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Synopsis

Exploring the use of pre-hospital pre-alerts and their impact on patients, Ambulance Service and Emergency Department staff: a mixed-methods study

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Abstract

Background: Ambulance clinicians use pre-alert calls to emergency departments to enable them to prepare for the arrival of a patient. This can lead to improved time-critical treatment. However, pre-alerts should be used judiciously, as over-alerting may add pressures on busy emergency departments, while under-alerting may lead to delays in time-critical patient care. We undertook a mixed-methods study to explore how pre-alerts are used and their impact on patients, ambulance and emergency department staff.

Method and design: The mixed-methods study integrated data from: (1) linked routine data set of 12 months' (2020–1) electronic patient records (3 ambulance services), clinician information and routine hospital statistics, (2) semistructured interviews with 34 ambulance clinicians and 40 emergency department staff and 162 hours non-participant observation of pre-alerts across 6 emergency departments, (3) national online survey of ambulance clinicians (1298 responses). Multivariate logistic regression was undertaken in R™ (The R Foundation for Statistical Computing, Vienna, Austria) to identify factors associated with pre-alert rates in terms of patient (National Early Warning Score 2, working diagnosis, age, sex), ambulance clinician (experience, role, sex, time to end of shift) and hospital factors (journey time, percentage of ambulances waiting > 30 minutes). Qualitative data were analysed using thematic analysis in NVivo™ (QSR International, Warrington, UK). Findings were integrated using a triangulation protocol.

Findings: Pre-alerts are key to enabling emergency department staff to prepare physically and psychologically for critically ill patients, particularly when resources are constrained. We identified significant variation in pre-alert practice and pre-alert rates at both individual and organisational level that was not explained by patient case mix.

Pre-alert decisions were based on clinician risk perception, clinical experience (pattern recognition), protocols and anticipated response by emergency department staff, including consideration of different emergency department expectations regarding pre-alerts. Pre-alert calls included advice calls, 'courtesy' or 'heads up' calls where clinicians had no immediate clinical concern, but called due to protocol requirements or concern about the potential for subsequent deterioration during a handover delay. Frustrations arose from different individual expectations of a pre-alert.

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Inconsistent guidance between ambulance services and emergency departments, and limited clinician knowledge and awareness of guidance, led to uncertainty and misunderstanding regarding who required pre-alerting. Understanding how to pre-alert was based primarily on learning 'on the job' and informal feedback mechanisms rather than formal training and feedback, including emergency department response to previous pre-alerts.
Pre-alert calls created interruptions but were valued by emergency department staff. Emergency department response to pre-alert calls was highly variable and dependent principally upon resource availability (staffing, crowding, acuity of other patients) at the time of pre-alert. Variation in individual emergency department's clinician practice and in emergency departments processes for managing pre-alerted patients (particularly for patients not brought into resuscitation bay) contributed to different responses for similar types of pre-alert calls.
Different protocols and documentation used by emergency department and ambulance staff to deliver and document the pre-alert created interruptions and frustration during the pre-alert call. Provision of a headline clinical concern to frame the pre-alert was perceived as useful, particularly when observations and clinical concern did not align.
Limitations: Despite flexible recruitment procedures, no patients were interviewed.
Implications and future work: Pre-alert decision-making and communication may be improved by increased consistency of emergency department and ambulance service pre-alert guidance and training. Improved ambulance service and emergency department communication and co-produced shared documentation may help improve pre-alert clarity and usefulness while reducing tensions.
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Introduction

Rationale for research and background

Ambulance clinicians use pre-alert calls to inform receiving emergency departments (EDs) of the arrival of a critically unwell or rapidly deteriorating patient who they believe requires a different or special response (e.g. senior clinical review, time-critical treatment) immediately upon arrival. Pre-alert calls usually come through to the ED on a dedicated phone, often known as the 'red phone'. Pre-alerts enable the receiving ED to make preparations and can lead to earlier initiation of time-critical treatment, improved processes and better clinical outcomes for patients.[1–6] Pre-alerts can lead to shorter time to computed tomography scan and door-to-needle times for stroke,[7–10] improved adherence to sepsis protocols and lower time to antibiotic administration for sepsis,[2,11] and faster mobilisation of trauma teams with improved resuscitation performance.[1,12]

Pre-alerts are also recommended for a range of other conditions and are increasingly being recognised as standard practice for ambulance clinicians. In England, 4.2 million patients were conveyed to the ED by ambulance in 2022–3 and pre-alerts were undertaken in an estimated 10–15% of conveyances.[13,14] In the context of increased demand for emergency care services, with ED overcrowding and increased ambulance handover times, using pre-alerts appropriately is key to ensuring patients can bypass ambulance queues when appropriate.[15,16]

However, pre-alerts are not risk-free and inappropriate use of pre-alerts may result in staff being deployed for a pre-alert, taking resources away from other clinical areas and increasing the likelihood of pre-alert fatigue.[3,17–20] Unnecessary pre-alerts and fatigue due to the high volume of pre-alerts may have important patient safety risks if ED staff become less responsive to pre-alerts or where their attention and resources are diverted from other more critically ill patients in the ED.[21] Pre-alert fatigue may also lead to reduced trust in pre-alert calls, frustration over perceived lack of action from ED staff and increased incivility with potential for patient harm.[22,23]

Despite pre-alerts being a recognised and important aspect of the patient journey, there is a lack of research evidence around how pre-alerts should be undertaken, and the lack of consistent guidance was highlighted as a concern by a Healthcare Safety Investigation Bureau Report on transfer of critically ill patients in 2019.[24] Pre-alerts have been recognised as an important failure point of clinical handover within the emergency care pathway.[25] Poor communication of pre-alerts or failure to meet expectations can lead to disagreements over the appropriate course of action at handover, with associated confusion at the point of pre-alert and patient handover.[20,25,26]

The quality of information provided within pre-alerts is frequently inadequate for ED staff to correctly mobilise resources, with high levels of inadequate or incomplete information.[27–29] Similarly, there is evidence of

inconsistency in pre-alert practice. Retrospective studies exploring sensitivity and specificity of pre-alerts identified inconsistencies in how pre-alerts were undertaken, reporting an estimated 13–28% for different patient groups eligible for pre-alert but not receiving one, and 42–56% of pre-alerted patients who were not eligible according to study criteria.[4,5,20]

Although pre-alerts may also impact on the experiences and expectations of patients and accompanying family or friends, arriving at the ED in a blue-light ambulance with expectations of immediate care, we have been unable to find any literature exploring the patient or carer perspective. Similarly, there is a lack of evidence exploring how pre-alerts should be communicated in order to maximise efficiency. Given the potential benefits from appropriate use of pre-alerts, and harm and opportunity costs from their overuse, it is important that ED and ambulance staff have clear guidance and understanding of how to use pre-alerts effectively. In 2020, Association of Ambulance Chief Executives (AACE) and Royal College of Emergency Medicine (RCEM) produced joint guidelines for pre-alerting the deteriorating adult patient, noting a lack of evidence in the area.[16] In order to revise this guidance, a better understanding is needed of the processes underpinning pre-alert decisions and how these are communicated and acted upon within EDs.

We aimed to undertake a mixed-methods research study to inform the development of guidance on pre-alert decisions and communication to maximise the potential benefits for patients and minimise unnecessary impact on ED resources.

Our initial pre-alerts logic model is outlined in *Figure 1*.

Aims and objectives

This study aimed to understand how pre-alert decisions are made and implemented by pre-hospital staff, and the impact of these on receiving EDs and patients, in order to identify principles of good practice, areas of uncertainty and areas for improvement.

Objectives:

1. To map current pre-alert practice in terms of volume and types of pre-alerts and explore potential reasons for variation in practice by reviewing existing ambulance service patient records and mapping to local guidance [work package (WP) 1].
2. To explore and understand pre-alert decision-making by undertaking semistructured interviews with ambulance clinicians from three ambulance services and distributing a national survey of ambulance clinicians to identify key areas of uncertainty where further guidance would be useful (WP2).
3. To identify how pre-alert decisions are communicated, and what information needs to be communicated in order to improve patient care, by interviewing pre-hospital and ED staff (WP2 and WP3).
4. To understand how pre-alerts influence patient care in the ED, including potential benefits and unintended consequences, by observing pre-alert processes and responses to them within two EDs in each of the three ambulance service areas/regions (WP3).
5. To explore whether there are specific conditions or patient groups for whom pre-alerts are most likely to lead to action, or for whom action is unlikely to provide benefit, and explore factors that affect whether action is taken within the ED (WP3).
6. To understand service user experience of pre-alerts by interviewing patients and/or carers (WP4).
7. To identify good pre-alert practice, areas where further guidance is needed and co-produce information to inform the development of pre-alert guidance with research participants and other key stakeholders (WP5).

Methods for data collection and analysis

Protocol and permissions

Ethical approval for the pre-alerts project was obtained from Newcastle and North Tyneside 2 Research Ethics Committee (Ref: 21/NE/0132). All research was undertaken in accordance with relevant guidelines and regulations, with informed consent from all research participants. All participants gave consent to the use of anonymised quotations in publications.

Study design

The overall design is an observational mixed-methods study using five inter-related WPs. *Figure 2* details the individual WPs.

Methods are detailed briefly below with further detail available within *Appendix 1*.

Study setting

The study took place within three ambulance services and six EDs within these ambulance service areas. The three ambulance services covered a population of 15.5 million, including areas of high and low deprivation, rurality and diverse ethnic populations and were selected due to high rates of electronic Patient Report Form (ePRF) completion.

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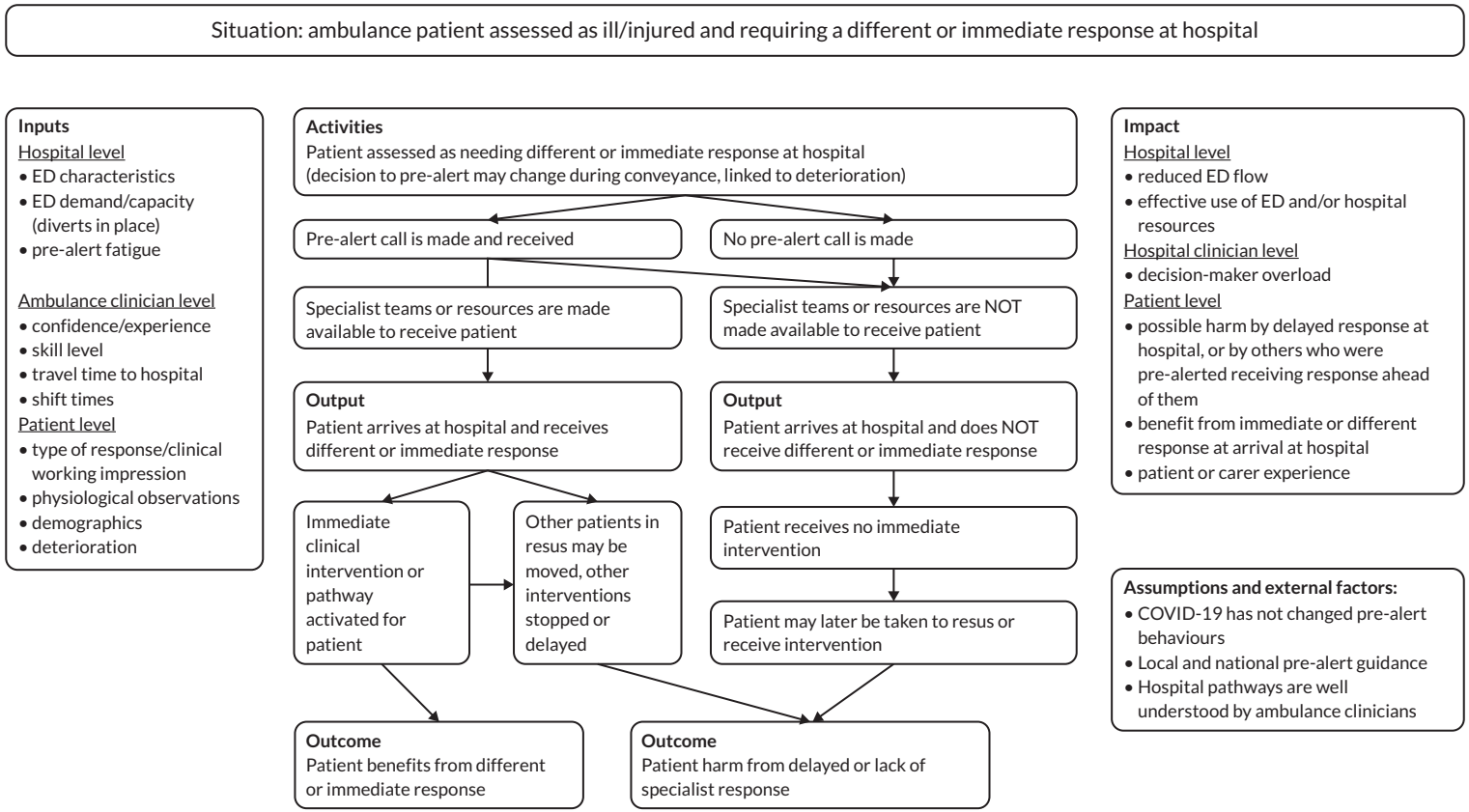

FIGURE 1 Initial pre-alerts logic model. COVID-19, coronavirus disease discovered in 2019.

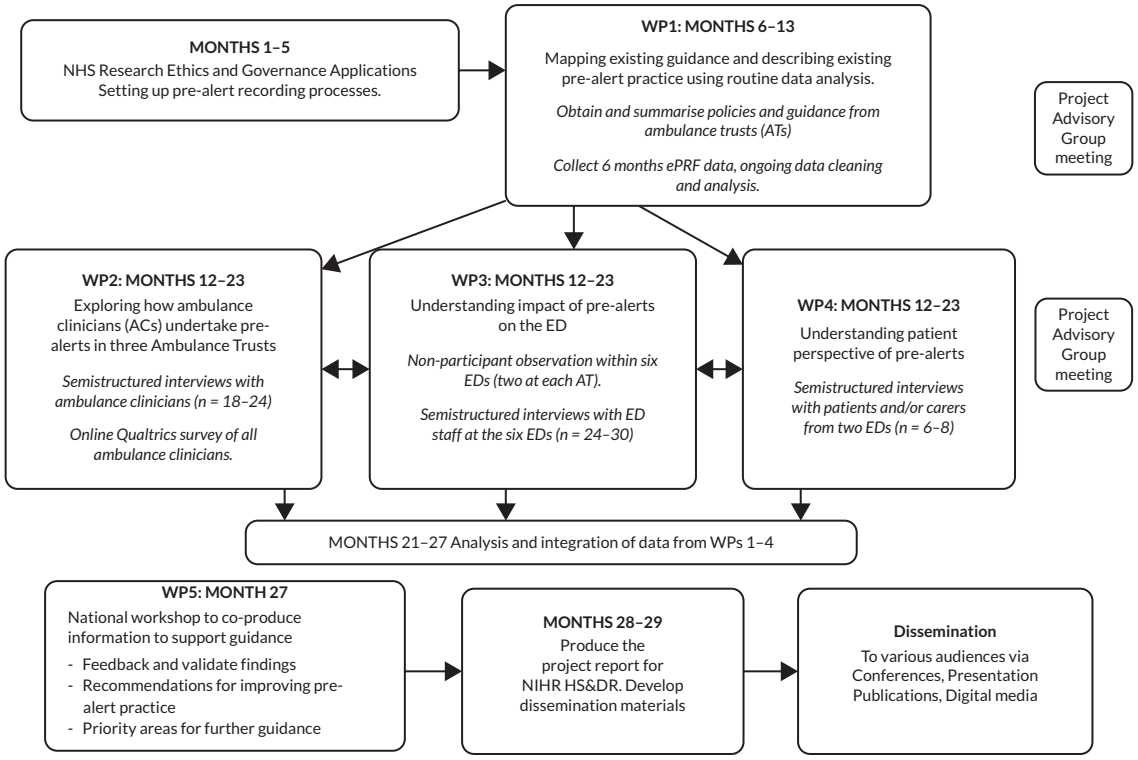

FIGURE 2 Study flow chart.

Emergency department sites were identified by reviewing pre-alert data for all hospitals in the region and selecting those with high numbers of pre-alerts in order to ensure that sufficient pre-alert activity could be observed during the researcher visits, including one major trauma centre (MTC) and one trauma unit (TU) within each site. We aimed to recruit EDs to cover as diverse a range of populations as possible, including ethnic, sociodemographic and urban/rural mix.

We also undertook a national guidance mapping review (UK and all ambulance services covered by AACE/RCEM guidelines) as well as a national survey of ambulance clinicians which was distributed to 10 Ambulance Services within England.

Work package 1: Mapping existing pre-alert guidance

We wrote to Research Leads, Medical Directors and Heads of Education in all 19 UK ambulance services (those covered by AACE guidelines) to ask for their most recent pre-alert guidance documents. We summarised the clinical conditions recommended for each ambulance service, and described the guidance in terms of areas of uncertainty, accessibility, clarity and focus. We used the AGREE2 Reporting Checklist for clinical guidelines to assess guidance quality.[30]

Work package 1: Routine data analysis

Data collection for work package 1

The statistical analysis plan was shared with the project management group and advisory group for approval (see *Report Supplementary Material 1*).

We analysed 12 months' ePRF data for all 999 calls that resulted in an ambulance transporting the patient to a hospital between 1 July 2020 and 30 June 2021. We aimed to understand whether pre-alert practice was affected by clinician factors (role, experience, age, sex, time of pre-alert during shift), patient factors [age, sex, National Early Warning Score (NEWS) 2, clinical working impression], hospital factors (catchment ED, handover delay status at time of pre-alert) and journey time. We collected attending ambulance clinician data (highest grade recorded on scene), computer-aided dispatch (CAD) system sequence of event log data and shift information from ambulance service rostering systems from each ambulance service and linked this to the ePRF data using the CAD unique incident identifier. We obtained daily statistics on ambulance handover delay status at the time of pre-alert from routine SituationReports (SITREP) data.[14]

We undertook univariate analysis to describe pre-alert practice, including patient characteristics and clinical

information for all conveyances with and without a pre-alert, to understand which patients and clinical conditions were pre-alerted.

We then undertook multivariable logistic regression to understand whether any clinician or hospital variables were associated with prediction of pre-alert after adjustment for patient case mix. Model selection was performed using least absolute shrinkage and selection operator (LASSO).[31] We excluded interfacility transfers, conditions that may have been pre-alerted as part of an ED bypass [ST elevation myocardial infarction (STEMI), stroke] and under-16s. We used NEWS2 score and a binary classification of whether the patient presentation met the RCEM/AACE non-physiological pre-alert criteria to adjust for case mix. Where a calculated NEWS2 score was not available in the electronic Patient Record (ePR) data, we calculated the NEWS2 score from the available physiological variables. Missing data were imputed with the value zero, classifying missing as normal, unless three or more physiological variables were missing. We undertook sensitivity analyses to explore the impact of selecting first NEWS2 versus last NEWS2 and using hospital as a fixed effect with a global test for the significance of hospital overall. Models were compared using a likelihood ratio test.

We developed two clinician role categories; simplified clinician role for all cases (paramedic, non-registered clinician) and a five category role for sites 1 and 2 where more detailed data were available [senior clinician, paramedic, newly qualified paramedic (NQP), non-registered clinician and non-registered clinical support staff]. Due to differences in data availability at the three sites, we were only able to use the simplified clinician variable for site 3 so included only sites 1 and 2 in the final model.

Work packages 2–3: Semistructured interviews with ambulance and emergency department staff and non-participant observation in emergency departments

Recruitment

Ambulance clinicians were selected purposively, sampling for length of experience, sex, role, ethnicity and whether they were high or low pre-alerters according to routine data from WP1. We recruited clinicians initially via targeted direct invite from research leads, then via open invitations from research leads at each ambulance service as well as clinicians who we identified during observation at individual EDs (see below).

We recruited ED staff to take part in interviews via direct invitation during observation, and via local principal investigators (PIs) who invited staff identified as having a key role in pre-alert response (e.g. clinical lead, nurse co-ordinators). We aimed to recruit a sample of different roles at each site, including senior and junior medical and nursing staff as well as other roles identified as important at individual sites during the fieldwork [e.g. ambulance clinicians working within the ED in roles such as hospital ambulance liaison officers (HALOs)].

For non-participant observation, researchers visited the EDs to inform staff of the purpose of the research and what the observations entailed. Additional communication included e-mails, posters, leaflets, attendance at briefings and researcher introductions during the actual observations.

Data collection methods

Semistructured telephone or online interviews were conducted by JL and JC. We undertook interviews with a total of 34 ambulance clinicians and 40 ED clinicians from across the 3 ambulance service regions. Characteristics of respondents are detailed in *Appendix 1*.

During the observations, staff were made aware of the presence of researchers and were given the option to 'opt out' of being observed. Researchers placed themselves within sight of the pre-alert phone for the majority of the fieldwork but also followed patients throughout their journey and observed in other areas where pre-alerted patients were taken (e.g. the ED front door, ambulance waiting areas). Further details of how observations took place are available in *Appendix 1*. Fieldwork was undertaken principally by JL and JC, with FS also undertaking initial site visits. We completed a total of 162 hours non-participant observation across the six sites.

Data collection instruments, technologies and processing

Topic guides were developed with the study set-up patient and public involvement (PPI) group and project management group and submitted as part of the ethics application. Topic guides were followed flexibly (i.e. all topics were covered, but not in the same order).

Observation guides to outline what to observe and document were developed and refined during initial visits. We created a form to record individual pre-alert call details (time, who answered, condition etc.) but did not record any patient data. Interviews were recorded using encrypted dictaphones and transcribed verbatim by University of Sheffield transcribers. Data were stored in a restricted area of university secure filestores, accessible only by the research team at University of Sheffield. All

participants were allocated a unique code, which was used when quoting direct excerpts from transcripts. We asked for permission to quote excerpts of data within the consent forms and therefore did not make transcripts openly available due to concerns about anonymity.

Observation notes and interview notes were written up in detail shortly after the observations/interviews took place, including reflexive notes from the researchers. All fieldwork data (interview transcripts and observation notes) were loaded into NVivo (*NVivo Qualitative Data Analysis Software*. 12th edn. QSR International Pty Ltd; 2018) and coded in NVivo. Files were backed up regularly on the restricted area of the shared drive, accessible only to the researchers involved in the qualitative analysis.

Researcher characteristics and reflexivity

Four researchers undertook the data collection and analysis of qualitative data. All were health service researchers with between 8 and 22 years' experience working in health services research and social science/psychology background but with no clinical background. Observations were often undertaken in parallel, and the research team met following observations to debrief and share reflections on findings.

Data analysis

Data were analysed using a thematic approach according to the principles of Braun and Clarke.[32] This involved data familiarisation, with ROH, JL, JC and FS all reading and discussing a subset of the interviews to develop an initial coding framework. Coding was undertaken initially by ROH (who had not undertaken any fieldwork) and JL (who had done the majority of data collection). Data were coded independently and discussed within the wider group on a weekly basis in order to refine coding and analysis. Codes and changes to coding frameworks were documented and labelled at each stage of change. Code summaries were developed and cross-cutting themes identified after discussion between the group.

Techniques to enhance trustworthiness

During interviews and observations, researchers clarified points and summarised findings during interviews to clarify any misunderstandings. Researcher triangulation within both the data collection and analysis phase helped improve trustworthiness of analysis. Discussion and feedback on initial findings were undertaken with research participants and key stakeholders from ambulance service and ED national bodies during stakeholder workshops. Findings from the workshop were summarised and distributed to all participants for comment.

Work package 2.2: National online survey of ambulance staff

Following initial analysis of ambulance clinician data, we developed a national online survey of ambulance clinicians to explore whether the issues raised within our fieldwork were represented nationally and to explore the scale of variation in practice indicated within our fieldwork.

Participants were recruited through local ambulance trusts. The survey was administered in Qualtrics during May–July 2023. The survey content was developed from issues identified in published research and from analysis of our interviews with ambulance clinicians. The survey questions focused on pre-alert decision-making, the process of making the call and communicating with the ED. We piloted the survey to ensure that the survey content was relevant to all ambulance services. We undertook a descriptive analysis of the survey data in Statistical Product and Service Solutions [SPSS Inc., Chicago, IL, USA (version 18 and below)] and coded and analysed text comments in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Further details are available in *Appendix 1*.

Work package 4: Semistructured interviews with patients and carers

We aimed to recruit six to eight sets of patients and carers across two EDs (one MTC and one TU) but were unable to recruit despite many changes to recruitment procedures. Details are explained in *Amendments to protocol and recruitment challenges*.

Integration of findings

This was a convergent parallel mixed-methods study. WP2 included a sequential mixed methods design, in which we analysed initial findings of ambulance clinician interviews in order to design our national online survey. We integrated findings using an adapted integration protocol to display the findings together and consider the presence of convergence, complementarity, agreement, disagreement or silence.[33]

Work package 5: Stakeholder workshops

We undertook two main stakeholder workshops to discuss our findings, a PPI workshop and a stakeholder workshop, as PPI members wanted a separate workshop. The stakeholder event included ED and ambulance service representatives, clinicians and researchers in the field. We presented a summary of triangulated findings and

facilitated discussion with the aim of identifying key areas for improvement.

Workshop methods summary

The event on 12 September 2023 was attended by 28 stakeholders, out of an invited 56. The event was held online using Blackboard Collaborate and chaired by Janette Turner, an expert in ambulance policy and service-based research. A range of attendees, representing ED clinical, ambulance clinical and emergency and prehospital care policy and practice, attended and contributed to the event.

At the start of the workshop, a summary of the pre-alerts' main findings from each WP was presented by the study lead. This was followed by jam board discussions where attendees used anonymous notes to describe which finding they felt was the most important and which was the most surprising. Stakeholders then discussed the findings. To facilitate discussion and involvement, discussions were held in online breakout rooms, with the groups reconvening to summarise key points on each topic. Discussion topics were: (1) guidance and support for pre-alert decision-making, (2) communicating pre-alerts, (3) training and feedback and (4) incorporating learning into practice.

Patient and public involvement workshop

In advance of the stakeholder event a separate PPI event was held, which mirrored the stakeholder workshop format and content but was tailored for PPI. The attendees were all members of the study PPI group (detailed in *Patient and public involvement*). Key messages from the PPI workshop about their interpretation of the results and which results were important for PPI were included in the presentation of triangulated findings to the stakeholder workshop participants.

Results summary

To date, six results papers have been submitted for publication with one in press and the remaining five under editorial review. These are summarised in *Table 1*.

Key findings from these papers are summarised below in relation to the main study objectives (see *Aims and objectives*).

Mapping pre-alert practice and exploring potential sources of variation

Objective 1 is addressed within two papers. In Boyd *et al.*[34] we mapped UK ambulance service guidance to explore consistency of pre-alert guidelines and identified significant variation in guidance available. Five of the 15 ambulance services who responded had no specific pre-alert guidance. For the 10 services who sent us the guidance, there was significant variation in the conditions stated as suitable for pre-alert and differences in physiological thresholds and terminology, even for conditions with established care pathways such as STEMI or hyperacute stroke. There was also a lack of alignment with the national AACE/RCEM pre-alert guidance. Accessibility and format of guidance also differed, with guidance often provided as short sections within lengthy handover procedure/policy documents that were difficult to access.

In Pilbery *et al.*, [35] we analyse 12 months' routine data from three ambulance services to explore pre-alert practice and variation. We identified that around 1 in 10 conveyances (142,795/1,363,274) were pre-alerted and fewer than half of pre-alerts were for conditions with clear pre-alertable pathways (stroke, STEMI, sepsis and major trauma). There was a significant difference in pre-alert rates between ambulance services and in rates for conditions expected to be pre-alerted.

Clinical factors (i.e. working impression matching RCEM/AACE guidance for pre-alert) were the main predictors of pre-alert use. However, we also identified that male patient sex, receiving hospital, and anticipated handover delay at receiving hospitals were also statistically significant predictors, after adjusting for case mix. There was evidence that NQPs were more likely to undertake pre-alerts but no evidence of higher pre-alert rates in the final hour of shift.

Exploring understanding of pre-alert decision-making and areas of uncertainty

Objective 2 is met across two further papers (O'Hara *et al.*[37], Coster *et al.*[36]). Factors affecting variation in practice identified within Pilbery *et al.*[35] are explored and explained by qualitative components of the study (WP2–4). O'Hara *et al.*[37] explain how pre-alert decision-making is influenced by clinician experience, confidence, attitude to risk and clinical support, as well as concerns about anticipated response from receiving EDs.

We identified potentially avoidable variation in decision-making, which has implications for patient care and emergency care resources and can contribute to tension between the services. Pre-alert decisions were based on rapid assessment of clinical risk based on physiological observations and clinical judgement as well as perceived risk of future deterioration, in conjunction with pre-alert guidance. Clinical experience and confidence helped clinicians understand which patients were at highest risk of deterioration or in need of immediate care upon arrival at ED.

TABLE 1 Publications contributing to synopsis

Working title	Formal title	Publication/submission
Variation in pre-alert guidance Boyd *et al.*	How should ambulance clinicians undertake pre-alerts? Review of UK ambulance service guidelines	*British Paramedic Journal 2024*[34]
Factors predicting pre-alert use Pilbery *et al.*	What factors predict ambulance pre-alerts to the Emergency Department? Analysis of routine data from three UK ambulance services	*BMJ Open* 2025[35]
Ambulance survey of pre-alert practice Coster *et al.*	Variation in pre-alert process and practice: findings and insights from a national survey of ambulance clinicians in England	*Emergency Medicine Journal* 2025[36]
How do ambulance clinicians decide to pre-alert? O'Hara *et al.*	What influences ambulance clinician decisions to pre-alert patients to ED? A qualitative exploration of decision-making in three UK ambulance services	*Emergency Medicine Journal* 2025[37]
How do ED staff respond to pre-alerts? Long *et al.*	How do EDs respond to ambulance pre-alert calls? A qualitative exploration within six UK EDs	*Emergency Medicine Journal* 2025[38]
How should pre-alerts be communicated? Sampson *et al.*	Understanding good communication in ambulance pre-alerts to the emergency department:findings from a qualitative study of UK emergency services	*BMJ Open* 2025[39]

Ambulance clinicians mainly learnt how to pre-alert 'on the job' and from informal feedback mechanisms, including ED response to previous pre-alerts. Availability and access to clinical decision support was variable, and clinicians balanced use of guidelines with concerns about retention of clinical judgement and autonomy. Perceived receptiveness to pre-alerts from receiving EDs was also a factor in decision-making. Differences in pre-alert criteria between ambulance services and EDs created difficulties in deciding whether to pre-alert and was particularly challenging for less experienced clinicians.

Within Coster *et al.*[36] we explore factors highlighted as influencing decision-making and explore differences in pre-alert practice across a national survey of ambulance clinicians (n = 1298). We identified significant differences in pre-alert practice at both individual and organisational level. The survey showed that half of clinicians reported that pre-alerts were always communicated directly to the ED by on-scene crews, with just over a third always communicated via control rooms. On-scene crews often used their personal mobile phones to make the pre-alert calls (607/1298, 45%), with 30% (390/1298) using ambulance radio. Although most recorded the pre-alert in documentation using a tick box, usually alongside free text (929/1298, 72%), 13% (165/1298) only recorded the call using free text, which has implications for the accurate auditing of pre-alert calls being made.

The survey identified differences in pre-alert rates, pre-alerting when unsure and use of guidance. Although the majority (75%) said they pre-alert once a shift or once or twice a week, 7% reported pre-alerting several times a shift and 15% pre-alert infrequently (once or twice a month). Over half of ambulance clinicians reported calling in cases where they were unsure, or using the pre-alert phone for 'courtesy calls' or 'heads-up' calls, which suggests different responses to perceived risk and different perceptions of what the pre-alert phone should be used for.

Local ambulance guidance or national guidance from the Joint Royal Colleges Ambulance Liaison Committee (JRCALC) clinical guidelines was used more often than RCEM/AACE guidance and there was evidence of differential understanding of who should be pre-alerted even for clearly pre-alertable conditions, with only 75% of clinicians stating they would always pre-alert a cardiac or respiratory arrest. Where criteria were less clear across guidance, fewer would always pre-alert (e.g. 20% for tachycardia > 131). Ambulance clinicians expressed a need for further guidance, particularly for silver trauma (older injured adults) and medical pre-alerts. Student paramedics had higher need for guidance, with specialist paramedics scoring lowest in their need for further guidance across the board.

A third of ambulance clinicians (36%, 464/1298) always used standard predefined formats/mnemonics [age, sex, history, injuries, condition, expected time of arrival (ASHICE)/age, time, mechanisms, injury, signs, treatment (ATMIST)/situation, background, assessment, recommendation (SBAR)] when delivering pre-alert, with 15% saying they do not use a structured format. Nearly two-thirds of respondents reported not having received specific training on how to make a pre-alert call (854/1298). Most had received informal training from a mentor or senior colleague, or learnt on the job, with a fifth reporting learning from written guidelines. Over half of ambulance clinicians (695/1298) had not received feedback on pre-alert decisions from EDs or the ambulance service, but reported wanting useful feedback.

Only 9% of ambulance clinicians reported that ED staff always listened to them and took the call seriously, listened without interrupting and made appropriate arrangements in the ED, with mean scores of between 3.09 and 3.31 (1 = never, 5 = always).

How should pre-alerts be communicated?

Objective 3 is met within a paper exploring how pre-alert decisions should be communicated (Sampson *et al.*[39]). We identified that communication issues were a key source of frustration and incivility, but that these may be improved through improving communication processes.

Both ED and ambulance clinicians recognised the value of efficient and concise pre-alerts to enable them to focus on direct patient care, yet both expressed frustrations at the other for extending the call unnecessarily either through interruptions or through lack of structure, making it difficult to identify relevant information.

Both groups of clinicians identified a lack of 'shared language' when communicating pre-alerts and we identified significant variation in how pre-alerts were communicated and received that influenced how effectively information was transferred. ED and ambulance clinicians often followed different information sharing formats which could lead to interruptions, loss of information and tensions. Use of structured formats (e.g. ATMIST, SBAR) helped focus handovers but restricted information to clinical observations. Communication of a 'headline' clinical concern at the start of the call was considered useful to identify the key clinical concern quickly, particularly when observations did not reflect clinician concerns (i.e. the patient 'just doesn't look right'). Neither ED nor ambulance staff received significant formal training about how to undertake or receive pre-alerts, which may explain variance in understanding which structured formats should be used and reliance on personal preference.

Additional sources of frustration included poor communication of estimated time of (ambulance) arrival (ETA) and the call giver or call receiver not identifying who they are at the start of the call. This was particularly problematic when poor communication lines or loss of signal resulted in multiple calls. Technological solutions to improving information transfer (e.g. shared patient notes) were varied.

Communicating the rationale for ED response (i.e. where the patient should go) may be key for patients who are not brought into resus. ED response was based primarily on resource availability at the time of call, but inconsistent responses to pre-alerts could be confusing for ambulance clinicians assessing whether they have pre-alerted appropriately.

How do pre-alerts influence patient care in the emergency department and does it differ by patient group?

Objectives 4 and 5 are addressed within Long *et al.*[38] where we explain how pre-alerts influence patient care in the ED, what factors affect the action taken in response to the call and whether any specific conditions may lead to different responses.

Pre-alert calls involved significant time and resources for ED staff but enabled staff to prepare for patient's arrival, particularly when demand was high. Pre-alert calls were taken seriously and patients who were pre-alerted were usually prioritised. Even when unable to make practical changes (e.g. creating space in resus) ED clinicians valued pre-alerts as enabling them to anticipate demand and provide psychological preparedness. Despite some pre-alert fatigue for patients who did not always require a special response or active treatment (e.g. sepsis), ED clinicians prioritised and valued pre-alerts, perceiving higher risks from over-alerting than under-alerting. This was particularly the case when resources were constrained and finding space for high-need patients was more difficult. However, high demand also created additional pre-alerts due to advice or 'heads up' calls from ambulance clinicians concerned about handover delay. This also led to frustration from ED clinicians who did not feel the 'red phone' was the place for advice calls.

We identified a number of areas of variation that meant that ambulance clinicians may not get an expected or consistent response to pre-alert calls. ED pathways for pre-alerted patients varied, particularly with regards to processes for senior clinical review of pre-alerted patients who were not brought into resus. Over a third (53/143) of the patients in our fieldwork were given a response other than resus or high care.

Documentation processes varied in terms of the information collected and the flow of information following the call. Where processes for passing on pre-alert documentation or information were not clear, this could lead to pre-alerts not being communicated appropriately, causing stress for both ED and ambulance clinicians. Having a senior clinician respond and take ownership of the call helped provide a more consistent response, yet pre-alert calls were often answered by junior staff who were less aware of how to respond. Individual clinician practice and risk perception varied both in terms of answering the call and the decision-making process when providing the response. ED response (where the patient should be taken) varied depending on the resources available (beds, staffing, acuity of other patients) and did not always reflect whether a resus bed would be appropriate for the patient.

Patient and carer perspectives of pre-alerts

We were unable to recruit any patients and carers to achieve objective 6, which we discuss in *Challenges faced and limitations*. We were able to understand some patient and carer perspectives from our PPI group (see *Patient and public involvement*).

Identifying areas of good pre-alert practice and need for further guidance

Our final objective was to identify areas of good practice and areas for improvement, which were developed from the fieldwork and discussed at the stakeholder workshop (see *Appendix 2* for summary of WP5 stakeholder workshop). The stakeholder workshop also provided additional ideas for dissemination (see *Impact and learning*).

Stakeholders felt that some of the most surprising findings of the study were also the most important, including the extent of variation in the pre-alerts process, the lack of training and the need to align ED and ambulance service perspectives on pre-alerts. Stakeholders felt that having more consistent guidance and alignment between ambulance and ED services would improve the quality of care for patients and providing training and feedback to both ED and ambulance staff could improve practice.

Within the fieldwork and during stakeholder discussions, a number of areas for improvement in relation to pre-alert practice were proposed:

- Increased collaboration between ambulance services and EDs in order to improve consistency in practice.
- Shared understanding of what needs to be pre-alerted, supported by agreed criteria and thresholds was regarded as necessary to minimise variation in pre-alerts.
- Suggestions for improved access to clinical decision support included an alternative ('amber') telephone number to contact the ED for advice or access to appropriately skilled staff within the ambulance service.
- An agreed format/structure for pre-alert calls between the ambulance clinician and receiving ED, including identifying what condition/patient specific information, is most pertinent for EDs to prepare a response.
- The need for better training to ensure the necessary experience and confidence for staff involved in pre-alerts. For ambulance clinicians, this includes understanding when to pre-alert and how to communicate information most efficiently. For ED staff, this includes understanding how to receive and respond appropriately to information in pre-alert phone calls.
- Opportunities for training that would develop a better understanding of practice in the other service.
- Feedback mechanisms for ambulance clinicians to enable development of good practice.
- ED staff identified scope for improved processes in relation to the communication/documentation of pre-alert information within the ED to minimise risk of information loss, particularly for patients not accepted in resus, and for audit purposes.
- Additional suggested practical improvements included an alternative phone line or strategy to communicate pre-alert information when the red phone is engaged, better sound quality on phones/radios and better use of technology to improve transfer of information from ambulance clinicians to the receiving to ED.

Discussion/interpretation

Principal findings

In this section, we present the integrated findings and key themes. The adapted triangulation protocol is available within *Report Supplementary Material 2*.

Pre-alerts are key to enabling ED staff to prepare physically and psychologically for critically ill patients, particularly when resources are constrained. However, we identified significant variation in pre-alert practice and pre-alert rates at both individual and organisational level that was not explained by patient case mix. While we identified a number of areas of shared understanding, we also identified areas of inconsistencies or differences in understanding that contributed to variation in practice and resulted in frustration and tension between ED and ambulance service clinicians. Our integrated findings explain some of the variation.

Pre-alert decisions are influenced by hospital and clinician factors

Ambulance clinician pre-alert decision-making was influenced by clinician risk perception, confidence and experience (e.g. pattern recognition), and incorporated different ED expectations for patients who should be pre-alerted. We identified that the receiving hospital had a significant impact on pre-alert decisions. This was partly due to different ED protocols (e.g. some hospitals required a pre-alert for patients with suspected neck of femur fracture) but also due to anticipated response (perceived negativity or inaction) and feedback on previous pre-alert decisions.

Emergency departments had different processes for managing ambulance patients who were not pre-alerted and differing thresholds for discussion of unclear cases over the phone (i.e. advice calls). Ambulance clinicians valued senior clinical review to provide reassurance and may be more likely to pre-alert borderline cases when they had more expectation of receiving advice or reassurance, whether via telephone or front door assessment.

Ambulance clinicians sometimes made 'heads up' calls to the pre-alert phone for patients who did not meet criteria for pre-alert but may be at risk of deterioration. This was principally due to concerns about their ability to look after a potentially deteriorating patient while waiting in an ambulance queue. This supports the WP1 findings that NQPs may be more likely to pre-alert (when adjusted for case mix) and that pre-alerts were more likely when there was a longer anticipated handover delay at the receiving hospital. More experienced clinicians were potentially more likely to understand when pre-alert protocols need to be strictly adhered to and when to use their clinical judgement as a guide alongside their clinical judgement.

At periods of high demand and long ambulance queues, advice calls could provide reassurance to ambulance clinicians but added to the pressures within the ED, creating another layer in the process of ED triage. While calls for advice were generally recognised to have patient safety benefits, individual ED clinician attitudes towards advice calls and perceptions of what the 'red phone' should be used for could cause tension. Variation in processes, protocols and management of patients at different EDs could lead to ambulance clinician confusion about whether or not to pre-alert borderline cases, particularly when managing patients outside of usual locality or where there were no established relationships with ED staff.

Ambulance clinicians reported that responses to pre-alerts varied depending on the receiving ED and the role or seniority of the person who answered the phone. ED observation and interviews also identified variation in ED response by clinician and seniority, ED processes for reviewing patients, and the level of demand at the time of the call. Ambulance clinicians were impacted by feedback from ED staff and reported taking previous ED responses to pre-alert calls into account when making pre-alert decisions. Established relationships between ambulance clinicians and ED staff helped build trust in pre-alert calls, but sometimes also led to judgements of clinicians who were perceived to 'over-alert'.

Misaligned understanding of what a pre-alert call is and expectations of response led to frustration and influenced future pre-alert behaviour

We identified that although there was a shared understanding that pre-alerts were of value, there was variation in understanding of what a pre-alert is, its purpose and the anticipated response to a pre-alert. We identified a typology of pre-alerts that influenced ambulance clinicians' expectations of the ED response to their call. These include:

- Information provision with specific expectation of response – the ambulance clinician is informing the ED about a patient who they consider requires a specific response, usually a bed in the resuscitation department (resus).
- Information provision with no specific expectation of response – the ambulance clinician is handing over the information for the ED to make the decision.
- Adherence to guidance and calling because there is an expectation to call (often due to ambulance service pre-alert criteria but where there is no immediate clinical concern from the ambulance clinician) and no specific response expected.
- Providing information about a patient who may not require a specific response immediately or is borderline, but the ambulance clinician has concerns about deterioration, particularly if there are long waits to be seen.
- Information or clarification about how to manage the patient or where to convey to (within the ED or which hospital) – often related to trauma calls.

However, ED expectations of a pre-alert call centred principally on receiving information that would require them to provide a different response, whether this was immediate practical changes (e.g. making space in resus, notifying trauma team) or anticipating needs of a patient who was at risk of deterioration. This could lead to frustrations when receiving calls for patients whose management within the ED would not be changed by a pre-alert, that is where they

met a protocol threshold for pre-alert but there was no clinician concern, or where the ambulance clinician was calling for advice.

Clarifying expectations from a pre-alert call

Crucially, frustrations arose where the ED response did not match ambulance clinician expectations and ambulance staff frequently discussed the 'success' or acceptance of a pre-alert when a patient was brought into resus, or 'failed' where the requested response was not offered. Ambulance staff reported reluctance or increased caution about pre-alerting when they had experienced or perceived a lack of response from the ED or had previous pre-alerts 'rejected' (i.e. not brought into resus). This perception of 'acceptance' or 'rejection' therefore impacted on future decision-making, particularly in the absence of other feedback or where feedback was perceived as rejecting the ambulance staff's clinical autonomy and judgement.

In contrast, ED staff described how 'acceptance' or 'rejection' of the pre-alert was frequently driven by resource availability (e.g. bed capacity, staff) and the number of patients requiring a resus bed at the time of call, rather than disagreement with the ambulance clinician's assessment of the patient. They valued the pre-alert information in helping them to manage capacity and resus prioritisation within the department, even when the pre-alerts were not admitted to resus, and did not perceive these to be 'failed' pre-alerts.

Emergency department staff reported a preference for pre-alerts, preferring to be informed, even at short notice or for borderline patients. Pre-alerts enabled ED's to plan for the patient's arrival and prepare psychologically, even when they were unable to make practical changes due to lack of resources. ED staff expressed more concern about potential under-alerting of patients than over-alerting, while recognising that responding to pre-alert calls potentially impacted current ED patients. This has implications for potential risk and additional workload in already stretched departments, particularly when pre-alerts calls are more advice-focused.

Communication of pre-alerts

We identified variation in pre-alert communication methods and processes that influenced not only how effectively information was transferred but also clinician experience. Calls were made either directly to the ED (within our fieldwork) or via the ambulance emergency operations centre (EOC), which could lead to information not being passed on appropriately or details being lost. We observed practical communication problems including loss of signal or radio interference leading to repeated calls. Almost half of ambulance clinicians reported that calls were undertaken with personal mobiles with only a third on recordable ambulance radio. Communication problems could lead to pre-alerts not being passed to the correct personnel and acted on appropriately. Similarly, unclear ED processes for handing over information about pre-alert calls to staff within the ED (particularly for patients who were not brought into resus) could lead to poor pre-alert response.

Communication of the pre-alert was a key area of conflict and uncertainty, often due to different expectations of how the information handover should be structured. Pre-alert documentation varied between EDs observed and the survey indicated significant differences in how ambulance clinicians communicated pre-alerts, with 15% saying they do not use mnemonics/fixed format. Interviews and observations revealed the same mix of formats and found that staff in both services are often unaware of the format that the other is using. Choice of mnemonic was often due to personal choice rather than clinical appropriateness or formal agreed format.

Use of different checklists or formats between ED and ambulance clinician led to tensions where expectations of information or the order in which information was given were not aligned. This could lead to interruptions and questioning by ED staff, which ambulance clinicians often found frustrating and undermining. Ambulance clinicians valued being listened to, their clinical judgement being taken seriously and not being interrupted during a pre-alert call. Within the survey only 1 in 10 ambulance clinicians felt ED staff always listened and took the call seriously, always listened to them without interrupting and always made appropriate arrangements in the ED. This demonstrates a need for improved communication during information handover, but also a need for an explanation of ED response when a pre-alert may be useful; however, ED clinicians are not able to provide a high-priority response.

Emergency department clinicians valued being given a specific reason for the call at the outset, concise information and an accurate arrival time as well as an early understanding of the clinical concern, particularly when receiving information from observation-driven handover formats and pre-alert protocols. Providing a headline concern could enable ED staff to understand how to frame the receipt of information and begin the process of understanding the patient's needs, particularly when the level of concern is not reflected in the physiological observations.

Training and feedback

Formal training on how to undertake or receive pre-alert calls was limited or absent for both ambulance and ED

clinicians. Learning to make or receive pre-alerts was usually undertaken 'on the job': watching pre-alerts take place or from senior mentors or colleagues, with ambulance clinicians learning and understanding who to pre-alert as they gained experience. Both ED and ambulance clinicians expressed a need for further training.

Many ambulance clinicians reported a lack of feedback mechanisms and useful feedback on pre-alert decisions. Lack of constructive feedback about appropriateness of pre-alert decisions or reasons for ED staff's decisions not to admit a patient to resus may lead ambulance clinicians to be overinfluenced by negative or unintended feedback (e.g. witnessing 'eye-rolling' by ED staff picking up the red phone or perceived 'rejection' of pre-alert calls). With most ambulance clinicians stating that they learnt how to pre-alert based on experience, this lack of positive and/or informative feedback may impact ambulance clinicians' confidence to make pre-alert decisions and their future pre-alert behaviour. Improved collaboration and communication between ambulance and ED organisations was highlighted as a key area for improvement.

Guidance and support

Variation in guidance across ambulance services and EDs as well as clinician knowledge and understanding of different types of guidance is likely to have a significant impact on variation in practice. Different sources of guidance, unclear or inaccessible guidance led to difficulties in understanding who to pre-alert, and potential conflict when ambulance service guidance did not align with ED guidance. This may be particularly difficult for less experienced clinicians who may stick to guidance more rigidly, and who did not yet have the trust of local EDs when calling in pre-alerts. ED staff were often unaware of ambulance guidance and changes in ambulance guidance were often not communicated to EDs. This could lead to EDs questioning the pre-alert and tensions during the call.

There was variation in pre-alert decision support provided between ambulance trusts and EDs, with some EDs happy to provide advice over the phone, and others frustrated at the use of the pre-alert phone for anything other than 'genuine' pre-alerts. Some ED staff felt that advice should be provided by the ambulance service to reduce burden on the ED. There was a suggestion that ambulance staff may need an alternative to a pre-alert call on a more standard basis, particularly for borderline cases, such as an alternative phone line, but no consensus on how this could be provided.

Throughout, ED and ambulance staff referenced 'barn door' pre-alerts who were in obvious need of immediate clinical attention, contrasting with borderline or 'grey area' cases where clinical gestalt would likely lead to variation in practice. However, even for 'barn door' pre-alerts there was evidence of variation in pre-alert rates which may be accounted for to some degree by differential knowledge and understanding of guidance (e.g. pre-alerting stroke within/outside of the 4-hour window).

Ambulance clinicians (particularly student paramedics) expressed a need for further guidance, mainly for silver trauma and medical pre-alerts. Sepsis was highlighted by both services as an area where further clarity and consistency of guidance may be useful due to low thresholds in some protocols leading to high numbers of potentially inappropriate pre-alerts but ED staff not always perceiving the need for these patients to be seen in resus. Silver trauma was highlighted as an area where ambulance clinicians wanted further guidance (65% in the survey) and where ED clinicians reported most concerns about potential under-alerting practice.

Contribution to existing knowledge

The project was service-led research, initiated due to the lack of research exploring pre-alert practice or understanding how pre-alerts should be undertaken. Previous literature around pre-alerts focuses almost exclusively on the effectiveness of pre-alerts in specific conditions (notably stroke, sepsis, STEMI and major trauma). Our study is the first to explore the causal mechanisms for improved effectiveness and understand the impact that pre-alerting has on the wider system beyond the individual patients or conditions.

We identified problems and conflict around pre-alerting were not necessarily associated with the conditions mentioned above but the 'grey area' patients where the clinical criteria were less clear and there was more scope for clinician judgement (and a lack of evidence of effectiveness of pre-alerting). We identified that ED clinicians value pre-alerts in terms of enabling them to prepare space and staff, as well as psychological preparedness to enable them to plan for a range of patients who require time-critical care. Our study identified the variation in pre-alert practice that has not been identified outside of small observational studies. We identified that variation is due to variation in guidance, individual clinician understanding of how pre-alerts should be used and variation in practice of EDs in receiving pre-alerts.

Strengths and weakness of the study/in relation to other studies

This study is the first to explore the use and impact of pre-hospital pre-alerts for a general population (i.e. not

focusing on specific conditions) and to explore pre-alert practice in depth. We undertook a scoping review of the literature (expanded from our proposal) to identify other studies that explored pre-alert practice and identified scant literature in the field beyond studies exploring the pre-alert effectiveness on specific clinical outcomes (e.g. door-to-needle times in stroke).

The mixed-methods approach incorporated perspectives of both ambulance and ED clinicians, along with non-participant observation and use of routine data. Our mixed-methods design enabled us to confirm and corroborate findings between WPs, but also to understand validity and transferability of findings.

Variation in pre-alert rates in routine data between ambulance services led us to question the validity of the data and whether pre-alerts were being accurately recorded. We tested this through three ways. Firstly, the ambulance service at site 1 mandated the pre-alert field within the ambulance ePRF form from 1 January 2021. This meant that ambulance clinicians could not leave the field blank. We thought this may lead to a change in pre-alert rates in comparison to the other sites, but there was no evidence of this (see *Methods*, *Appendix 1*). Secondly, survey data for the ambulance services suggested that ambulance clinicians at these sites did not rely on free text to record pre-alerts, which would not be captured within our routine data. Thirdly, the observation log from fieldwork suggested that case mix of pre-alert conditions being received by EDs was similar to that logged by ambulance clinicians. The only condition that varied was that of major trauma (higher in observation data) which is to be expected given that we oversampled from MTCs and units.

We undertook the national online survey of ambulance clinicians to understand whether the findings from our interviews were generalisable beyond the three ambulance services. We identified significant convergence between interview and survey findings with the main difference highlighted as the model of pre-alert delivery (i.e. via the EOC).

The qualitative analysis presented here is based on observation of 143 pre-alerts and 74 semistructured interviews with clinicians. This in-depth exploration has enabled us to gain significant insight into how pre-alerts are used and their impact on staff. In particular, the use of non-participant observation (and inductive methods) enables an understanding of embedded beliefs or behaviours that may not be identified using direct elicitation methods (e.g. surveys and interviews) only.[40] Other studies exploring pre-alerts are principally observational studies (e.g. audit), with only limited findings from small surveys or qualitative analysis.

We were unable to produce written guidance to ambulance and ED staff during the course of the project but aim to undertake this within the next 12 months.

Findings in relation to other studies are discussed in more detail within individual publications and summarised below, structured by key findings.

Variation in pre-alerting/pre-alert rates

We identified a number of factors contributing to ambulance pre-alert decision-making that contributed to variation in pre-alert rates. The identification of wider context and concerns in pre-alert decision-making demonstrates that we cannot necessarily define pre-alerts as appropriate or necessary without understanding wider concerns. The use of the outcome 'pre-alert' as an assessment of clinician understanding of whether a patient requires special response is problematic, as ambulance clinicians may have arrangements for checking patients at arrival that are used instead of a pre-alert.

Variation in pre-alerting rates have been reported for patients with suspected stroke[17,20,41] with significant under-alerting and over-alerting of suspected stroke according to protocols. James *et al.* similarly reported 28% non-prenotification and under-triage of trauma activations.[4]

Our quantitative findings identified that male sex was a predictor for pre-alert, after adjusting for case mix. This finding was not suggested or reflected within the fieldwork so we cannot identify any potential causal mechanisms to explain this finding. However, other studies have identified similar findings of lower Emergency Medical Services (EMS) prenotification rates for female patients for stroke[8] and STEMI[42] and identified disparities in treatment based on non-clinical patient characteristics that suggest inequalities in care exist.[43] Wong *et al.* 2016 identified that trauma alert cases were all correctly prenotified by ambulance crews (in contrast to findings above) but that female patients were less likely to receive emergency consultant-led trauma team activation within 5 minutes.[44]

Communication

We identified that the communication and handover of information had potential for information loss when calls were cut off or inadequately documented. Use of different mnemonics or structured documentation led to

frustration and interruption when ambulance and ED staff were following different formats and not having a shared mental model of the information required.

Other studies have identified incorrect or incomplete information that impacted upon subsequent treatment. Lawson and Godfrey reviewed pre-alert call recordings to MTCs from the air ambulance and identified variable compliance with completion of all variables.[45] James *et al.* reported high levels of incomplete or inaccurate information in 80% of trauma notification calls, leading to incorrect activation of trauma teams in a small proportion of patients (3.8%).[4]

Chivers *et al.* undertook an audit of the pre-alert logbook in a single centre and identified that a redesign of the ATMIST proforma enabled ambulance clinicians to spend more time on their patients and enabled ED staff to have clear ownership and accountability for the pre-alert.[46] Fitzpatrick *et al.* developed a low-tech intervention for use by ambulance clinicians aimed at improving recording and delivery of handover information including pre-alert. The intervention was well received and felt to be useful for both the recording and delivery of information. Early findings suggested improvements in handover of clinical information, but the study was small and only ran for 12 weeks.[47]

There is some evidence that aligned ED and ambulance understanding of pre-alert information may improve pre-alert response. Lally *et al.* reported variable response from ED staff, sometimes experiencing interruptions when undertaking pre-alerts with enhanced information, depending on whether ED staff were aware of the PASTA trial.[48] They welcomed the structured handover format. Sheppard *et al.* identified variation in pre-alerts for stroke, with half of identified stroke patients pre-alerted but not always alerted correctly according to protocol. They identified that EMS staff (n = 7) could get frustrated with the lack of ED response to stroke pre-alert and that simplified pre-alert protocols may help align the perspectives of ED and ambulance clinicians.[20]

There is limited evidence around how pre-alerts should be delivered, and whether direct to ED or via a control room is most effective. Gunn reported a mean reduction in time on scene of 4 minutes 55 seconds where a radio-style pre-alert sending a short radio message informing the ED of an incoming patient compared to pre-alert calls requiring a conversation with the receiving hospital prior to acceptance of the patients.[49] Li *et al.* reported barriers to providing prenotification from a survey of 301 EMS providers in New York State USA. Results included short transport time (40.5%), information being lost in dispatch (39.5%) and not having direct communication with ED staff (30.2%). However, there was no further elaboration about lost information or lack of direct communication.[50]

Training, feedback and guidance

We did not identify any literature relating specifically to pre-alert feedback, but our finding that clinicians received limited feedback about pre-alerts is reflected in other literature relating to pre-hospital feedback more widely. Li *et al.* reported that the majority of EMS providers in their survey wanting to receive feedback on the stroke patients they transported (93.7%), and 49.5% reported that the optimal method of providing feedback is via a mobile application.[50]

Cash *et al.* identified that 45.5% had not received feedback on practice with a month in the USA, and in Canada Croskerry *et al.* found that feedback was identified as not being part of routine practice.[51,52] Wilson *et al.* highlight the potential benefits of feedback for clinical practice, patient outcomes and staff mental health, including improving clinical decision-making, protocol adherence and documentation.[53,54] They similarly identified a lack of feedback as an issue for ambulance clinicians in the UK and internationally, despite an expressed desire for feedback.

Impact of pre-alerts on emergency department staff and patients

There is a particular lack of literature exploring how pre-alert impacted on patients, ED staff, other ED patients or the wider system. Berglund *et al.* identified that stroke prenotification improved time to thrombolysis, with no negative impact (defined as harm to other urgent medical needs) on other prehospital patients.[55]

Take-home message(s)

We highlight our principal take-home messages which we lay out in line with our initial aims of identifying principles of good practice, areas of uncertainty and areas for improvement.

- Pre-alerts are an important part of the emergency care pathway and critical to helping ED staff prepare for a patient's arrival, particularly when demand is high. Pre-alerts give ambulance clinicians the opportunity to highlight concerns about deteriorating patients.
- Ambulance and ED staff value pre-alerts that are delivered succinctly and in a format that can be followed by both ambulance and ED staff to minimise interruptions and maximise usefulness of information documented. Outlining the 'headline' concern, along with observations and clinical gestalt/concern can

be helpful. ED staff can help ambulance clinicians by explaining their response to pre-alert calls. Accurate ETA and updates when patient condition changes are useful to ED staff.
- Pre-alert practice is currently subject to significant variation due to different protocols and guidance used nationally, as well as a lack of formal training and feedback about appropriateness of pre-alerts. Consistency of guidance and protocols may reduce decision uncertainty for ambulance clinicians, including use of the same guidance and protocols by EDs.
- Increasing the shared understanding of the purpose of a pre-alert and clarifying how information only calls should be dealt with may help to address issues of pre-alert fatigue and tensions and frustrations.
- There is a need for senior clinical advice or alternative support for ambulance clinicians, particularly at times of high demand.

Challenges faced and limitations

Impact of coronavirus disease discovered in 2019 for emergency services research

The study was designed in 2019 prior to the coronavirus disease discovered in 2019 (COVID-19) pandemic. The pandemic had an impact on the timelines of the project, although we managed to restrict the impact by undertaking WPs that were originally planned sequentially in parallel. During COVID-19 lockdowns and periods of high demand for emergency services, research paramedics were moved into front-line work and were unable to work on research projects. Once services resumed to 'normal', ambulance services were under unprecedented pressure and timescales for providing data for WP1 were longer than planned.

Amendments to protocol and recruitment challenges

The most significant challenges we faced were in recruiting ambulance clinicians (WP2) and patients (WP4). We made four ethics amendments to try to increase recruitment which resulted in minor amendments to protocol (see *Report Supplementary Material 3*). Protocol amendments related to changes in recruitment processes for ambulance clinicians and patients/carers. Details of changes to ambulance clinician recruitment processes are detailed in *Appendix 1*.

Patient recruitment

We aimed to recruit patients directly while undertaking observation in EDs, handing out project information to patients who would contact us at a later date. During initial observations it became apparent that many patients within the resus area who had been pre-alerted were too ill to be approached, and that staff were unable to take time out from direct patient care to approach patients on our behalf.

After receiving no response, we consulted with our PPI group who suggested that the introduction of a simpler patient recruitment card might be more accessible to patients and therefore easier to hand out in the ED. We developed a new A5 fold-up card in collaboration with the PPI group (minor amendment 5).

We distributed the card to our ED staff leads but due to the extreme pressure the EDs were operating in, clinical staff were unable to commit to handing them out. We extended the recruitment to a third site (site 6) where fieldwork had not yet begun and discussed different options for recruitment. The site suggested an approach they had taken previously in which the researchers noted names of pre-alerted patients and passed these to the research nurses. The research nurses would then contact patients after discharge to ask whether they were happy to be sent information about the study (once they had assessed the patient had capacity and was well enough). This constituted a further amendment to ethics (amendment 6), submitted in December 2022.

This was rejected on the grounds that the researchers should not have access to patient names and the committee suggested that the clinician approach the patient to ask whether they were happy for their names to be passed onto the research nurse who would then contact the patient at a later date. We felt that this was potentially more distressing and confusing for patients so suggested that the clinician could write down a list of pre-alerted patients for the research nurses to collect. This approval was granted in March 2023, along with approval for site 2 to undertake a similar process whereby details of pre-alerts were recorded by clinical staff in order for the research nurses to then approach patients directly (amendment 8).

At site 2, we were able to fund the use of research nurses using the Clinical Research Network (CRN) 'unblocking the block' funds. Due to low numbers of pre-alerts during fieldwork at site 2, we asked staff to leave details of pre-alerted patients in a folder in resus for the research nurse to collect and approach the patient once out of resus. However, due to high ED demand and other factors including multiple healthcare strikes, staff were unable to collect the information for the research nurse to collect.

We handed out information to seven patients during observations at sites 1 and 2 (out of a total of 32 patients observed) but did not receive any response. At site 3, research nurses contacted 13 patients and although they had positive initial responses from 2 patients the patients did not go on to take part in an interview. We were unable to contact carers, partly due to lower numbers of carers being conveyed into the ED, in part due to COVID-19 restrictions.

Limitations: transferability of findings

Although we aimed to represent a diverse population within our fieldwork, there will be limitations to the transferability of findings across other EDs and ambulance services. Fieldwork did not include ambulance services or EDs where pre-alerts are primarily delivered via EOC rather than ambulance clinicians, which was the principal model of pre-alert delivery at a small number of other ambulance services (as highlighted within our national ambulance clinician survey).

Although we used a wide range of data sources, we did use different data sources to understand the ED and ambulance clinician perspectives. We were unable to observe pre-alert calls from the ambulance perspective due in part to the number of hours observation required to obtain an adequate sample. Similarly, we did not undertake a survey of ED staff to understand whether issues identified within our fieldwork are representative outside of the regions involved. This was principally due to concerns over low response and fewer issues requiring exploration than for ambulance clinicians (pre-alerts are ambulance-service led).

Recruitment for the national ambulance clinician survey was undertaken using advertising via ambulance services and wider social media. This meant that we did not have a known sample and cannot calculate the impact of potential response bias.

The lack of patient and carer voice limits our understanding of how pre-alerts may affect patients and carers. We had anticipated difficulties in recruitment at the outset, due in part to the likely lack of patient awareness about the pre-alerts and had included carers in order to combat this, as they may have more awareness. However, in part due to the COVID-19 pandemic, most patients were unaccompanied on their journey. The PPI group recognised pre-alerts as a health service-based process. While engaging with services users to understand their views and experiences of pre-alerts was thought to be beneficial, PPI agreed the primary focus of the research was on health service processes and systems.

Our quantitative data analysis was exploratory and based on a logic model that was developed based on very limited literature. While this is not a limitation per se, it is possible that factors associated with pre-alerts may have been missed. These could be explored in future research. Despite excellent confirmation of findings within the triangulation, there were certain factors that were not explored within qualitative work, such as male sex being a predictor for pre-alert. We may therefore have not included other characteristics (e.g. ethnicity, deprivation etc.) that may have an impact on pre-alert practice.

We recruited a diversity of roles within our qualitative sample and undertook qualitative data collection until we identified a high level of thematic saturation. However, there were a number of areas where we did not have sufficient data to be able to explore different role perspectives or type/length of experience with enough confidence to fully understand how clinician role impacted upon pre-alert practice.

Reflections on the project and what could have been done differently

The study provided learning points for the future, in particular with regards to recruitment of participants for interview as discussed in *Amendments to protocol and recruitment challenges*. If we were to run the study again, we would incorporate research nurse costs at each ED to help recruit patients as clinical staff were unable to help with patient recruitment. Similarly, we would add in the provision of a CPD certificate as well as the vouchers as participation incentives for clinicians from the outset.

The study was a convergent mixed-methods study integrating different stakeholder perspectives to understand how pre-alerts are used and their impact. The routine data analysis was intended to be exploratory with the intention of following up findings within our qualitative work. Due to delays in obtaining the data (with ambulance services under intense pressure due to COVID-19), we undertook the interviews prior to completing the routine data analysis which meant that we did not have chance to explore findings (e.g. male sex as a predictor for pre-alert) that did not arise during the interviews.

We selected EDs based on the premise that we would match MTCs with TUs from the same networks. However, in retrospect we should have focused less on trauma (which only accounts for a small proportion of pre-alerts)

and included EDs with no trauma status who may have managed pre-alerts differently.

Within the ambulance clinician interviews, participants talked about EDs who were particularly problematic in their management of pre-alerts. Unfortunately, we were unable to explore this within fieldwork as we had already selected our EDs and started the lengthy process of research governance. Given longer project timescales, we would have chosen our final two EDs based on findings from the ambulance clinicians interviews so that we could gain more insight into when pre-alerts do not work well from the ED perspective.

Engagement with partners and stakeholders

Engagement with partners and stakeholders was ongoing throughout, with research lead Co-Apps from three ambulance services and ED and ambulance clinician Co-Apps and PPI Co-App involved in the 6-weekly project management meetings. We disseminated early findings at a number of key conferences national and international emergency care conferences (see *Additional information* for details). We included a WP to specifically engage with partners and stakeholders with our stakeholder workshops (WP5 – described above).

Individual and institutional capacity strengthening

The study provided development opportunities for researchers within both ambulance and university settings. AB (research paramedic) undertook the guidance mapping exercise and published it as her first peer-reviewed first-author paper. Over the course of the study, RP was appointed to a permanent role as research paramedic at Yorkshire Ambulance Service NHS Trust (YAS), JM was appointed to Research Fellow at University of Sheffield and two researchers were promoted from Research Fellow to Senior Research Fellow (JC and AF). The project has also supported the continued capacity building within the key partner organisation YAS, and during the period of the study YAS has launched a new Research Institute which builds on this relationship to leverage greater research infrastructure and capacity within a sector which has historically received low research infrastructure investment.

Patient and public involvement

Aim

The aim of the PPI activity for the pre-alert study was to ensure that the views and lived experiences of people who have experienced ambulance care and pre-alerts were included in all aspects of this research and the dissemination strategy.

Methods and outcomes

We used a golden thread PPI approach, which meant that PPI was woven through the project from inception and design to dissemination.[56] This enabled the voices of PPI to be heard and included throughout the research process, from developing the initial proposal, protocol writing, project decision-making, ethics applications and amendments relating to patient recruitment methods, PPI interpretation of the results and project outputs.

The PPI group (see *Table 2* and *Figure 3* for details) was formed in two stages. Stage 1 included a small group of PPI representing different PPI groups (including from the DeepEnd PPI group which represents underserved communities and Sheffield Emergency Care Forum) who were

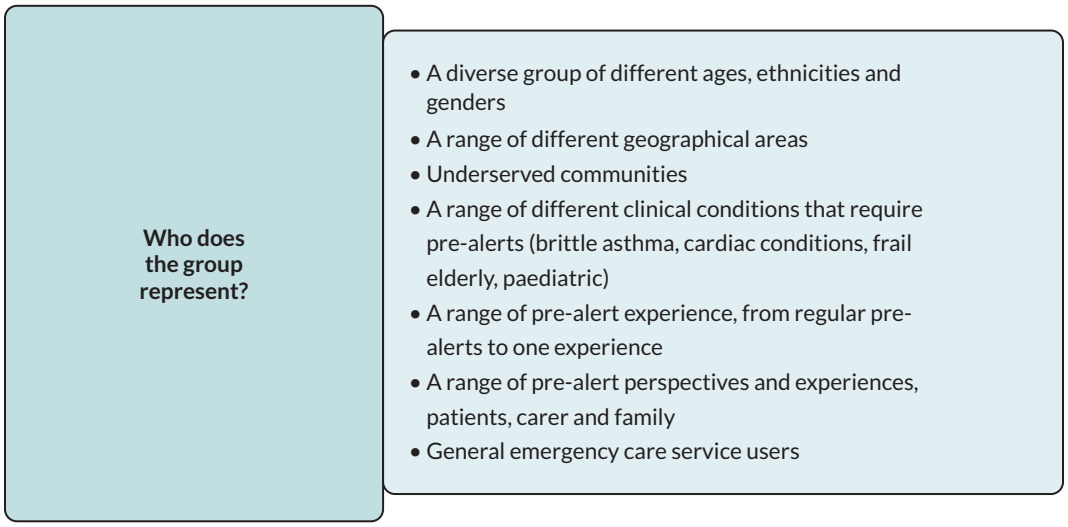

FIGURE 3 Pre-alert PPI group representation.

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TABLE 2 Patient and public involvement characteristics

Role in the study	Gender	Ethnicity	Age group	Employment status	Geographical location	Experience of pre-alerts	Other PPI experience
Co-applicant, Attended project management group meetings, PPI group member	M	White British	70 +	Retired	Yorkshire	No	YAS Critical Friend, Patient Ambassador at a Hospital Trust
PPI group member	F	White British	60–70	Retired	Yorkshire	Yes, as a friend and family member	The DeepEND PPI group
PPI group member	F	White British	70 +	Retired	Yorkshire	Yes, as a family member	Sheffield Emergency Care Forum PPI group
PPI group member	F	South Asian	41–60	Working full time	London	Yes, as a patient and also as a family member	NICE expert panel PPI member
PPI group member	F	Not stated	41–60	Carer and working part time	Greater London	Yes, as a carer and family member	NICE expert panel PPI member
PPI group member	F	White British	41–60	Unable to work due to illness	Dorset	Yes, multiple times as a patient	NICE expert panel PPI member. Experience of experience of being on PPI panels, patient advocacy and reviewing research

NICE, National Institute for Health and Care Excellence.

involved in the development of the research bid. They advised on the research question and aims, the importance of the research and the proposed research processes, including patient recruitment. These PPI members stayed with the study during its entirety and were a core part of the pre-alerts PPI group. Stage 2 was recruitment of additional members with lived experience of pre-alerts, resulting in six active members of the PPI group. Recruitment was undertaken via local PPI contacts, National Institute for Health and Care Excellence clinical expert group and National Institute for Health and Care Research (NIHR) people in research. We were guided by the 'no decision without me' ethos for inclusion of underserved groups.[57]

Patient and public involvement meetings and involvement processes

We had a PPI co-applicant who was part of our project management team and attended meetings. Another PPI representative was a member of the study advisory committee. PPI meetings were held at key points in the study timeline and were held online for practical reasons, including the geographical spread of our PPI members and their health conditions. Meetings were discussion based, with a focus on hearing from all PPI members on matters such as recruiting patients; design of patient research materials; thematic analysis coding, views on the findings; advice on how to disseminate the research and who it should be disseminated to. During the study set-up period and throughout the research process our PPI panel members helped to shape and guide decisions about research processes, particularly patient recruitment, which was a challenging area for this study.

Patient recruitment

Patient and public involvement were involved in the development of different recruitment strategies, which led to multiple applications to amend ethics approval. PPI felt that the initial recruitment pack, which included the participant information sheet, was too large and difficult to read. As members had lived experience of pre-alerts, they were able to add insights into the difficulty of taking the information packs around the different areas of the hospital. PPI developed a more portable and easier-to-read approach based on a birthday card design and including a QR code and study contact details. Unfortunately, due to the low number of pre-alerts that were deemed clinically appropriate for the study researchers to approach, we did not get the opportunity to test this approach on many patients. Following this, PPI guided and were supportive of a strategy whereby the hospital research department approached patients for interview post discharge. Despite the many efforts and input from PPI, no patients were recruited. We reflected on this with the PPI group during a meeting.

> *I think if patients realised some of the findings that you show, they'd have been more willing to be involved, It's almost like, if you told them there's such a mishmash of different policies and different forms and paperwork, they'd probably be quite interested to be involved*

Interpreting results from a patient and public involvement perspective

Interim study findings were presented and discussed with the PPI group throughout the study and final results were presented and discussed at a 3-hour online workshop. As we were not able to recruit patients to take part in interviews, the PPI group was vital in providing the patient voice to this research. Following the workshop, PPI had key messages about the pre-alert findings, and these were presented at and used to inform the discussion at the multi-stakeholder workshop. These are detailed in *Table 3*.

Reflections and critical perspective

Patient and public involvement made important and meaningful contributions to this study and have helped to steer and develop research processes and dissemination strategy. Having a PPI group with lived experience of pre-alerts, either as a carer, family member or someone who has been pre-alerted themselves meant that the group were able to provide important perspectives to the study. The identification of the key findings from a PPI perspective and subsequent feedback to the multi-stakeholder group was meaningful and their views and perspectives were considered in the multi-stakeholder discussion. The PPI group will continue to be involved in the dissemination of the study findings, including a PPI focused publication to *Health Expectations Journal* which will be co-written by PPI and in the development of an infographic of the study findings. PPI input and findings to this research has already been presented at the launch of the Yorkshire Ambulance Service Research Institute and was well received. The PPI group have been extremely supportive of this research, recognising its importance from a clinician and process perspective, and also that improvement of pre-alert processes will lead to better and more consistent care for patients.

The PPI messages about the key study findings were used to feed into the multi-stakeholder workshop, provide the PPI perspective in our research papers, other dissemination materials and presentations and were presented to ambulance clinicians and ED staff by one of the PPI group members.

TABLE 3 Patient and public involvement messages about the pre-alert findings

	PPI message
1	PPI members were quite shocked by the findings about the amount of variation between different services/hospitals despite there being national guidance.
2	PPI were concerned about how the implications of variation on patients and their families.
3	PPI members were concerned by how much variation there is and appreciate while there needs to be some tailoring to local contexts this could be on a regional level and needs to incorporate national guidance.
4	PPI members did not agree with ED concerns that ambulance staff may pre-alert near the end of their shift to help them get finished. PPI members felt that ambulance staff will stick by patients more than other professionals, for example not clocking off when shift finished but sticking with patients or ensuring that the patient is properly handed over to the next shift staff.
5	PPI members felt it was worrying that there was no set pro-forma for ED/ambulance staff to go through each time they prealert. PPI members felt it would save time, be more consistent for staff and be more reassuring for patients if there was a standard pro-forma that all ambulance and EDs use. PPI members feel that this needs to be a codesigned pro-forma by staff on the ground not by management.
6	PPI members felt that the variation in practice has often been due to organic development of pre-alerts processes rather than there needing to necessarily be differences because of contexts. They felt organisations are so busy doing they do not have the opportunity to reflect on best practice or learn from other hospitals/ambulance services.
7	PPI members felt there was more scope to coproduce guidance from on the ground ambulance and ED staff and incorporate national guidance.
8	PPI members want ambulance staff to have the discretion to be able to trust their instinct if they feel a patient needs to be prealerted, even if guidance suggests otherwise.
9	PPI members felt the research team should focus on disseminating results to ambulance and ED services and their respective professional organisations rather than to the general public. They felt this would be more likely to lead to change that would benefit patients.

Equality, diversity and inclusion

Research team and patient and public involvement

We developed an interdisciplinary team to address the complex, mixed-methods research design. The project management team comprised researchers from ambulance services and University of Sheffield staff. We included early career researchers within important roles in the study, enabling them to lead on key areas of work and lead on authoring abstracts and publications from the study.

Generalisability and transferability: site selection

The three ambulance services covered a population of 15.5 million, including areas of high and low deprivation, rurality and diverse ethnic populations that are broadly representative of the population of England. We similarly aimed to recruit EDs to cover as diverse a range of populations as possible, including ethnic, sociodemographic and urban/rural mix. We originally invited a MTC in a city with high mix of ethnic minority patients and a rural TU to be two of the sites. However, after a lack of response from these sites we replaced them with sites 4 and 6, which had below average White British representation but did not include the rurality of the original site.

Participant selection

We collected data on sex and ethnicity when purposive sampling for the paramedic sample. For the ambulance clinician interviews, 31/34 participants who provided ethnicity date reported their ethnicity as white and 13/34 described their sex as female which is representative of the ambulance workforce.[58]

Within WP1 we sought to understand whether there were any sex or ethnicity differences in pre-alert practice. We identified differences in pre-alert rates by sex but were unable to include patient ethnicity in the final data set due to poor data quality. The logic model for WP1 included variables for hospital, clinician and patient factors that may have an impact on pre-alert decisions. We limited the model to simple patient characteristics (age, sex and ethnicity) and did not include variables that would enable us to explore other characteristics that may influence health outcomes, such as deprivation. Given that deprivation is a major factor associated with pre-alertable conditions such as stroke, STEMI and mortality from sepsis, it is likely that pre-alert practice will not affect populations equally.[59]

Wider involvement focused on the inclusion of key stakeholders who were primarily ED and ambulance service personnel. Stakeholders were selected based on their

role and we did not collect data on protected characteristics. While we achieved a representative sample of the workforce, the workforce did not reflect a representative sample of the population they serve. Emergency medicine is recognised as not being representative of the wider population, with over-representation of white men within the higher roles. However, we achieved female senior representation of both RCEM and AACE within the workshop.

Recruitment of patients would have enabled us to achieve a more balanced and diverse sample than that of staff. However, for reasons described above, we were unable to recruit patients to the study.

Impact and learning

In addition to the learning reported above within our findings, we identified a number of areas of methodological learning relating to recruitment of participants within emergency settings (see *Challenges faced and limitations*). In this section, we explore the learning during the study, pathway to impact and highlight dissemination to date.

In September 2023, we ran a national stakeholder workshop and PPI workshop to discuss the findings and identify how key findings could be used to change future practice. The workshops aimed particularly to help bring together ambulance and ED clinicians to enable an improved shared understanding of how pre-alerts can be used to improve patient care within the current context of high demand. Co-production of recommendations will improve the likelihood of research findings being adopted into practice.[60,61] The workshops were key to understanding whether our findings resonated with a wider group of ED and ambulance staff than we had involved within our project management group and to understand how we could maximise learning from our research.

Findings from our workshop have been written up and included in *Appendix 2*.

Pathways to impact

We hope that the findings of this study will lead to improved understanding of what pre-alerts are, how they are used and understanding of how these should be delivered to achieve improved patient care. Notably, we hope that by disseminating our findings we can help both ED and ambulance staff to understand the others' concerns and understand how to use pre-alerts judiciously. We will also work to help ensure findings can feed into improved and well-disseminated guidelines.

Within the stakeholder workshops, we discussed how our findings could be used to influence practice. We identified the following pathways to impact:

- Develop shared documentation for communicating pre-alerts to improve the handover of information on the phone. This should include a 'headline' stating the ambulance clinician's concern.
- Develop a set of core principles for the pre-alert process to be included within the revised AACE/RCEM guidelines. AACE/RCEM guidelines due for revision.
- Training around pre-alerts is important but needs to be brief and could be integrated into existing training around handover. Creation of short interprofessional online modules, for example RCEM short learning pieces. This can be taken forward by Higher Education Industry (HEI) providers via College of Paramedics and Prehospital Emergency Medicine professional advisory group [approved by the Quality in Emergency Care Committee (QECC)]
- Set up an online Community of Practice to disseminate areas of good practice and areas where guidance is needed.
- Review senior clinical advice mechanisms (i.e. an alternative to the red phone) available for ambulance clinicians when making pre-alert calls due to current inconsistency.
- Explore ways to improve communication and understanding between ED and ambulance staff, either through shared roles (e.g. HALO) or enabling work shadowing.

Dissemination and collaborations

We have disseminated early findings from the study widely at national and international Emergency and Prehospital Care conferences, including three oral presentations, two elevator posters and six posters. We were invited to present a summary of the findings at the Yorkshire Ambulance Service Research Institute launch. We have had one peer-reviewed paper accepted for publication and submitted four more. Details of conference papers and publications are included in *Additional information*. In addition to the dissemination detailed above, we have plans for the following:

Booked dissemination

- CDPme webinar. How should we improve the use and communication of pre-hospital pre-alerts? 12 December 2023.
- Presentation of summary and findings and PPI perspective to Sheffield Emergency Care Forum 18 January 2024.

- Faculty of Prehospital Care Pre-alerts webinar. 5 March 2024.

Further planned dissemination to include

- Application to host a workshop at 999 EMS Research Forum 2024.
- Presentation at Ambulance Service Chief Executives (AACE) Ambulance Leadership Forum annual conference.
- Presentation of findings at Health Services Research UK conference July 2024.
- Development of infographics by Nifty Fox.

Publications

We plan to undertake further publications to explore some of the qualitative findings in more depth, particularly around cross-boundary working and the implications on incivility. We also plan to publish a short report of PPI (led), in which we highlight difficulties in recruiting patients in critical conditions or where the research need does not involve direct patient care.

Collaborations

From the WP5 workshop and dissemination activities to date, we have developed new collaborations, notably around developing a community of practice for discussing pre-alert practice. Prior to the workshop, we were contacted by a number of ED and ambulance service clinicians who had heard about our research and wanted to discuss how to improve the pre-alert process within their organisations. We plan to involve these organisations in our infographic development process in early 2024.

Implications for decision-makers

The research has significant implications for decision-makers. The research was problem driven and supported by a range of key individuals from prehospital and ED national bodies including National Ambulance Service Medical Directors Group, JRCALC and NHS England (NHSE).

The workshops highlighted the following recommendations that should be taken forward by decision-makers:

Closer working between ambulance and ED staff can be supported by decision-makers at professional college levels (RCEM, communities of practice and AACE). This may include communications and training plans to ensure compliance and satisfaction with any standardisation of processes between all parties.

We anticipate that the planned revision of RCEM/AACE guidance will incorporate findings from the study, notably around definitions of pre-alerts and understanding how pre-alerts should be communicated.

It is expected that NHSE policy and decision-makers will be interested in the findings when developing Urgent and Emergency Care plans, specifically work around ambulance handover delay. We have highlighted two findings that have particular implications for NHSE:

1. Ambulance clinician pre-alert behaviours are influenced by individual ED processes. This has an impact on opportunities to standardise and improve flow into the ED, and feed into work around single point of access models for ED care that are currently being developed.
2. Ambulance clinicians place a high value on being able to access top level or senior clinical support to aid their decision-making around the most seriously ill and injured patients. This highlights the importance of developing ambulance-accessible services that interact directly with the ED and receiving hospital.

Research recommendations

We identified the following areas for future research.

A key recommendation was the *development of joint pre-alert documentation*, using established mnemonics that could be shared between ED and ambulance staff to improve consistency. Developing, piloting and evaluating this checklist to understand which areas of documentation would benefit from a national 'standard' and areas where local development and piloting of a joint pre-alert shared checklist. Similarly, any joint training modules should be evaluated and assessed.

Interventions to improve understanding across service boundaries, cross-boundary roles (e.g. HALO) and improving cross-boundary working and reducing incivility. This could also help to explore different ways of working and managing ambulance demand, which in turn has an impact on pre-alerts.

Our findings identified significant differences in how EDs manage pre-alerts amidst wider patient flow management between the six sites studied. *Research to explore and understand different models of ED demand and patient flow management* may help to identify what models work best in enabling management of ambulance patients within the wider ED system. This may include developing plans around ED single point of access to senior clinical support for ambulance clinicians.

Further research is needed to *understand what feedback mechanisms may help in improving pre-alert practice.* This may explore what type of feedback is most effective for individual clinicians, how this differs by different type of clinician depending on experience and other characteristics.

Identifying which patients need a pre-alert was not in the remit of this research, although we did identify a number of areas where further guidance was required (e.g. medical alerts, silver trauma) and areas where further clarification was required due to different guidelines across ambulance services and EDs (e.g. sepsis).

Like many other studies in the field of emergency care (and others), we experienced difficulties in recruiting both ambulance clinicians and patients to take part in the research.[41,62] *Understanding ambulance clinician barriers to participation in research requires further exploration*. Similarly, *understanding patient motivations for participating in service-based research in the emergency setting (where there is no specific patient group) is important* and would be helpful to health service researchers undertaking research in the field of emergency and urgent care.

One area of findings that was not reflected across all the different WPs was the finding that men were more likely to be pre-alerted than women. There is evidence that referral decisions are influenced by sex and ethnicity across a number of domains of health care. Further work is needed to understand the impact of this on patient outcomes, and to understand how any inequalities can be reduced in this setting.

Conclusions

Ambulance pre-alerts have become an integral part of the chain of emergency care, enabling ambulance clinicians to alert EDs to patients who they feel require a special response upon arrival. Pre-alerts are key to enabling patient safety and patient flow within the department, particularly when ED demand is high. Pre-alerts enable ED staff to prepare for the patient's arrival both practically and psychologically and provide ambulance clinicians with reassurance that concerns were shared. Ambulance and ED clinicians have the same goal of high-quality patient care when undertaking pre-alerts, but this is rooted in their own perspectives and contexts (individual patient v all ED patients). This study highlighted difficulties in cross-boundary working, delivering care across different organisations.

We identified a number of areas of potentially avoidable variation in pre-alert practice at both organisational and individual level. Areas of confusion and uncertainty appeared to stem largely from a lack of formal training and variance in guidance available. This study highlighted a need for improved and consistent understanding of conditions and patients who would benefit most from a pre-alert, both from the perspective of the ambulance clinician, who has concerns about a deteriorating patient, and the ED staff who may need to provide additional resources for a patient. While some variation in practice is to be expected, particularly variation relating to experience, this may be mitigated by improving training and guidance available to new or less experienced clinicians. There is also value to more consistent access to senior clinical decision support for ambulance clinicians to enable best decision-making for patient to get appropriate timely care.

We identified a number of important ingredients for what constitutes a good pre-alert. Concise and structured pre-alerts should enable efficient handover of pre-alerts, minimise incivility and maximise time spent on patient care. Using an agreed format for communication of information, framed by a statement of concern that highlights the ambulance clinician's clinical concern, may ensure that both parties can follow the pre-alert structure and minimise interruptions or superfluous information. Risks of information loss, due to technical difficulties and loss of signal or inappropriate transportation, may be minimised by both parties stating their name and organisation at the start of the call. Timely communication and accurate ETA are important, along with updated information when there has been a change in a patient's condition.

Workload in the ED is not always visible to ambulance staff, which can cause frustration for ambulance clinicians who may perceive their pre-alert to have been in vain if an expected response is not received, and potentially alter future practice based on a misguided perception that the patient did not require a pre-alert. Providing a brief explanation for the ED response may help ambulance clinicians understand ED decisions and developing mechanisms for appropriate feedback on pre-alert decision-making may improve future practice.

We identified a number of areas of good practice and areas where services have worked to improve the pre-alert processes that aim to improve communication and understanding of each other's perspectives. This includes joint development of information handover forms, development of ambulance triage that enable patient review and joint ambulance/ED roles (e.g. HALO). Improving pre-alert practice was perceived to be important by ambulance and ED clinicians alike and co-producing training models and shared documentation were agreed as key actions by stakeholders.

This synopsis should be referenced as follows:
Sampson FC, Long J, Coster J, O'Hara R, Pilbery R, Bell F, *et al*. Exploring the use of pre-hospital pre-alerts and their impact on patients, Ambulance Service and Emergency Department staff: a mixed-methods study. *Health Soc Care Deliv Res* 2026;**14**(9). https://doi.org/10.3310/GJFS4321

Additional information

CRediT contribution statement

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Other contributions

Patient and public involvement group.

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Patient data statement

This work uses data provided by patients and collected by the NHS as part of their care and support. Using patient data is vital to improve health and care for everyone. There is huge potential to make better use of information from people's patient records, to understand more about disease, develop new treatments, monitor safety, and plan NHS services. Patient data should be kept safe and secure, to protect everyone's privacy, and it is important that there are safeguards to make sure that they are stored and used responsibly. Everyone should be able to find out about how patient data are used. #datasaveslives You can find out more about the background to this citation here: https://understandingpatientdata.org.uk/data-citation

Data-sharing statement

The data used for this study are subject to data-sharing agreements with the three Ambulance Services involved, which prohibit further sharing of individual level data. The data sets used are obtainable from these organisations subject to necessary authorisations and approvals. The qualitative data generated for this study are in the form of confidential transcripts of interviews that are not available for sharing. Participants consented for anonymised quotations to be shared but did not consent to share the full transcripts. All queries should be submitted to the corresponding author.

Ethics statement

Ethical approval for the pre-alerts project was obtained from Newcastle & North Tyneside 2 Research Ethics Committee (Ref: 21/NE/0132, letter of approval 28 July 2021) All research was undertaken in accordance with relevant guidelines and regulations, with informed consent from all research participants. All participants signed an informed consent form for publication declaring consent to include anonymised quotations in publications.

Information governance statement

The University of Sheffield is committed to handling all personal information in line with the UK Data Protection Act (2018) and the General Data Protection Regulation (EU GDPR) 2016/679. Under the Data Protection legislation, the University of Sheffield is the Data Controller, and you can find out more about how we handle personal data, including how to exercise your individual rights and the contact details for our Data Protection Officer here: dataprotection@sheffield.ac.uk, https://www.sheffield.ac.uk/govern/data-protection/privacy/general

Disclosure of interests

Full disclosure of interests: Completed ICMJE forms for all authors, including all related interests, are available in the toolkit on the NIHR Journals Library report publication page at https://doi.org/10.3310/GJFS4321.

Primary conflicts of interest: Fiona C Sampson undertook a CPDme workshop to promote the study but waived payment (requested charity donation instead). Steve Goodacre was Chair of the NIHR CTU Standing Advisory Committee until 31 December 2022 and was Deputy Director of the NIHR HTA programme and Chair of the NIHR HTA commissioning committee until 31 December 2020. None of the other authors have any other competing interests to declare.

Department of Health and Social Care disclaimer

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This synopsis was published based on current knowledge at the time and date of publication. NIHR is committed to being inclusive and will continually monitor best practice and guidance in relation to terminology and language to ensure that we remain relevant to our stakeholders.

Study registration

This study is registered as Current Controlled Trials ISRCTN12652860.

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Award publications

This synopsis provided an overview of the research award *Exploring the use of pre-hospital pre-alerts and their impact on patients, Ambulance Service and Emergency Department staff*.

Other articles published as part of this thread are:

O'Hara R, Sampson FC, Long J, Coster J, Pilbery R. What influences ambulance clinician decisions to pre-alert patients to emergency department? A qualitative exploration of decision-making in three UK ambulance services. *Emerg Med J* 2024;**42**:e213849. https://doi.org/10.1136/emermed-2023-213849

Boyd A, Sampson FC, Bell F, Spaight R, Rosser A, Coster J, *et al*. How consistent are pre-alert guidelines? A review of UK ambulance service guidelines. *Br Paramed J* 2024;**8**:30–7. https://doi.org/10.29045/14784726.2024.3.8.4.30

Coster J, Sampson FC, Long J, O'Hara R. Variation in prealert processes and practice: findings and insights from a national survey of ambulance clinicians in England. *Emerg Med J* 2024;**42**:14–20. https://doi.org/10.1136/emermed-2023-213851

Pilbery R, Sampson FC, Herbert E, Goodacre S, Bell F, Spaight R, *et al*. What factors predict ambulance prealerts to the emergency department? Retrospective observational study from three UK ambulance services. *BMJ Open* 2025;**15**:e097122. https://doi.org/10.1136/bmjopen-2024-097122

Long J, Sampson FC, Coster J, O'Hara R, Bell F, Goodacre S. How do emergency departments respond to ambulance prealert calls? A qualitative explorations within six UK emergency departments. *Emerg Med J* 2024;**42**:e213854. https://doi.org/10.1136/emermed-2023-213854

For more information about this research, please view the award page (www.fundingawards.nihr.ac.uk/award/NIHR131293).

Additional outputs

Sampson FC, Long J, O'Hara R, Coster J. Understanding good communication in ambulance pre-alerts to emergency department: findings from a qualitative study of UK emergency services. *BMJ Open* 2025;**15**:e094221. https://doi.org/10.1136/bmjopen-2024-094221

Conference papers

Sampson FC, Long J, Coster J, O'Hara R, Pilbery R, Bell F, *et al*. *Using triangulated findings from a mixed methods study to improve ambulance service and emergency department pre-alert processes and practice*. Health Services Research UK conference, Oxford July 2024 (oral presentation).

Sampson FC, Bell F, Webster P, Coster J, O'Hara R, Goodacre S, *et al*. *Exploring the Use of Pre-hospital Pre-alerts and Their Impact on Patients, Ambulance Service and Emergency Department Staff: Protocol for a Mixed Methods Study*. 999 EMS Research Forum 2022, online March 2022.

Boyd A, Sampson FC, Pilbery R, Bell F, Millins M, Coster J *et al*. *Which patients should be pre-alerted? A review of UK Ambulance Service Guidelines*. College of Paramedics conference, Nottingham, 2023.

Boyd A, Sampson FC, Pilbery R, Bell F, Millins M, Coster J, *et al*. *Which patients should be pre-alerted? A review of UK Ambulance Service Guidelines*. 999 EMS Research Forum June 2023, Manchester, UK.

Coster J, Sampson F, O'Hara R, Long J. *Time Critical Care at the Ambulance and ED Interface: Qualitative Research Exploring UK Ambulance and ED Staff Perspectives and Practice of Pre-hospital Pre-alerts to the ED*. European Emergency Medicine Congress, Barcelona, Spain, September 2023 (Oral presentation).

Long J, O'Hara R, Sampson FC, Coster J, Bell F, Webster P, *et al*. *How Do Pre-alerts Influence Patient Care in the Emergency Department? Findings from Qualitative Research within Three UK Ambulance Services*. 999 EMS Research Forum June 2023, Manchester, UK.

Sampson FC, Pilbery R, Herbert E, Bell F, Rosser A, Spaight R, *et al*. *What Factors Affect Pre-hospital Pre-alerts? Analysis of Routine Ambulance Data*. 999 EMS Research Forum June 2023, Manchester, UK.

Sampson FC, Pilbery R, Herbert E, Long J, Coster J, Bell F. *What Factors Influence Prehospital Decisions to Pre-alert Emergency Departments of a Potentially Deteriorating Patient's Arrival?* International Conference for Emergency Medicine, Amsterdam, Netherlands, June 2023 (Oral presentation).

Sampson FC, Coster J, Long J, O'Hara R, Bell F, Webster P, *et al*. *What Is a Pre-alert? Exploring Ambulance and Emergency Department Staff Perspectives of the Pre-alerts Process*. 999 EMS Research Forum, Manchester, UK (Elevator Pitch), June 2023.

Sampson FC, Pilbery R, Herbert E, Long J, Coster J, O'Hara R, *et al*. *Factors That Influence Ambulance Clinician's Decisions to Pre-alert Emergency Departments of a Patient's Arrival: Findings from a UK Mixed-methods Study*. European Emergency Medicine Congress, Barcelona, Spain (ePoster presentation), September 2023.

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Sampson FC, Pilbery R, Herbert E, Long J, Coster J, O'Hara R, *et al*. *Mixed Methods Study Exploring Factors Influencing Ambulance Clinician Decisions to Pre-alert Emergency Departments (EDs) of a Patient's Arrival*. RCEM Annual Scientific Conference, Glasgow, UK, September 2023 (Oral presentation).

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List of supplementary material

Report Supplementary Material 1 The statistical analysis plan

Report Supplementary Material 2 Triangulation Protocol matrix – summary of triangulated findings

Report Supplementary Material 3 Amendments to protocol and Health Research Authority approvals

Report Supplementary Material 4 Data collection instruments

Report Supplementary Material 5 Appendix 1: Survey

Supplementary material can be found on the NIHR Journals Library report page (https://doi.org/10.3310/GJFS4321).

Supplementary material has been provided by the authors to support the report and any files provided at submission will have been seen by peer reviewers, but not extensively reviewed. Any supplementary material provided at a later stage in the process may not have been peer reviewed.

The supplementary materials (which include but are not limited to related publications, patient information leaflets and questionnaires) are provided to support and contextualise the publication. Every effort has been made to obtain the necessary permissions for reproduction, to credit original sources appropriately, and to respect copyright requirements. However, despite our diligence, we acknowledge the possibility of unintentional omissions or errors and we welcome notifications of any concerns regarding copyright or permissions.

List of abbreviations

AACE	Association of Ambulance Chief Executives
ASHICE	age, sex, history, injuries, condition, expected time of arrival
ATMIST	age, time, mechanisms, injury, signs, treatment
CAD	computer-aided dispatch
COVID-19	coronavirus disease discovered in 2019
CRN	Clinical Research Network
ED	emergency department
EMS	Emergency Medical Services
EOC	emergency operations centre
ePRF	electronic Patient Report Form
ETA	estimated time of (ambulance) arrival
HALO	hospital ambulance liaison officer
HEI	Higher Education Industry
JRCALC	Joint Royal Colleges Ambulance Liaison Committee
LASSO	least absolute shrinkage and selection operator
MTC	major trauma centre
NEWS2	National Early Warning Score 2
NIHR	National Institute for Health and Care Research
NQP	newly qualified paramedic
PI	principal investigator
PPI	patient and public involvement
QECC	Quality in Emergency Care Committee

RCEM	Royal College of Emergency Medicine
SBAR	situation, background, assessment, recommendation
STEMI	ST elevation myocardial infarction
TU	trauma unit
WP	work package
YAS	Yorkshire Ambulance Service NHS Trust

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Appendix 1 Methods: further detail

Study design

The overall design is an observational mixed-methods study using five inter-related WPs. *Figure 2* details the individual WPs.

Ethical considerations and approval

Ethical approval for the pre-alerts project has been obtained from Newcastle & North Tyneside 2 Research Ethics Committee (Ref: 21/NE/0132).

Work package 1: Mapping ambulance service guidance

Data collection

We wrote to Research Leads, Medical Directors and Heads of Education in all 19 UK ambulance services (those covered by AACE guidelines) to ask for their latest pre-alert guidance documents. We summarised the clinical conditions recommended for each ambulance service and described the guidance in terms of areas of uncertainty, accessibility, clarity and focus.

Data analysis

We assessed guidance quality using the AGREE2 Reporting Checklist (2016) for clinical guidelines. The checklist uses 6 domains, incorporating 23 questions: (1) Scope and Purpose, (2) Stakeholder Involvement, (3) Rigour of Development, (4) Clarity of Presentation, (5) Applicability and (6) Editorial Independence. Two appraisers assessed each guideline.

Work package 1: Analysis of routine data

Data collection

In the UK, ambulance services are part of the UK NHS but organisationally independent from hospitals. Ambulance clinicians are paramedics and ambulance technicians who

usually work without medical support. The ambulance clinician phones the pre-alert through to a dedicated number in the ED and provides information in a structured way. The ED then determines the hospital response and informs the ambulance clinician where they should bring the patient.

We developed a logic model for factors affecting pre-alerts based on a rapid review of the literature and stakeholder consultation with three UK Ambulance Service Research leads and the UK RCEM/AACE. The model assumes that pre-alert practice may be affected by clinician factors (role, experience, sex, time of pre-alert during shift), patient factors (age, sex, NEWS2 score, clinical working impression classified into RCEM non-physiological criteria), hospital factors (catchment ED, handover delay status at time of pre-alert) and journey time.

We obtained routine, retrospective data from three adjoining ambulance services in England, covering a total population of 15.4 million people with a wide urban/rural and demographic mix. The ambulance service sites were selected pragmatically, based on their high rates of ePRF completion and accessibility with ePRF usage rate between 90% and 100%.

We analysed 12 months' ePRF data for all 999 calls that resulted in an ambulance transporting the patient to a hospital between 1 July 2020 and 30 June 2021. We collected attending ambulance clinician data (highest grade recorded on scene), dispatch system Sequence of Event log data and shift information from Global Rostering System data from each ambulance service and linked this to the ePRF data using the CAD ID unique incident identifier. We obtained daily statistics on ambulance handover delay status at the time of pre-alert from routine SITREP data.[23]

Analysis

We undertook univariate analysis to describe pre-alert practice, including patient characteristics and clinical information for all conveyances with and without a pre-alert to understand which patients and clinical conditions were pre-alerted. Variable selection for the multivariable logistic regression model was performed using LASSO.[24] The LASSO process begins with a full model of all potentially relevant predictors and simultaneously performs predictor selection and penalisation during model development to avoid overfitting. Potential hospital, clinician and patient predictors considered for the logistic regression model are listed in *Table 4*.

We excluded cases from the regression model where the patient was transferred to the ED from another healthcare setting (inter-facility transfers), or who were taken to the ED with a clinical working impression of ST-segment elevation myocardial infarction or hyperacute stroke, in order to mitigate for cases who had pre-alerted as part of an ED bypass (e.g. STEMI, stroke bypass as part of a pathway). We excluded patients under 16 years due to different physiological/NEWS2 thresholds.

Due to high levels of correlation between NEWS2 scores and individual physiological criteria, we only included NEWS2 (i.e. not separate observations) in the final model. In order to account for presentations that may be pre-alertable but not identified by NEWS2 (e.g. acute stroke) we also included UK RCEM/AACE non-physiological pre-alert criteria,[2] using a dichotomous variable of non-physiological criteria Y/N.

We developed two clinician role categories. A simplified clinician role variable was available for all cases (paramedic, non-registered clinician). For sites 1 and 2 where more granular data were available, clinician roles were allocated one of five categories (senior clinician, paramedic, NQP, non-registered clinician and non-registered clinical support staff).

We undertook the following sensitivity analyses: (1) investigating the impact of selecting first NEWS2 score versus last NEWS2 score, fitting the model with the worst score, then again using the first score with an interaction term for change in score (2) using hospital as a fixed effect with a global test for the significance of hospital overall (i.e. likelihood ratio test).

Where a calculated NEWS2 score was not available in the ePR data, we calculated the NEWS2 score from the available physiological variables. Missing data were imputed with the value zero, classifying missing as normal, unless three or more physiological variables were missing.

Work packages 2–3: Interviews and non-participant observation

This research was problem driven and a qualitative approach was most appropriate to explore pre-alert decision-making by ambulance clinicians. The methods included interviews with ambulance crew/clinicians and ED staff, and non-participant-observation within receiving EDs.

TABLE 4 Potential predictors for multivariable logistic regression model

Hospital factors	
Journey time	Time arrived at hospital – Time left scene. Handover time was used where hospital arrival time was missing.
Handover delay status	Obtained daily for each hospital from SITREP data, proportion of ambulance handovers > 30 minutes.[23]
Hospital characteristics	Hospital name. Excluded where no ED, or Hyper Acute Stroke Unit or Primary Percutaneous Coronary Intervention only.
Ambulance clinician factors	
Length of experience	Only available for sites 1 and 2. Length of clinical experience. Consecutive time in a clinical role.
Role	Senior clinician, paramedic, NQP (NQP – < 2 years since qualification), non-registered clinician (e.g. Emergency Medical Technician, Associate Ambulance Practitioner) and non-registered clinical support staff.
	Simplified role only available for site 3 – paramedic/non-registered clinician.
Qualification status	Registered on Health and Care Professions Council as paramedic. Binary yes/no Sites 2 and 3 unable to provide data.
Sex	Male/female/other.
Ethnicity	ONS categories. Excluded due to poor completion.
Proportion of shift	Binary variable for last hour of shift. Calculated using time left scene – Shift start time. Unable to obtain for site 3.
Patient factors	
Age	Continuous variable
Sex	Male/female/transgender
NEWS2[a]	First and last NEWS2 score (clinician input NEWS2 or calculated from physiological variables).
RCEM non-physiological criteria.	Clinical working impression code(s).
	Variables used to derive non-physiological criteria for pre-alert: respiratory rate, blood pressure (systolic and diastolic), pulse rate, GCS (total, eyes, verbal motor).
	Interventions (airway management; defibrillation/cardioversion/pacing; trauma-related; haemorrhage control or drug administration).

ONS, Office for National Statistics.
a NEWS2 is an early warning score based on routine physiological measures that is used in UK ambulance services and hospitals as a measure of illness acuity.[25]

Details of data collection instruments are available in *Report Supplementary Material 4*.

Sampling strategy

Three ambulance services in England were selected prior to receiving the funding, with research leads from three ambulance services involved in the bid process. The three ambulance services covered a population of 15.5 million, including areas of high and low deprivation, rurality and diverse ethnic populations and all had high rates of ePRF completion.

Emergency department sites were identified by reviewing pre-alert data for all hospitals in the region and selecting those with high numbers of pre-alerts in order to ensure that sufficient pre-alert activity could be observed during the researcher visits. We aimed to recruit EDs to cover as diverse range of populations as possible, including ethnic, sociodemographic and urban/rural mix.

Sites were approached by the PI, inviting their participation in the research and explaining what this would involve. In most instances, a positive response to this contact was received; where there was no response after a number of contacts, another site was selected for contact. Two sites (one MTC with a higher mix of ethnic minority patients and one more rural TU) were contacted following non-response from two initial sites and agreed to participate.

Data collection: interviews

Semistructured telephone or online interviews via video conference (Google Meet or MS Teams) were conducted by JL and JC with a purposive sample[12] of 34 ambulance clinicians from 3 ambulance services and 40 ED staff from 6 linked receiving EDs. Ambulance service interviewees were recruited via open communications targeting ambulance crews. ED staff were recruited via direct invitation during observations and via local research leads who invited staff in particular roles to take part. This helped to ensure that a range of roles at each site were represented (e.g. senior, junior, medical, nursing). Interviewees were provided with study information and completed a consent form. The interview topics are presented in *Box 1*. Topic guides were developed in collaboration with the project management team and PPI group and were used flexible to explore issues identified during the interviews and observations where possible. Interviews were audio-recorded and transcribed verbatim.

BOX 1 Interview topics: ambulance service and ED

Ambulance service clinicians

- Role details
- Details of recent pre-alert decisions – factors considered, different levels of ease/difficulty?
- Details of recent pre-alert calls to ED – how, information provided, format/structure, different EDs?
- Details of recent pre-alert that 'went well' – why?
- Details of recent pre-alert that 'didn't go well' – why?
- Expected response to recent pre-alert call?
- Anything that could improve pre-alert communication?
- Changes in pre-alert behaviour over the length of your career – why?
- Views on guidance
- Views on appropriate use of pre-alerts
- What would help in making pre-alert decisions – details?
- How can receiving EDs help in the pre-alert process?
- Anything else not discussed?

ED staff

- Role details and how it relates to pre-alerts
- Details of recent pre-alert calls – information provided/requested, format/structure
- Details of response to recent pre-alert calls – actions, factors considered
- What factors influence responses to pre-alerts – personal, colleagues, any changes in practice
- Details of recent pre-alerts that were useful and their influence on patient care?
- What are the benefits of pre-alerts?
- Details of recent pre-alerts that were not useful – in what way, impact on patient care?
- What are the potential risks for pre-alerts?
- Are there any conditions/patients pre-alerted too often?
- Are there any conditions/patients that should be pre-alerted more than they are?
- Is there variation between ambulance clinicians in pre-alert decisions?
- What could EDs do to make the pre-alert process easier for ambulance clinicians?
- Do you provide feedback to ambulance staff about their pre-alert decisions?
- What would help ambulance clinicians improve pre-alert decisions?
- Anything else not discussed?

Data collection: non-participant observation

Summary

Non-participant observation of ED staff responses to pre-alert calls (n = 143) and patient handover in resus was conducted in the six EDs, and included informal conversations with hospital and ambulance staff present. Observations were undertaken between June 2022 and April 2023 by JL and JC. Initial familiarisation observations involved the research lead (FS) to clarify the scope of data collection. A total of 25 observation sessions were undertaken (162 hours). For some sessions (n = 9; 39 hours) both researchers attended together to ensure continuous cover and compare observations. Initial site visits communicated to staff the purpose of the research and what it involved. Additional communication to inform staff of the observations included e-mails, posters, leaflets, attendance at briefings and researcher introductions during the actual observations. Staff were offered the chance to opt out if they did not wish to be observed (nobody opted out). Handwritten and audio-recorded field notes, including observations, informal conversations and researcher reflections, were fully transcribed.

Setting up the emergency department fieldwork

Following initial agreement, contact was made with the research and development team at each site to obtain Capacity and Capability at the site, together with Research Passports for the researchers undertaking the observations. Once these approvals had been received, an online Site Initiation meeting was set up with the local PI, local research team and our research team to arrange the details of how the observations would be undertaken, how invitations for interview would be sent to ED staff, and to address any practical or ethical concerns.

Approvals took very varying lengths of time to be processed, and this dictated the order in which the sites participated in the study. Most of the time, we undertook all observations at one site before moving on to the next, but there was some overlap, and visits were sometimes spaced out to allow time for reflection and review in between.

Non-participant observation: data collection process

At each site, the initial visit was agreed with the local PI, who in collaboration with the research nurses notified

ED staff about the research study and what it involved, and offering staff a chance to opt out if they did not wish to be observed (this was not requested by anyone). Processes for informing staff varied and included e-mails, posters, leaflets and attendance at briefing meetings. These approaches were effective to varying degrees, and the researchers also ensured they introduced themselves to any staff they were closely observing during the actual sessions.

On arrival, the researcher(s) met with the PI or research nurse, and following issuing of any ID/swipe cards to allow full access to the department, were taken around the ED area and then introduced to the staff working in resus or the main ED (depending on where the red phone was located). Subsequent visits were either set up in a similar way or the local PI informed relevant staff ahead of the visit and the researcher(s) introduced themselves on arrival. Once in the department, the researcher(s) generally based themselves close to the red phone so that they could observe the response from ED staff answering, including what was said and what was written on the pre-alert form, what was then done with the information, who was informed or involved in the decision-making and what subsequent preparations were made. In many instances, this involved following the relevant staff member as they moved around the department discussing the pre-alert with colleagues. When two researchers were observing the other would remain by the red phone, as there were a significant number of occasions when more than one pre-alert was received in a very short time period, sometimes immediately on replacing the receiver or on a second line.

Researchers took detailed notes of conversations and actions, and where appropriate asked relevant staff for further information, for example why a particular decision had been made, how the pre-alert information had been conveyed by the ambulance clinician etc. This often led on to more general comments about the process of pre-alerts, all of which were noted. Through these conversations or through observations of the process, key people were identified and approached to take part in interviews – where staff were interested their names were taken and subsequently passed to the local PI who sent out the invitation letter, information sheet and consent form. This process was used as staff were too busy to take information from us at the time, and would not have had anywhere to put it.

The researchers either stood or sat near the red phone most of the time, except when following a specific pre-alert. When two researchers were present, it was possible for one person to go and speak to staff working in other parts of the ED who were involved in the process of decision-making and response to the pre-alert. Once the ambulance crew arrived with the pre-alerted patient, the researcher stood near enough to be able to observe their arrival and reception into the department, and to overhear the handover, but tried to remain out of sight and to avoid observing the patient as much as possible. As most beds within particular areas were only separated by curtains, this was generally possible, although some areas were very cramped and where there were a number of staff attending the patient, this could not always be done. Once the handover was complete, the researchers also sometimes approached the ambulance crew to ask about their experience of the pre-alert and on a few occasions to invite them to participate in an interview. While crews were generally happy to talk, and some provided their contact details, this route produced very little response in terms of recruitment, with only one paramedic being recruited this way.

Details of interview participants and observations

Details of ambulance clinician interview participants are provided in *Table 5* and ED staff participants are provided in *Table 6*. Details of ED observations are provided in *Table 7*.

Description of emergency departments

Brief descriptions of each site and processes for managing pre-alerts are presented in *Table 8* and an overview of the ED working environment for each site during observations is presented in *Table 9*.

Data analysis

Interview transcripts and observation notes were imported into NVivo[13] and analysed using thematic analysis. Thematic analysis is an iterative process for systematically analysing qualitative data; it is useful in identifying similarities and differences across data sources.[14] An initial coding framework was developed by RO, JL, JC and FS. Coding involved systematically reviewing and coding all data by RO (who had not undertaken any fieldwork) and JL (who undertook the majority of data collection), after agreement on interpretation of the codes. Subsequent code changes were discussed and documented. Further analysis by the four researchers involved reviewing codes to identify and refine themes, and regular discussion of the emerging findings.

Triangulation involving multiple researchers in data collection and analysis of the multiple data sources was designed to enhance the rigour and trustworthiness of the research. The different data sources (ambulance service and ED

TABLE 5 Details and number of participants per ambulance service

Service	
Site 1	13
Site 2	11
Site 3	10
Role	
Paramedic	25
Advanced/specialist paramedic	6
Technician	2
Clinical Lead	1
Years in role	
< 1 year	6
1–5 years	15
5–10 years	9
> 10 years	4
Gender	
Female	13
Male	21
Ethnicity	
White British	31
Other ethnicity	3

TABLE 6 Details and number of staff participants per ED

EDs	
MTC	
Site A	7
Site D	8
Site E	6
TU	
Site B	4
Site C	10
Site F	5
Role	
Consultant	16
Registrar	7
Junior doctor	2
Senior nurse	10
Nurse	2
Practitioner	3
Years in role	
< 1 year	8
1–5 years	20
6–10 years	6
> 10 years	6
Gender	
Female	23
Male	17
Ethnicity	
White British	33
British Asian	4
Not reported	3

interviews, and ED observations) were integrated within the coding and analysis process. The researchers followed the Standards for Reporting Qualitative Research.

Researcher characteristics and reflexivity

The researchers involved in the data collection were experienced researchers working in health services research with social science/psychology background but not clinically trained. Two of the researchers (FS and ROH) had prior experience of undertaking non-participant observation in emergency settings, while the researchers involved in fieldwork (JL/JC) had no prior experience and thus fewer pre-conceptions about how emergency services worked. Observation notes were written up in detail shortly after the observation took place to incorporate researcher reflections and interpretation of events.

Data collection instruments and technologies

Researcher characteristics and reflexivity

The researchers involved in the fieldwork; data collection were all health service researchers with between 8 and 22 years' experience working in health services research and social science/psychology background but not clinically trained. FS and ROH had previously undertaken non-participation within EDs and ambulance service as part of previous research (ref IMPEDE, VAN etc). JC and JL had not undertaken non-participant observation and were more naive to the setting than FS and ROH.

Work package 2: Survey

We undertook a cross-sectional online survey to explore ambulance clinician's understanding and experiences of

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TABLE 7 Details of pre-alerts observed

Site	Number of alerts observed	Type of alert	Number of hours observed	Number of resus/high care	Front door[a]	Senior clinician triage	No other
A[b] (MTC)	26	21 medical, 5 trauma	31.5, 5 days	15	11	0	0
B (TU)	6	6 medical, 0 trauma	14, 3 days	5	0	1	0
C (TU)	34	27 medical, 7 trauma	28, 6 days	16	0	11	7
D[b] (MTC)	28	26 medical,[c] 2 trauma	35.5, 4 days	20	0	5	3
E[b] (MTC)	24	19 medical, 5 trauma	25, 3 days	18	0	1	5
F[b] (TU)	25	25 medical, 0 trauma	28, 4 days	16	8	0	1

a Front door is the term used for the main ambulance entrance (e.g. pitstop).
b Includes some hours double observation (A = 8 hours; D = 18 hours; E = 8 hours; F = 5 hours).
c One alert classed as both medical and trauma.

TABLE 8 Summary of each site and processes for managing pre-alerts

Site code, type of site (MTC/TU)	Resus provision. Alternative options if not accepted to resus.	Access to resus for ambulance crews	Location of red phone(s). Who answers?	Pre-alert documentation. How information about pre-alert is communicated to others, including use of documentation.	Who is involved in pre-alert decision-making? Key staff involved in management of alerts.
A – MTC	Eight resus beds, with trauma/high acuity bays nearest ambulance entrance. Alternative: initial assessment area	Direct from outside or from 'front door'[a] following assessment. Crews only bring direct to resus if this has been agreed on the phone	In resus, but audible throughout the department. Policy is to be answered by consultant, but answered by whoever is nearest.	One form for all calls. Form either goes by patient's bed in resus or is taken to 'front door' for the receiving nurse/staff. Other relevant staff informed verbally by call-taker.	Decision made by person answering, with input if needed. Consultant and NIC assigned specifically to resus.
B – TU	Five resus beds, with trauma/high acuity bay nearest ambulance entrance. Alternatives: (a) two high-dependency beds; (b) initial assessment area	Either direct from outside, or from assessment area. Crews only bring direct to resus if this has been agreed on the phone?	In majors, on main desk where doctors are sitting. Answered by doctor generally, as tend to be nearest person to the phone.	Separate trauma and medical forms. Form taken to resus, high dependency cubicle, or left by ambulance handover bays for nurse receiving ambulance crew. Other relevant staff informed verbally by call-taker.	Decision made by person answering, with input if needed. Consultant has oversight of resus, high dependency and majors,
C – TU	Four resus beds Alternatives: (a) four beds with higher staff/patient ratio; initial assessment area or assessment on ambulance	Off main corridor into the department only. Crews only bring direct to resus if this has been agreed on the phone. No other access route.	In majors, at NIC desk. Not audible in other areas of department. Answered by NIC when possible, by whoever is nearest if not.	One form for all calls. Form taken to resus or high care area, or given to assessment nurse in 'front door' area receiving ambulance crew. Other relevant staff, including HALO, informed verbally by call-taker.	Most decisions made by NIC, with consultant/medical input when needed. Consultant manages resus and high care, others in majors.

TABLE 8 Summary of each site and processes for managing pre-alerts (*continued*)

Site code, type of site (MTC/TU)	Resus provision. Alternative options if not accepted to resus.	Access to resus for ambulance crews	Location of red phone(s). Who answers?	Pre-alert documentation. How information about pre-alert is communicated to others, including use of documentation.	Who is involved in pre-alert decision-making? Key staff involved in management of alerts.
D – MTC	Five resus beds, with trauma/high acuity bays nearest ambulance entrance Alternatives: (a) six bed rapid assessment and treatment area; (b) direct to majors	Off the main corridor from the front door and majors area. Crews only bring to resus if agreed on the phone. No other access route.	Two phones in resus at staff desk; a third phone rings in majors if other two lines engaged. Answered by whoever is nearest who feels confident to do so, often ODP.	Separate trauma and medical forms in folders. Forms generally remain in folders. Relevant staff, including rapid assessment area staff, receiving nurse and HALO, informed verbally and/or through a 'bleep' system via main switchboard.	Decision mostly made by person answering, with additional input if needed. Consultant informed of/approves all decisions regarding patients NOT accepted to resus. Consultant cover from majors, variably in resus much of time
E – MTC	Nine resus beds, some of which can be divided, with trauma/high acuity bays nearest ambulance entrance. Alternatives: initial assessment area	Immediately off the corridor by the ambulance entrance. Crews can drop in and ask about patients they are concerned about but have not alerted. Also an entrance from 'front door'/majors	In resus, at NIC desk. Answered by NIC mostly, but whoever is nearest.	One form for all. Forms either goes by patient's bed in resus or may be taken to 'front door' area but not consistently – some are left in a pile by the red phone. Other relevant staff in resus informed verbally.	Decision mostly made by person answering, with additional input when needed. Consultant and NIC assigned specifically to resus. Consultant variably involved in decision-making.
F – TU	Seven resus beds, with trauma bay nearest ambulance entrance. Alternative: initial assessment area	Through 'front door' area. Crews cannot access without going through pit stop. Crews only bring to resus if agreed on the phone.	In resus, at staff desk. Bell also rings in majors, making them aware of the call. Answered by whoever is nearest, generally NIC or more senior doctor.	One form for all. Forms either go by patient's bed in resus or are taken to 'front door' and handed to NIC or doctor. Other relevant staff informed verbally.	Decision mostly made by person answering, with additional input when needed. Consultant cover from majors.

NIC, nurse in charge; ODP, Operating Department Practitioner.
a The term 'front door' is used to describe all department's initial assessment and treatment area, i.e. where those patients not being taken to resus etc. are received.

This synopsis should be referenced as follows: Sampson FC, Long J, Coster J, O'Hara R, Pilbery R, Bell F, *et al.* Exploring the use of pre-hospital pre-alerts and their impact on patients, Ambulance Service and Emergency Department staff: a mixed-methods study. *Health Soc Care Deliv Res* 2026;**14**(9). https://doi.org/10.3310/GJFS4321

TABLE 9 Overview of the ED working environment during observations

Site	Brief description
A MTC	Department, including resus, often full, and ambulances frequently queuing outside. Some assessment of patients on ambulances at particularly busy times. HALO also present at these times to help prioritise queues, support ambulance crews. Resus has an allocated consultant, nurse in charge and other medical and nursing staff. Pre-alert phone rings very loudly. Information regarding pre-alerts not accepted into resus generally reliably conveyed to staff in 'front door' area.
B TU MTC TU	Relatively spacious, with a large number of computer terminals. Pre-alerts a much smaller part of the workload, occurring much less frequently than at other sites during observations. Resus area separate from the rest of the ED, and only staffed when patients were there – it was rarely full. Ambulance crews rarely queue for any length of time for assessment, even when not pre-alerted.
C TU	Very overcrowded, with patients frequently assessed and managed in corridor and on ambulances. Department generally full, with ambulances often queueing for long periods. Pre-alert phone inaudible at any distance a significant issue. Pre-alerts often required significant 'reshuffling' of multiple patients between areas and communication with numbers of staff to make space – nurse in charge has key role and answers the phone most of the time to facilitate. HALO paramedic often on site to facilitate management of queues, sometimes providing additional information on incoming patients. ED staff had access to ambulance crews' ePRFs before arrival.
D MTC	Core resus staffing included specialist practitioners who had key role in answering phone and treating patients. Three phone lines for pre-alerts. Details of alerts not accepted into resus conveyed verbally, but generally reliably. 'Bleep' system via switchboard used to notify key staff of incoming alerts. Pre-alert paperwork not linked to patient notes. HALO generally present and with key role in facilitating communication. Department generally full, with ambulances often queueing. Rapid assessment area provided an intermediate level of response for some pre-alerts. Variable level of consultant input into resus, depending on individuals and demand. ED staff had access to ambulance crews' ePRFs before arrival.
E MTC	Large resus area, with capacity for further sub-division at busy times. Much smaller initial assessment area for patients not accepted into resus, but crews sometimes called into resus on arrival with non-alerted patients for a quick assessment, and this was accepted by resus staff. Information regarding pre-alerts not accepted into resus not consistently recorded or passed to 'front door' staff. Patients generally not held on ambulances but booked in and then queuing on trolleys along corridors, often for long periods. Resus has an allocated consultant, nurse in charge and other medical and nursing staff. Consultant input into decisions varied depending on the individuals and demand.
F TU	Resus largely managed by nurse in charge and 'junior' doctors, including experienced registrars – consultant based in majors and provided input depended on level of experience of resus staff and demand. Alert phone triggers bell in majors department but does not prompt any specific response. Initial assessment area very busy, with frequent movement through to majors area as beds became free. Some tension observed when pre-alerts not accepted into resus and passed to 'front door' staff – concern re risk, ability to manage. Very busy department, with ambulances often queuing, though generally not for long periods.

the pre-alert process. Survey data were collated in the Qualtrics platform and downloaded to SPPS for analysis. A total of 266 cases were deleted due to missing data, leaving 1298 usable responses. Cases met the threshold for deletion as missing if they had completed less than two-thirds of the survey. The final section of the survey was the participant characteristics section; therefore, if a survey had two-thirds completion the majority of survey questions about pre-alerts had been completed.

Variables were modified to facilitate analysis. For example, questions containing multiple text answers were assigned a numerical value and labelled.

A descriptive analysis of the quantitative data was conducted, with the frequency and percentage of each response reported using graphs and tables. Qualitative text data were analysed thematically using the coding framework developed for the interviews and observations. Qualitative data were used to illustrate and support quantitative findings in more detail.

Sampling and recruitment

We surveyed all ambulance trusts in England. We recruited ambulance clinicians involved in the pre-alert process via local ambulance trusts. Ambulance trusts used their usual staff research recruitment methods including e-mails, newsletters, staff facebook groups, posters and advertising on twitter. These differed by site. All participants were required to confirm that they are an ambulance clinician involved in pre-alert decision-making prior to completing the survey.

Mode of administration

The survey was administered online using Qualtrics and was accessed via an online link or QR code, open between 1 May 2023 and 14 July 2023, for a minimum of 6 weeks at each site. Participants were required to confirm their

understanding of the study and their consent prior to accessing the full survey. Information including QR code and survey web link to aid participant recruitment was sent to each site once research governance approval had been obtained. The survey was developed to be accessible from a number of different electronic devices, including mobile phones, laptops and tablets. At the end of the survey, participants were given the opportunity to anonymously enter a prize draw to win a £50 voucher with one voucher available per ambulance service.

The content of the questionnaire

The questionnaire was developed based on issues identified in the literature and preliminary analysis of pre-alert focused interviews with 36 ambulance clinicians across 3 ambulance services. The survey questions explored the pre-alert process from decision to pre-alert to ED response and the survey topic areas are described in *Box 2*. We collected information on respondent characteristics to explore if there were differences in survey responses at service level and by role in service.

Survey questions used similar formats throughout and included rating scales, multiple and single choice tick boxes and text boxes to provide additional information.

Survey pilot

An initial draft of the survey was developed by the research team and piloted with ambulance clinicians from different ambulance services. Analysis of interview data and service level pre-alert policy had identified variation in pre-alert practice and policy; therefore, we used the survey pilot to develop a questionnaire that was relevant and inclusive to all ambulance services. There were 13 responses to the survey pilot, which involved ambulance clinicians accessing the survey through the Qualtrics platform and answering the survey questions. Additional feedback on the survey was collated via e-mail. In addition, the survey was also reviewed by each of the ambulance service trusts as part of the local research sign off process and comments about the survey emailed to the study team. This resulted in some changes to the survey, for example, a reduction in the questions included in the survey. The final survey was approved by local ambulance service trusts and the study management group. A copy of the survey is provided as *Report Supplementary Material 5*.

BOX 2 Survey topics

Section 1: making a pre-alert decision

- Reasons for making a pre-alert
- Frequency of making a pre-alert
- Actions when unsure whether to make a pre-alert
- Guidance used to aid pre-alert decisions
- Factors affecting decisions to pre-alert
- Areas where more pre-alert guidance would be useful

Section 2: Undertaking the pre-alert call

- Who contacts the receiving ED
- What device is used to contact the receiving ED
- Is the pre-alert recorded in the patient notes and if so how is it recorded
- Learning to make a pre-alert
- Feedback on pre-alert decisions

Section 3: Communicating with the ED

- ED staff responses to pre-alert calls (taking pre-alerts seriously, making appropriate plans in the department, listening without interrupting)
- Pre-alert format used

Other

- Anything else to add about pre-alerts

The survey did not collect any identifiable information such as name or e-mail address. However, if participants wished to enter the survey prize draw, they selected a link which asked them to enter their e-mail address into a separate form if they wanted to be entered for the prize draw. Information from the prize draw was stored separately and could not be linked to survey responses.

Analysis

Survey data were collated in the Qualtrics platform and downloaded to Statistical Package for the Social Sciences (SPPS, IBM v27) 28 for analysis. We received 266 partial responses (completed < 70% of the survey) and these were excluded. *Figure 2* describes the survey responses and exclusion process. Variables were cleaned and modified to facilitate analysis. Categorical data were assigned a numerical value and labelled and responses reported at the number and proportion in each category. Continuous data from rating scale answers were reported using the mean, standard deviation and proportion of responses at the scale end points. Any missing values were coded as missing.

A descriptive analysis of the data was undertaken to address the primary aim of describing how ambulance clinicians make pre-alert decisions and undertake pre-alert calls. Variation was explored through subgroup analyses using ambulance service and role in ambulance service variables.

Free-text responses were extracted into Microsoft Excel and coded using a thematic framework developed for the study interviews. Text data were used to further understand the experiences and views of the pre-alert process.

Overall study techniques to enhance trustworthiness

Researchers clarified points and summarised findings during interviews to ensure a shared understanding of the data. Researcher triangulation within both the data collection and analysis phases helped improve trustworthiness of analysis. Results were presented to PPI at an online workshop and their views of the findings and which findings were most important to PPI contributed to a wider stakeholder workshop incorporating research participants and key stakeholders from ambulance service and ED national bodies on how to use the findings to improve practice.

Amendments to protocol and recruitment challenges

Ambulance clinician recruitment

Recruitment of paramedics for WP1 was intended to be undertaken purposively, recruiting paramedics who were identified as high and low pre-alerters within the analysis for WP1, using anonymised clinician identifiers. However, due to delays in obtaining and analysing data, we were unable to wait for the analysis to be completed before recruiting ambulance clinicians. We undertook some purposive sampling of high and low alerters using unadjusted estimates. Due to low response, we changed our recruitment strategy (after discussion with advisory group).

We aimed to recruit ambulance clinicians via two routes: (1) using ambulance service data from WP1 to identify a purposive sample of clinicians based on role, range of experience, qualifications, age, sex and high/low rate of pre-alert use, (2) direct invitation of ambulance clinicians identified within ED observation.

Complete data for site 1 were obtained in April 2022 and we were able to provide a sample of ambulance clinicians with high/low (unadjusted) pre-alert rates. We sent 20 invitations in April 2022. After a low response rate we sent out further invites (in May, June and August 2022), stratified by whether the respondent was a high or low pre-alerter. We provided different codes for respondents to quote when expressing an interest. Details of recruitment stages are detailed below (*Table 10*).

Due to a low response rate at site 3, a research paramedic at site 3 sent out a group e-mail to all ambulance clinicians on their mailing list and an amended invite informing potential participants that they would receive a CPD certificate in addition to their £20 Love2Shop voucher.

TABLE 10 Ambulance clinician interview invitations

Site	Invitation dates	Who was invited
Site 1	29 April 2022	Mixed group
	20 May 2022	20 invites, stratified by high and low
	16 June 2022	20 invites, stratified by high and low
	8 August 2022	40 invites, low pre-alerters
		Direct invitation from researchers in ED
Site 2	1 July 2022	80 invites, stratified by high and low
	8 August 2022	40 invites, low pre-alerters
		Direct invitation from researchers in ED
Site 3	6 June 2022	40 invites, stratified by high and low
	15 July 2022	80 invites, stratified by high and low
		Direct invitation from researchers in ED
		General e-mail

We were unsuccessful in recruiting any ambulance clinicians who we identified and approached during ED fieldwork. After all attempts we recruited a total of 34 ambulance clinicians interviewed (13 site 1, 11 site 2, 10 site 3).

Amendments to protocol and recruitment challenges

The most significant challenges we faced were in recruiting ambulance clinicians (WP2) and patients (WP4). We made four ethics amendments which resulted in minor amendments to protocol (see *Report Supplementary Material 3*). Protocol amendments related to changes in recruitment processes for ambulance clinicians and patients/carers.

Recruitment of ambulance and emergency department staff for interview (work packages 2–3)

We initially planned to recruit a purposive sample of ambulance clinicians, sampling for length of experience, sex, role and whether they were high or low pre-alerters, using data from WP1 to enable us to select an appropriate sample. Due to delays in obtaining data for WP1, we were unable to identify clinicians who were high or low pre-alerters after adjusting for case mix, but we were able to identify clinicians who had high or low unadjusted pre-alert rates. We initially invited clinicians using this

method, using three waves of recruitment. Following low recruitment rates, we expanded recruitment via open recruitment invites within each ambulance service.

We also originally planned to recruit ambulance clinicians who brought in pre-alerted patients to the ED during observation but only recruited one ambulance clinician via this route so moved to recruitment via ambulance services.

Interviews with ED staff and non-participant observations was undertaken at six sites: three MTCs and three TUs, spread across the three study ambulance areas.

We recruited ED staff via direct invitation during observation and via local PIs who invited staff within particular roles (e.g. nurse co-ordinators) to take part in interviews. We aimed to recruit a sample of different roles at each site, including senior and junior medical and nursing staff as well as other roles identified as important at individual sites during the fieldwork (e.g. HALOs).

Recruitment of patients (work package 4)

We aimed to recruit patients directly while undertaking observation in EDs, handing out project information to patients who would contact us at a later date. During initial observations it became apparent that many patients within the resus area who had been pre-alerted were too ill to be approached, and that staff were unable to take time out from direct patient care to approach patients on our behalf.

After receiving no response, we consulted with our PPI group who suggested that the introduction of a simpler patient recruitment card might be more accessible to patients and therefore easier to hand out in the ED. We developed a new A5 fold-up card in collaboration with the PPI group (minor amendment 5).

We distributed the card to our ED staff leads, but due to the extreme pressure the EDs were operating in, clinical staff were unable to commit to handing them out. We extended the recruitment to a third site (site 6) where fieldwork had not yet begun and discussed different options for recruitment. The site suggested an approach they had taken previously in which the researchers noted names of pre-alerted patients and passed these to the research nurses. The research nurses would then contact patients after discharge to ask whether they were happy to be sent information about the study (once they had assessed the patient had capacity and was well enough). This constituted a further amendment to ethics (amendment 6), submitted in December 2022.

This was rejected on the grounds that the researchers should not have access to patient names and the committee suggested that the clinician approach the patient to ask whether they were happy for their names to be passed onto the research nurse who would then contact the patient at a later date. We felt that this was potentially more distressing and confusing for patients so suggested that the clinician could write down a list of pre-alerted patients for the research nurses to collect. This approval was granted in March 2023, along with approval for site 2 to undertake a similar process whereby details of pre-alerts were recorded by clinical staff in order for the research nurses to then approach patients directly (amendment 8).

At site 2, we were able to fund the use of research nurses using the CRN 'unblocking the block' funds. Due to low numbers of pre-alerts during fieldwork at site 2, we asked staff to leave details of pre-alerted patients in a folder in resus for the research nurse to collect and approach the patient once out of resus. However, due to high ED demand and other factors, including multiple healthcare strikes, staff were unable to collect the information for the research nurse to collect.

We handed out information to seven patients during observations at sites 1 and 2 (out of a total of 22 patients observed) but did not receive any response. At site 3, research nurses contacted 13 patients and although they had positive initial responses from 2 patients the patients did not go on to take part in an interview. We were unable to contact carers, partly due to lower numbers of carers being conveyed into the ED, in part due to COVID-19 restrictions.

Appendix 2 Findings from stakeholder workshop

Workshop aim

We presented a summary of the findings from the pre-alert study to a multi-stakeholder workshop representing policy and practice, aiming to identify attendees' views and response to the findings. Here we summarise the workshop discussions and describe how the findings can be transferred into practice.

Workshop methods summary

We held an online event which was attended by 28 stakeholders. The event was chaired by Janette Turner, an

expert in ambulance policy and service-based research. A range of attendees, representing ED clinical, ambulance clinical and emergency and prehospital care policy and practice, attended and contributed to the event.

The workshop was held on 12 September 2023. To facilitate involvement, discussions were held in online breakout rooms. Groups fed back to the whole group their discussion points. Discussion topics were:

- guidance and support for pre-alert decision-making
- communicating pre-alerts
- training and feedback
- incorporating learning into practice.

Prior to the discussion topics, a summary of the pre-alerts main findings was presented by the study lead, Dr Fiona Sampson. This was followed by interactive jam board discussions where attendees used anonymous notes to describe which finding they felt was the most important and which was the most surprising. Important and surprising findings seemed to be linked, with some findings that were important also identified as surprising. For example, the amount of variation, lack of consistency and standardisation, lack of training and absence of feedback were all identified as both important and surprising. A lack of shared understanding about pre-alerts and the need for more alignment between ambulance and ED services was also highlighted as important.

Patient and public involvement

In advance of the stakeholder event, a separate PPI event was held, which mirrored the stakeholder workshop format and content but was tailored for PPI. The attendees of the PPI event were the study PPI group, which is predominantly made up of people who have lived experience of pre-alerts as either experiencing a pre-alert themselves or as a carer or family member of someone who is pre-alerted. Key messages from the PPI workshop about their interpretation of the results and which results were important for PPI were included in the presentation of the findings to the stakeholder workshop participants.

Key discussion points from each session

Session 1: Guidance and support for pre-alert decision-making

Our research identified that there are multiple different types of guidance (local ambulance service, national and ED guidance) and that these are often not aligned. The survey and interviews also identified these differences and that where ambulance and ED guidance is not aligned this can cause tension and confusions during the pre-alert process. The interviews also identified a lack of awareness of national guidance. PPI preferred a consistent approach to guidance and felt that pre-alert processes would be improved if everyone was 'singing from the same hymn sheet'. They wanted guidance that was co-developed with ambulance and EDs, but also felt that ambulance clinicians should be able to use their clinical judgement if they are concerned.

Stakeholders were not surprised at the variation and discussed the following:

- There will always be local variation as every service/ED is different, but local guidance should be based on national guidance and variation should relate to local context. There is potential that guidance could be more standardised within geographical areas.
- The national AACE/RCEM guidance is due for review and the findings from the pre-alert study can feed into this review; however, there is not currently a timescale for this process.
- Any review of national guidance would need to be accompanied by an implementation plan to ensure guidance is adopted locally.
- Stakeholders agreed that ambulance clinicians should be able to use their clinical judgement in pre-alert decision-making and not only rely on guidance.
- Stakeholders agreed that guidance should be co-developed between ambulance services and EDs.

Session 2: Communicating pre-alerts

The interviews, observations and survey all identified variation in pre-alert communication, in who makes pre-alert calls, how they are made, the format that is used to communicate them and who answers the phone in the ED. Some staff expressed preferences for specific types of communication, for example calls made by crew on scene, calls made using a recorded line, specific types of pre-alert formats or certain staff types answering the call. Ambulance clinicians perceived that pre-alert calls were often interrupted by ED staff asking questions, that ED staff did not listen to what they were saying or that EDs expected to receive information that could instead be given during the patient handover, for example social history. PPI favoured a consistent approach to communication and felt strongly that the same format should be used by ambulance clinicians and receiving EDs. PPI did not mind if staff used personal mobile phones to make the pre-alert and were empathetic that staff were doing all they could to make the pre-alert as quickly as possible.

Stakeholders discussed the following:

- Pre-alert communication should be straightforward and recognise the time pressure and urgency of the situation, including that ambulance clinicians are also dealing with transporting and caring for the patient while making a pre-alert.
- Where different types of staff answer the phone in the ED, stakeholders felt that they should be aware that taking a pre-alert call is more than 'answering the phone'. Training may be beneficial.
- Stakeholders were mostly in favour of a structured proforma to communicate pre-alert information. There was discussion about the inclusion of a section at the end of a structured format for an anything else section, where the ED could ask questions if they required additional information. This may help to limit interruptions during the pre-alert call.
- Communicating headline information at the start of the pre-alert call, for example the condition/clinical need for resus was considered useful so that EDs are aware of the level of urgency of the pre-alert and in case the pre-alert call is cut off.
- Electronic methods for communicating pre-alerts were discussed, for example via electronic records or text messages. However, ED staff felt that telephone calls are useful because the urgency in the voice of the person making the pre-alert call gives them an indicator of the situation and they value clinician-to-clinician communication.
- Advice calls were discussed and while they were not considered as an essential use of the pre-alert line, there was recognition that advice is sometimes needed and this is best provided by the ED as only they are aware of their current capacity. The use of an additional phone line for advice calls was discussed, but there were concerns this would not be answered.
- The use of mobile phones to make pre-alert calls was surprising to some attendees.

Session 3: Training and feedback

The interviews and survey identified that there is wide variation about pre-alert training, with some staff having received training but most have not. Most ambulance clinicians have learnt through experience or via colleagues. In EDs it was common practice for pre-alert call taking to be reserved for more senior clinicians, but this was not always the case. Training on how to receive pre-alert calls was not usual practice. Most ambulance clinicians expressed that feedback was beneficial if given constructively and would help them to learn and make better pre-alert decisions. However, feedback was infrequently received and was sometimes done in a negative way. PPI were in favour of training and feedback, particularly feedback and felt this would lead to better patient care.

However, PPI were concerned that negative feedback may affect newly qualified staff's confidence in making pre-alert decisions and calls.

Stakeholders discussed the following in relation to training:

- Stakeholders were not aware of any formal pre-alert training for either ambulance or ED staff and emphasised that learning is usually on the job. Some attendees were concerned about a lack of pre-alert training.
- Issues such as staff rotation in EDs mean that training requirements are ongoing, and these could potentially be part of induction processes.
- The advantages and disadvantages of having mandatory pre-alert training were discussed and additional mandatory training was not fully supported. However, there was concern that if the training was optional, that people who would benefit from the training would not access it.
- ED staff awareness that pre-alert training may be beneficial could be impacted by the view that taking a pre-alert call is 'just answering the phone'.
- Pre-alert training could be merged with other training or included as part of handover training.
- Opportunities for ambulance staff to spend time in the ED and vice versa were welcomed.
- Different types and formats of training were discussed. Such as a RCEM module on pre- alerts, during inductions, distribution of an infographic/information pack or during newly qualified professional development.
- Training for ambulance staff should include information on communicating information, for example, tone of voice and emphasising concerns. It should also include that there are many different outcomes of a pre-alert call in addition to admission to resus, and this is often dependent on the capacity within the ED at the time of the call.
- Training needs to include examples of what constitutes a 'good' pre-alert.

Stakeholder discussion about feedback was around the following:

- Stakeholders felt that it is important to develop feedback mechanisms about pre-alerts, but this does not have to be a formalised process.

- Feedback needs to be seen as a reciprocal sharing of information and learning rather than 'negative' feedback.
- There was a recognition that feedback may not be provided about every case, but that there should be a consistent system.
- Feedback was seen as a key component of training and practice improvement.
- Stakeholders felt having informal feedback mechanisms was important to help build people's confidence and knowledge of pre-alerts. However, ambulance staff need to be prepared that the ED may not always agree with their pre-alert decision.
- It was perceived as beneficial for ED staff to be trained in how to provide constructive feedback on pre-alerts so that ambulance staff do not feel 'told off'.
- Some services have a 'bulk' feedback mechanism where the ED feedback on a monthly basis about pre-alerts and developing similar processes may be valuable.

Session 4: Incorporating the study learning into practice

This was discussed and some key principles and methods of incorporating the study learning into practice were identified.

- Dissemination from the research should include examples of what is working well so that people can learn from good practice.
- It was suggested that the research team work with AACE/RCEM to feed the findings into the revision of national guidance.
- Some hospitals/ambulance services are revising their pre-alerts processes and would be interested in forming a community of practice with other people to draw upon learning from different areas.
- PPI members preferred the research team to focus on dissemination to ambulance and ED services and their respective professional organisations rather than to the public. They felt this would be more likely to lead to change, which ultimately would benefit patients. However, feedback to patient or condition groups that experience a lot of pre-alerts, such as charity groups, may also be beneficial. Examples include breathing groups, British Heart Foundation and diabetes groups.

Planned dissemination

- The input from the stakeholder event is being used to reflect on the implications of the study findings and to develop recommendations for practice and further research.
- We have been invited to take part in a webinar for the College of Paramedics to share the learning from the study.
- We have shared the findings at a number of practice-based conferences including 999 EMS research forum and RCEM 2023.
- We are writing up the results of the study for publication in peer-reviewed journals and as a synopsis report for study funders (NIHR).
- We have presented the findings at the inaugural Yorkshire Ambulance Service Research Institute event and will present findings to Sheffield Emergency Care PPI Group at their next meeting.

Planned pathway to impact

- Develop shared documentation for communicating pre-alerts to improve the handover of information on the phone. This should include a 'headline' stating the ambulance clinician's concern.
- Develop a set of core principles for the pre-alert process to be included within the revised AACE/RCEM guidelines.
- Training around pre-alerts is important but needs to be brief and could be integrated into existing training around handover. Creation of short interprofessional online modules, for example RCEM short learning pieces will be useful. This can be taken forward by HEI providers via College of Paramedics and Pre-Hospital Emergency Medicine professional advisory group (approved by QECC)
- Set up an online Community of Practice to disseminate areas of good practice and areas where guidance is needed.
- Review senior clinical advice mechanisms (i.e. an alternative to the red phone) available for ambulance clinicians when making pre-alert calls due to current inconsistency.