BMJ*. 2021;374:n2198. <https://doi.org/10.1136/bmj.n2198>

16. Little P, Stuart B, Francis N, et al. Antibiotic Prescribing for Acute Respiratory Tract Infections 12 Months After Communication and CRP Training: A Randomized Trial. *Ann Fam Med*. 2019;17(2):125-132. <https://doi.org/10.1370/afm.2356>

Appendix 1



Point of Care Testing - C-reactive Protein (CRP) Service Outline



Appendix 2

Primary existing medical condition reported	N (%)
Asthma	36/117 (31%)
Hypertension	26/117 (22%)
Diabetes	9/117 (8%)
Thyroid problems	8/117 (7%)
Epilepsy	5/117 (4%)
Multiple sclerosis	4/117 (3%)
Rheumatoid arthritis	4/117 (3%)
Heart condition	4/117 (3%)
Mental health problems	4/117 (3%)
Allergies	2/117 (2%)
Angina	1/117 (1%)
Fibromyalgia	1/117 (1%)
Stomach problems	1/117 (1%)
Sjorgen's disease	1/117 (1%)
Chronic leukaemia	1/117 (1%)
Lipidaemia	1/117 (1%)
Arthritis	1/117 (1%)
ENT nasal symptoms	1/117 (1%)
Long QT syndrome	1/117 (1%)
Proctitis	1/117 (1%)
Hernia	1/117 (1%)
Hypercholesterolaemia	1/117 (1%)
Inflammatory condition	1/117 (1%)
Cancer	1/117 (1%)
COPD	1/117 (1%)

Appendix 3

Other symptoms reported	N (%)
Sore throat / dry throat	46/185 (25%)
Headache / head cold symptoms	26/185 (14%)
Chest tightness / wheeze	23/185 (12%)
Chest pain	21/185 (11%)
Congestion	16/185 (9%)
Aches & pains / systemic symptoms	11/185 (6%)
Flu symptoms	12/185 (6%)
Blocked nose	6/185 (3%)
Sinus symptoms	4/185 (2%)
Feeling cold	3/185 (2%)
Fever	2/185 (1%)
Swollen glands	2/185 (1%)
Sweats	2/185 (1%)
General pain	2/185 (1%)
Insomnia	2/185 (1%)
Tiredness / fatigue	2/185 (1%)
Change in taste	2/185 (1%)
Light head	2/185 (1%)
Ear symptoms	2/185 (1%)
Shortness of breath	2/185 (1%)

Appendix 4

Other treatment tried	N (%)
Cold & flu tablets / sachets	46/138 (33%)
Decongestant	16/138 (12%)
Inhalers	9/138 (7%)
Cough syrup	9/138 (7%)
Antibiotics	9/138 (7%)
Co-codamol	7/138 (5%)
Throat spray	6/138 (4%)
Fluids	6/138 (4%)
Vicks	5/138 (3%)
Nurofen	1/138 (1%)
Steam	1/138 (1%)
Aspirin	1/138 (1%)
Honey & lemon	1/138 (1%)
Cider vinegar	1/138 (1%)
Steroids	1/138 (1%)
Omeprazole	1/138 (1%)
Nasal spray	1/138 (1%)
Paracodol	1/138 (1%)
Benzydamine spray	1/138 (1%)
Salt and water	1/138 (1%)
Penicillin	1/138 (1%)
Pain relief tablets	1/138 (1%)
Rest	1/138 (1%)
Pholcodine	1/138 (1%)
Vitamin C	1/138 (1%)
Zell Oxygen Immunocomplex	1/138 (1%)