Human Vaccines & Immunotherapeutics

ISSN: 2164-5515 (Print) 2164-554X (Online) Journal homepage: www.tandfonline.com/journals/khvi20

Managing allergy-related COVID-19 vaccine hesitancy: A multi-methods analysis of practitioner notes and referral outcomes

Richard M. Clarke, Stephen P. O'Hickey, Elaine Walklet , Eleanor Bradley & Berenice Mahoney

To cite this article: Richard M. Clarke, Stephen P. O'Hickey, Elaine Walklet , Eleanor Bradley & Berenice Mahoney (2025) Managing allergy-related COVID-19 vaccine hesitancy: A multi-methods analysis of practitioner notes and referral outcomes, Human Vaccines & Immunotherapeutics, 21:1, 2561457, DOI: 10.1080/21645515.2025.2561457

To link to this article: https://doi.org/10.1080/21645515.2025.2561457

HUMAN VACCINES & IMMUNOTHERAPEUTICS
2025, VOL. 21, NO. 1, 2561457
https://doi.org/10.1080/21645515.2025.2561457

Taylor & Francis
Taylor & Francis Group

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Managing allergy-related COVID-19 vaccine hesitancy: A multi-methods analysis of practitioner notes and referral outcomes

Richard M. Clarke[a], Stephen P. O'Hickey[b], Elaine Walklet[a], Eleanor Bradley[c], and Berenice Mahoney[d]

[a]School of Education and Sciences, University of Gloucestershire, Cheltenham, UK; [b]Respiratory and General Medicine, Worcestershire Acute Hospitals NHS Trust, Worcester, UK; [c]College of Health and Science, University of Worcester, Worcester, UK; [d]School of Health and Wellbeing, University of Worcester, Worcester, UK

ABSTRACT

This study examines healthcare practitioners' decision-making processes when managing vaccine-hesitant patients concerned about allergic reactions to COVID-19 vaccines. A multi-methods secondary data analysis was conducted combining quantitative referral trends and qualitative thematic analysis of health practitioner recorded notes. Anonymized data from 326 individuals referred to an interim COVID-19 vaccine allergy advice service based in Herefordshire and Worcestershire, UK, were analyzed. Quantitative data included referral patterns and vaccination outcomes, while qualitative data consisted of thematic analysis of free-text health practitioner notes documenting patient concerns and practitioner decision-making. Of the referred cases, 23.3% were advised to proceed with vaccination in primary care without precaution, 29% with additional precautions such as antihistamines and extended observation. Hospital-based vaccination was only recommended for 0.9%, typically for individuals with complex allergy histories. In 22.7%, cases were escalated to a multidisciplinary team that mainly advised vaccination in primary care with precautions or in hospital settings. Notably, no cases resulted in recommendations against vaccination. The qualitative analysis of health practitioner free text notes developed three themes: diverse presentation of allergies, complex allergy histories, and patient anxiety and lack of trust. Themes suggest healthcare practitioners face significant challenges in clinical decision-making with these patients and highlight the complexity of managing vaccine hesitancy. This study underscores the need for enhanced training and standardized documentation processes to support healthcare practitioners in managing allergy-related vaccine hesitancy. Public health messaging should proactively address misconceptions about vaccines as they relate to allergies, to build trust and reduce hesitancy.

ARTICLE HISTORY
Received 1 August 2025
Revised 27 August 2025
Accepted 10 September 2025

KEYWORDS
Vaccine hesitancy; allergy; COVID-19 vaccination; mRNA vaccines; electronic health records; healthcare practitioner decision-making

Introduction

In December 2020, during the global spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2; from here on COVID-19), the UK paused use of the mRNA Pfizer-BioNTech vaccine for individuals with a history of severe allergies following anaphylactic reactions post-vaccination in two healthcare workers.[1,2] This Medicines and Healthcare products Regulatory Agency (MHRA) directive was withdrawn 3 weeks later[3] after an investigation found no such risk for individuals with serious, but unrelated, allergy histories. The initial short-lived MHRA announcement and media coverage caused significant public concern,[4] overshadowing attention to the revision, as is commonly the case with corrections,[5] and leaving a vacuum for vaccine hesitancy to fill.[1] mRNA vaccine-related hesitancy more broadly is a growing public health challenge beyond COVID-19 vaccines[6] given their wide-ranging application including disease prevention,[7] and curative therapies for cancers.[8]

Public concern about vaccine safety often follows a similar pattern. In the case of the measles, mumps and rubella (MMR) vaccine, early public debate was shaped by two stories. The first, which garnered far greater attention, is the now-debunked claim, originating with Andrew Wakefield's withdrawn 1998 Lancet paper, that MMR causes autism.[9]

CONTACT Berenice Mahoney b.mahoney@worc.ac.uk School of Health and Wellbeing, University of Worcester, Henwick Grove, Worcester, Worcestershire WR2 6AJ, UK.

Supplemental data for this article can be accessed online at https://doi.org/10.1080/21645515.2025.2561457

The second, a legitimate question concerning the use of egg protein in its manufacture, with healthcare providers and parents concerned about potential allergic reactions to the vaccine among the egg allergic.[10] Despite evidence that the MMR vaccine is safe for egg-allergic individuals,[11–14] concerns about the safety of the MMR vaccine linger among the general public and healthcare practitioners, placing additional strain on healthcare resources through outdated practices (e.g., unnecessary referrals for hospital-based vaccinations).[15] The allergy-related parallel to egg for the Pfizer-BioNTech COVID-19 vaccine is Polyethylene glycol (PEG), a common stabilizer in medicines, cosmetics, and food.[16] The PEG excipient in the Pfizer-BioNTech COVID-19 vaccine has raised concerns about the risk of allergic reactions, especially anaphylaxis, among the PEG allergic. Similar to the MMR vaccine, evidence now shows the Pfizer-BioNTech COVID-19 is safe for most individuals. Greenhawt et al.'s 2021 systematic review and meta-analysis found the incidence of anaphylaxis to all COVID-19 vaccines was approximately 7.91 cases per million doses administered and there was in fact a lower risk for mRNA vaccines such as BNT162b2 and mRNA-1273 (2.5–5 per million). No fatalities related to vaccine-induced anaphylaxis were documented, indicating the risk of severe allergic reactions exists but are rare and non-fatal.[17,18] The estimated fatality rate from COVID-19 infection varies significantly but markedly exceeds the risk of vaccine-related anaphylaxis.[17] Thus, evidence proved to support the vaccination, with allergy specialist involvement, process for individuals with severe allergies.

Vaccine hesitancy is studied widely but the role of allergies in shaping vaccine concerns is less explored, particularly in the context of mRNA vaccines.[19] Vaccine hesitancy may be heightened among individuals with allergies given perceived or actual risks associated with vaccination can appear greater to these individuals than the risks posed by the disease.[20] This dynamic reflects the known interplay of risk perception, cognitive biases (e.g. omission bias, availability heuristic, conformation bias), and attitudinal drivers of vaccine hesitancy that could be heightened among individuals with allergies, amplifying fears and distorting risk perceptions.[21–23] Addressing these psychological drivers is essential for reducing vaccine hesitancy, particularly in populations with heightened concerns about allergic reactions.

Trust is also a key determinant of vaccine attitudes and behaviors. Confidence in government institutions, political actors, and the media has at times been associated with lower compliance with public health guidance, while trust in healthcare professionals and administrative institutions is more consistently linked to positive health behaviors.[24–26] In the context of COVID-19, such findings highlight the central role of practitioners as trusted intermediaries when government or political trust is lacking. Given that vaccine hesitancy often emerges at the intersection of broader societal trust and individual health concerns, understanding the dynamics of trust is crucial for interpreting how patients and practitioners negotiate allergy-related vaccination decisions.

Shared decision-making provides opportunities for tackling vaccine hesitancy.[27–29] Typically in consultations, vaccination is the clear and obvious choice from a clinical and public health perspective, allowing healthcare practitioners to support and recommend vaccination unequivocally. Healthcare practitioner endorsement can influence vaccine uptake[30] but supporting vaccine uptake becomes more complex when patients have specific concerns, such as a history of allergies. Evidence supports vaccination in individuals with allergies,[31] but healthcare practitioners must navigate these patient vaccine-related concerns to ensure consultations are patient-centered while also communicating the benefits and low risks of vaccines with sensitivity to patient fears and preferences. Kogseder et al. found that allergy patients who sought a COVID-19 vaccine risk assessment had significantly higher anxiety and depression scores than allergy patients that did not present for COVID-19 related concerns.[32] This suggests effective risk communication could be important for tackling vaccine hesitancy among patients with allergies.

Healthcare professionals' self-efficacy for effectively communicating risks and benefits of treatment options to patients are also critical for successful shared decision-making.[33,34] However, the potential for severe reactions can lead healthcare practitioners to be overly cautious which, even though well intended, can emphasize risks over benefits and not fully considering of the patient's values and preferences.[28] During the COVID-19 vaccine campaign, these challenges were compounded by the demand for additional allergy advice for patients and reliable communication and referrals by healthcare practitioners.[35] Informal and peer consultations were primary sources of guidance, but robust documentation of patients' allergy histories is inconsistent, further complicating decision-making.

Aims of the current research

Practitioner notes taken during and after consultations with patients offer rich, contextual insights into patient conditions, treatments, and responses.[36] Such notes can provide critical information about patient behavior and healthcare practitioner decision-making such as reasons for vaccine refusal and clinical judgment on the differentiation between true allergies from sensitivities or intolerances.[37,38]

The current research aims to analyze vaccine hesitancy in the context of allergies, drawing on practitioner notes to explore how healthcare professionals navigated concerns and outcomes related to COVID-19 vaccination.

Our research question is: *How do healthcare practitioners respond to patients' concerns about their risk of allergic reactions to COVID-19 vaccines?*

We aim to:

(1) Identify the number and nature of concerns reported, those resolved within primary care, and those referred to an ad hoc allergy service.
(2) Describe the decision-making processes healthcare practitioners use when supporting patients concerned about allergic reactions to COVID-19 vaccines.

Methods

Context

For this study, we analyzed secondary data obtained in partnership with the Herefordshire and Worcestershire Integrated Care System (ICS) in June 2022 using the Data Protection Impact Assessment process. During the COVID-19 mass vaccination campaign, Herefordshire and Worcestershire ICS lacked a dedicated allergy service, which is not unusual in many parts of the UK.[39] To comply with national recommendations to vaccinate at-risk adults in a timely manner, a three-step system-level service that involved an ad hoc network of professional advice was utilized. The dataset for this study comprises 326 individuals who reported a previous allergy, expressed concerns about allergies, or experienced a suspected or confirmed allergic reaction to a COVID-19 vaccine between March 2021 and December 2022 (see Figure 1).

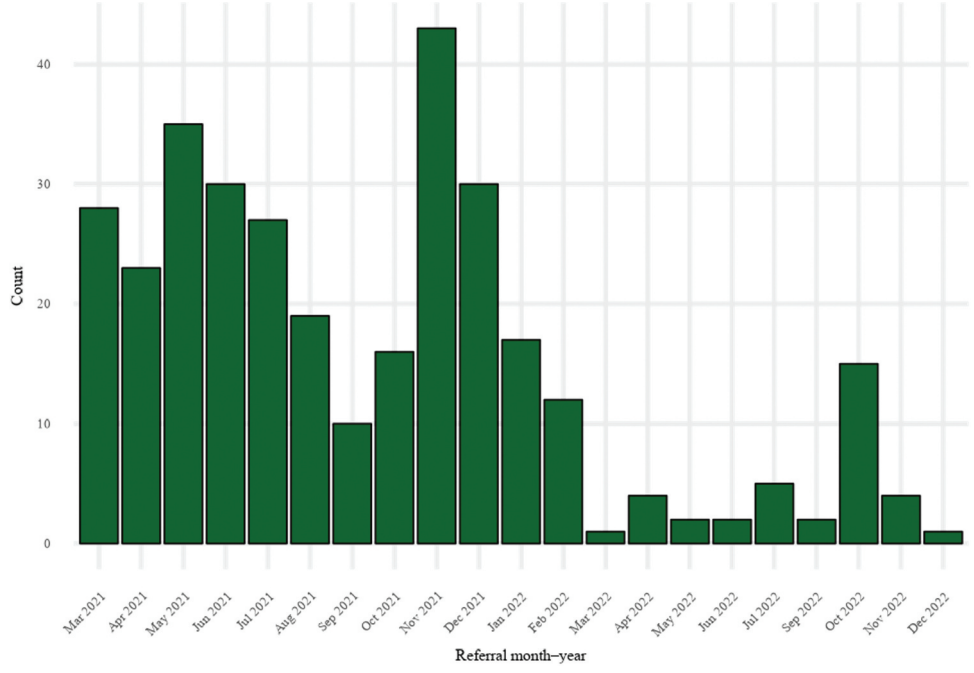

Figure 1. Date of referral for allergy advice. Date of referral for allergy advice (March 2021–December 2022). Bar chart showing the number of referrals received by month-year.

Referrals clustered around UK vaccination rollout milestones. An early wave during spring–summer 2021 as eligibility widened from priority groups to all adults and a secondary surge in December 2021–January 2022 coinciding with the accelerated booster campaign in response to the Omicron strain of the virus. A smaller rise in autumn 2022 can be seen, this likely relates to the seasonal booster opened to over-50s and clinical-risk groups.

Data collection

Step 1 – the COVID-19 vaccine allergy referral form

Data were obtained using a form developed by the Herefordshire and Worcestershire ICS, distributed to all vaccine centers and practices in the two counties ("*COVID-19 Vaccine – Allergy Referral form*", see Table 1 for a summary and supplemental materials for the complete form).

Completed referral forms were sent to a designated NHS e-mail address.

Step 2 – allergy review team notes and tracking

Following Referral Form submission, details were extracted and summarized in an Excel spreadsheet that formed the central database for tracking vaccination recommendations, healthcare practitioner decision-making and vaccination outcomes. In many cases, this required follow-up with the referring healthcare practitioner for additional clinical information regarding the referral or the patient's medical history. The spreadsheet was updated to include any new information obtained from these communications.

Cases were then reviewed by the Herefordshire and Worcestershire ICB allergy panel, consisting of GPs and pharmacists with specialized knowledge of vaccination and allergy management. Cases requiring further expertise were escalated to a multidisciplinary team of specialist clinicians, such as allergists, whose recommendations were recorded in the spreadsheet. Communication back to the referring healthcare practitioner was also documented, providing them with specific guidance on next steps.

Where follow-up information was available, such as whether the patient received the recommended vaccination and any adverse outcomes, these details were added to the tracking system. However, such information was not consistently reported for the majority of patients. This structured process ensured that each referral was reviewed systematically and that all relevant clinical decisions were documented and traceable.

Table 1. Overview of sections included in the COVID-19 vaccine allergy referral form.

Section	Details Captured
Patient Details	Full name, GP practice, address, date of birth, contact number, NHS number, hospital number.
COVID-19 Vaccination Status	Vaccination details for 1st, 2nd, and 3rd primary doses, and booster doses (date of administration and vaccine brand).
Exclusion from Referral	Categories where vaccination could proceed without referral, including: – Family history of allergies. – Non-systemic reactions to vaccines. – Hypersensitivity to NSAIDs.
Adverse Reaction Details	Documentation of adverse reactions, including: – Fainting/vasovagal responses – Panic attacks – Non-allergic reactions – Swelling or rash at injection site – Urticaria/angioedema – Systemic symptoms within two hours of vaccination
Allergy/Adverse Reaction History	Overview of allergic reactions or responses, particularly to COVID-19 vaccines: – Immediate systemic symptoms (e.g., anaphylaxis) to mRNA or other vaccines – Known allergies to vaccine components (e.g., PEG, polysorbate 80) – Open-text responses on potential allergens, timing, descriptions of reactions, and treatments
Consent and Referral Information	Confirmation of patient consent for referral and referring clinician's details.
Additional Guidance for Managing Allergies	The form contained additional advice to healthcare professionals such as: – Consulting the Green Book Chapter 14a for managing patients with allergies. – For patients yet to receive their first dose or who had reacted to a previous dose, refer to a lead clinician for assessment and potential specialist referral. – The [location anonymized for peer review] ICS COVID-19 Vaccine Allergy Review process.

Overview of the sections and information captured in the COVID-19 Vaccine Allergy Referral Form used to document patient demographics, vaccination status, adverse reactions, allergy history, consent, and referral details.

Step 3 – data anonymisation, governance and lawful transfer

To ensure that our use of this data met the ethical and legal standards, we began by securing a formal Data Protection Impact Assessment with the Herefordshire and Worcestershire ICB in June 2022. This assessment clarified roles and responsibilities: Herefordshire and Worcestershire ICB remained the data controller while identifiable information was still present, and the University of Worcestershire became merely a recipient of anonymized research data. Before any transfer took place, Herefordshire and Worcestershire ICB information governance staff removed all direct and indirect identifiers. Including initials, power of attorney details, GP and referrer information, and full dates of birth. The dataset then only contained year of birth, gender, vaccination setting and product, relevant allergy history, and decision-making notes. The de-identified file was then uploaded to a password protected OneDrive folder restricted to the named researchers; no third-party processing, cloud storage outside the UK or onward sharing was permitted.

Because the data were originally gathered for patient care, Herefordshire and Worcestershire ICB relied on the public task and healthcare provisions in Articles 6(1)(e) and 9(2)(h) of UK GDPR, supported by the COVID 19 Control of Patient Information notice. We confirmed that secondary use for research is deemed a 'compatible purpose' under Article 5(1)(b) and safeguarded by Article 89 and the Data Protection Act 2018, meaning individual consent is not legally required once the records have been fully anonymized. Nonetheless, the Herefordshire and Worcestershire ICB privacy notice alerts patients that their de-identified data may support approved research and offers an opt out while their record remains identifiable.

The study received ethical approval form the University of Worcester Research Ethics Panel (author BM, REP CODE ANBPS22230010, 7 November 2022).

Analysis

A multi-method approach that combined quantitative and qualitative data was used to analyze the Referral Form data. The quantitative component comprised descriptive statistics of referral trends among N = 326 individuals referred to the allergy service, outcomes, and the nature of allergy-related concerns documented in the notes (see Table 2 for demographic characteristics). The qualitative component comprised the thematic analysis of free-text practitioner notes and Referral Form data that was provided by GPs. The analysis was guided by a critical realist ontology and interpretivist epistemology. This perspective acknowledges the objective challenges of managing allergy-related vaccine hesitancy while recognizing the subjective experiences and social contexts influencing healthcare professionals' decisions.[40,41]

Qualitative coding was conducted by three researchers: RC, BM and EW. The team brings expertise in health psychology, public health and qualitative methods. Coders familiarized themselves with the corpus, developed codes and themes independently, then collectively developed the final thematic structure through discussion and consensus.

The service cohort was predominantly female (241/326; 73.9%). Age was skewed to mid-life: 46–60 years formed the largest group (101/326; 31.0%), followed by 61–75 (74/326; 22.7%) and 31–45 (72/326; 22.1%).

Results

Quantitative analysis of the COVID-19 vaccine referral form data

Of the 326 patients referred to the service 135 (41.4%) were identified prior to their first COVID-19 vaccination. The remaining individuals reported to the service were either due to similar concerns (even though, for some, their first vaccine led to no allergic reaction) or because they had received a COVID-19 vaccination and experienced an allergy related symptom (98 cases, 30.0%). These symptoms ranged from mild (and undefined by the practitioner) to anaphylaxis. The majority of the symptoms reported were either angioedema (29 cases, 29.6%) or undefined "mild symptoms" (47 cases, 48.0%).

Figure 2 presents the distribution of recommended vaccination pathways for the 317 patients initially reviewed by the GP allergy panel and, where necessary, the 72 cases escalated to a multidisciplinary team (MDT). The most frequent GP recommendation (29%) was primary care vaccination with additional

Table 2. Patient characteristics.

Patient characteristic	Count(%) N = 326
Gender	
Female	241 (73.9)
Male	83 (25.5)
Unknown	2 (0.6)
Age Category	
<18	11 (3.4)
18–30	36 (11.0)
31–45	72 (22.1)
46–60	101 (31.0)
61–75	74 (22.7)
75+	32 (9.8)
Dose required at contact with system	
1st	135 (41.4)
2nd, 3rd or booster	176 (54.0)
Unknown	15 (4.6)
Reason for reporting to service	
Allergy concern	210 (64.0%)
Suspected allergic reaction to COVID-19 vaccination	98 (30.0%)
Unclear/Unknown	18 (5.5%)
Reported symptom from service prompting COVID-19 vaccination reaction (N = 98)	
Anaphylaxis	7 (7.1%)
Serious symptoms but not classified as anaphylaxis	4 (4.1%)
Angioedema	29 (29.6%)
Breathlessness Hyperventilation	2 (2.0%)
Hives	9 (9.2%)
Undefined mild symptoms	47 (48.0%)

Demographic and clinical characteristics of patients (N = 326) referred to the COVID19 Vaccine Allergy Service, including gender, age category, vaccine dose required, reason for referral, and symptoms reported following suspected vaccine reactions.

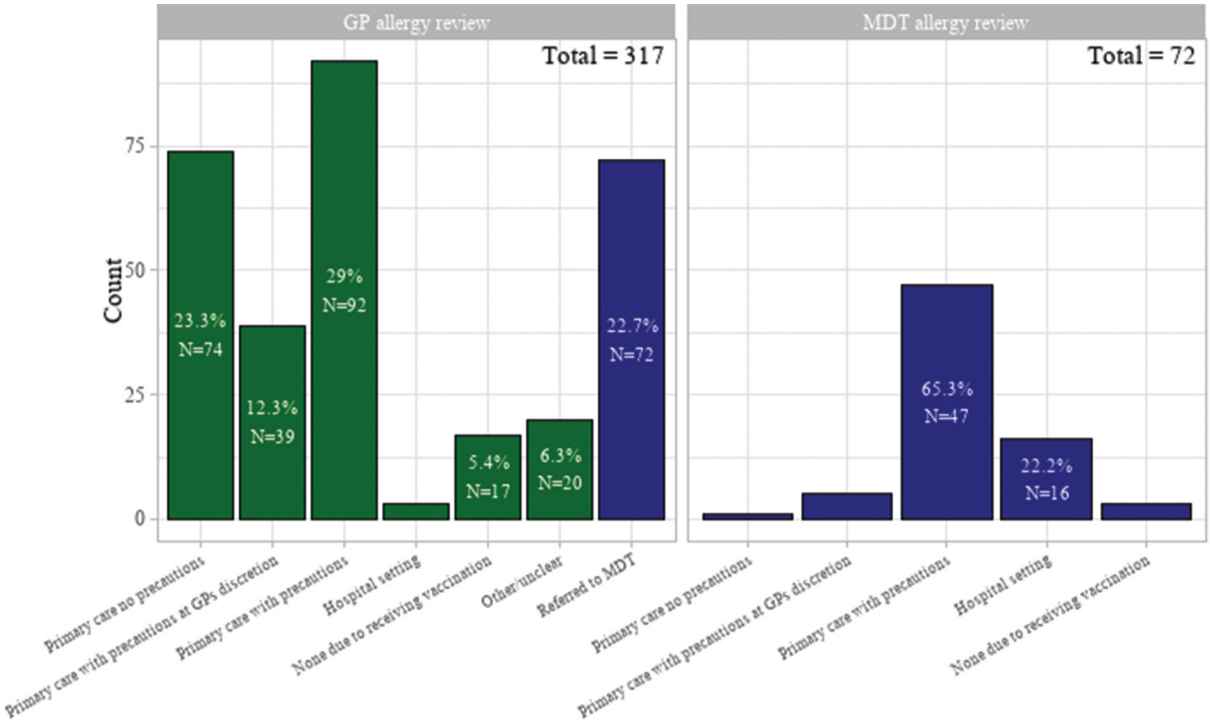

Figure 2. Number of cases advised and referred to multidisciplinary team (MDT). Number of cases advised and referred during GP allergy review (N = 317) and multidisciplinary team (MDT) allergy review (N = 72). Bars represent the number and percentage of patients managed in each setting (e.g., primary care with or without precautions, hospital setting) or referred for further review.

Table 3. Outcome after referral advice (N = 277).

Setting	N	Percentage
Hospital setting		
Confirmed, no adverse reaction	8	42.1
Vaccine declined	3	15.8
No adverse reaction reported	4	21.1
Other/unclear	1	5.3
Adverse reaction reported	3	15.8
Primary care no precautions		
Confirmed, no adverse reaction	1	1.3
Vaccine declined	1	1.3
No adverse reaction reported	73	97.3
Primary care with precautions		
No adverse reaction reported	138	99.3
Adverse reaction reported	1	0.7
Primary care with precautions at GPs discretion		
No adverse reaction reported	44	100.0

Outcomes following referral advice for patients (N = 277), including the setting in which vaccination was administered, whether precautions were used, and the proportion experiencing adverse reactions or declining vaccination.

precautions, whereas 23.3% were advised to proceed with no extra measures. Notably, 22.7% of cases were referred on to the MDT for further assessment. Among those reviewed by the MDT, 65.3% were ultimately cleared to receive vaccination in primary care with precautions, while 22.2% were deemed suitable for hospital-based vaccination.

For a range of referral cases, there were data to suggest the outcome of the recommendation. This can be seen within Table 3.

Adverse reactions to a vaccine after recommendation were reported in three of those individuals referred to hospital for vaccination and once in an individual sent to primary care with precautions. There were also four cases of individuals that were engaging with the system but eventually made their own decision to decline the vaccination.

Qualitative analysis of the COVID-19 vaccine referral form data

Qualitative analysis of free-text entries in GP records provided insight into how allergy concerns were documented and navigated during the vaccination rollout. The following themes (Table 4) emerged from this dataset, reflecting both the clinical and emotional complexity surrounding allergy-related consultations.

Theme 1: diverse presentation of allergies

The range of allergies are recorded in the healthcare practitioner notes encompassing a spectrum of triggers, severity, and patient experiences. Diversity also characterizes the varied allergic reactions recorded (e.g., childhood incidents, recent reactions to the COVID-19 vaccine), with many patients' allergies recorded as self-diagnosed and unrelated to medications.

Subtheme: childhood experiences

Some patients' childhood allergic reactions are recorded by HCPs as having a long-term role in how patients seemed to perceive, and make, their vaccine-related decisions in adulthood: one clinician noted

Table 4. Themes and subthemes in practitioner notes.

Themes	Subthemes
Diverse presentation of allergies	*Childhood experiences* *Self-diagnosed versus clinically diagnosed* *COVID-19 vaccination*
Complexity of allergy history as a challenge for healthcare practitioners	
Patient anxiety and vaccine hesitancy	

Themes and subthemes identified from practitioner notes outlining the diverse presentation of allergies, diagnostic context, COVID19 vaccination experiences, and the impact of complex allergy histories and patient anxiety on vaccine hesitancy.

that a 35-year-old man was *"intubated and ventilated after anaphylaxis"* as a child *"mouth swelling . . . during another vaccine"* as a teenager *"afraid to have COVID-19 vaccine"*. Likewise, patients' childhood allergic reactions, in addition to their more recent health experiences, are recorded as relevant to understanding patients' current COVID-19 vaccine hesitancy: the notes for a 22-year-old woman state she *"had serious reaction to whooping-cough part of vaccine as a baby . . . had series of serious convulsions"* as a child *"doctors concerned she has very reactive system"* and was *"recently . . . in hospital for 4 days"* after being ill with flu. However, despite severe childhood reactions, some patients are recorded as willing to receive the COVID-19 vaccine but with medical caution stemming from their documented allergy histories, necessitating supervised vaccination, as in the case of a 19-year-old man who *"had an anaphylactic-type reaction to 1st DTP at two months . . . multiple hospital admissions"* yet is *"keen to have Covid vac"* to regain a sense of normality, with the GP recommending it be given *"under supervision"*.

Subtheme: self-diagnosed versus clinically diagnosed

Practitioners recorded that differentiating between self-reported allergies and those confirmed through medical evaluation was complex. Notes described many instances where patients' self-diagnosis of allergy appears related to both patient and practitioner uncertainty and hesitancy, particularly regarding vaccinations: one record stated that a 71-year-old man *"attended for vaccination last week"* but *"believes he is allergic to an excipient of the vaccine"*. Such uncertainty was also described in practitioner notes when patients reported experience of severe allergic reactions or anaphylaxis: a 63-year-old woman recalled a *"non-specific anaphylaxis . . . attributed (not proven) to a 'build-up' of medications"* and ultimately declined her first AstraZeneca dose because *"we didn't have a doctor present"*. The notes further suggest that even medical diagnoses can present challenges when there are ongoing efforts to precisely identify allergens and their triggers for patients; for example, a GP letter for a 45-year-old woman confirmed she is *"currently listed as allergic to trimethoprim . . . codeine . . . clarithromycin . . . lignospan special . . . scandonest 3% plain"*, described a recent rash after dental anaesthetic, noted she has *"never had an anaphylactic reaction"*, and concluded that she has been *"referred for patch testing"*.

Subtheme: reactions to COVID-19 vaccination

Healthcare practitioner notes also record variability in how reactions to a COVID-19 vaccination are reported. For instance, a mild reaction after a second Pfizer-BioNTech dose is documented: a 56-year-old man experienced *"numbness and tingling in his tongue and a metallic taste"* within ten minutes, remained for observation but *"nothing progressed"*, and linked the episode to *"similar symptoms"* previously triggered by toothpaste containing polyethylene glycol. By contrast, one of the few severe reactions in the dataset followed a second AstraZeneca dose, when a 47-year-old woman developed *"urticaria, flushing, throat tightness . . . tachypnoea"*, with clinicians judging the event was *"heading towards a full anaphylaxis"* until *"early . . . IM adrenaline"* and other interventions prevented escalation.

Theme 2: complexity of allergy history as a challenge for practitioners

The data suggested that healthcare practitioners frequently experienced challenges navigating the variability in allergy presentations among patients, particularly when managing vaccine-related concerns. In the absence of a formal diagnosis, allergy histories were often ambiguous and difficult for practitioners to assess with confidence; these presentations ranged from severe reactions to everyday substances to vague, generalized symptoms that lacked medical confirmation. One 41-year-old woman, for example, was recorded as listing *"grass, cats, mould, blue cheese"* as potential triggers, recalling *"anaphylaxis"* in 2010, yet more recent immunology testing had found only a *"mild allergy to grass and pollen"* and there had been *"nil [EpiPen use] since"*.

Practitioners also noted apparently severe reactions to non-medical products. A 53-year-old woman reported swelling of *"face, lips [tongue]"* after an eyelash-tint procedure, required a *"steroid [injection] in A&E,"* but had *"no allergies to any medication"* and had previously tolerated an influenza vaccine during pregnancy.

Uncertainty about how best to manage complex cases is explicit in some notes: a GP reviewing a 46-year-old man felt that his request for vaccination *"in a specialist setting was quite appropriate"* and commented that an emergency-department registrar's earlier advice *"was not sufficiently informed"*. Decision-making could be further complicated by family pressures; in one case a daughter insisted her 68-year-old mother's reaction was *"severe"*, emphasized they had always lived within a *"three-minute ambulance radius"*, and argued that her mother *"should have"* the same Nuvaxovid jab the daughter had received in hospital. Although the clinical panel *"still [stood] by the original recommendation"*, they sought a hospital specialist's view *"to ensure [the] full process has been completed"*.

Finally, inconsistencies in patient records often left practitioners reliant on patient-reported histories. Correspondence about a 52-year-old woman shows repeated requests for clarification of *"severity/frequency of angio-oedema"* and a reply noting that apart from a hospital-treated ibuprofen episode in 2020, there was *"no mention . . . of any potential previous reactions"* to influenza vaccine. Such complexities are further illustrated in Figure 3, which outlines the communication steps involved when assessing patients with severe or uncertain allergy histories.

Events are presented relative to Day 0, the day of the first Pfizer-BioNTech vaccine dose, highlighting the patient's reactions, clinical management decisions, and multidisciplinary team (MDT) recommendations over the course of vaccination. This figure illustrates the complexities of addressing vaccination in patients with severe allergy histories.

Demographics: Female, 35

Medical History:

- Idiopathic anaphylaxis with previous ITU admission.
- Two previously documented anaphylaxis episodes.
- Three previous allergic reactions to wasp stings.

Timeline of Key Events:

1. **Day 0:** Received the first dose of Pfizer-BioNTech vaccine.
2. **Day 6:** Presented to A&E with shortness of breath, chest tightness, urticaria, lip swelling, and fever. Treated with IV hydrocortisone and chlorphenamine.
3. **Day 209:** GP clarified that the reaction occurred three days post-vaccine, not six as initially reported.
4. **Day 214 - Day 225:** Supporting documents (GP summaries, A&E notes) obtained. GP review noted doubts about vaccine reaction but deferred to MDT.
5. **Day 260:** MDT recommended the second Pfizer dose in hospital with antihistamines and prolonged observation. Suggested immunology referral.
6. **Day 282:** Second Pfizer dose administered in hospital. Patient experienced symptoms (tingling, rash, swelling) and was treated with adrenaline and oxygen. Observed in A&E for 24 hours.
7. **Day 302:** MDT reviewed the case and determined the reaction was not anaphylaxis. Recommended a booster in hospital with precautions.
8. **Day 385:** Patient declined the hospital-administered booster after moving house, citing reluctance to pursue further vaccination.

Figure 3. Timeline of key events in the management of COVID-19 vaccination for a 35-year-old female patient with a history of idiopathic anaphylaxis. Timeline of key events in the management of COVID19 vaccination for a 35yearold female patient with a history of idiopathic anaphylaxis, summarizing medical history, clinical presentations, and multidisciplinary decision-making at each timepoint.

Theme 3: patient anxiety and vaccine hesitancy

The practitioner notes also indicated practitioner impressions of patient anxiety as related to COVID-19 vaccine hesitancy, particularly concerning the risk of allergic reactions. One practitioner recorded that a 47-year-old woman had *"spoken to her GP"* but had *"decided not to proceed with Pfizer"*; although the clinician explained that the dose could be given *"in a hospital setting"* to mitigate risk, she preferred to *"risk COVID than another vaccine"* after receiving *"AZ × 2"*, having had COVID-19, and obtaining a positive antibody test, and *"understands this is her decision"*.

Anxiety can also play a clear role in trust and the decision-making process: notes for a 64-year-old woman state that she was *"still very anxious and wishes to speak to a doctor regarding risk – benefit of vaccination"*, had declined a hospital appointment because she *"wanted to discuss with Dr again"*, and would go ahead only if her GP could confirm that she had consented to a second Pfizer dose in a hospital setting.

In this case, the individual's reluctance to proceed without further clinical discussion highlights both a lack of confidence in the recommended vaccination pathway and a desire for more relational trust with her GP.

While anxiety about vaccination was a significant barrier for some individuals, it could at times be mitigated through tailored support and additional healthcare resources. For example, the record for a 25-year-old woman notes that her *"1st dose Pfizer [was] given without ill effect"* and that the *"2nd dose [was] planned for hosp as patient very anxious"*.

In some cases, it was challenging to disentangle physiological vaccine reactions from symptoms associated with anxiety or psychosomatic responses. One 61-year-old woman who was *"very anxious prior to vaccine given previous history of serious allergic reaction"* reported feeling *"hot, throat felt tight . . . rash to neck"* and was hypertensive ten minutes after her AstraZeneca dose, but symptoms settled with antihistamine and observation. Another patient, a 44-year-old woman, experienced a rapid onset of *"dizzy, disorientated, throat tight . . . chest then felt heavy, shaky, heart racing"* within 30 seconds of vaccination and felt unwell for several days afterward; although she had a history of *"anxiety, panic attacks"*, she insisted this episode was *"quite different, wasn't anxious at all about having the immunisation"* and stated she would accept an alternative vaccine but was *"not happy to have further AZ"*.

Discussion

In this study, we aimed to utilize health practitioner notes to quantitatively and qualitatively investigate patient concerns about their risk of allergic reaction to COVID-19 vaccines. The high usage of the ad hoc allergy referral service described above demonstrates both a clear need for formalized allergy support and the efficacy of bespoke referral pathways within the Herefordshire and Worcestershire region. Although it is difficult to determine precisely how many individuals would have refused a COVID-19 vaccination in the absence of such a service, the reassurance it provided is evident, both in the quantitative and qualitative data analyzed. Consistent with previous research, recommendations and reassurance from trusted healthcare professionals are known to be key drivers of vaccine acceptance.[30] By channeling cases with uncertain or self-reported allergy histories to an appropriate forum for risk assessment, the referral service appears to have helped sustain public confidence in COVID-19 vaccination.

Despite involving only 326 patients, around 0.04% of the Herefordshire and Worcestershire population of 790,000 residents,[42] the referral service underscored significant unmet needs and represents a critical subset whose concerns and complex allergy histories may otherwise have gone unaddressed. Demographically, users were predominantly female and aged 46–60, a profile consistent with UK primary-care utilization patterns (women consult more often than men, especially between 16 and 60)[43] and with a greater likelihood of antibiotic-allergy labeling with increasing age.[44] The mid-life peak may also reflect programme logistics: adults aged ≥50 were invited early in the rollout, plausibly increasing contacts from this cohort.[45]

Our dataset as a whole reflects the early UK rollout (2021–2022) of COVID-19 vaccinations. More recent evidence suggests attitudes *evolved* after this period rather than simply subsided, with high continuation among older adults but lower uptake in younger groups and persistent inequalities.[46] Reasons for hesitancy shifted toward perceived necessity, side-effects, practical access and elements of mistrust as boosters became targeted.[47,48] Future follow-up using later-phase cohorts (post-2022) would be valuable to test the durability of these patterns and assess whether allergy-related safety concerns attenuated as the programme matured.

A recurring theme emerging from the referral data was the reliance on inconsistent or purely self-reported allergy histories to inform clinical judgment. Such histories often place practitioners in a position of uncertainty, particularly when the underlying diagnosis had not received a formal confirmation. Around 23% of referred cases ended up requiring the review of a multidisciplinary team with specialist expertise, reflecting the real-world complexity that GPs and pharmacists encountered. Previous studies highlight how individuals' beliefs regarding "potential allergens" can range from clinically significant triggers to self-identified conditions that might in reality be sensitivities or intolerances.[37] Better standardization and more detailed documentation (for example, via structured referral tools or risk-assessment questionnaires) could help delineate, high-risk allergy histories from those that warrant reassurance but not a full specialist work-up.

Practitioner confidence itself likely varied over time. At the start of the pandemic, rapidly evolving vaccine guidance, particularly the early (and later reversed) advice from the MHRA to avoid vaccinating those with a history of anaphylaxis, seems to have exacerbated both public and professional hesitancy. The parallels with historical issues around MMR vaccine safety are striking. Similar misconceptions about egg allergy and MMR once prompted unnecessary hospital referrals despite robust evidence that egg allergy was not a contraindication.[11,13] Much like the MMR case, initial concerns about novel vaccine components, in this instance, polyethylene glycol (PEG), fueled anxiety and prompted media coverage disproportionately emphasizing severe but very rare reactions.[31,49]

In managing this uncertainty, public health messaging emerged as another pivotal element. Rapidly changing guidelines, sensationalist press coverage, and widespread internet searches amplified anxiety. For example, Bent et al. observed a 200-fold increase in German-language Google queries about "PEG allergy" during the COVID-19 pandemic, illustrating how novel ingredients can become a focus of vaccine hesitancy.[49] Timely, proactive communication strategies that clarify common misconceptions, particularly around PEG and mRNA technology, can be crucial for building trust. Similar lessons can be drawn from the complex interplay of mistrust, misinformation, and individual decision-making seen in previous vaccine campaigns.[5]

In some cases, it appears that the absence of on-site medical professionals at vaccination centers sometimes undermined patient confidence. Multiple individuals expressed willingness to proceed only if vaccinated in a hospital or specialist setting, citing the need for immediate medical support in case of severe reactions. Such hesitancy underscores that structural aspects, like the availability of a doctor at community clinics, can matter as much as clinical evidence for certain at-risk or anxious individuals. Providing real-time allergy advice services could alleviate these uncertainties: an "Allergy Call Centre" in Italy, for instance, offered immediate specialist consultation during the COVID-19 vaccine rollout and successfully reduced unnecessary referrals.[35]

Psychological factors, particularly anxiety, likewise played a substantive role. Some reported symptoms (throat tightness, dizziness, chest discomfort etc) could reflect a mixture of physiological responses and heightened anxiety. Indeed, anxiety was acknowledged or retrospectively recognized by a number of patients, suggesting the need for practitioners to convey empathy and reassurance without dismissing genuine concerns. Such reactions may also fall under the umbrella of immunization stress-related responses, which the WHO highlights as psychogenic responses that can occur around the time of vaccination, particularly in individuals with heightened anticipatory anxiety.[50] Training designed to distinguish clinically significant allergies from anxiety-driven presentations would support more consistent outcomes in primary care. This aligns with previous calls for enhanced risk-communication training to combat vaccine refusal and encourage shared decision-making.[27,33]

Finally, these findings highlight the scholarly potential of data from referral forms and clinical notes. While unstructured and prone to inconsistent detail, such records capture important patient – practitioner interactions and decision-making processes "in real time." With appropriate analytic frameworks, referral data can reveal the intricate interplay of medical, psychological and contextual factors behind vaccine acceptance or refusal. This is particularly relevant given the growing prominence of mRNA vaccine platforms and the evolving nature of mRNA-specific hesitancy, which is likely to remain salient in future immunization efforts.[6] Nonetheless, the difficulties in systematizing referral data, limited follow-up for many cases, and the need for robust ethical safeguards point to areas for methodological improvement in future research.[38,51] Whether for COVID-19 vaccines or other immunization programmes, refining the ways in which real-world data are recorded and analyzed could help design more responsive and patient-centered vaccine services.

Reflection

The notes in this study are presented verbatim, which posed significant challenges for our analysis. The medical terminology and complex language often made interpretation difficult, particularly for those of us without a medical background. Accurately understanding the nuanced details of these clinical notes required considerable effort and collaboration with our medical coauthors. This was crucial, as their expertise helped clarify ambiguous entries and ensured that our interpretations were accurate.

Acknowledgments

The authors thank NHS Herefordshire & Worcestershire ICB for their tracking and collation of the original dataset and providing expert interpretation of the system. Conceptualisation: [BM;EW]; Methodology: [BM;EW;RC]; Formal analysis: [BM;EW; RC]; Investigation: [BM;EW; RC]; Data curation: [BM; SO]; Writing – original draft: [BM;RC]; Writing – review & editing: [BM; RC; EB]; Visualisation: [RC]; Supervision: [BM]; Project administration: [BM; RC]. All authors approved the final manuscript and agreed to be accountable for all aspects of the work.

Author contributions

CRediT: **Elaine Walklet:** Conceptualization, Formal analysis, Methodology; **Eleanor Bradley:** Writing – review & editing; **Berenice Mahoney:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

Notes on contributors

Richard M. Clarke is a senior lecturer in Health Psychology at University of Gloucestershire. Their research explores the biopsychosocial factors that shape vaccine decision-making, with particular attention to the ways trust, risk perception and information seeing behaviour influence uptake. They have published on adult vaccine hesitancy in several contexts, including antenatal pertussis immunisation and wider public attitudes towards routine vaccination.

Stephen P. O'Hickey is a Respiratory Physician who provides clinics in Worcestershire- he has a special interest in allergic diseases- his research interests include asthma, and allergy.

Berenice Mahoney is a Principal Lecturer and Chartered Psychologist at University of Worcester. Their research explores the experiences of adults living with allergy, and healthcare professionals working with them. Focusing on diagnosis, symptom interpretation and responses to these, they have published on adult onset allergy and the support needs of the allergic, and healthcare professionals supporting them.

ORCID

Berenice Mahoney http://orcid.org/0000-0002-7414-8185

Data availability statement

The data are not publicly available because they contain information that could compromise participant privacy.

References

1. Glover RE, Urquhart R, Lukawska J, Blumenthal KG. Vaccinating against COVID-19 in people who report allergies. BMJ. 2021;372:n120. doi: 10.1136/bmj.n120.

2. Medicines and Healthcare Products Regulatory Agency. Confirmation of guidance to vaccination centres on managing allergic reactions following COVID-19 vaccination with the Pfizer/BioNTech vaccine. 2020 Dec 9 [accessed 2025 Apr 24]. https://www.gov.uk/government/news/confirmation-of-guidance-to-vaccination-centres-on-managing-allergic-reactions-following-covid-19-vaccination-with-the-pfizer-biontech-vaccine.
3. Medicines and Healthcare Products Regulatory Agency. Oxford University/AstraZeneca COVID-19 vaccine approved. 2020 Dec 30 [accessed 2025 Apr 24]. https://www.gov.uk/government/news/oxford-universityastrazeneca-covid-19-vaccine-approved.
4. Klimek L, Novak N, Hamelmann E, Werfel T, Wagenmann M, Taube C, Bauer A, Merk H, Rabe U, Jung K, et al. Severe allergic reactions after COVID-19 vaccination with the Pfizer/BioNTech vaccine in Great Britain and USA: position statement of the German allergy societies: medical association of German allergologists (AeDA), German society for allergology and clinical immunology (DGAKI) and society for pediatric allergology and environmental medicine (GPA). Allergo J Int. 2021;30:51–55. doi: 10.1007/s40629-020-00160-4.
5. Lewandowsky S, Ecker UK, Seifert CM, Schwarz N, Cook J. Misinformation and its correction: continued influence and successful debiasing. Psychol Sci Public Interest. 2012;13(3):106–131. doi: 10.1177/1529100612451018.
6. Xu J, Wu Z, Wass L, Larson HJ, Lin L. Mapping global public perspectives on mRNA vaccines and therapeutics. npj Vaccine. 2024;9(1):218. doi: 10.1038/s41541-024-01019-3.
7. Rzymski P, Szuster-Ciesielska A, Dzieciątkowski T, Gwenzi W, Fal A. mRNA vaccines: the future of prevention of viral infections? J Med Virol. 2023;95(2):e28572. doi: 10.1002/jmv.28572.
8. Li Y, Wang M, Peng X, Yang Y, Chen Q, Liu J, She Q, Tan J, Lou C, Liao Z, et al. mRNA vaccine in cancer therapy: current advance and future outlook. Clin Transl Med. 2023;13(8):e1384. doi: 10.1002/ctm2.1384.
9. Deer B. How the case against the MMR vaccine was fixed. BMJ. 2011;342:c5347. doi: 10.1136/bmj.c5347.
10. Bandi S, MacDougall C. Mmr and egg allergy: to vaccinate or not to vaccinate? Br J Gen Pract. 2010;60(578):693–694. doi: 10.3399/bjgp10X515511.
11. Andersen DV, Jørgensen IM. Mmr vaccination of children with egg allergy is safe. Dan Med J. 2013;60(2):A4573. PMID 23461988.
12. Elitok G, Çelikboya E, Bulbul L, Kaya A, Toraman T, Bulbul A, Uslu S. Does food allergy require any change in measles-mumps-rubella vaccination? Indian J Pediatr. 2019;86(10):915–920. doi: 10.1007/s12098-019-02981-w.
13. Cunha L, Almeida D, dos Santos FR, Falcão H. Measles, mumps, and rubella vaccination in children with egg allergy. Nascer E Crescer-Birth Growth Med J. 2022;31(1):25–30. doi: 10.25753/BirthGrowthMJ.v31.i1.23897.
14. Carballo IC, Pastor MD, Zavala BB, Cano MS, De la Hoz Caballer B. Safety of measles-mumps-rubella vaccine (MMR) in patients allergic to eggs. Allergologia et Immunopathologia. 2007;35(3):105–109. doi: 10.1157/13106778.
15. Hawkes CP, Mulcair S, Hourihane JOB. Is hospital based MMR vaccination for children with egg allergy here to stay? Ir Med J. 2010;103(1):7–9.
16. Cabanillas B, Akdis CA, Novak N. Allergic reactions to the first COVID-19 vaccine: a potential role of polyethylene glycol? Allergy. 2021;76(6):1617–1618. doi: 10.1111/all.14711 .
17. Greenhawt M, Abrams EM, Shaker M, Chu DK, Khan D, Akin C, Alqurashi W, Arkwright P, Baldwin JL, Ben-Shoshan M, et al. The risk of allergic reaction to SARS-CoV-2 vaccines and recommended evaluation and management: a systematic review, meta-analysis, GRADE assessment, and international consensus approach. J Allergy Clin Immunol. 2021;9(10):3546–3567. doi: 10.1016/j.jaip.2021.06.006.
18. Shimabukuro TT, Cole M, Su JR. Reports of anaphylaxis after receipt of mRNA COVID-19 vaccines in the US—December 14, 2020-January 18, 2021. JAMA. 2021;325(11):1101–1102. doi: 10.1001/jama.2021.1967.
19. Larson HJ. Understanding vaccine hesitancy: a call for more social science in RNA vaccine research. Vaccine Insights. 2024;3(3):107–111. doi: 10.18609/vac.2024.020.
20. Li L, Robinson LB, Patel R, Landman AB, Fu X, Shenoy ES, Hashimoto DM, Banerji A, Wickner PG, Samarakoon U, et al. Association of self-reported high-risk allergy history with allergy symptoms after COVID-19 vaccination. JAMA Netw Open Open. 2021;4(10):e2131034. doi: 10.1001/jamanetworkopen.2021.31034.
21. DiBonaventura MD, Chapman GB. Do decision biases predict bad decisions? Omission bias, naturalness bias, and influenza vaccination. Med Decis Making. 2008;28(4):532–539. doi: 10.1177/0272989X08315250.
22. Brown KF, Kroll JS, Hudson MJ, Ramsay M, Green J, Vincent CA, Fraser G, Sevdalis N. Omission bias and vaccine rejection by parents of healthy children: implications for the influenza A/H1N1 vaccination programme. Vaccine. 2010;28(25):4181–4185. doi: 10.1016/j.vaccine.2010.04.012.
23. Soni S, Bleichrodt H. Biases and heuristics underlying vaccine hesitancy. 2021 May 30. doi: 10.13140/RG.2.2.15358.05441.
24. Kar B, Kar N, Panda MC. Social trust and COVID-appropriate behavior: learning from the pandemic. Asian J Soc Health Behav. 2023;6(3):93–104. doi: 10.4103/shb.shb_183_22.
25. Larson HJ, Jarrett C, Eckersberger E, Smith DM, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. Vaccine. 2014;32(19):2150–2159. doi: 10.1016/j.vaccine.2014.01.081.

26. De Figueiredo A, Simas C, Karafillakis E, Paterson P, Larson HJ. Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. Lancet. 2020;396(10255):898–908. doi: 10.1016/S0140-6736(20)31558-0.
27. Mack DP, Greenhawt M, Bukstein DA, Golden DB, Settipane RA, Davis RS. Decisions with patients, not for patients: shared decision-making in allergy and immunology. J Allergy Clin Immunol. 2024 Jun 6. 12 (10):2625–2633. doi: 10.1016/j.jaip.2024.05.046.
28. Greenhawt M. Shared decision-making in the care of a patient with food allergy. Ann Allergy Asthma Immunol. 2020;125(3):262–267. doi: 10.1016/j.anai.2020.05.031.
29. Bukstein DA, Guerra DG Jr, Huwe T, Davis RA. A review of shared decision-making: a call to arms for health care professionals. Ann Allergy Asthma Immunol. 2020;125(3):273–279. doi: 10.1016/j.anai.2020.06.030.
30. Newman PA, Logie CH, Lacombe-Duncan A, Baiden P, Tepjan S, Rubincam C, Doukas N, Asey F. Parents' uptake of human papillomavirus vaccines for their children: a systematic review and meta-analysis of observational studies. BMJ Open. 2018;8(4):e019206. doi: 10.1136/bmjopen-2017-019206.
31. Dreskin SC, Halsey NA, Kelso JM, Wood RA, Hummell DS, Edwards KM, Caubet JC, Engler RJ, Gold MS, Ponvert C, et al. International consensus (ICON): allergic reactions to vaccines. World Allergy Organ J. 2016;9:1–21. doi: 10.1186/s40413-016-0120-5.
32. Kogseder N, Puxkandl V, Hoetzenecker W, Altrichter S. Vaccine hesitancy in patients presenting to a specialized allergy center: clinical relevant sensitizations, impact on mental health and vaccination rates. Front Immunol. 2024;15:1324987. doi: 10.3389/fimmu.2024.1324987.
33. Boland L, Lawson ML, Graham ID, Légaré F, Dorrance K, Shephard A, Stacey D. Post-training shared decision making barriers and facilitators for pediatric healthcare providers: a mixed-methods study. Acad Pediatr. 2019;19(1):118–129. doi: 10.1016/j.acap.2018.05.010.
34. Osaghae I, Darkoh C, Chido-Amajuoyi OG, Chan W, Padgett Wermuth P, Pande M, Cunningham SA, Shete S. HPV vaccination training of healthcare providers and perceived self-efficacy in HPV vaccine-hesitancy counseling. Vaccine. 2022;10(12):2025. doi: 10.3390/vaccines10122025.
35. Badiu I, Nicola S, Rashidy N, Della Mura S, Tarrini D, Bernardi V, Gallicchio M, Ridolfi I, Saracco E, Montabone E, et al. How a novel approach of allergy call center improved the management of the anti-COVID vaccination campaign in Piedmont: Italy. J Epidemiol Glob Health. 2024;14(4):1764–1770. doi: 10.1007/s44197-024-00309-2.
36. Bansler JP, Havn EC, Schmidt K, Mønsted T, Petersen HH, Svendsen JH. Cooperative epistemic work in medical practice: an analysis of physicians' clinical notes. Comput Support Coop Work. 2016;25(6):503–546. doi: 10.1007/s10606-016-9261-x.
37. Carlisle AF, Greenbaum SM, Tankersley MS. Scribes, EHRs, and workflow efficiencies in allergy practices. Curr Allergy Asthma Rep. 2020;20(10):1–7. doi: 10.1007/s11882-020-00950-4.
38. Vielot NA, Ballard CA, St Jean DT, Page S, Hammond K, Thompson P, Butler AM, Ranney LM. Documenting human papillomavirus vaccine refusal among adolescents in electronic health records: a mixed methods study. Vaccine. 2024;42(26):126467. doi: 10.1016/j.vaccine.2024.126467.
39. Sinnott L, Dudley-Southern R. Developing allergy services in the North West of England: lessons learnt. North West Allergy and Clinical Immunology Network; 2011 [accessed 2025 Apr 24]. https://allergynorthwest.nhs.uk/wp-content/uploads/2023/08/AA-NW-Paed-Allergy-Lessons-learnt.pdf.
40. Koopmans E, Schiller DC. Understanding causation in healthcare: an introduction to critical realism. Qual Health Res. 2022;32(8–9):1207–1214. doi: 10.1177/10497323221105737.
41. Sturgiss EA, Clark AM. Using critical realism in primary care research: an overview of methods. Fam Pract. 2020;37(1):143–145. doi: 10.1093/fampra/cmz084.
42. Office for National Statistics. 2021 census data for England and Wales. 2021. https://www.ons.gov.uk/census.
43. Wang Y, Hunt K, Nazareth I, Freemantle N, Petersen I. Do men consult less than women? An analysis of routinely collected UK general practice data. BMJ Open. 2013;3(8):e003320. doi: 10.1136/bmjopen-2013-003320.
44. Jani YH, Chen B, Powell N, Howard P, Sandoe J, West R, Lau WC. Characteristics, risk factors and clinical impact of penicillin and other antibiotic allergies in adults in the UK general practice: a population-based cohort study. J Infect. 2025;90(2):106367. doi: 10.1016/j.jinf.2024.106367.
45. NHS England. NHS England invites everyone aged 50 and over to be jabbed as NHS vaccination programme marks 100th day. 2021 Mar 17. https://www.england.nhs.uk/2021/03/nhs-england-invites-everyone-aged-50-and-over-to-be-jabbed-as-nhs-vaccination-programme-marks-100th-day/.
46. Office for National Statistics. Coronavirus and vaccination rates in adults by socio-demographic characteristic and occupation, England: December 2020 to March 2023. Office for National Statistics; 2023 Mar 27. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthinequalities/bulletins/coronavirusandvaccinationratesinadultsbysociodemographiccharacteristicandoccupationengland/december2020tomarch2023.
47. Lockyer B, Moss RH, Endacott C, Islam S, Sheard L, Bradford Institute for Health Research Covid-19 Scientific Advisory Group. Compliant citizens, defiant rebels or neither? Exploring change and complexity in COVID-19 vaccine attitudes and decisions in Bradford, UK: findings from a follow-up qualitative study. Health Expect. 2023;26(1):376–387. doi: 10.1111/hex.13667.

48. Paul E, Fancourt D. Predictors of uncertainty and unwillingness to receive the COVID-19 booster vaccine: an observational study of 22,139 fully vaccinated adults in the UK. Lancet Reg Health–Eur. 2022;14:100317. doi: 10.1016/j.lanepe.2022.100317.
49. Bent RK, Faihs V, Tizek L, Biedermann T, Zink A, Brockow K. Peg allergy—a COVID-19 pandemic-made problem? A German perspective. World Allergy Organ J. 2022;15(11):100714. doi: 10.1016/j.waojou.2022.100714.
50. World Health Organization. Immunization stress-related response: a manual for programme managers and health professionals to prevent, identify and respond to stress-related responses following immunization. Geneva: World Health Organization; 2019 [accessed 2025 Apr 24]. https://www.who.int/publications/i/item/9789241515948.
51. Brewer SE, Barnard J, Pyrzanowski J, O'Leary ST, Dempsey AF. Use of electronic health records to improve maternal vaccination. Women's Health Issues. 2019;29(4):341–348. doi: 10.1016/j.whi.2019.04.017.