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“I know this is on my chest, let’s act”: a qualitative study exploring self-management of acute COPD exacerbations with a sputum colour chart to reduce unnecessary antibiotic use

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Half of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) are caused by bacterial infection, but self-management plans (SMPs) generally advocate use of antibiotics and steroids for all events. We report findings from a qualitative study exploring the acceptability of a sputum colour chart and SMP to guide patient use of antibiotics and steroids (commonly termed a ‘rescue pack’). Qualitative interviews were conducted with healthcare professionals (HCPs) and patients from the Colour COPD trial – a randomised controlled trial of usual care (SMP alone) versus usual care plus sputum colour chart to manage AECOPD across England and sampled to promote maximum variation. Interviews were audio-recorded, transcribed clean verbatim, then analysed thematically, using an adapted Framework approach. Expert patients contributed to the patient data analysis. Fourteen HCPs and 39 patients were interviewed from primary and secondary care. Three overarching themes were identified. (1) Handling tensions: the tension between stewardship of antimicrobials and need to reduce risk of serious illness. (2) Clinical and embodied legacies: established clinical practices of infection control and patient’s own experiences of managing their condition over time have focused on early intervention for AECOPD. (3) Changing self-management practices: opportunities for changing practices through negotiating change between HCP and patient. In conclusion, while, in principle, the assessment of sputum colour using a chart to manage AECOPD was acceptable to both patients and HCPs, in practice, it is unlikely to have significant impact on well-established clinical practices for infection control and patient habits of self-management.

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a chronic condition affecting 2 million people in the UK¹, causing over 140,000 hospital admissions and 1.7% of UK hospital bed days per year¹. Most admissions to hospital in COPD patients are for acute exacerbations of COPD (AECOPD) and these drive the economic burden of COPD, estimated at £1.8bn in direct costs alone within the UK². AECOPD are defined by “worsening of respiratory symptoms beyond normal day-to-day variations and leading to a change in medication”³. Sub-types of exacerbation can be classified according to symptoms⁴ and may require treatment with steroids alone or steroids and antibiotics⁵. There has been a drive over the last few decades by health care professionals (HCPs) to encourage early intervention to reduce the negative impacts of serious AECOPD. Intuitively, early recognition and treatment of AECOPD would reduce exacerbation severity and duration, and improve prognosis; evidence for this is limited but supportive⁶.

Exacerbation pathophysiology is not fully understood but includes elements of infection and of environmental triggers^{7,8}. A systematic review in 2012 found bacteria in just 46% of events⁹, suggesting antibiotics will effectively manage only half of AECOPD episodes; nevertheless, they are used in most events. Inappropriate use or overuse increases the long-term risk of antimicrobial resistance (AMR)¹⁰. Controlling AMR through appropriate stewardship of antibiotics and other antimicrobials is recognised as a global emergency¹¹. In hospitalised AECOPD patients, resistance

occurs in up to 66% of cases, and relates to past antibiotic use¹², suggesting those with prior hospitalisation, frequent antibiotic courses or high risk of AECOPD are key groups to target for interventions aimed at reducing antibiotic usage. It is well recognised that there is potential tension in practice between the goals of reducing antibiotic usage and ensuring early intervention for AECOPD (and other infections)¹³.

In the UK, self-management of AECOPD involves the use of self-management plans (SMPs) alongside a self-administered pack of antibiotics and steroids (commonly known as a ‘rescue pack’) to reduce the impact of AECOPD on patients¹⁴. Sputum colour is a marker of neutrophilic inflammation and bacterial infection¹⁵, suggesting it could be used to guide antibiotic treatment and reduce inappropriate use. In studies conducted in Birmingham in approximately 100 patients over a year¹⁵ there was 94% probability that infectious exacerbations of COPD had green sputum (sensitivity of green sputum = 94%). Specificity of green sputum for bacterial infection was 77%. Therefore, the use of a sputum colour chart could be a simple way to guide antibiotic treatment and enhance appropriate self-management by AECOPD patients. Qualitative research has identified the high levels of fear experienced by patients during serious episodes or AECOPD¹⁶, and the importance of individual knowledge about how to look after oneself in COPD¹⁷. There is, however, currently limited understanding of patients’ process of learning to better self-manage their symptoms using a rescue pack, whether and how they learn about appropriate self-management from their

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interactions with HCPs, or how they adapt to changing guidance around antibiotic use for AECOPD.

Participants on the Colour COPD trial were given 5 days' supply of antibiotics and steroids with a personalised SMP (adapted from the NHS Salford SMP, see Supplementary files 1 & 2) explaining what symptoms might necessitate the use of the medications in their 'rescue pack' and to wait 2 days before using it, unless symptoms fell into the red zone of their SMP. Those in the intervention arm were also given a credit card sized 5 point Bronkotest® (sputum colour chart) to use alongside their rescue pack. For those in the intervention arm, the SMP advised them to use their colour chart to decide whether to use steroids alone versus antibiotics and steroids. The aim of the trial was to investigate the effectiveness of using sputum colour charts alongside a SMP in guiding patients' antibiotic use. The purpose of the qualitative sub-study reported in this paper was to investigate the acceptability of the intervention for patients and healthcare professionals. A related paper looking at whether the colour chart could be used by those with colour blindness has been published¹⁸.

METHODS

Study design

A nested qualitative sub-study was conducted in the UK with COPD patients recruited to a randomised controlled trial, "Sputum colour charts to guide antibiotic self-treatment of acute exacerbation of COPD (Colour COPD)," and their healthcare providers in primary and secondary care. However, the trial only ran for part of the planned data collection period due to the COVID-19 pandemic affecting recruitment and funding. Despite this, the qualitative team were able to continue their exploration of the acceptability of the intervention as well as contextual views and experiences regarding self-management of COPD and antibiotics as originally planned. Qualitative interview data were collected from July 2022 – November 2023. Analysis was conducted using a modified version of Framework analysis¹⁹ in collaboration with lay co-analysts.

Ethical review

The Colour COPD trial and sub-studies were reviewed by the Yorkshire & The Humber – South Yorkshire Research Ethics Committee, ref number: 20/YH/0273 and all participants gave informed consent.

Access and recruitment

COPD patients from primary and secondary care with a history of ≥ 2 AECOPD in the 12 months prior to screening or ≥ 1 hospital admission for AECOPD were invited to participate in the trial. Randomised patients received a follow up call to ensure that they had received the trial tools and understood how to use them. Patients received information about the qualitative study as part of the patient information sheet for the trial and were given the option to consent to being contacted by the qualitative team. All HCPs involved in the trial were advised about the qualitative interviews and all were invited to participate. Informed consent was obtained verbally from each participant prior to the interview commencing, recorded in writing by the researcher and a copy sent to the participant.

Sampling

The adequacy of the sample size was carefully monitored throughout to increase the information power to develop our knowledge in relation to the research questions^{20–22}. This was limited by the period of data collection, and the characteristics of the participants who agreed to participate in this arm of the study.

All eligible participants were entered into a sampling frame so that potential participants could be selected to increase the diversity of the sample (e.g. trial arm, reports of AECOPD at 3, 6 or 12 month follow up, age, gender, ethnicity and additional long-term conditions) as far as possible. Some patients were invited to participate in follow up interviews, for instance, when they had first been interviewed after they had received the colour chart and it was valuable also to explore their views on it after they had been using it for some months.

Data collection

A topic guide (see Supplementary file 3) was developed, in conjunction with our patient and public involvement (PPI) group, drawing on existing literature and theories on attitudes to and practices around antibiotic prescription, experiences of health care provision and self-management to prevent AECOPD. Interviewees in the intervention arm were additionally asked questions about their use of the colour sputum charts. The topic guide was developed iteratively throughout the period of data collection. Interviews were conducted by RLA (a nurse and senior research fellow) and NLM (social research associate). In response to the COVID-19 pandemic and the vulnerability of this group, all the interviews were recorded and conducted online using video conferencing, or on the telephone. Interviews lasted between 24 and 90 minutes.

Data analysis

To help ensure that the patient voice remained central to our research, expert patients (KA & SS) were recruited to contribute to the analysis of the patient data as lay co-analysts throughout the analysis. We recruited our patient co-analysts through local PPI networks e.g. the University of Birmingham respiratory patient advisory group (PAG) and the CRN West Midlands Regional network of Research Champions. Interested persons submitted expressions of interest and CVs in response to recruitment adverts (e.g. posters in the local respiratory department and at meetings with local research champions) and appointed following online discussions. At the first of 3 meetings an overview of the study and qualitative processes were given. 2 interviews from phase 1 of the main trial were shared so that the co-analysts could identify areas needing further investigation during data collection. At the second meeting a further 2 interviews were shared along with a preliminary coding framework for refinement. In the final meeting the University team shared their thoughts on the key messages arising from the data, these were refined. Documents for discussion at each meeting were sent in advance. During the writing up phase the co-analysts had constant access to the online paper and were prompted at key moments to review it. An example of their contribution was that KA drew the teams' attention to the link between patients' repeated use of terms like "I know", used in this paper's title, when making decisions about their AECOPDs and their self-management of exacerbations, the importance of "being heard" during an exacerbation, and also corroborated our interpretation of the data, particularly that of the language used to describe rescue packs.

Analysis comprised eight stages:

Stage 1: Transcription (data were transcribed intelligent verbatim and anonymised by a professional transcription company).

Stage 2: Familiarisation with the transcripts (RLA, NLM, KA, SS & NKG). Transcripts were discussed in team meetings and co-analyst workshops.

Stage 3: Initial coding of selected transcripts (RLA, NLM).

Stage 4: Development of a coding framework (RLA, NLM, KA, SS & NKG) through discussion in team meetings and co-analyst workshops.

Stage 5: Application of the coding framework to the remainder of the transcripts (RLA, NLM).

Stage 6: Charting data – for the purposes of this paper data for key codes were summarised (RLA, NLM).

Stage 7: Interpreting the data (RLA, MM, NLM, KA, SS & NKG). To address the research question, the data were arranged into themes and summarized. Emergent themes were discussed in team meetings and co-analyst workshops, which fed into the final three themes presented below.

Stage 8: Writing Up (All authors contributed to the writing up of the paper).

Results from the trial will be published elsewhere.

RESULTS

Participants

In total, there were 53 participants in the study, with 39 patients and 14 healthcare professionals interviewed. 4 patients were interviewed twice. Table 1 provides a breakdown of their characteristics.

Overall findings

Overall, there was a high level of acceptability of the intervention for both patients and healthcare professionals; however, there were some potential challenges to its implementation in practice. To explain this further, three overarching and interacting themes identified in the data are presented in this paper. The first theme related to the ways in which HCPs and patients were interpreting and *handling tensions* between stewardship of antimicrobials and the need to reduce the risk of serious infection and illness in COPD. The second theme focused on the impact of *clinical and embodied legacies* on how easy it was to implement the addition of the colour chart into the self-management plan. The final theme was around where opportunities lay for *changing practices* through negotiating change between HCP and patient.

Theme 1: Handling tensions. The colour chart was designed to ‘guide’ patient use of antibiotics and ultimately to change practice through reducing the use of antibiotics, so that they were only used in the case of bacterial infections. Both patients and HCPs were aware to a greater or lesser extent of the tension between our growing understanding of the potentially catastrophic risk of antimicrobial resistance and the need to minimise the risk of serious infection and illness in this vulnerable population that would lead to AECOPD. However, there were some important differences in the language used around them, reflecting different interpretations of the tensions and how they should be handled.

The narratives about the antibiotic and steroid packs were framed with a clear sense of urgency by all participants. The term ‘rescue pack’ was used widely by HCPs and patients and ‘rescue’ itself means to save someone from a dangerous situation. That this sense of crisis was internalised by patients is well illustrated by P1 who, searching for the word ‘rescue’, referred to their pack as a ‘parachute thing’, stressing that it was something they had control over accessing at home, without consulting a medical professional.

I've also got a parachute thing of steroids and antibiotics in the cupboard ... an emergency thing, it's just an emergency supply of steroids and antibiotics in the house (P1).

The patient language around exacerbations was often highly emotive and illustrated how frightening the experience of breathlessness during an exacerbation can be. Words such as ‘choking,’ ‘panic,’ ‘frightening,’ ‘scared,’ ‘dangerous’ and ‘horrendous’ depict a period of acute risk, language which was not typically used to describe their day-to-day breathlessness. ‘Alarming’ (P3) experiences of having been admitted to hospital

Table 1. Characteristics of study participants.

	Patients	HCPs
Total	39	14
Male (N(%))	21 (53.8)	3 (21.4)
Age Range (N: Mean(SD): Range)	38: 68.7 (9.3): 48.3–84.6	42–51
Missing	–	3
Ethnic minority groups (N(%))		
White- British/English/Northern Irish/ Scottish/Welsh	37 (95)	7
Asian and Asian British- Indian	1 (2.5)	1
Asian and Asian British- Pakistani		1
Black and Black British- African Caribbean	1 (2.5)	0
Mixed other	0	1
Missing	–	3
Education level, n (%)		
No formal education	11 (28%)	N/A
GCSE, CSE, O level or equivalent	14 (36%)	N/A
A-level/AS level or equivalent	3 (8%)	N/A
Degree level or higher	7 (18%)	N/A
Other	4 (10%)	N/A
Follow up interviews	4	0
Intervention group (N(%))	18 (46.2)	–
Recruited from primary care	20	8
FEV1 (Pre-bronchodilator) (n: mean(sd))	20: 1.5 (0.66)	–
MRC Score (n(%))		–
1	–	–
2	5 (12.8)	–
3	15 (38.5)	–
4	15 (38.5)	–
5	4 (10.2)	–
Number reporting AECOPD during trial	29	
Nursing	–	6
Medical	–	6
Non-clinical ^a	–	2
Co-morbidities (N(%))		
Diabetes	8 (20.5)	–
CVA/Stroke/TIA	3 (7.7)	–
Osteoporosis	8 (20.5)	–
Hypertension	16 (41.0)	–
Arthritis	14 (35.9)	–
CHD	7 (17.9)	–
Depression/anxiety	9 (23.1)	–
GORD	14 (36.8)	–
IBS	2 (5.1)	–
OSA	3 (7.7)	–
GOLD staging for COPD		
GOLD C:	1 (2.6%)	–
GOLD D:	38 (97.4%)	–

^aE.g. trials’ manager.

via ambulance on the advice of their HCPs also fed into these anxieties, as did the ‘knacker[ing]’ (P23) after effects with associated reduction in muscle mass and negative impacts on mental health.

I got rushed into hospital with suspected sepsis, and November was exactly the same. ... pulmonary rehab [said to] ... phone the ambulance ... I'd be going to the doctors, and he'd be sending me straight down to A&E or x-ray, to have a chest x-ray, because I've left it for too long. Where now it's like if I start feeling a bit dodgy I don't even hesitate (P19).

For both HCPs and patients there was a very similar focus of concern around the immediate risks that AECOPD posed to patients, although the language used by HCPs was more emotionally muted.

It's better to err on the side of caution rather than them becoming really unwell (H13).

As well as this 'caution', there were layers of concerns operating at different levels and most HCPs and patients were also highly positive about the trial concept and reducing 'inappropriate use of antibiotics' (H4). A major reason for this was the potential benefits for antimicrobial stewardship, concern being expressed that patients thought that antibiotics were 'a miracle drug' (H6). Indeed, healthcare professionals' understanding of the need to reduce the use of unnecessary antibiotics was evidenced by some volunteering the term 'antimicrobial stewardship' (H6).

Patients, on the other hand, while they also focused on potential future benefits of the trial, tended to express the desire to benefit others in more general terms, such as 'if it can help other people in the future' (P14), rather than specifically focused on issues of antimicrobial stewardship. Where they did focus on antibiotics, they tended towards viewing the risks of AMR at a personal or individual, rather than population level. Most knew that one should not overuse antibiotics, and often framed the risks of overuse in terms of 'immunity': 'if you do take them too often then you could possibly get immune to them, or they wouldn't be so good for you' (P9). Few patients volunteered an understanding of the difference between bacteria and viruses, which is key to understanding whether a rescue pack is needed for people with COPD. HCPs argued that they had difficulties in facilitating understanding of the risks of population level antibiotic resistance with patients, and stressed the importance of dialogue and tailoring of messages in how they handled the tension:

I ... obviously use different terms with different patients, ... "the bugs become resistant, they respond less." ... Who does see something on a population level? You always look at things from your own perspective (H14).

Ultimately, both HCPs and patients were having to actively negotiate this tension and make decisions with an inevitably imperfect resolution between them. This quote below from P11 contrasts with that of H14, illustrating the tension:

I know there's the argument if they become immune to them. The only thing for me is they're the only thing that will shift it when I get it [an exacerbation] ... (P11).

Nonetheless, there was clear evidence in the data that patients did understand that antibiotics should not be overused, and they cited the media, their doctors and posters in the waiting room as sources of knowledge about antimicrobial resistance. They sought to distance themselves from any label of being an irresponsible user of antibiotics:

They [antibiotics] won't work if you just take them on a whim we'll say, which I wouldn't do that anyway ... I don't [just] dive in and think, "Oh my god I need antibiotics." I have a

neighbour actually who takes antibiotics as the answer to everything, and I think, "Well no, it isn't" (P20).

There was a strong, principled commitment to improving appropriate use of medication and antimicrobial stewardship while also preventing any increase in AECOPD (hence support for the trial) but, in practice, this was experienced as a tension. The risk of AECOPD was often experienced and interpreted with a powerful sense of emotional urgency – saving or 'rescuing' individual patients, while the risks associated with antimicrobial resistance seemed more emotionally distant.

Theme 2: Clinical and embodied legacies. The introduction of the colour chart was praised by many HCPs as a 'simple' intervention to reduce unnecessary antibiotic use, however, its introduction was in the context of many years of clinical interventions to reduce AECOPD that has become standard practice for HCPs (clinical legacies), and self-management approaches to dealing with illness that had become habitual for patients (embodied legacies).

HCPs could see that historical approaches taken by the profession to manage individual risk in AECOPD had had a profound impact on clinical practice over many years.

I think we were hell bent on preventing hospital admissions ... getting in there early [because some patients were] not accessing them [antibiotics] as quickly as we would like to (H9).

This had been reinforced in many cases through clinicians' own clinical experiences of seeing severe exacerbations that were avoidable, leading to a position where they pro-actively encouraged self-management through 'rescue packs'.

Patients ... have an extremely low threshold for starting [rescue packs], and I think that's encouraged for good reason ... my respiratory experience was in secondary care ... they would be the more severe patients ... it was pretty much absolutely routine that they would have been prescribed [antibiotics] (H2).

Most of the patients that we spoke to had been issued with their pack of antibiotics and steroids prior to participating in the Colour COPD trial, and many had been using them for years. They had developed strong tacit knowledge about when they needed to use the 'rescue pack', building on and being reinforced through interactions over many years with medical professionals.

[Sputum colour] being a traditional way of the doctors diagnosing anyway, with the oral information from the patient. So the doctor would have been taking soundings with the stethoscope and all that, and saying, "What colour is your sputum?" ... I think there would have been on the part of the doctor a reliance on my having acquired that folk knowledge [when to take my rescue pack] anyway through interaction with them if you see what I mean? I've never seen any of it written down, and I don't recall having any specific information, but I would have been given that information after a fashion (P3).

Throughout the data, patients made reference to their ability to 'know' their own body and when they were exacerbating – 'I know this is on my chest' (P11) or 'you know, because it's your chest sputum that tells you' (P23) – and explained that they felt confident in using their 'rescue packs' appropriately.

I just know when I'm poorly. My body, because I'm so in tune is that the right word? With my body, and I know when I'm getting poorly (P37).

HCPs also described the depth of experience and knowledge that COPD patients had built up over years of dealing with their condition. Indeed, they cited patients' expert knowledge as a factor in deciding whether or not to prescribe antibiotics, validating patients' embodied and experiential knowledge.

I think somebody with chronic illness is quite good at knowing when they're not well (H10).

This was not, however, always viewed positively. Dealing with perceived patient overconfidence in managing their symptoms caused frustration to some members of the clinical research team recruiting to the trial:

I thought, "We'll get absolutely loads of people on it," just because I think it's a really good study. But ... a lot of COPD patients seem to think that they already know everything about COPD and that you can't possibly give them something that might guide them to help them (H3).

In short, the legacies of clinical intervention for AECOPD and the embodied experiences that patients had been coping with for many years caused some inertia in attempts to intervene with a colour chart to reduce unnecessary antibiotic usage.

Theme 3: Changing self-management practices. Moving from a self-management strategy that seeks to increase use of 'rescue packs' towards one that attempts to limit or control inappropriate use of these packs (while also not missing real need for them) requires both HCPs and patients to change their practices around self-management.

It was clear that the written self-management plans alone had little impact on patients' practice, and often they couldn't remember receiving them (P21) or they found them confusing (P3), so dialogue between patients and their HCPs was vital. In this context, HCPs often recognised the need to co-opt patient knowledge to create meaningful dialogue around the issues.

Part of what I do, ... even with "expert" patients ... those who'd had the disease for many, many years, is continue to provide education on ... exacerbations ... I ... avoid ... conflict with patients ... agree with the patient, hold their hand, and turn them around very gently ... [to get] engagement (H14).

The introduction of a colour chart to aid decision-making around whether to take the antibiotics in the 'rescue pack' was seen to be valuable, especially for those who were new to the self-management of AECOPD.

That is the only major thing that I have struggled with, and it's all very well having steroids and antibiotics here, but actually then giving yourself permission to take them is hard, and so having that colour chart if you've then got a little, a guideline of when to start taking them, especially when you first get your first rescue pack, it's difficult and you don't want to just keep chomping away on steroids all year round. So having a chart I think would be a great tool (P21).

By contrast, those who had been self-managing AECOPD for many years prior to the trial and felt confident doing so, these patients did not see the colour chart as particularly useful because they were already used to using sputum colour as an indicator as to when they needed to use their rescue packs, neither did these patients describe having used their SMP during an exacerbation.

I know I've got infection because it does change colour. It's more yellow, it's thicker, and it's more yellow (P28).

Moving towards a model where patients used their embodied knowledge about AECOPD, in combination with the colour chart may be ideal, but as in the case below, it was not always endorsed by the HCPs which highlights the need for building a longer-term trusting and dialogical relationship to support self-management:

I rang the doctor, and I couldn't get through, so I started myself on the antibiotics along with the steroids, because ... I know my own body and from previous experience that was what cleared it up. So I used the sputum chart and I needed both. ... When I later went to the doctors' I'd said that I'd used my rescue medication ... she said, "Well you shouldn't have used it without getting in touch with me." I said, "Well I tried to get in touch with you, and I tried to get an appointment and I wasn't successful, it was 6 to 8 weeks and a chest infection can't wait 6 to 8 weeks." ... So I did ring the nurse then, and she got the doctor to prescribe for me again (P13).

Some HCPs used other (non-dialogical) strategies to control antibiotic use, such as requiring patients to book an appointment to get another pack, rather than having them on repeat prescriptions (H9), although this was generally unpopular with patients who appreciated the ability to control their symptoms in a timely way and highlighted that the reality of booking an appointment could be quite onerous. Others used gentler strategies such as providing rescue packs strictly for out of hours' use (H10), negotiating the decision not to prescribe antibiotics with an accompanying "just in case" prescription (H9), or 'safety netting' with advice to contact the practice if symptoms changed (H12). Another policy, which had been adopted in a couple of areas, was to stop providing rescue packs routinely, instead they were limited to specific patients e.g. those who had had "multiple exacerbations or hospital admissions" (H10), that is, at the more severe end of the spectrum.

It was a decision that was made to ... minimise the use of rescue packs, and this was mainly driven by the fact that there are a lot of patients are ending up with a rescue pack after rescue pack without appropriate clinical either review or appropriate counselling right at the beginning of the issuing of the rescue pack. So at the moment rescue packs are only issued on the recommendation of specialist ... we've had quite a lot of problems locally with bacterial resistance (H14).

In summary, while some HCPs concluded that more disciplinary or restrictive approaches were necessary to drive change, an approach that facilitated discussion and dialogue between HCP and patient was generally more acceptable as a way to negotiate changing self-management practices.

DISCUSSION

The findings of this study show that, in a context where both HCPs and patients are having to handle tensions between risks of AECOPD and AMR, the colour chart was a welcome and acceptable intervention to help change self-management practices, specifically to aid in reducing unnecessary antibiotic use as part of 'rescue packs'. However, in its implementation, the colour chart intervention faced resistance and challenges from both clinical legacies designed to reduce the incidence of AECOPD (which encourage early intervention with antibiotics) and embodied, tacit, and experiential patient knowledge about when an infection was 'on the chest' and required intervention. These two legacies were mutually reinforcing – through ongoing dialogue, sometimes over many years, between patients and their HCPs. Shifting these habitual practices of reducing the risk of AECOPD were not easily achieved, despite support in principle for

the colour chart. There was greater potential for the colour chart to have an immediate effect in levels of antibiotic usage for patients new to the management of AECOPD, who would be learning self-management practices new and incorporate this from the start.

This study contributes to our understanding of antimicrobial stewardship in medical practice. The tension experienced by healthcare professionals between individual versus population health risk in relation to antibiotic prescribing is relatively well understood^{13,23} and studies have explored views on AMR: how 'inappropriate prescribing' is understood by clinicians, and how they approach the management of uncertainty²⁴. Our findings add to this body of literature through a distinctive micro-social lens, that focuses on patients as well as HCPs and demonstrates how that tension plays out *in practice*. Specifically, our findings explain why changes designed to control antibiotic use can be difficult to implement in the context of established clinical patterns and patients' experiential knowledge of their condition. A recent call to rename exacerbations (a poorly understood term) as "lung attacks,"²⁵ resonates with our data due to the emotional intensity experienced during AECOPD. However, we note that this would likely contribute to the maintenance of the tension between antimicrobial stewardship and AECOPD management. Conceptually and methodologically, our study highlights the dimension of *time* in assessing the acceptability of interventions, i.e. that more established practices (both clinical and patient practices) may take time to shift but should not be regarded as fixed.

This study also contributes to our understanding of the potential of patient self-management to contribute to the management of long-term conditions. Self-management is often framed as a way to save resources and improve responsiveness of healthcare, through shifting activity from clinical to domestic spaces, by 'educating' patients on how to manage their symptoms. Existing literature acknowledges that self-management is complex, multi-faceted and contentious, with the ability to both empower, by giving individuals greater independence, or repress, by directing and governing actions²⁶. In order for self-management plans to empower patients, partnership between receiver and provider is critical²⁷ and studies stress the importance of an iterative approach to building effective self-management practices²⁸. This emphasises the need for shared decision making and personalised, patient centred approaches to care as central values in the delivery of care, as recommended by WHO²⁹. Our findings add to this literature by detailing how self-management practices require us to understand the importance of ongoing, dialogical relationships between HCPs and patients to shape self-management over time. There is clear evidence, from patients' accounts of how they have previously learned self-management practices through repeated interactions with HCPs, that a 'one-off' consultation, in which information is imparted to the patient (whether or not it is accompanied by a written self-management plan) is unlikely to be sufficient. Whilst such reiteration could be delivered through a variety of means (e.g. digitally³⁰) there are those who rely on face-to-face interactions, as demonstrated in our results.

Recommendations

The contributions of this study to policy and practice are that, first, we cannot reduce the issues around self-management in AECOPD as simply being about patients overusing antibiotics due to lack of understanding - rather, patients are utilising legitimate forms of knowledge which has previously been developed in partnership with their HCPs. The focus needs to be equally on HCPs and patients in shifting prescribing culture in the context of self-management. Incorporating guidance on AMR into the NICE guidance for AECOPD (rather than simply directing users to the

AMR guidance) may help resolve prescribing tensions. Discontinuing the routine use of the expression 'rescue pack' and replacing it with something less emotive may also help contribute to this shift. Second, interventions designed to shift self-management practices also require a plan to incorporate consistent opportunity for dialogue and discussion between patients and their HCPs. Patients should have opportunities to see the self-management guidance enacted in practice by their HCPs, such as decisions to increase inhalers or prescribe a course of oral steroids without antibiotics. Implementing this, however, may be challenging within a context of cost containment for primary care in many countries.

Strengths and limitations

This study gathered data from both patient and HCP perspectives in order to inform our understanding of attitudes towards, and experiences of, decision making in relation to exacerbations and antibiotic stewardship. We recruited from different geographic areas of the UK and of different educational levels, enriching the findings. However, there was a lack of ethnic diversity within our patient sample. This is an ongoing problem in research, going forward, using the REP-EQUITY toolkit may go some way to resolving this³¹. We were only able to access patients who had consented to participate in the trial, which may have affected our assessment of acceptability. All the trial materials and processes were reviewed by our patient advisory group, however, the environments and circumstances in which they were reviewed is very different to the environments and circumstances in which trial participants receive them. Participants found the online/telephone interviews convenient, this method also enabled us to recruit rapidly from a wide geographical area despite the reduced period of data collection. However, the reduced recruitment period limited data collection to the early initial phases of the trial and also limited the range of participants. One of the real strengths of our findings is that the patient voice came through in the contributions from our patient co-analysts.

CONCLUSION

Assessment of sputum colour in the context of the self-management of AECOPD through self-administered 'rescue packs' was acceptable to both patients and HCPs. However, the colour chart was more likely to be effective in patients new to AECOPD self-management, whereas the legacy of strategies aimed at prescribing antibiotics early to reduce individual risk inhibited the intervention's effectiveness in others. Regular opportunities for discussion, including reiteration of guidance for antibiotic use for AECOPD, within clinical interactions could maximise the effectiveness of the intervention. In summary, while in principle the assessment of sputum colour using a chart to manage AECOPD was acceptable to both patients and HCPs, in practice, it is unlikely to have significant impact on well-established clinical practices for infection control and patient habits of self-management.

DATA AVAILABILITY

The raw data (transcripts) are protected and are not publicly available due to participant confidentiality. However, they can be obtained from the author subject to a data sharing agreement.

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AUTHOR CONTRIBUTIONS

N Bakerly and A Turner co-led the study design, with contributions and advice from N Gale. R Adams led data collection, supported by N Le Mesurier. R Adams led analysis, overseen by N Gale and supported by K Allsopp, S Saleem, M McKenna, N Le Mesurier and A Turner. R Adams and N Gale wrote the manuscript with input from all other authors. A Turner was the CI and oversaw all project activities. All authors contributed to and approved the final version of this paper.

COMPETING INTERESTS

MM declares no financial or non-financial competing interests. All other authors received funding for their contributions to this study, they declare no non-financial competing interests.

ADDITIONAL INFORMATION

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