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Non-allergist healthcare workers views on delivering a penicillin allergy de-labelling inpatient pathway: identifying the barriers and enablers

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Background: Non-allergist delivered PADL is supported by UK and World Health Organization guidelines but is not yet routine in UK hospitals. Understanding the views of healthcare workers (HCWs) on managing patients with penA records and exploring perspectives on delivering a PADL inpatient pathway are required to inform the development of non-allergist delivered PADL pathways.

Objective: To explore the perspectives of non-allergist HCWs working in medical specialties on managing patients with penA records, and to explore the enablers and barriers to embedding PADL as a standard of care for inpatients.

Methods: Semi-structured interviews with doctors, nurses, pharmacists and medicines optimization pharmacy technicians working in a district general hospital in the UK. Thematic analysis was used to analyse the data.

Results: The PADL pathway was considered a shared responsibility of the multidisciplinary team, which needed to be structured and supported by a framework. PADL aligns with HCW roles but time to deliver PADL was a barrier. Training for HCWs on the benefits of PADL and delivering PADL for those patients where a penicillin might be beneficial during the current episode of care would both motivate HCWs to deliver PADL.

Discussion and conclusion: The PADL pathway was acceptable to HCWs and aligned with their roles and current healthcare processes but their capacity to deliver PADL in a time pressured environment was a significant barrier.

Introduction

Patients with a record of penicillin allergy (penA) have reduced antibiotic options and are given 'second choice' antibiotics that can be less effective, are more likely to cause side effects and put people at risk of multidrug resistant infections.[1] Approximately 15% of hospitalized patients have a record of PenA but approximately 95% of these patients can safely take penicillin.[2] This is because the 'allergy' described is not a true allergy, but instead a mild side effect, also known as an intolerance, or they may have grown out of their allergy.[3] Consequently, a large number of patients are unnecessarily denied penicillins and unnecessarily put at risk of the harms associated with 'second choice' antibiotics. The process for assessing patients and removing incorrect penA labels is called 'de-labelling' (PADL).

Non-allergist delivered PADL is supported in the UK by the British Society of Allergy and Clinical Immunology, the UK's Department of Health and by the World Health Organization but is not yet routine in UK hospitals.[4–6] A survey by the authors in 2016 identified that healthcare workers (HCWs) were motivated to tackle the issue of removing incorrect penA records, and a focus group study in the same hospital in 2017 explored barriers and enablers to inpatient PADL and found that some HCWs were confident de-labelling patients with a low risk of genuine penA, such as intolerance, but capacity to deliver PADL was considered a challenge.[7,8] More recently, a survey of doctors' views of a PADL pathway identified a lack of time to be the greatest barrier to delivering PADL but also a lack of knowledge and skills within the clinical team, nurse anxiety about administering penicillin to these patients and a lack of space within busy clinics were barriers to implementation.[9]

The purpose of the current study was to explore the perspectives of (HCWs) in medical specialties on managing patients with penA records and to explore perspectives on delivering a proposed PADL inpatient pathway. We were particularly interested

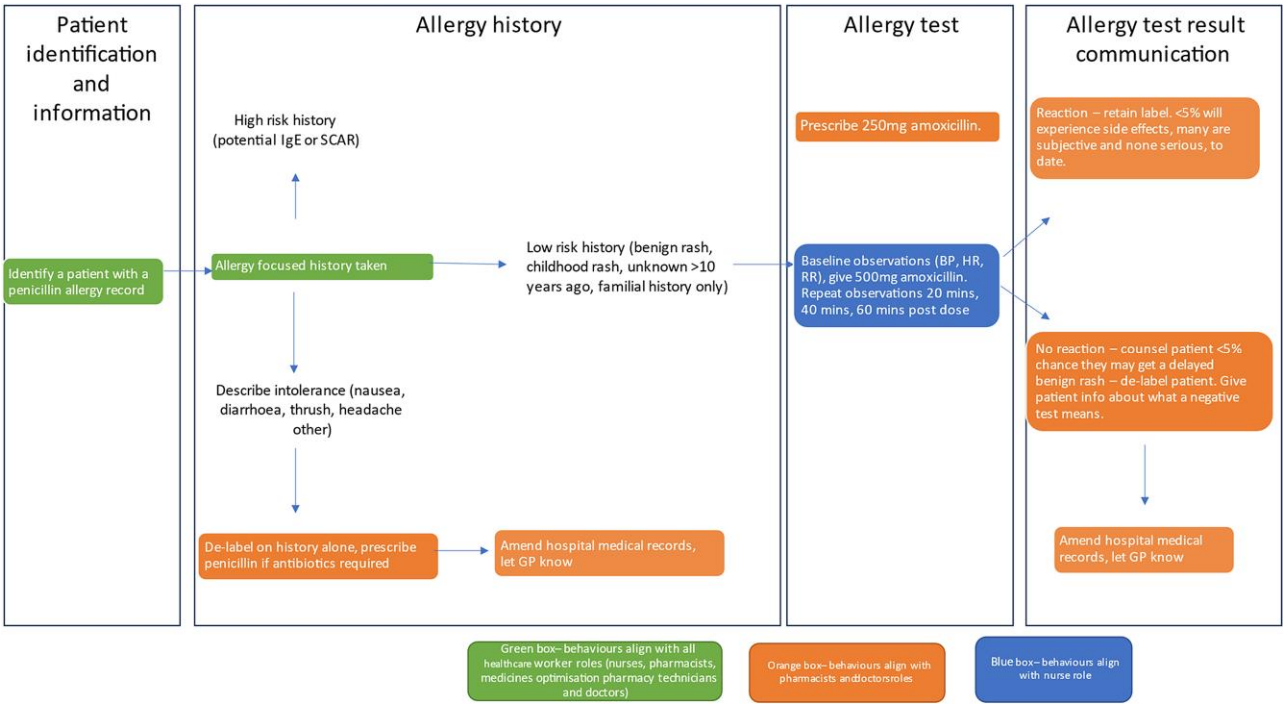

Figure 1. The penicillin allergy de-label patient pathway showing which of the key behaviours align with each of the HCW groups roles (nurses, pharmacists, MOPT and doctors).

in identifying the enablers and barriers to embedding this as a standard of care for inpatients. This work will inform the design of an inpatient PADL patient pathway in an English hospital.

Methods

Study design and setting

This was a qualitative study using semi-structured interviews with doctors, nurses, pharmacists and medicines optimization pharmacy technicians (MOPT) working at the Royal Cornwall Hospital in the UK. The study hospital is a 760-bed district general hospital serving a population of 450 000 people. In 2022 there were 120 627 hospital admissions and 83 555 emergency department (ED) attendances.

Participant selection

Purposive sampling was used to identify participants from medicine, nursing and pharmacy with a range of years' experience. Specialty lead consultants working in the ED and each of the medical specialties (acute medicine, elderly care, respiratory, endocrine, cardiology, renal, gastroenterology) were emailed an invitation to participate in the study and were requested to cascade the invitation to all consultants, associate specialists and staff grades. Junior doctors (Foundation Years, Core Trainees and Specialist Trainees) were invited to participate via e-mail sent via the Medical Education Administrator. Clinical pharmacists and MOPTs were invited to participate by e-mail sent via the pharmacy administrator. Clinical Matrons emailed the study invite to ward nurses and ward managers. The e-mail invitation included a brief outline of the study, a participant information sheet, a consent form and researcher contact details. People who were interested in participating were asked to contact the lead researcher. Three reminder emails were sent over a 3month period. Staff were also approached in person during clinical duties. We aimed for diversity across range of years of experience, HCW grade and gender.

Data collection

A semi-structured interview guide was developed based on relevant literature and informed by the Theoretical Domains Framework.[10] This asked about experiences and opinions on current and optimal management of patients with penA records, before proposing an inpatient PADL pathway (as described in Figure 1) and exploring HCWs views on their roles in that process.

Interviews were conducted over Microsoft Teams, and audio recorded and transcribed verbatim by an independent transcription services company. Written informed consent was collected. Interviews continued until data indicated saturation in each of the participant groups.[11]

Data analysis

Data collection and analysis took place concurrently. Transcripts were uploaded to NVivo 12. Inductive thematic analysis was used to analyse the transcripts.[12] NP read and familiarized himself with all transcripts before independently coding five transcripts and discussing these with STC to agree on preliminary codes. These codes were used to develop an initial coding framework, discussed with STC, and used to analyse the remaining transcripts. Additional codes were added as new data were identified in later transcripts and the framework adapted as necessary.

Ethics

This study was reviewed and approved by the Liverpool Central Research Ethics Committee (IRAS Project ID 299708).

Table 1. Interviewees by HCW group, staff grade, years' experience and gender

HCW group	Grade	Specialty	Number of participants	Gender (M/F)	Years' experience mean (range)
Doctors[a]	Consultants	ED, acute medicine, eldercare	5	3/2	—
	Registrars	Cardiology, general medicine	2	1/1	—
	Core medical trainee	Medicine	1	1/0	—
	Foundation Year Doctors	Medicine	3	1/2	—
Pharmacy	Ward pharmacists	Medicine, ED	5	2/3	10 (1–22)
	MOPT	Medicine	2	0/2	17 (4–30)
Nurses	Ward nurse, Clinical matron, ward sister	Acute medicine, respiratory and cardiology	5	1/4	20 (3–33)
Total			23	9/14	

ED, emergency department.
[a]Years of experience was not collected for doctors because it is indicated by their role.

Results

Participants

Twenty-three interviews were conducted between 5 August 2022 and 6 April 2023, lasting between 25 and 53 minutes (mean 40 minutes). Eleven doctors, seven pharmacists and five nurses were interviewed (Table 1).

Four broad themes captured the views of HCWs on managing patients with penicillin allergy records and how to tackle the problem of incorrect penA labels (see Supplementary Data available at *JAC-AMR* Online for further supporting quotes).

Theme 1: the PADL patient pathway aligns with HCW roles and is a shared responsibility

HCWs said it was common to find discrepancies between penA records and penA histories, with details often vague, making it difficult to determine allergy risk. Some doctors and pharmacists described scenarios where they had proactively explored allergy histories, in some cases removing the penA label before prescribing penicillin, but that the most common approach was to prescribe an alternative antibiotic.

> *They say, 'I've been told as a child that I can't have penicillin', or, 'I come out into a rash or, I almost died…' usually it's one of those three answers and obviously when the patient says, I almost died, you don't touch it and if someone comes out with a rash, that's when you don't feel very confident saying, well this is not an anaphylactic reaction, but the ones who say I can't remember, then that's when I ask the GP to review the status.* Cardiol. reg.

PADL was felt to be a multidisciplinary responsibility, shared between doctors and pharmacists, supported by MOPT and nurses, although ultimately responsibility lay with the senior doctor.

> *To make this pathway just be owned solely by one profession is not a very efficient use of it. It needs to be an MDT approach. So it's part of the making every patient contact count. Anyone involved in healthcare is involved in the allergy side of things. So you can't be involved in healthcare and not pay attention to their allergy status.* Ward Pharm. 3

Figure 1 shows HCW views on which PADL tasks aligned with their roles. Doctors were confident using an algorithm to risk stratify patients and prescribing a challenge dose (Quote 1, Appendix S1). Less experienced doctors said they would want support from senior colleagues and for the final decision to prescribe a challenge dose to be made by senior doctors (Quote 2, Appendix S1). Senior doctors felt that they had the skills to allergy assess and decide who to challenge test and were confident about managing unintended consequences, such as anaphylaxis (Quote 3, Appendix S1). They acknowledged that access to an expert with knowledge of penA and PADL to offer advice when required, would be useful for implementation (Quote 4, Appendix S1).

> *…we are used to pathways. Junior doctors respond really well to pathways, and you feel like, 'Okay, well, I followed the pathway, so I'm backed'. If someone who knows a lot more has told you, 'This is a way you can follow it', we're more than happy to follow a pathway.* FY2 doc. 2

Pharmacists and MOPT reported penA history taking, determining allergy risk and removing incorrect allergy records aligned with the medicine's reconciliation process and their roles (Quotes 5 and 6, Appendix S1), but that that senior support, particularly for more junior staff would be valuable (Quotes 7 and 8, Appendix S1).

> *…the de-labelling aspect is what a lot of pharmacists already do, I think a fair number of pharmacists are comfortable amending the EPMA records, and I have seen it on DMR [discharge medicines reconciliation] notes to GPs saying, we treated patient with amoxycillin, had allergy on SCR but was diarrhoea, has been downgraded to a sensitivity.* Pharm. 4.

Nurses said taking an allergy focused history and risk stratifying patients did not align with their role and would require further training but administering the challenge dose, ensuring rescue medications were available and post-challenge monitoring of observations aligned with their roles, were deliverable in the ward environment and would want to feel supported by more senior staff (Quotes 9 and 10 Appendix S1).

> *We do the same thing [for] a blood transfusion. We monitor a patient closely for any reaction to the bloods so we have that set up in the obs monitoring. You can set up in the obs machine so it will prompt you when will be the next check. So, it will help the nurses and healthcare to bear in mind that you need to check again the patient.* Acute med. nurse 2

Theme 2. Ensuring patient safety and patient engagement are necessary to optimize PADL

Across the HCW groups, it was acknowledged that the hospital was a safe environment and a good opportunity to de-label patients (Quote 11, Appendix S1), although testing clinically stable patients on base wards was preferable, and more deliverable, to testing clinically unstable patients, particularly in fast patient turnover environments such as ED (Quote 12, Appendix S1).

> *The ward, I think, definitely would accept it—the inpatient wards. I could see that being something that would be on your jobs list, but after ward round, and it being done and being done properly—like properly having observations. ED—I think people wouldn't do it—AMU, they might—I don't know...*FY2 doc. 2

Patient anxiety and long held beliefs about allergy status may prevent patient engagement with PADL. However, with the appropriate verbal and written information on the risks and benefits, it was felt that most patients would agree to testing (Quote 13, Appendix S1).

PADL was only really considered if it affected antibiotic prescribing during the current episode of care, but there was acknowledgement by a minority that PADL was relevant for all inpatient stays as it might benefit the patient in a future episode of care made (Quote 14, Appendix S1).

> *If I feel that a patient qualifies for Penicillin then I probably wouldn't mind doing [a history] and, if time allows, but, if a patient's not on antibiotics, then it's not gonna be my priority.* ward pharm. 1

Promoting PADL as safe, in the patients' best interests, and ensuring patient safety throughout the process was considered key to optimizing PADL for hospitalized patients (Quote 15, Appendix S1).

> *...something that's communicated that has their best interests and their health improvement at the heart of it, then I think they would be fine so long as it's approached in the right way and that it's about them, not the institution, that actually they still remain at the heart of it, then I think they will be fine. But that part has to be communicated very carefully.* Acute med. Cons. –1

Theme 3: PADL needs to be supported by a wider framework

There was very little experience of formal allergy testing among participants, and a lack of awareness of formal penicillin allergy testing processes and local allergy testing services (Quote 16, Appendix S1). For HCWs to have confidence to deliver PADL, they said the pathway (Figure 1) needed to be structured, standardized and evidence based (Quote 17, Appendix S1). Participants welcomed a hospital approved and ideally validated decision support tool for risk assessment (Quote 18, Appendix S1). Some participants identified the issue of record keeping and discussed the challenges with ensuring allergy records are updated and accurate. Ensuring good communication with the patient and the GP about the negative test result was considered important by several HCWs with one pharmacist suggesting a dedicated letter would overcome some of these challenges.

> *What you wouldn't want it to be is just a little note in MAXIMS discharge that says FYI, penicillins are not allergic. I think, for the patient to feel validated that they have got an allergy and that someone has taken that seriously enough to test it and to challenge it and de-label, having a letter to the GP emailed across, or something that's attached to the end of the discharge summary that's not just a one-liner would help.* Ward pharm. 2

Doctors across the staff grades said that having a policy or a protocol, endorsed by the executive team recognizing PADL as a standard of care would encourage doctors because it would make them feel supported and protected to deliver PADL (Quote 19, Appendix S1). However, two senior doctors both said that making PADL mandatory, or as a tick box exercise in the medical notes, might risk losing clinician support for PADL.

> *one thing I wouldn't want is a sticker in the notes, saying, 'Have you checked to see if this patient really is "Penicillin-allergic?"' because that would drive people nuts, I think.* ED cons. 2

Training and education, tailored to training needs of the HCW group and sustained, delivered by a multitude of channels was identified as important for implementing PADL by all HCW groups.

> *I know the A&E has a Safety Message of the Week that gets mentioned at every handover, so it could be for that week, this is the week we're going to focus on de-labelling penicillin, or something like that. Or just being aware of the pathway. Yeah, I think it could work quite nicely.* Core trainee

Several other ways to potentially optimize PADL were suggested, and are shown in Table 2.

Theme 4. PADL has resource implications

Participants reported, that with competing demands on HCW time, PADL could not add significant workload or include steps which would take more than a few minutes.

> *...it is often difficult to take the time to explore the nature of their penicillin allergy because treatment needs to be delivered in a timely fashion and kind of the next patient seen, it's more likely that the penicillin allergy will be taken as a truth and a non-penicillin antibiotic prescribed for the pneumonia and kind of the next patient seen as opposed to the allergy challenge or questioned or more details taken.* Acute med. cons. 1

If the allergy history only took a few minutes, then time was not seen as a barrier, but making several phone calls to ascertain the allergy history, or PADL generating a load of paperwork, would make PADL less deliverable.

> *I think the bottom line is what it would involve, so what the de-escalation or the de-labelling would involve, because if it was something that took two minutes or five minutes per patient then it's not necessarily a problem but if it's something that takes five or six or seven phone calls to various different people, plus filling in a load of paperwork, then it's going to be very difficult to*

Table 2. Suggested ways to optimize penicillin allergy de-labelling patient pathway

Suggestions	Supporting quote
Reminders and prompts in the EPMA system to deliver PADL	*...there could be a little notification that comes up and says, 'This patient is Penicillin-allergic—has somebody done their de-labelling process—has somebody spoken to them about de-labelling them?'* FY2 doc. 1
Poster visible in ward areas to deliver PADL	*I'm guessing we could do with a copy of the procedure and like the flowchart that you were showing us an e-mail document that could be printed out and put on the like medicines prep room walls and that. So I think also it might be useful to have like a copy of the flowchart maybe on laminated cards that you could put in your pocket so you can actually have it particularly when it's a new procedure.* Acute med. nurse 3
Prompts from ward pharmacists to deliver PADL	*I imagine that it will take a bit of time for people to get used to thinking about something that they're not maybe not thinking about already and will probably take some gentle encouragement from the pharmacists on the ward, I would imagine as I find they quite often find information that we don't, maybe on the initial clerking because sometimes it's very difficult to find information, I find or at least accurate information.* Middle grade doc.
Leadership was viewed as important to facilitate the embedment of PADL. Doctors mentioned several initiatives successfully implemented with a champion, a named individual, or individuals	*It is relevant to my role, but I need to be incentivised. Someone needs to drive it forward and someone needs to champion it and if someone challenges the champion the champion needs to be able to say this is the reason.* Acute med. Cons. 2
Awareness raising in the community healthcare settings of the PADL pathway to ensure medical records are updated, to facilitate allergy history obtainment and to contribute to the de-label effort	*I don't know whether you'd have to let the community teams know about this as well, so they're aware of this and they're not what do you mean, they've had a test of amoxicillin? If they're aware of the new system that's coming in then when patients talk to them about it they're not out of the loop.* Core trainee doc.
Empowering patients through raising public awareness of the risks of penicillin allergy records might be a useful way to encourage patients to reflect on their penA status and to enquire about penA testing when in hospital, promoting HCWs to review their allergy record	*There are other ways and again I'm thinking patients need to get more involved. This is a mantra of the NHS patient involvement; in some way you have to make patients ask the questions they need to get more involved. Why can't a patient ask am I really allergic to penicillin, have you looked at it. Sometimes all it needs is a prompt from someone, am I allergic okay well I didn't really think of it but yeah might kind of be worth looking at it.* Acute med. cons. 2
Supporting material/information is easily available	*I wonder whether having like an A4 sheet that you can download from Oceano or intranet that you can just write the obs on, and that might have a patient information leaflet attached to it saying you have been de-labelled, or you have had to be de-labelled or something like that might be helpful, a little pack. And then you can just sit back and they'll know it, rather than having to put all the e-obs online every 20 minutes or so. Yes, there could be a clear benefit. Yeah, I think it's very doable.* Core trainee 1
A triage set of questions completed by initial contact that flags patients for inpatient follow-up	*So as part of my role we have introduced the smoking cessation nurses and we use NerveCentre to gather our information because nurses use it every day for every single patient and it's a really easy way to pick up that information and people can ask those questions at admission or it flags if they've not been asked. So for me I would suggest NerveCentre would be a really easy to use tool for nurses to get that information.* Clinical matron

get it up the priority list. So I think it very much depends on what it involves and I think that's why if there were a standardised format it would make it easier. Eldercare cons.

Nurses expressed some concerns with potentially being diverted to other duties required of them, which might result in the necessary observations being delayed.

[it may be difficult] if we were so busy we couldn't guarantee doing the observations at 20 minute intervals. Acute med. nurse 3

Several participants suggested reducing the number of post-challenge observations, and one doctor suggested that PADL was streamlined as much as possible so that it aligns with healthcare processes.

> *[The] process of it will need to be clear and easy to achieve and made as streamlined as possible such that it's something that just fits in rather than is an arduous new task in an already overloaded system.* Acute med. cons. 1

In addition to the proposed PADL pathway, several other models of delivery were proposed; ward clinical teams could refer low risk patients to a dedicated penicillin allergy team; dedicated shifts for doctors to deliver PADL, either as a paid role or an opportunity to meet domains for their portfolio of training and using nursing or medical students to monitor patients with oversight from nursing and medical teams (Quotes 20–23, Appendix S1).

Discussion

Participants were largely supportive of a PADL pathway. They considered it a shared responsibility of the multidisciplinary team and felt it needed to be structured and supported by a framework that included leadership and senior ownership. The required behaviours to deliver the pathway were felt to align with HCW roles but the greatest challenge to delivering PADL in an already stretched healthcare system, was reported as HCW time. HCWs were motivated to deliver PADL in those patients where a penicillin might be beneficial during the current episode of care. Participants felt information on the benefits of PADL for HCWs and the public, and ensuring PADL remained patient focused, would further facilitate PADL.

The findings of a survey of doctors and non-medical prescribers in a hospital in the north-west of England on how to better manage patients with penA by Elkhalifa *et al.* concurred with those in our study, and identified the need for practical education sessions and an interactive questionnaire to guide allergy history taking and risk classification.[13] Similarly, a previous focus group study in the study hospital identified the need for hospital management support for PADL, and the PADL intervention to be informed by the evidence, developed by stakeholders and supported by HCW education and engagement before implementation, and requested a named lead and a recognized expert in PADL be available for support and guidance.[8]

A survey of HCWs at the study hospital identified time as a barrier to PADL with about half of respondents reporting they did not have the necessary time to talk to patients about penicillin allergies.[7] Time too featured in the current study findings. Similarly, Elkhalifa *et al.* reported time to be a barrier to allergy history reconciliation.[13] This highlights an issue of prioritization as well as a need for efficient models of penicillin allergy assessment.

Alagoz *et al.* interviewed HCWs in the USA to explore barriers and enablers to PADL in a hospital with an embedded non-allergists PADL guideline and found some HCWs reluctant to engage with PADL due to apprehension about inducing an allergic reaction and having inadequate skills and resources to treat a possible allergic reaction.[14] We found junior doctors and pharmacists had similar concerns, but senior doctors had fewer concerns about their ability to treat allergic reactions, should they occur. Alagoz found HCWs were amenable to delivering PADL but a lack of familiarization with PADL was a barrier.[14] Similar to our findings, HCWs said the algorithm for risk stratifying patients was straightforward but expressed concerns about trying to apply the algorithm to patients who could not remember their reaction.[14] Alagoz also found that PADL was considered a multidisciplinary process, requiring a collaborative approach.[14] Contrary to our findings, neither the doctors nor pharmacists felt that removal of incorrect penA records aligned with their current roles, instead aligning with allergists roles at their hospital.[14] In our study, HCWs felt empowered to prescribe a challenge test and de-label patients in the absence of an allergist but had requested access to an expert to help with the more complicated decision making and somebody to champion PADL. A lack of PADL champion has been cited as a reason for non-consistent delivery of PADL.[14] Other similarities were that workload and competing priorities prevented implementation and prescribing alternative antibiotics was too easy with concerns that PADL might slow patient flow, a priority in busy hospitals, and if PADL affected the current hospital antibiotic therapy then it became more of a priority.

Strengths and limitations

In this study, we interviewed HCWs from four different disciplines with a wide range in years of experience, capturing a range of experience. We included all HCWs who could potentially support a PADL pathway to understand how optimal implementation would work for all disciplines.

Similar studies of HCW views on PADL from the USA and Denmark had similar findings to ours and the job roles and work environment participants described is likely similar across UK hospitals. Therefore, many of these findings are likely to apply to other NHS hospitals that are similarly resourced. The pathway is likely to be able to be integrated into any NHS hospital with clear leadership, support and training for staff. Much previous related research has been done at this study hospital and as such there may be more enthusiasm for the intervention compared to other settings; other hospitals may need greater motivational aspects to the intervention.

Although a few interviewees had experience of de-labelling patients in their clinical roles, this study explored HCWs views on a theoretical PADL patient pathway. Other barriers and enablers may emerge during the implementation of the PADL intervention.

Conclusions

Patients incorrectly labelled as penA was acknowledged as a problem and HCWs were supportive of finding a solution to the removal of incorrect penA labels. The PADL pathway was acceptable to HCWs and aligned with their roles and current healthcare processes but their capacity to deliver PADL in a time pressured environment with multiple competing priorities in a limited resource setting such as the NHS was identified as a significant barrier to implementing the PADL patient pathway.

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Transparency declarations

None to declare.

Supplementary data

Appendix S1 is available as Supplementary data at *JAC-AMR* Online.

References

1 Krah NM, Jones TW, Lake J *et al*. The impact of antibiotic allergy labels on antibiotic exposure, clinical outcomes, and healthcare costs: a systematic review. *Infect Control Hosp Epidemiol* 2021: **42**: 530–48. https://doi.org/10.1017/ice.2020.1229

2 Krishna MT, Huissoon AP, Li M *et al*. Enhancing antibiotic stewardship by tackling "spurious" penicillin allergy. *Clin Exp Allergy* 2017; **47**: 1362–73. https://doi.org/10.1111/cea.13044

3 Blumenthal PJ, Trubiano JA, Phillips EJ. Antibiotic allergy. *Lancet* 2019; **393**: 183–98. https://doi.org/10.1016/S0140-6736(18)32218-9

4 World Health Organization, Europe. Antimicrobial Stewardship Interventions: a Practical Guide. 2021. https://apps.who.int/iris/bitstream/handle/10665/340709/9789289054980-eng.pdf.

5 Department of Health. Start Smart—Then Focus Antimicrobial Stewardship Toolkit for English Hospitals. 2015. https://www.gov.uk/government/publications/antimicrobial-stewardship-start-smart-then-focus/start-smart-then-focus-antimicrobial-stewardship-toolkit-for-inpatient-care-settings.

6 Savic L, Ardern-Jones M, Avery A *et al*. BSACI guideline for the set-up of penicillin allergy de-labelling services by non-allergists working in a hospital setting. *Clin Exp Allergy* 2022; **52**: 1135–41. https://doi.org/10.1111/cea.14217

7 Wilcock M, Powell N, Sandoe J. A UK hospital survey to explore healthcare professional views and attitudes to patients incorrectly labelled as penicillin allergic: an antibiotic stewardship patient safety project. *Eur J Hosp Pharm* 2019; **26**: 329–33. https://doi.org/10.1136/ejhpharm-2017-001451

8 Powell N, Wilcock M, Roberts N *et al*. Focus group study exploring the issues and the solutions to incorrect penicillin allergy-labelled patients: an antibiotic stewardship patient safety initiative. *Eur J Hosp Pharm* 2021; **28**: 71–5. https://doi.org/10.1136/ejhpharm-2019-001863

9 Sneddon J, Cooper L, Ritchie N *et al*. An algorithm for safe de-labelling of antibiotic allergy in adult hospital in-patients. *Clin Exp Allergy* 2021; **51**: 1229–32. https://doi.org/10.1111/cea.13878

10 Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci* 2012; **7**: 37. https://doi.org/10.1186/1748-5908-7-37

11 Braun V, Clarke V. To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qual Res Sport Exerc Health* 2021; **13**: 201–16. https://doi.org/10.1080/2159676X.2019.1704846

12 Braun V, Clarke V. Conceptual and design thinking for thematic analysis. *Qual Psychol* 2022; **9**: 3–26. https://doi.org/10.1037/qup0000196

13 Elkhalifa S, Bhana R, Blaga A *et al*. Development and validation of a mobile clinical decision support tool for the diagnosis of drug allergy in adults: the drug allergy app. *J Allergy Clin Immunol Pract* 2021; **51**: 4410–8.e4. https://doi.org/10.1016/j.jaip.2021.07.057

14 Alagoz E, Saucke M, Balasubramanian P *et al*. Barriers to penicillin allergy de-labeling in the inpatient and outpatient settings: a qualitative study. *Allergy Asthma Clin Immunol* 2023; **19**: 88. https://doi.org/10.1186/s13223-023-00842-y