BMJ Open Respiratory Research

Targeted self-directed learning can support clinicians to improve patient adherence to inhaled corticosteroid therapy in asthma

Maeve Savage,[1] Ian Bates,[2] Grainne d'Ancona [1,3]

To cite: Savage M, Bates I, d'Ancona G. Targeted self-directed learning can support clinicians to improve patient adherence to inhaled corticosteroid therapy in asthma. *BMJ Open Respir Res* 2025;**12**:e002720. doi:10.1136/bmjresp-2024-002720

Received 25 October 2024
Accepted 18 September 2025

[1]Guy's and St Thomas' NHS Foundation Trust, London, UK
[2]University College London, London, UK
[3]King's College, London, UK

Correspondence to
Grainne d'Ancona;
grainne.dancona@nhs.net

ABSTRACT

Background Inhaled corticosteroids (ICS) are the foundation of asthma treatment, yet approximately 50% of patients are sub-optimally adherent to them. ICS non-adherence is associated with significant morbidity including uncontrolled symptoms, exacerbations, hospitalisation and, unfortunately, death. The factors influencing a patient's adherence to inhaled treatments vary, and healthcare professionals (HCPs) require multifactorial skills to address them. Effective tools must be available for HCPs to develop these skills.

Aim To assess if a newly developed self-directed online module changed knowledge of and confidence in the management of ICS non-adherence in asthma.

Methods This study employed a mixed-methods, pre-test and post-test quasi-experimental design. Before starting the module, participants rated their confidence to manage medicine non-adherence in asthma on a 5-item Likert scale (from 'not at all confident' to 'very confident') and answered five multiple choice questions that tested knowledge. The questions were answered again after completing the module. The change in individual knowledge score and confidence pre-module and post-module completion was analysed using a paired sample *t*-test. Volunteers undertook a semi-structured interview following module completion, and data were scrutinised by thematic analysis.

Results 194 participants completed pre-module and post-module assessments. Compared with baseline, a significant increase in knowledge (t=−17.809, df=193, p<0.001) and confidence scores (t=−12.820, df=193, p<0.001) was noted. Nine participants were interviewed, revealing key themes including how the module changed their understanding of the patient perspective, practical advice gained to support the patient and barriers to making changes in practice.

Conclusion Completion of the self-directed online module improved HCP knowledge of and confidence to manage non-adherence to ICS in asthma. Further research is required to determine if it has a measurable effect on patients' clinical outcomes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Poor adherence to inhaled therapies in asthma is common and complex; however, clinicians often fail to identify or address it. This is unsurprising given the paucity of evidence-based tools to support healthcare professionals (HCPs) in this area.

WHAT THIS STUDY ADDS

⇒ This study presents an educational module that can improve healthcare professionals' knowledge of and confidence to manage non-adherence to inhaled corticosteroids in routine practice.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results would encourage clinicians who care for people with asthma to complete the short self-directed online module described in this paper. This will ensure they are supporting optimal ICS use by patients and may influence their ability to prescribe optimised medicines more widely.

INTRODUCTION

Asthma is a common long-term condition characterised by chronic inflammation of the airways. The UK has among the highest prevalence of asthma in the world[1] and some of the highest mortality rates in Europe[2] despite the availability of highly effective treatments, such as inhaled corticosteroids (ICS). Initiated at diagnosis,[3] an ICS reduces airway inflammation, prevents lung function decline, improves symptom control and minimises exacerbation frequency and the risk of death.[4–9] Conversely, non-adherence to ICS leads to a greater number and severity of exacerbations,[10] lung function decline [9] and increased risk of death.[11 12] Inappropriate use of ICS is associated with excessive use of short-acting beta$_2$-agonist, itself a phenomenon associated with an increased risk of severe exacerbations and death.[3 13 14]

Moreover, the economic effect of non-adherence to ICS is considerable. Symptoms from uncontrolled asthma result in visits to general practitioners (GPs) or emergency departments, avoidable treatment escalation and misplaced referrals to secondary

care.[15 16] The cost of asthma care in the UK National Health Service is currently £1.5 billion annually, with productivity loss and quality of life costs estimated to add a further £4.5 billion.[17] Adherence to ICS improves clinical outcomes and reduces the need for healthcare utilisation,[18] yet up to 50% of patients fail to take their medications as directed at least some of the time.[19] The reason for this is multi-faceted: clinicians do not consistently identify non-adherence, with one study suggesting that just 60% of patients with asthma in the UK are asked about adherence in their annual asthma review[20]; inhaler non-adherence is a complicated mix of patient beliefs, capability and understanding[21 22]; and when detected, HCPs may not have the required skills to manage it effectively.[22]

Fortunately, ICS adherence in asthma can be improved by effective engagement of evidence-based interventions, such as shared decision-making,[23] electronic inhaler reminders[24] and education,[25–27] when applied with an individualised patient-centred approach.[3 21] Tools to help clinicians develop their skills in this area are vital,[22] but only two feasibility studies have been published investigating this,[28 29] and neither programmes were implemented more widely after the study. This mixed-methods, pre-test and post-test quasi-experimental study addressed this gap and aimed to investigate whether completion of a bespoke self-directed online learning module improves HCP knowledge of and confidence to address and manage non-adherence to asthma treatments.

METHODS

This mixed-methods, pre-test and post-test quasi-experimental study investigated the effect of an online self-directed learning module entitled 'modifying non-adherence to medicines in asthma'[30] on HCP knowledge of and confidence to address non-adherence to asthma therapies. One of the authors, a consultant pharmacist in respiratory medicine, was commissioned by NHS England to develop a programme to equip HCPs with the appropriate skills to identify and address their patients' non-adherence to ICS. The module content was derived from adherence management research and experience in practice. The module was available on PULSE 365, a large online education and events platform specifically designed for GPs, but accessible free of charge to all HCPs. The module was promoted by email, via Academic Health Science Networks in England, and on social media. HCPs who accessed the module from its launch in October 2022 to March 2023 completed the mandatory pre-module questionnaire to begin the module and the post-module questionnaire to finish it. The data collection instruments were integrated into the online learning module, so additional consent to participate in the study was not required.

Data collection took place in two distinct phases: a quantitative data collection exercise and the qualitative data collection (via semi-structured interviews).

The study questionnaire used in the quantitative phase consisted of five multiple choice questions testing knowledge, and one self-reported confidence question to be answered on a Likert scale of 1–5 (1 = not at all confident; 2 = not confident; 3 = somewhat confident; 4 = confident; 5 = very confident). One pilot semi-structured interview was conducted to test feasibility and comprehension of the interview questions, the data from which were included in the results. All data were analysed using SPSS (V. 29.0.0.0) at the p=0.05 level. A point-biserial correlation analysis was conducted to test for the reliability of the knowledge items. Changes in overall mean knowledge score and confidence scores were tested using paired samples *t*-test. The overall change in the proportion of correct answers for individual knowledge items was tested using paired samples *t*-test. A one-way analysis of variance (ANOVA) tested differences in overall knowledge and confidence scores between HCP groups and between regions.

Following the completion of the module, participants could volunteer to take part in a semi-structured interview. Volunteer contact details were securely passed to the researcher who then contacted volunteers via email. Written consent to partake in and record the interviews was provided by email response. Sample interviews took place in December 2022 and January 2023, either in person or via Microsoft Teams. Each interview lasted 20–30 min and was recorded to facilitate transcription. Transcripts from the interview recordings were anonymised before responses were subjected to thematic analysis.

Owing to the scarcity of studies, it was not possible to calculate a meaningful statistical sample size. Chan *et al*[31] attempted to test the effect of an intervention on knowledge of non-adherence to medication and calculated a sample size to achieve a power of .80 to detect a 20% difference in mean knowledge scores before study initiation, with α set at .05 and SD at 15%. Therefore, using the same parameters and accepting an effect size d=0.5, a sample size of 34 HCPs is required to achieve a power of .80 to detect a 20% difference in mean knowledge scores.

Patient and Public Involvement

No patients or members of the public were involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS

A total of 314 participants undertook the baseline (pre-module) questionnaire, 194 of whom (62%) completed the post-module questionnaire. Figure 1 summarises the movement of clinicians through the intervention, whereas table 1 describes in more detail where these clinicians worked in terms of healthcare sector and geographical region. Table 1 also illustrates the diversity of HCPs who started and completed the module (including

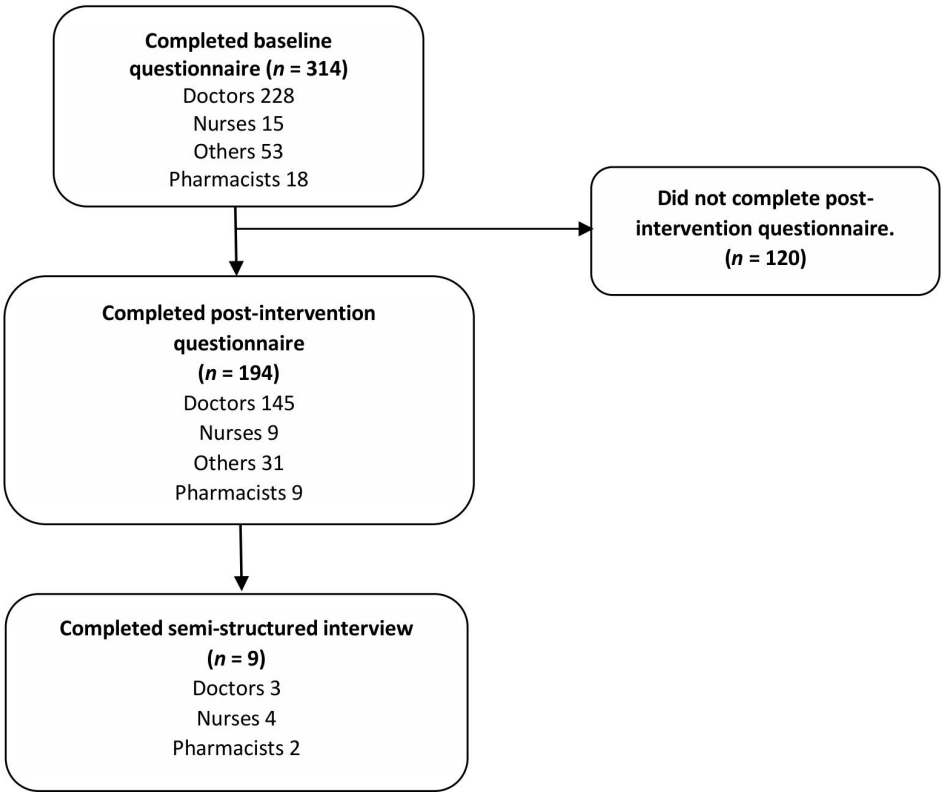

Figure 1 Flowchart describing study participants passing through each phase of the study.

doctors, nurses and pharmacists) and the wide range of UK regions where they worked.

The minimum knowledge score was 0 (ie, the participant did not answer any questions correctly) up to a maximum score of 5. Figure 2 illustrates the knowledge scores of participants and shows an overall knowledge score shift from a normal distribution at baseline (figure 2A) to a skewed distribution post-intervention (figure 2B).

For the 194 module completers, scoring each individual knowledge item correctly significantly correlated to a higher overall knowledge score at baseline ($r_{pb}(192)$ = 0.433-0.636, p<0.001). The same was true post-intervention ($r_{pb}(192)$ = 0.405-0.635, p<0.001). When comparing the proportion of baseline knowledge items answered correctly with the proportion of correctly answered corresponding post-intervention knowledge items in the module completer group, the proportion of correctly answered questions significantly increased post-intervention across all five knowledge items (p<0.001).

For the 194 module completers, the mean knowledge score significantly increased from 2.4/5 to 4.4/5 (t=−17.809, df=193, p<0.001). Those who did not complete the module had a mean baseline knowledge score of 2.3/5.

Overall baseline knowledge scores were analysed for differences between HCP groups. No significant difference between groups was found in the non-completer cohort (ANOVA $F(3, 116)$ = 0.850, p=0.469); however, a significant difference was noted between groups in the module completer cohort (ANOVA $F(3, 190)$ = 3.448, p=0.018). Post-hoc analysis revealed a difference between doctors, with a mean score of 2.50/5, and pharmacists, with a mean score of 1.11/5 (p=0.011). Analysis of post-intervention knowledge scores also revealed a significant difference between HCP groups (ANOVA $F(3, 190)$ = 3.716, p=0.013), which was found between doctors, with a mean score of 4.40/5, and pharmacists, with a mean score of 3.44/5 (p=0.017), and 'others', with a mean score of 4.58/5, and pharmacists (p=0.008) in the post-hoc analysis.

No significant differences were noted in the knowledge scores between regions at baseline (ANOVA $F(7, 186)$ = 0.669, p=0.698) or post-intervention (ANOVA $F(7, 186)$ = 1.885, p=0.074).

Figure 3 describes the distribution of self-reported confidence scores before and after completing the module.

Self-reported confidence scores were analysed, and the increase in mean confidence score from 2.73/5 at baseline to 4.18/5 post-intervention for the 194 module completers was significant (t=−12.820, df=193, p<0.001). When self-reported confidence scores were compared across all HCP groups, no significant difference was found at baseline in the module completer cohort (ANOVA $F(3, 190)$ = 0.371, p=0.774) or in the non-completer cohort (ANOVA $F(3, 116)$ = 1.593, p=0.195). Moreover, no difference between groups was found in self-reported confidence scores post-intervention (ANOVA $F(3, 190)$ = 1.010, p=0.390), as well as in confidence scores between

Table 1 Participant demographics

	Participants pre-module (n=314)		Participants post-module (n=194)	
	Frequency	Percent (%)	Frequency	Percent (%)
Profession				
Doctor	**228**	**72.6**	**145**	**74.7**
Doctor (hospital)	43	13.7	24	12.4
Doctor (general practitioner)	185	58.9	121	62.4
Nurse	**15**	**4.8**	**9**	**4.6**
Nurse (general practice)	12	3.8	6	3.1
Nurse (hospital)	3	1.0	3	1.5
Other	**53**	**16.9**	**31**	**16.0**
Pharmacist	**18**	**5.7**	**9**	**4.6**
Pharmacist (primary care, community or integrated care)	8	2.5	4	2.1
Pharmacist (hospital)	10	3.2	5	2.6
Total	**314**	**100.0**	**194**	**100.0**
Location				
Other UK location	75	23.9	50	25.8
East of England	37	11.8	21	10.8
London	57	18.2	38	19.6
Midlands	45	14.3	24	12.4
North and East Yorkshire	32	10.2	24	12.4
North West	32	10.2	19	9.8
South East	25	8.0	11	5.7
South West	11	3.5	7	3.6
Total	**314**	**100.0**	**194**	**100.0**

regions at baseline (ANOVA $F(7, 186) = 0.633$, p=0.728) and post-intervention (ANOVA $F(7, 186) = 0.980$, p=0.447).

Semi-structured Interviews

Nine primary care HCPs who completed the module participated in an a priori structured interview. Four nurses (N1-4), 3 doctors (D1-3) and 2 pharmacists (P1 and 2) took part. Most (8/9) were female. Table 2 provides a summary of the thematic analysis of the interviews under the following themes:

- Impact of module on HCP knowledge
- Impact of the module on HCP confidence
- Impact of module on how the HCP discusses adherence
- Module's practical advice to support the patient
- How the module has changed the HCP's practice
- How the module changed the HCP's understanding of the patient perspective and consultation style, for example, using shared decision making
- Possible barriers to implementing these changes in practice
- Application of module outside asthma

DISCUSSION

Despite widespread acknowledgement of the extent[19] and consequences[9 15 16] of non-adherence in asthma, robust education is not widely available to support HCPs' delivery of care in this area. While previous studies have similarly demonstrated improvements in GP confidence to address medicines non-adherence in asthma,[28 29] this evaluation of the learning resource 'modifying non-adherence to medicines in asthma' is the first to assess a range of HCPs and include an important additional dimension – change in HCP knowledge of the most appropriate intervention to make to improve adherence.

Several studies have described education-focussed interventions that have produced statistically significant improvements in HCP knowledge of how to manage treatment non-adherence in other disease areas,[31–34] but this is the first to do so for inhaled therapies in asthma. Each clinical scenario was purposefully chosen to test participants on the most common causes of medicines non-adherence in asthma: lifestyle, personal beliefs, understanding of the medical condition and the treatment, access to medicines and financial constraints. The results suggest that HCPs, regardless of profession, who completed the module demonstrated a statistically

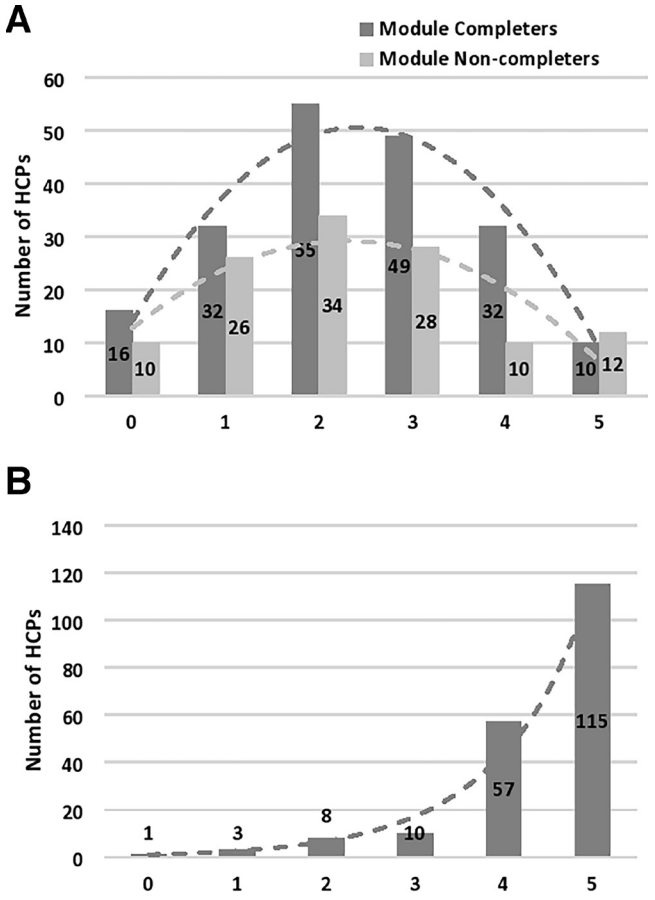

Figure 2 Distribution of knowledge scores pre-module and post-module completion. (A) Pre-module knowledge scores, ■ module completers and ■ module non-completers. (B) Post-module knowledge scores. HCP, healthcare professionals.

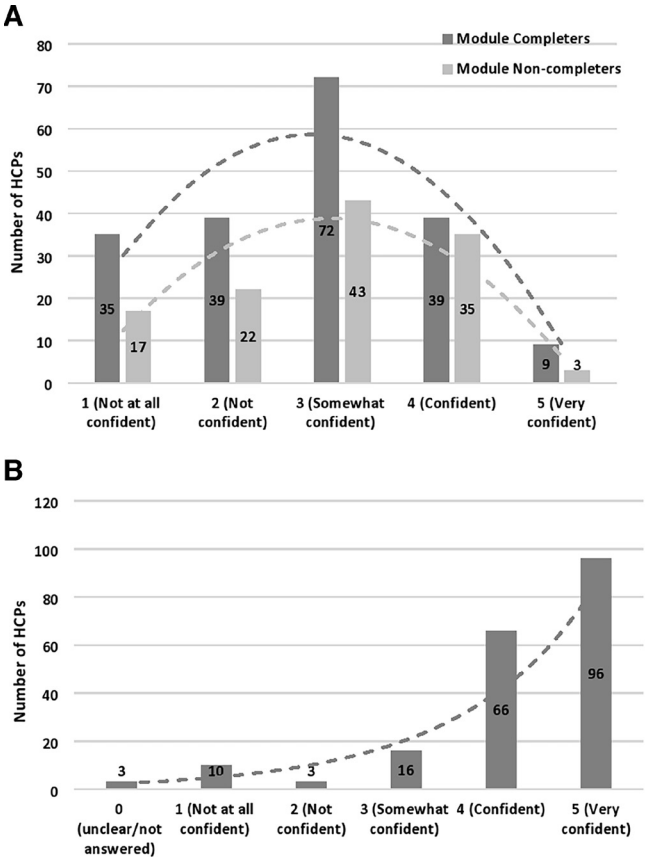

Figure 3 Distribution of confidence scores pre-module and post-module completion. (A) Pre-module confidence scores, ■ module completers and ■ module non-completers. (B) Post-module confidence scores. HCP, healthcare professionals

significant improvement in their knowledge of how to manage ICS non-adherence in asthma. The reasons for non-completion of the module were not part of the analysis; however, interestingly, this self-selecting subgroup had a numerically lower mean baseline score (2.3/5) than module completers (2.4/5), so were arguably more in need of finishing the training.

The significant improvement in knowledge following completion of the module was unsurprisingly accompanied by a significant improvement in HCP confidence to address non-adherence to inhaled therapies. Participants commenced the module with a mean self-reported confidence score of 2.8/5, a score between 'not confident' and 'somewhat confident'. When comparing the confidence of those who did not complete the module with those who did, module non-completers declared a numerically higher confidence score (2.9/5 compared with 2.7/5); however, this higher self-confidence may be misplaced given their lower baseline knowledge scores. This suggests a disconnect between perceived capability and that demonstrated in the scenarios.

Overall, answers given during the semi-structured interviews largely supported and corroborated the quantitative findings of an improvement in confidence post-intervention, with interviewees reiterating their greater confidence in their ability to discuss and manage non-adherence to asthma treatments in their patients. This was partly attributed to reflections on how they currently addressed adherence, or that they did not, but also the practical advice delivered by the module. The nurses commented on how particularly useful they found the suggestions for integrating medication into a patient's lifestyle. Interviewees recognised that the tools and strategies they learnt from the module could also be applied to adherence in other long-term conditions.

Interviewees were struck by how important it is to normalise non-adherence with their patients. One interviewee described how this gave their patient space to acknowledge their poor adherence, and another felt it would allow for a more collaborative discussion.

The module encouraged interviewees to think about the role of patient education in improving adherence to medication and how this should be delivered. Interestingly, there was recognition that education was not the answer in all scenarios but that interventions should be tailored to the patient. Interviewees described how

Table 2 Summary of the themes and related excerpts from the semi-structured interviews

Quotation	HCP
Impact of the module on HCP knowledge	
"It's made me consider adherence more. It's more important than I thought it was initially".	N1
"So, what I think, what's really sticking with me was just I think how much of a problem adherence is with asthma medication in this country".	D1
"…salbutamol shouldn't ever be used alone for management of asthma; I was pretty sure it could be…"	D2
"…the amount of salbutamol inhalers that you use…correlated to how many exacerbations and even deaths that might be caused by asthma. That was quite…that was very surprising".	D2
Impact of the module on HCP confidence	
"(I now have the) *confidence to spend a bit more time really exploring…the barriers of that patient really engaging in their treatment"*	D2
"(the module) empowered me more to have those conversations".	N3
"*It has impacted my confidence. I think before …you rely on things that you would have learnt in medical school … it's really helpful …to have it contained in a succinct module…"*	D2
"I think I certainly…will be more confident…partly because I was already doing some of the things, but it came from a source that's clearly very expert in this so having that…affirmed".	D1
"*I think the module did give me some thoughts about a practical approach to patients. And would make me feel more confident to have those conversations with patients".*	P1
"It gave me more of the confidence side than the knowledge because it made me consider lots of different things that we've learnt about before, but not putting it to practice…"	N1
How the module gives practical advice to support the patient	
"I suppose that was a bit helpful thinking about that, you know …advising patients to leave their inhalers with their toothbrush".	N3
"…advise having it while you're at home and making sure you take it like if you're having your "morning coffee or breakfast, you pair it with that".	N1
"*I think the bit about sort of putting a more positive spin on it…saying it is really difficult to remember to take things…so introducing that as something that most people do…*".	D4
"*As humans we get defensive. So, you ask a patient, "O,h how often are you having your inhalers?" And they say, "Yeah, yeah, I take it often". But if you just mention, you know, a lot of patients tend to forget…".*	N1
"Also, things like knowing that I can say to patients it's okay not to take your ICS all the time and a couple of missed doses are completely normal".	D1
"…there was a suggestion whereby you should ask, "How many times have you missed your inhaler?" I've never heard of that. Actually, that's quite a good prompt…".	D3
"…we'e pretty mean with our inhaled preventative medications, often not giving very much…most of the other chronic stuff, patients get…3 months…it must be infuriating".	D4
Impact of module on how the HCP discusses adherence	
"It has re-highlighted, I guess the importance of questioning about adherence and also how you question about adherence because I think I…could possibly do a better job".	N2
"I'm more aware of the wording that I might use in the questioning".	D3
"…this will help me do a better job by giving me more tools to know how to…talk about it".	N2
"…the module showed me how I might have those conversations and how I might lead into those conversations".	P1
"I find there's…there can be quite a lot of judgmental, "Do as I say" kind of language toward patients, which…to me, it doesn't work. So, I think that would be a good (thing) for some people to consider".	N3
How the module has changed the HCP's practice	
"I notice I ask more questions…now I will ask, "So, tell me about your inhalers. Which ones are you on and how often are you taking them?".	N1
"*…often you get an alert to say "High…salbutamol use" and I think I probably just ignore it, but now I wouldn't. I would contact the patient back".*	D2
"*It will be a definite impact for when I…prescribe…salbutamol inhalers. One, not starting them only on salbutamol inhalers but making sure that they're…taking their inhaled steroid too".*	D2

Continued

Table 2 Continued

Quotation	HCP
"…focus should be checking adherence…I might just change the layout of the consult".	D3
"*Well, certainly made me think that we're probably not doing enough".*	D3
"It would not be difficult to…run some (searches) looking at people who aren't getting very many preventative medications…proactively contacting those patients".	D4
How the module changed HCP understanding of the patient perspective and consultation style	
"Well, something I didn't consider…that a possible reason for non-adherence is financial…"	N1
"I think my approach now would be giving the patient a chance to speak first without…rather than launching straight into your dialogue…"	P1
"*It's not as simple as…telling them what to do and they do it. So, the module was really interesting in the way that it…worked with the patient…for them to achieve their best outcome".*	D2
"…the information…about shared decision making…making sure that you understand all of their…concerns…to achieve the best outcome for patients was really helpful".	D2
"we all talk about patient-centred care, but I think often in the day-to-day busyness…I think there isn't enough emphasis on having these conversations…"	P1
"*So, like motivational interviewing, I know about it but I haven't actually seen it linked with asthma in that way when it came to adherence…that technique…is helpful for me…".*	N1
"…prior to doing the module I would've been launching into…educate patients…without really understanding their views on things first…they might feel they're being preached to…".	P1
"Trying to establish…their understanding, how it affected their lives…and actually, were they receptive to education?"	P1
Possible barriers to implementing these changes in practice	
"…and I think it is really important to remind people that these asthma reviews…they…shouldn't just be an escalator ride through a template".	P1
"*…you open up this conversation and you maybe lead the way for change, but then do you have the time to follow-up with the patient?" Because I don't think this is a one-off conversation…*".	P1
"*The patient's often not there for their asthma…I might be seeing them because of several other conditions and I… don't have time to address what they've come about as well as…that*".	D4
"I only get 20 min appointments with patients. So, to have adherence as well as all the other things with asthma, so it does fill me with a bit of fear…"	N2
"The biggest barrier for me is, I do struggle with the telephone consultation".	N1
"*I think we lose a lot of the nuance and the quality of our work when we end up for various reasons, having to rely on telephone reviews".*	P2
"Some of the asthma reviews I've seen done…I feel like they're missing depth".	P2
Application of module outside asthma	
"*…there was a lot of targeted asthma information, but then there was also information that you could apply to other medications…"*	D1
"*…it's not just asthma related, is it? It could be applied to any other kinds of medication…"*	N3
"*I think it's a really good resource and I think a lot of people do struggle with those conversations…that would be something that would be beneficial to a lot of colleagues…"*	N3
"…Some of the…motivational stuff which is actually very useful for other things…not just asthma".	D1

HCPs, healthcare professionals.

completing the module changed their perception of how to approach consultations about medicines adherence.

Interestingly, the question gotten wrong most often at baseline was that investigating 'access to medicines'. Across all interviews, this was only mentioned by one participant but with the reflection that it should be better managed.

The interviews facilitated the emergence of other important themes, including how participants' practice has changed within asthma, such as by reflecting on adherence to ICS when prescribing salbutamol inhalers, but also in other areas. One interviewee recognised that the skills taught in the module can apply to adherence

to other medicines, suggesting the module can provide benefits beyond its intended purpose.

Although many interviewees agreed that the module had taught them skills and developed their confidence to better manage non-adherence, there were concerns voiced about how change might be implemented. Several barriers were identified: the time available for consultations, stepping away from traditional template-driven approaches, the need to further develop their skills and not being comfortable with remote consultations.

This study has several limitations. A significant number of people (n=120) completed the baseline questionnaire but did not complete the post-module questionnaire. The barriers to completing the final step of the module are unknown. In terms of participants, most identified as a doctor, likely a reflection of where the module was hosted. The second biggest HCP group was 'other', followed by nurses and pharmacists. The background of those chosen is impossible to say, but knowledge and confidence improvements were seen across all groups. In the qualitative phase of the study, the participant profession profile differed from that in the quantitative phase. All module completers were asked to participate in the interviews, with nine willing to participate. This was a limitation of the interviewee selection process, where participants were chosen based on timely email responses. The authors also acknowledge the response bias that may have been introduced by having the lead researcher conduct the interviews.

Despite these limitations, this study confirms that the learning module tested can improve both the knowledge and confidence of various HCPs in how to address and manage non-adherence to asthma treatments, at least in the short term. Furthermore, this self-directed, online module does so in a time- and resource-efficient manner. Although these results are encouraging, the fundamental aim of such research is to optimise patient adherence to their ICS and improve clinical outcomes. This would require long-term retention of these new skills and implementation into the HCP's clinical practice. Future studies examining the effect of such an educational intervention are warranted.

CONCLUSION

Completion of the 'modifying non-adherence to medicines in asthma' self-directed online module led to a statistically significant improvement in HCP knowledge of and confidence to address and manage non-adherence to ICS in asthma. Semi-structured interviews confirmed these findings and revealed additional benefits of completing the module beyond knowledge, confidence and asthma. The aim of improving HCPs' ability to manage medicines adherence to an ICS in asthma is to achieve better clinical outcomes for patients; hence, further research is warranted to investigate the wider effect of the module.

Contributors MS, IB and GDA developed the research question. MS developed the study protocol, questionnaire and interview schedule with input and support from IB and GDA. MS collected the quantitative data, with support from Cogora (a collaborator of Pulse 365). IB and MS analysed the quantitative data. MS collected and analysed the qualitative data, with significant contributions from GDA. MS drafted the manuscript. All authors read, commented on and approved the manuscript. GDA is the guarantor for this study and accepts full responsibility for the work carried out.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by Research Ethics approval was provided by the University College London Research Ethics Committee (22657/001). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

ORCID iD

Grainne d'Ancona https://orcid.org/0000-0003-1936-6769

REFERENCES

1 Our World in Data. Prevalence of asthma. 2021. Available: https://ourworldindata.org/grapher/asthma-prevalence
2 Asthma and Lung UK. Lung conditions kill more people in the UK than anywhere in Western Europe. 2022. Available: https://www.asthmaandlung.org.uk/media/press-releases/lung-conditions-kill-more-people-uk-anywhere-western-europe
3 GINA. Global strategy for asthma management and prevention. 2025.
4 Adams NP, Bestall JB, Malouf R, *et al*. Inhaled beclomethasone versus placebo for chronic asthma. *Cochrane Database Syst Rev* 2005;2005:CD002738.
5 Adams NP, Bestall JC, Lasserson TJ, *et al*. Fluticasone versus placebo for chronic asthma in adults and children. *Cochrane Database Syst Rev* 2005;2005:CD003135.
6 O'byrne PM, Barnes PJ, Rodriguez-roisin R, *et al*. Low Dose Inhaled Budesonide and Formoterol in Mild Persistent Asthma. *Am J Respir Crit Care Med* 2001;164:1392–7.
7 Pauwels RA, Pedersen S, Busse WW, *et al*. Early intervention with budesonide in mild persistent asthma: a randomised, double-blind trial. *Lancet* 2003;361:1071–6.
8 Suissa S, Ernst P, Benayoun S, *et al*. Low-dose inhaled corticosteroids and the prevention of death from asthma. *N Engl J Med* 2000;343:332–6.
9 O'Byrne PM, Pedersen S, Lamm CJ, *et al*. Severe Exacerbations and Decline in Lung Function in Asthma. *Am J Respir Crit Care Med* 2009;179:19–24.
10 Ernst P, Spitzer WO, Suissa S, *et al*. Risk of fatal and near-fatal asthma in relation to inhaled corticosteroid use. *JAMA* 1992;268:3462–4.
11 NRAD. Why asthma still kills. 2014. Available: https://www.rcplondon.ac.uk/projects/outputs/why-asthma-still-kills
12 Sturdy PM, Victor CR, Anderson HR, *et al*. Psychological, social and health behaviour risk factors for deaths certified as asthma: a national case-control study. *Thorax* 2002;57:1034–9.
13 Nwaru BI, Ekström M, Hasvold P, *et al*. Overuse of short-acting β_2-agonists in asthma is associated with increased risk of exacerbation and mortality: a nationwide cohort study of the global SABINA programme. *Eur Respir J* 2020;55:1901872.
14 Reddel HK, FitzGerald JM, Bateman ED, *et al*. GINA 2019: a fundamental change in asthma management: Treatment of asthma with short-acting bronchodilators alone is no longer recommended for adults and adolescents. *Eur Respir J* 2019;53:1901046.
15 Lindsay JT, Heaney LG. Nonadherence in difficult asthma - facts, myths, and a time to act. *Patient Prefer Adherence* 2013;7:329–36.

16 Brennan V, Mulvey C, Costello RW. The clinical impact of adherence to therapy in airways disease. *Breathe (Sheff)* 2021;17:210039.
17 Asthma and Lung UK. Investing in breath: measuring the economic cost of asthma and COPD in the UK and identifying ways to reduce it through better diagnosis and care. 2023.
18 Mäkelä MJ, Backer V, Hedegaard M, *et al*. Adherence to inhaled therapies, health outcomes and costs in patients with asthma and COPD. *Respir Med* 2013;107:1481–90.
19 Murphy J, McSharry J, Hynes L, *et al*. Prevalence and predictors of adherence to inhaled corticosteroids in young adults (15-30 years) with asthma: a systematic review and meta-analysis. *J Asthma* 2021;58:683–705.
20 Asthma and Lung UK. Transforming asthma care in the UK. 2022.
21 NICE. Medicines adherence: involving patients in decisions about prescribed medicines and supporting adherence. 2009. Available: https://www.nice.org.uk/guidance/cg76/resources/medicines-adherence-involving-patients-in-decisions-about-prescribed-medicines-and-supporting-adherence-pdf-975631782085
22 d'Ancona G, Weinman J. Improving adherence in chronic airways disease: are we doing it wrongly? *Breathe (Sheff)* 2021;17:210022.
23 Wilson SR, Strub P, Buist AS, *et al*. Shared Treatment Decision Making Improves Adherence and Outcomes in Poorly Controlled Asthma. *Am J Respir Crit Care Med* 2010;181:566–77.
24 Foster JM, Usherwood T, Smith L, *et al*. Inhaler reminders improve adherence with controller treatment in primary care patients with asthma. *J Allergy Clin Immunol* 2014;134:1260–8.
25 Federman AD, O'Conor R, Mindlis I, *et al*. Effect of a Self-management Support Intervention on Asthma Outcomes in Older Adults: The SAMBA Study Randomized Clinical Trial. *JAMA Intern Med* 2019;179:1113–21.
26 Otsuki M, Eakin MN, Rand CS, *et al*. Adherence feedback to improve asthma outcomes among inner-city children: a randomized trial. *Pediatrics* 2009;124:1513–21.
27 Williams LK, Peterson EL, Wells K, *et al*. A cluster-randomized trial to provide clinicians inhaled corticosteroid adherence information for their patients with asthma. *J Allergy Clin Immunol* 2010;126:225–31.
28 Broers S, Smets E, Bindels P, *et al*. Training general practitioners in behavior change counseling to improve asthma medication adherence. *Patient Educ Couns* 2005;58:279–87.
29 Foster JM, Smith L, Usherwood T, *et al*. General practitioner-delivered adherence counseling in asthma: feasibility and usefulness of skills, training and support tools. *J Asthma* 2016;53:311–20.
30 CPPE. Modifying non-adherence to medicines in asthma. Vimeo.com; 2022.
31 Chan E, Doroudgar S, Huang J, *et al*. Interprofessional Education on Medication Adherence: Peer-to-Peer Teaching of Osteopathic Medical Students. *J Am Osteopath Assoc* 2020;120:218–27.
32 Byrne MK, Deane FP. Enhancing patient adherence: outcomes of medication alliance training on therapeutic alliance, insight, adherence, and psychopathology with mental health patients. *Int J Ment Health Nurs* 2011;20:284–95.
33 Kisely S, Ligate L, Roy M-A, *et al*. Applying Motivational Interviewing to the initiation of long-acting injectable atypical antipsychotics. *Australas Psychiatry* 2012;20:138–42.
34 Tacchi MJ, Downie E, Sreeneth S, *et al*. Improving the understanding of medication non-adherence among mental health professionals: findings from a series of UK training workshops. *J Ment Health* 2012;21:600–7.