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Extended Research Article

Strategies to manage emergency ambulance telephone callers with sustained high needs: the STRETCHED mixed-methods evaluation with linked data

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Disclaimer: This article contains transcripts of interviews conducted in the course of the research and contains language that may offend some readers.

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This article

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Abstract

Background: Emergency ambulance services aim to respond to patients calling with urgent healthcare needs, prioritising the sickest. A small minority make high use of the service, which raises clinical and operational concerns. Multidisciplinary 'case management' approaches combining emergency, primary and social care have been introduced in some areas but evidence about effectiveness is lacking.

Aim: To evaluate effectiveness, safety and costs of case management for people frequently calling emergency ambulance services.

Design: A mixed-methods 'natural experiment', evaluating anonymised linked routine outcomes for intervention ('case management') and control ('usual care') patient cohorts within participating ambulance services, and qualitative data.

Cohorts met criteria for 'Frequent Callers' designation; we assessed effects of case management within 6 months on processes, outcomes, safety and costs. The primary outcome combined indicators on mortality, emergency hospital admission, emergency department attendance and emergency ambulance call.

Focus groups and interviews elicited views of service providers on acceptability, successes and challenges of case management; interviews with service users examined their experiences.

Setting: Four United Kingdom ambulance services each with one intervention and one control area.

Participants: Natural experiment: adults meeting criteria for 'frequent caller' classification by ambulance services during 2018.

Service providers: service commissioners; emergency and non-acute health and social care providers.

Service users: adults with experience of calling emergency ambulance services frequently.

Interventions: Usual care comprised within-service management, typically involving: patient and general practitioner letters; call centre flags invoking care plans; escalation to other services, including police.

Intervention care comprised usual care with optional 'case management' referral to cross-service multidisciplinary team to review and plan care for selected patients.

Results: We found no differences in intervention (n = 550) and control (n = 633) patients in the primary outcome (adjusted odds ratio: 1.159; 95% confidence interval: 0.595 to 2.255) or its components. Nearly all patients recorded at least one outcome (95.6% intervention; 94.9% control). Mortality was high (10.5% intervention; 14.1% control). Less than 25% of calls resulted in conveyance (24.3% intervention; 22.3% control). The most common reasons for calling were 'fall' (6.5%), 'sick person' (5.2%) and acute coronary syndrome (4.7%).

Case management models varied highly in provision, resourcing, leadership and implementation costs. We found no differences in costs per patient of healthcare resource utilisation (adjusted difference: £243.57; 95% confidence interval: −£1972.93 to £1485.79).

Service providers (n = 31) recognised a range of drivers for frequent calling, with some categories of need more amenable to case management than others. Some service users (n = 15) reported deep-seated and complex needs for which appropriate support may not have been available when needed.

Conclusions: People who called frequently had a high risk of death and emergency healthcare utilisation at 6 months and were a heterogeneous group. Case management may work for some, but we did not find effects on emergency healthcare utilisation or mortality across the population.

Limitations: This retrospective study provided limited options in selecting control areas, or in meeting recruitment targets. Data quality was variable. Arranging patient interviews proved challenging.

Future research: This should prospectively evaluate different forms of case management; improve data collection; and include patients fully in qualitative components.

Study registration: This study is registered as research registry (www.researchregistry.com/) researchregistry7895.

Funding statement: This award was funded by the National Institute for Health and Care Research (NIHR) Health and Social Care Delivery Research programme (NIHR award ref: 18/03/02) and is published in full in *Health and Social Care Delivery Research*; Vol. 13, No. 37. See the NIHR Funding and Awards website for further award information.

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Supplementary material can be found on the NIHR Journals Library report page (https://doi.org/10.3310/PWGF6008).

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.

List of abbreviations

AS	ambulance service
CCA	cost–consequences analysis
CCG	Clinical Commissioning Group
CI	confidence interval
DHCW	Digital and Health Care Wales
ED	emergency department
EEAS	East of England Ambulance Service
FreCaNN	Frequent Caller National Network
FTE	full-time equivalent
GP	general practitioner
HES	Hospital Episode Statistics
HIU	high-intensity user
HRG	Healthcare Resource Group
LAS	London Ambulance Service NHS Trust
LEAP	Lived Experience Advisory Panel
MDT	multidisciplinary team
OOH	out of hours
OR	odds ratio
PPI	patient and public involvement
RMG	Research Management Group
SAIL	Secure Anonymised Information Linkage
SHEAP	Statistical and Health Economics Analysis Plan
SOP	standard operating procedure
SSC	Study Steering Committee
STU	Swansea Trials Unit
WAST	Welsh Ambulance Services Trust
WMAS	West Midlands Ambulance Service

Plain language summary

Ambulance services respond to patients calling with urgent healthcare needs. A small minority of people make very high use of this emergency service. This is of concern to ambulance service staff and commissioners, patients and the wider National Health Service.

Some ambulance services have introduced, in collaboration with other emergency, primary and social care services, in some areas a multidisciplinary approach to the care of people who call the emergency ambulance service frequently. We assessed the effectiveness, safety and costs of this approach in four United Kingdom ambulance services.

Using a nationally agreed definition, we included patients who made 5 or more calls in a month (or 12 or more in 3 months) and compared their outcomes between case management (intervention) and usual care (control) sites within each service.

We discussed the acceptability, successes and challenges of case management with ambulance service managers and other health and social care staff. We spoke to a range of people who had made high use of the emergency ambulance service.

We found no differences in key outcomes for patients between intervention and control sites. Most patients (95.6% of intervention patients; 94.9% of control patients) contacted an emergency healthcare service at least once within a 6-month follow-up period. Mortality within this period was high (10.5% intervention; 14.1% control).

We found variations in approaches to and costs of case management across the four ambulance services, but no systematic differences in emergency treatment costs between intervention and control sites.

Staff recognised a range of possible reasons for calling frequently, with some more suitable to case management than others. Some patients reported deep-seated and complex needs for which other forms of support may not have been available when needed.

Patients who call the emergency ambulance service frequently have high but varied needs. Provision of case management did not reduce further calls to the emergency ambulance service, other emergency healthcare contacts or deaths.

Scientific summary

Background

Ambulance services, an integral part of the UK's NHS, are under sustained pressure, with emergency calls increasing annually by at least 6%. A small minority of people make high use of the emergency ambulance service. These callers often have complex needs and may be at high risk of mental health or other crises; providing an emergency ambulance response to them has operational implications for ambulance services and may not meet their needs. The standard response to these callers can be punitive and may shift unmet demand from one part of the health and social care system to another, with concomitant resource implications.

In some areas within ambulance services, multidisciplinary approaches provided with input from emergency, primary and social care – known as case management – have been introduced. However, evidence supporting the use of this approach for the care of patients who frequently call the emergency ambulance service is lacking. To address this gap, the STRETCHED study was designed as a mixed-methods evaluation using anonymised linked routine data outcomes to evaluate the effectiveness, safety and efficiency of case management for the care of this patient group.

Aim

To evaluate effectiveness, safety and efficiency of case management approaches to the care of people who frequently call the emergency ambulance service and gain an understanding of barriers and facilitators to implementation.

Objectives

The objectives of the STRETCHED study were to:

1. develop an understanding of predicted mechanism of change to underpin evaluation
2. evaluate case management approaches to the care of people who call the emergency ambulance services frequently in terms of:
    a. further emergency contacts [emergency ambulance service calls, emergency department (ED) attendances, emergency hospital admissions] or death
    b. effects on other services
    c. adverse events (deaths; injuries; serious medical emergencies, police arrests)
    d. costs of intervention and care
3. describe the epidemiology of sustained high users of emergency ambulance services
4. understand the views and experience of patients
5. identify challenges and opportunities using case management models, including features associated with success, and develop theories about how case management works in this population.

Design

STRETCHED was designed as a mixed-methods 'natural experiment' evaluation based on anonymised linked routine outcomes and qualitative data in four UK ambulance services: East of England Ambulance Service, London Ambulance Service, Welsh Ambulance Service and West Midlands Ambulance Service. These services each identified where case management and usual models of care were in place in different areas ('sites') within its catchment area. The natural experiment design established links between exposure to care model and outcomes.

Participants

Natural experiment

Involving adults meeting nationally agreed criteria for classification as ‘frequent caller’ by ambulance services during 2018. The study population comprised patients that had made 5 or more emergency ambulance service calls in 1 month or 12 or more calls in 3 months, were aged 18 years or older at the time of classification as ‘frequent caller’, and resident in a study site at that time.

Patients were included in the study cohort the first time they became eligible for classification as ‘frequent caller’; two ambulance services included patients already so classified at the start of 2018.

Service providers

We interviewed ambulance service front-line staff (paramedics and call handlers), partner health and social care providers, commissioners and managers.

Service users

We sought to interview people in intervention sites of each service referred for case management and further explored the patient experience through recruitment via third-sector organisations and social media.

Interventions for people meeting criteria for classification as ‘frequent caller’

Usual care comprised within-service management, typically involving: letters to patient and general practitioner (GP); call centre flags to invoke care plans, including ‘no send’ option; escalation to other services, including police action.

Intervention care comprised usual care with option of referral to cross-service multidisciplinary team (MDT) to review and plan care for selected patients in a case management approach.

Logic model

We held a face-to-face stakeholder event for patient representatives and a range of professional staff involved in commissioning, planning and delivering case management for people who call emergency ambulance services frequently. We developed the STRETCHED logic model from these discussions.

Outcomes

The primary outcome in STRETCHED is a composite hierarchical indicator of mortality, emergency hospital admissions, emergency department attendances and emergency ambulance service calls.

As per our published protocol, we sought data on:

1. further emergency contacts:
    - emergency ambulance calls
    - ED attendances
    - emergency admissions to hospital
    - declassification/reclassification as ‘frequent caller’
2. effects on other health and social care services, as available
3. adverse events, as available:
    - deaths
    - injuries
    - serious medical emergencies
    - police arrests

4. costs of intervention and subsequent use of health and social care
5. patient experience of care at intervention sites.

Data collection and analysis

Natural experiment

STRETCHED was not a blinded study. Ambulance services provided NHS Digital and Digital and Health Care Wales with identifiable information on study patients, enabling matching to anonymised data from multiple sources. In parallel, ambulance services submitted clinical and operational data on study patients to the Secure Anonymised Information Linkage (SAIL) databank, for inclusion in an integrated study database.

Patients could request that their data were not used in the study by contacting the appropriate ambulance service. Data 'opt-out' requests to NHS Digital and the SAIL databank were upheld.

We expected to identify 158 eligible patients per site – equivalent to 316 per ambulance service, 632 per arm, and 1264 in total. Allowing for 5% attrition, we expected to include in analyses data on n = 1200 patients, yielding 90% power to detect a standardised statistical effect of 0.2 at the 5% significance level.

The primary outcome and its components were assessed using treatment allocated (the 'intention to treat' principle) via logistic regression analysis adjusted for patient characteristics (age, gender, ethnicity, deprivation quintile) and prior service use (number of emergency ambulance service calls, emergency admissions, ED attendances, elective admissions and outpatient appointments).

Health economics

Intervention implementation costs

We obtained information from ambulance service documentation and discussions with, and questionnaire surveys of, staff involved in case management. Staff time required was converted into staff costs using the mean annual basic pay per full-time equivalent (FTE) for staff.

Healthcare resource utilisation costs

Resource utilisation data and the resulting costs of health care were obtained from routinely collected healthcare data available from ambulance services, the Hospital Episode Statistics dataset for England and the SAIL databank for Wales. Data were available on emergency ambulance service calls, ambulance dispatches, ED attendances, emergency admissions, elective inpatient stays and outpatient visits.

Healthcare resource group codes were used for all healthcare components and data sets. Costs, taken from the NHS Reference Costs, were expressed in 2018–9 Great British pounds. No discounting was applied as the follow-up period did not exceed 1 year.

Qualitative elements

We collected qualitative data at the intervention site within each participating ambulance service to explore perceptions of how the intervention worked, what created its effect (if any), why it might function differently in different settings and for different groups of people, and any challenges to implementation and delivery of the intervention.

We sought to conduct up to eight interviews with a range of service providers in each ambulance service intervention site. Interview guides covered case management delivery processes, barriers and facilitators to changed working, perceived impact for patients, issues around diversity and terminology, strengths and weaknesses of the approach and wider organisational impact across health economies, such as information sharing, communication and continuity of care.

We conducted in-depth interviews with a range of service users who had been referred for case management within one ambulance service; we were unable to recruit in the other three services. In order to gather additional data on the user perspective, we added a supplementary qualitative study (STRETCH-UP); this recruited, via third-sector organisations and social media, people who identified as frequent callers. Interviews were conducted by members of the study team; with interviewees' consent, we audio-recorded and transcribed all individual interviews.

Results

Natural experiment

We included in analyses data on $n = 1183$ patients: 550 at intervention sites and 633 at control sites. There was considerable variation in numbers of patients by ambulance service and arm, particularly noticeable in the intervention arm, with over half the patients in one site. Overall, study patients were relatively elderly, with a median age of 65 years (lower quartile 45, upper quartile 81), with slightly more females (51.9%), and were predominantly white (81.7%). Just under two-thirds of patients (65.1%) lived in areas classified in the two most socioeconomically deprived quintiles, only 5.2% lived in areas classified in the least socioeconomically deprived quintile. Intervention site patients were generally younger than control site counterparts in three out of the four participating ambulance services (AS2, AS3 and AS4), and hence generally younger overall (median age: 60 years for the intervention arm; 69 years for the control arm). The proportion of female patients varied from 44.1% (AS2 intervention site) to 59.2% (AS1 intervention site), with no obvious pattern across study arms or ambulance services.

Emergency ambulance service use by patients for the 6 months before inclusion in STRECHED was similar between arms. Approximately two-thirds of patients recorded at least one emergency admission (753/1183; 63.7%), and/or outpatient appointment (804/1183; 68.0%). The proportions of patients recording emergency admissions, ED attendances, elective admissions and outpatient appointments were generally similar between arms; however, the overall mean number (per patient) of emergency admissions, elective admissions and outpatient appointments were all higher in intervention sites.

The proportion of patients recording at least one component of the composite primary outcome was very high and similar between study arms: 95.6% in the intervention arm; 94.9% in the control arm [odds ratio (OR) = 1.159; 95% confidence interval (CI) 0.595 to 2.256; $p = 0.665$]. The majority of patients made at least one further emergency ambulance service call in the 6-month follow-up; almost as many patients recorded an event in at least one other component of the composite measure.

The proportion of patients that died within the 6-month follow-up period was relatively high (10.5% intervention, 14.1% control). Although mortality did not differ significantly with study arm (OR = 0.713; 95% CI 0.465 to 1.093; $p = 0.121$), it was strongly associated with age ($p < 0.001$), which did differ between arms.

Available but incomplete data showed that approximately two-fifths of eligible patients (39/97) were referred for case management, with 27/39 (69.2%) known to receive it.

Just over half of emergency ambulance service calls resulted in attendance (53.8% intervention; 50.4% control); < 25% of calls resulted in conveyance to hospital (24.3% intervention; 22.3% control). The most common reasons for calling were 'fall' (6.5%), 'sick person' (5.2%) and acute coronary syndrome (4.7%).

Health economics

Estimates of intervention implementation costs of case management varied between different intervention sites, reflecting different staff mixes and case management regimes. We estimated that case management costs between £25 and £333 per patient per month. This does not include cost to other services and opportunity costs which remain unquantified.

When adjusted for baseline total number of healthcare service contacts and total baseline cost, together with age, gender, deprivation quintile and ethnicity (collapsed into white/non-white), patients in the case management intervention sites had marginally lower mean per patient healthcare resource use and costs included in the primary outcome compared to patients in the usual care sites. Overall, patients in the intervention sites had −0.13 (95% confidence interval: −5.38 to 5.11; $p = 0.960$) more emergency healthcare contacts (including non-elective hospital admissions, ED attendances, emergency ambulance service calls) compared with control site patients over the 6-month follow-up period, at a slightly reduced mean cost of £243.57 (95% confidence interval: −£1972.93 to £1485.79; $p = 0.782$) per patient. There were no statistically significant differences between usual care and intervention groups at the 5% level for mean per patient healthcare service contacts or costs for any of the service use components included in the primary outcome.

Qualitative findings

Service providers

Thirty-one interviews with key service providers revealed a range of models of case management for people who called frequently, with some key components – such as MDTs – common to all ambulance services. Delivery of case management also varied, for instance, in terms of the role and seniority of those meeting with service users. Case management interventions were area-based, sometimes with changes over time, reflecting short-term funding allocations and changes in staffing or priorities.

Respondents recognised the complexities of needs among frequent callers and that medical presentations often resulted from long-term social needs. There was acknowledgement that emergency care was a default for those who – for whatever reason – had not received appropriate healthcare support through other routes. A minority of frequent callers seemed to be regarded as ‘nuisance’, but respondents were sympathetic to the unresolved needs of the majority.

Service users

Respondents ($n = 15$) generally called for emergency care because they had no other routes to access help; many seemed to use the emergency services as a gateway to accessing better care, and felt demoralised that repeated contacts with health professionals had not reduced or cured their symptoms.

Respondents prioritised receiving judgement-free reassurance when experiencing acute health needs; there was considerable dissatisfaction with the way they were treated.

Those who, according to service records, had been offered case management generally seemed not to be aware of this. None spoke of any resultant improvement in their lives or changes in their experience of making frequent emergency calls. Interventions for frequent callers, if considered at all, were generally regarded as caller management initiatives limiting contact with providers.

Public and patient involvement

We involved people with experience and healthcare backgrounds relevant to the STRETCHED study at all research stages, from project conception, through delivery and in dissemination of our findings. A layered approach enabled people to be involved at strategic and local levels in line with their interest, experience and health. We aimed to enable active and meaningful involvement throughout STRETCHED to enhance research quality, rigour and ethical standards.

Equality, diversity and inclusion

Participant recruitment to STRETCHED study did not proactively target specific groups other than on the grounds of clinical or self-reported healthcare need. Due to the nature of the study, participants were often marginalised and resident in relatively deprived socioeconomic areas.

Conclusions

We did not find any reductions in deaths, emergency ambulance calls or other emergency healthcare contacts associated with case management. The patients classified as frequent callers had high and varied needs. We do not believe that our findings mean that case management never works, or is not worth providing, but we found that expectations of its impact, based on advice and previous small-scale evaluations, were unrealistic.

Recommendations for further research include: the exploration of different forms of case management; feasibility of obtaining self-reported outcomes from this patient group; and the prospective evaluation of care options for this patient group.

Project management

STRETCHED was funded by the National Institute for Health Research (Health Services & Delivery Research programme), sponsored by Swansea University, and received approval from the Health Research Authority and R&D permissions at all participating NHS organisations. We obtained Swansea University Research Committee approval for the supplementary STRETCH-UP substudy.

Our independent Study Steering Committee drew its membership from: a non-participating ambulance service; the FreCaNN; a range of third-sector healthcare-related organisations; the police service; and academia. Two members offered a patient and public involvement (PPI) perspective; the chair had links with a carers' trust.

Study registration

This study is registered as research registry (www.researchregistry.com/) researchregistry7895.

Funding

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Chapter 1 Introduction

This chapter contains reproduced material from Aslam *et al*.[1] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) licence, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: https://creativecommons.org/licenses/by/4.0/. The text below includes additions and formatting changes to the original text.

A note on language and terminology

Language and terminology in this area are neither fixed nor universally agreed upon; terms used by one person, organisation or group without intention to cause offence may, nonetheless, be regarded as pejorative by others. In adopting specific instances of terminology, often those used by interested parties in this research, or by including this terminology in quotations from such parties, we do not intend to imply any moral judgement, nor should any such judgement be inferred.

As the term '999' does not distinguish between emergency services, we generally use the term 'emergency ambulance service'; where the term '999' is used here – for instance, in quotations – it should be taken to refer to a call to the emergency ambulance service, unless explicitly stated otherwise.

There are a range of international counterparts to the UK's emergency response service. The pan-European equivalent to 999 is 112, which can also be used in the UK; the USA and Canada use 911.

Background

Ambulance services are an integral part of the UK's NHS. Following mergers in the 1990s, UK ambulance services cover large areas, each serving a population of between 3 and 9 million people generally across a mixture of urban and rural locations. Ambulance services provide a range of emergency responses including telephone advice, attendance of an emergency vehicle for face-to-face assessment by a paramedic or Emergency Medical Technician, and conveyance to hospital for further care when judged clinically appropriate.

This care, free at the point of use, is usually initiated by dialling 999; these calls to the UK's nationwide emergency response system are then routed to an appropriate service, including the local ambulance service.

The NHS is under sustained pressure, particularly in the area of emergency and urgent care, with emergency calls to the ambulance service increasing by at least 6% every year,[2,3] although fewer than 10% of calls relate to patients with life-threatening conditions.[3] The volume of emergency calls to ambulance dispatch centres in England alone has increased from 4.72 million in 2001–2, to 13.2 million in 2022–3.[4] This dramatic rise has not been matched by an equivalent increase in resources. In addition, regular media reports describe unsustainable demand for ambulance services with concerns about delays in reaching high-risk patients, particularly in emergencies.[5] This has led to public and political pressure to improve emergency response processes including increasing ambulance staffing and funding and improving ambulance dispatch systems.[6] Some reports have also highlighted the issue of people who frequently call the ambulance services – sometimes almost daily.[2]

Definitions of frequent calling

Definitions for frequent calling in the pre-hospital emergency service settings have varied internationally and terminology is contested.[7,8] Thresholds usually mirror the emergency department (ED) description of frequent use, namely > 5 attendances a year, but have ranged from as low as > 2 emergency ambulance service calls a year[9] to the highest criteria used in the UK of 5 or more calls in 1 month or 12 calls or more over 3 months.[2,10–12] This UK definition was agreed nationally with all UK ambulance services, though it has recently been simplified to just five or more calls in 1 month.[13]

Terminology to describe people calling frequently have included 'frequent flyers', 'frequent callers' and 'super-utilizers'.[14] Addressing the needs of people who call frequently can result in increased costs for the healthcare system in terms of time and resources. In London, 1.7 million emergency calls were received in 2014–5. During this period, 1622 people meeting the national 'frequent caller' criteria generated 49,534 ambulance attendances, at a cost of £4.4 million to the London Ambulance Service (LAS).[2] A similar story is repeated around the country where many services struggle to meet demand.[15,16] Operating in this pressured environment, ambulance services are required to focus resources on people with urgent or life-threatening conditions.[17] The national target of reaching 75% of Category A (life-threatening) calls within 8 minutes was not met for 32 consecutive months in England.[9] The figures for the Welsh ambulance service have been worse with only 47.5% of Category A calls attended to within 8 minutes in March 2023, failing to meet the Welsh target of 65% for 32 months in a row.[18]

People who make frequent calls to the emergency ambulance service may not be experiencing an emergency situation or require immediate medical assistance from emergency services. These individuals are often vulnerable patients who may be feeling panicked, frightened or overwhelmed and are seeking help to address long-standing chronic health or mental health issues[2,7,10,19–22] and are more likely to:

- be under socioeconomic stress
- live alone
- experience mental health problems
- have a history of trauma or abuse
- live with chronic conditions
- fall

They may call the emergency ambulance service frequently because their problems are unresolved, or because they may not be aware of alternative and more appropriate pathways to access healthcare services.[2,7] Although this patient group may seek to address their problems through the emergency ambulance service system, without the necessary clinical or care expertise available to them, they may continue to seek help through emergency services, placing them at a higher risk of further crises and deterioration in their condition. As a result, they may require multiple interventions from different parts of the healthcare system and community-based agencies[21–23] placing a disproportionate burden on resources. Moreover, research shows that people who make high use of emergency ambulance and ED services frequently have higher mortality rates than those seeking care less often.[20,21,23,24] Most do not require acute clinical intervention by the emergency ambulance service or transportation to an ED and could be better cared for at home or by an alternative community-based care provider.[7,20]

Recent United Kingdom policy reviews

Major national policy reviews in England[25] and in the devolved administrations of the UK[26] have called for a whole-system approach to care, with care pathways and protocols to be further developed across unscheduled care, along with greater clinical autonomy and decision-making within the ambulance service to reduce unnecessary pressures on ED. Emergency call operators are trained to assess the situation and provide appropriate guidance to the patients who call while dispatching the necessary emergency services to the scene.

A 2016 review of strategies to manage people who make use of the emergency ambulance service described two models of care which are in current use across the UK.[27] A 'Hear and Treat' approach is used in the ambulance call centre for callers who are assessed as not needing an emergency ambulance response. Call-takers or clinical advisors in the call centre utilise protocols and local directories of services to advise self-care or to identify referral pathways for patients if immediate ambulance support is deemed not to be required. Provision of telephone advice or referral for emergency ambulance service callers without immediate clinical needs can be safe and effective,[28] although the evidence base does not extend to patients who call frequently. 'See and Treat' models of care require face-to-face assessment by an emergency ambulance responder, who can discharge the patient at the scene of their emergency call without conveyance to ED. There is considerable policy support for such initiatives and a growing body of evidence supporting the safety, clinical and cost-effectiveness of this approach.[29–32] However, people who are calling frequently may have complex medical histories and social backgrounds which can be challenging to manage in the emergency pre-hospital care setting.[33,34] Government policies, such as 'Taking Healthcare to the Patient',[3] the Keogh report,[35] Six Goals for Urgent and Emergency Care: Policy Handbook for 2021–6[36] and the NHS Long Term Plan[37] encourage the establishment of alternatives to hospital transport for non-urgent care. These policies recommend that patients receive appropriate care in the most suitable setting, but challenges remain in identifying which patients can be safely and effectively managed in the community, particularly in the absence of accessible community-level diagnostics and investigations.

The policy directive towards alternative care pathways has been further influenced by a push towards patient-centred care, and an attempt to mirror initiatives in primary care with the aim to prioritise the care of frail older patients who are at risk of emergency hospital admission.[17,25] Commissioners now require ambulance services to have management strategies in place for people who frequently call the emergency services.[25] While some new cross-sector case management approaches have emerged, the overall aim is to prevent people from calling the emergency services by referring them to other appropriate healthcare providers.[38] In rare cases, punitive interventions have been taken against individuals who are being vexatious in their calls, including the pursuit of criminal sanctions.[5] However, best practice guidelines focus on developing alternative care plans for individuals with complex health and social needs that can reduce their health-seeking behaviour through the emergency services route. These plans aim to reduce the reliance on the emergency services and ensure that patients receive appropriate care in appropriate settings.[4,35–37]

United Kingdom ambulance service initiatives

Several UK ambulance services have developed initiatives to manage patients who call 999 frequently, although approaches can vary across services. In 2019 we completed a survey of practice by e-mail and telephone through designated 'frequent caller' leads located at each of the participating ambulance sites.[11] We received responses from 12 out of 13 UK ambulance services. All ambulance services compile a list of patients meeting the national criteria for classification as a 'frequent caller' and are flagged on the ambulance call dispatch system but subsequent responses to patients differ. Eight services reported that they had implemented cross-sector case management models in at least one area within the service, with two services reporting that case management was in place across the entire service area. There was variation in the consistency of approach across services, despite nationally agreed best practice guidelines. The variation can be attributed to a variety of factors, such as funding arrangements, resource availability and local priorities. Each ambulance service operates within a specific geographical area and may have different challenges in providing care to patients who frequently call. As a result, they may need to adapt their approaches to manage these patients effectively within the constraints of their available resources.

In areas where case management approaches are implemented, the focus is on developing comprehensive care plans for patients who frequently call the emergency ambulance service. This is done through the use of multidisciplinary teams (MDTs), cross-sector management groups or forums that are specifically designed to address the needs of people who call frequently. The approach involves identifying, sharing and managing patients collaboratively. Key decision-makers from commissioning, acute, primary, secondary, third-sector health and social care providers including law enforcement meet with ambulance service staff to share information, stratify patients based on their level of need, and manage patients through regular MDT meetings. This collaborative approach is intended to ensure that patients receive appropriate care from the right provider, in the right setting, at the right time. It also ensures that resources are used effectively, and duplication of services is avoided.[2,28,38–40] The introduction of case management has the potential to provide safe and equitable out-of-hospital care for this patient group, and prevent patients being passed along the emergency care system or wider NHS without their care needs being addressed.[39,40] Initial research on this patient group in ambulance services has shown promising results. Research conducted at the LAS saw significant reductions in calls after the introduction of case management in one area of London. Although the sample size was small (n = 110) and the study design was a before-and-after comparison with no control group,[2] the study illustrated the complex range of resources, skills and services required to address need.

Links to other healthcare settings

Clinical case management has been used in other healthcare settings, such as emergency departments, for people who attend frequently, which has relevance to the pre-hospital context. A systematic review on the effectiveness of case management in ED settings[41] identified that there was heterogeneity in how the model was implemented among studies of variable quality, with the evidence pointing towards modest reductions in emergency department use and costs following intervention. Case management interventions within pre-hospital settings[11,15,39,40,42,43] taking person-centred care approaches also found modest improvements in further service use, but those with complex needs required longer intervention and more resources.[43]

The British Red Cross recently published a report on high-intensity use of emergency departments. The report called for improved access to case management services that can help to address the wider determinants of health that contribute to people using services frequently, including improved access to community-based care.[44] While such interventions are yet to be robustly evaluated in the UK, evidence from Switzerland suggests that similar case management interventions in ED settings can improve self-reported health literacy and motivation, with the majority of patients being satisfied with the service[45] and noting an improvement in self-reported quality of life.[46] Together, the evidence suggests some uncertainty around the effectiveness of clinical case management for people who use ED and ambulance services frequently, with suggestions that it should, at best, be considered an approach to demand reduction that does not necessarily address wider determinants of health.[47] Alternatively, it has been argued that the success of case management is largely dependent on how it is resourced and implemented.[48] Moreover, community-based services tend to be complicated in terms of organisational interfaces, inconsistency in resource use and insecure funding which represent an area of challenge for new systems.[2,28,38–40]

The NHS Long Term Plan[37] and Welsh Government's Six Goals handbook[36] indicate the high priority given by those working in the NHS and policy settings to improve the care of people who frequently access emergency care. Greater integration of emergency ambulance care with other parts of health and social care provision underpinned by patient-centred care is encouraged. The introduction of case management into emergency ambulance care settings is part of a wider movement to reduce the care burden in the acute sector and improve patient experience. Internationally, evidence indicates improved patient care and service delivery where case management has been used in ED and ambulance settings.[39,40,48]

STRETCHED aims, research objectives and work packages

Aims

STRETCHED aimed to evaluate effectiveness, safety and efficiency of case management approaches to the care of people who frequently call the emergency ambulance service, and gain an understanding of barriers and facilitators to implementation.

It was hoped that the study would provide evidence of the effectiveness, cost-effectiveness and impact of case management.

Given the lack of evidence to inform commissioning, policy or practice development, the STRETCHED study[1] was designed as a mixed-methods retrospective natural experiment in four ambulance services in England and Wales. STRETCHED was designed to have relevance internationally, in particular to the World Health Organization (WHO) agenda of investing in public and community-based services to improve patient experience,[49] with maximum transferability of learning beyond any one specific healthcare system.

It was also hoped that the in-depth insights generated from STRETCHED should assist ambulance service commissioners in implementing evidence-based practice for patient benefit. Findings can inform future service provision closely aligned to policy. The use of linked data in STRETCHED had the potential to develop a holistic picture of service use in areas where multidisciplinary case management is practised compared to areas where standard 'within-service' management is in place.

These intentions were distilled into the following research objectives.

Research objectives

1. Develop an understanding of predicted mechanisms of change to underpin evaluation.
2. Evaluate case management approaches to the care of people who call the emergency ambulance service frequently in terms of:
    - further emergency contacts (emergency ambulance service calls, ED attendances, emergency hospital admissions) or death
    - effects on other services
    - adverse events (deaths; injuries; serious medical emergencies; police arrests)
    - costs of intervention and care.
3. Describe the epidemiology of sustained high users of emergency ambulance services.
4. Understand the views and experience of patients.
5. Identify challenges and opportunities associated with using case management models, including features associated with success, and develop theories about how case management works in this population.

We devised the following work packages (WPs) to achieve these objectives.

Work package 1: logic model

This WP, addressing the first research objective, developed a logic model in consultation with stakeholders to underpin the evaluation and inform data collection and finalisation of outcome selection. The logic model included definition of key components of case management in this setting; predicted mechanisms of change; and possible outcomes, positive or otherwise.

Work package 2: evaluation

To address the second and third research objectives, we undertook an evaluation using a natural experiment cohort design in four ambulance services, using quantitative anonymised linked routine data to describe epidemiology and assess effects of the intervention on processes, outcomes, safety and costs of intervention and subsequent health and social care up to 6 months later, with adjustment for covariates including prior service use.

We also collected qualitative data from focus groups and interviews in each intervention site about the views and experiences of patients and other stakeholders (commissioners, emergency and non-acute health and social care providers) regarding acceptability, successes and challenges of case management approaches for this group of patients.[1]

Work package 3: synthesis of quantitative and qualitative findings

We synthesised quantitative and qualitative findings from WP2, informed by the logic model developed in WP1 and in consultation with stakeholders.

Study timelines

STRETCHED started on 1 April 2019 with a planned end date of 30 September 2021. Ambulance service activity was paused during the early months of the coronavirus disease discovered in 2019 (COVID) pandemic in 2020. This pause and other delays, most notably in the provision of data from NHS Digital and the SAIL databank, required extensions to the planned end date (see *Appendix 1*).

Chapter 2 Methods

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Study setting

STRETCHED was designed as a mixed-methods 'natural experiment' evaluation, based on anonymised linked routine outcomes and qualitative data in four UK ambulance services with one intervention ('case management') and one control ('usual care') site in each service. The East of England Ambulance Service NHS Trust (EEAS), London Ambulance Service NHS Trust (LAS), Welsh Ambulance Services NHS Trust (WAST) and West Midlands Ambulance Service University NHS Foundation Trust (WMAS) were approached and selected following a survey of practice across the UK, which identified where both case management and traditional models of care were in place in different areas ('sites') within an ambulance service's catchment area.

Study population: natural experiment

The study population was defined to include adults meeting nationally agreed criteria for classification as 'frequent caller' by ambulance services during 2018. Thus, people were eligible for inclusion in STRETCHED if:

- they were eligible for inclusion on a participating ambulance service's frequent callers list during 2018 (made 5 or more emergency ambulance service calls in 1 month, or 12 or more times in 3 months)
- were aged 18+ at the time they became eligible
- lived in a study site at the time they became eligible.

People were only added to the study cohort the first time they were eligible for inclusion on a frequent callers list during 2018; two ambulance services included patients classified as frequent callers at the start of 2018.

Participant recruitment: interviews

Service providers

We sought to interview a wide range of service providers, including front-line staff (paramedics, call handlers), partner health and social care providers, commissioners and managers (*n* ~ 36).

Patients receiving case management

To gain a strong picture of patient experience and circumstances, we sought to conduct largely unstructured interviews with people in intervention areas of each service referred for case management (*n* ~ 32).

People self-identifying as frequent callers (STRETCH-UP)

In an addition to the original protocol, we sought to boost the numbers of interviews exploring patient experience and circumstances by an open call recruitment process via third-sector organisations and social media (*n* ~ 20).

Interventions

Describing the intervention

Details of ambulance service resources used in the intervention implementation were obtained from relevant documents and through discussion with and surveys of staff involved in case management at the study sites. Documents reviewed included a survey of 12 UK ambulance services regarding the management of the care of people who make frequent emergency calls during the study period,[11] TIDIER checklists describing the intervention in the four study sites, and transcripts of the qualitative interviews with commissioners, frequent caller leads and care providers were undertaken as part of this study.

East of England Ambulance Service

In the EEAS intervention site, case management was initially organised by a clinical co-ordinator and a frequent caller lead. The team then evolved, comprising a frequent caller lead managing three clinicians and an administrator. Based on monthly reports, the frequent caller lead contacted patients who were identified as frequent callers. Patients were discussed at the monthly multidisciplinary high-intensity user group (HIUG) meeting, which agreed on individualised action plans, based on patient needs and linked with services involved in a patient's care [e.g. their general practitioner (GP), social services, mental health teams, one-on-one out-of-hours, police in some cases]. The clinical co-ordinator, frequent caller lead and management team liaised to put in place a management plan to reduce ambulance callouts by meeting unmet care needs.

London Ambulance Service

In the LAS intervention site, the frequent caller lead reviewed callers meeting the frequent caller criteria on a monthly basis and referred eligible patients to the most appropriate external care service based an assessment of needs. Patients were contacted within 1 week and their care needs discussed at MDT meetings where actions and a future care strategy were devised. This initiative was led by a GP, with patient contact largely undertaken by a specialist nurse and non-clinical care co-ordinator, both working part time on the initiative. Patients were monitored on a monthly basis if they continued to call.

Welsh Ambulance Service

In the WAST intervention site, a Clinical Support Officer (CSO) provided clinical and management support for 6 ambulance service frequent caller leads, working closely with 13 frequent attendee leads within hospital EDs. The CSO analysed available data monthly to identify frequent callers. Ambulance frequent caller leads and ED frequent attendee leads jointly managed patients identified via letters, case meetings with GPs, and home visits to assess patients' needs. Patients were discussed at ED-based MDT meetings, and referred to the appropriate agency with care plans created and shared with other agencies to provide a network of support for the patient.

West Midlands Ambulance Service

In the WMAS intervention site, the Ambulance Service frequent caller lead was head of clinical practice and WMAS consultant, with a varied portfolio of tasks, including the high-intensity service user or frequent caller portfolio. They provided strategic overview, data and information to all partners including 24 Clinical Commissioning Groups (CCGs), most with a high-intensity service user group working on behalf of the GPs. The CCG lead received the list of frequent callers from the ambulance service frequent caller lead on a monthly basis and contacted and/or visited identified patients to assess need. They also liaised with community services to provide required services, participated in MDTs and devised care plans to ensure that patients had access to the most appropriate care pathway.

Characteristics of care at control sites in the four ambulance services participating in STRETCHED are outlined in *Table 1*, together with a summary of key features of case management.

Intervention implementation costs

The health economic analysis compared the implementation cost of case management to the potential benefits of 'avoiding expenditure' in subsequent health and social care resource utilisation (where available). The implementation intervention costs included a descriptive summary of resource use, cost tables and an overview of incurred costs of intervention implementation at different study sites (where data availability and quality allowed). Although the model of delivery of these services can differ between ambulance services and within ambulance service sites and change over time, in all cases, case management was available in addition to usual care (even though the scope and nature of usual care differs). Usual care was therefore either non-existent or remaining unchanged and, for this analysis,

TABLE 1 Key features of control (usual care) and intervention (case management) sites within participating ambulance services

	Control site: usual care	Intervention site: case management
Aim	To discourage people classified as frequent callers from further calling	To identify and manage triggers and causes that lead to the patient making frequent calls (e.g. adverse childhood events, mental health, drug and alcohol dependency, frailty)
Care model: delivery	Within-service management	MDT[a] cross-sector case management
Model elements	• CSO contacts patient by letter stating they have called the emergency ambulance service more than normal and should seek help from their GP; contact number provided within letter for patient to talk to ambulance service manager[11] • CSO calls or sends letter to patient's GP to make them aware patient is calling the emergency ambulance service frequently • If calls persist, CSO may contact other services to intervene and support patient • CSO writes individual care plan which is shared with the call centre clinical team. When the patient calls, he/she is triaged to a clinician in the call centre rather than an ambulance being sent • If caller persists, he/she may be referred to the police and/or court	• CSO speaks to GP or practice manager to assess patient's case and needs • Patient is discussed at monthly MDT meeting • Patient is interviewed to assess unmet needs • Patient is allocated to appropriate agency to lead on care planning and provision. A care plan is created and shared so that any agency contacted by the patient knows what has been agreed • If calls persist or patient has an antisocial behaviour order, the CSO visits the patient along with a police officer or representative from the ED

CSO, Clinical Support Officer; MDT, multidisciplinary teams.

a Multidisciplinary teams typically have representation from the police, ED, out-of-hours primary care, voluntary sector, social services and other appropriate agencies. Around 50 patients may be discussed at a monthly meeting, 10–15 of whom make high use of the ambulance service.[11] The MDT is used to provide a network of support for the patient and to address their needs through multiagency working. Professionals see it as part of their role to support people who frequently access the ambulance service, police or ED.

was assumed, following Research Management Group (RMG) discussion, to be the same for patients receiving case management and those who do not. The intervention implementation cost included in the cost–consequences analysis (CCA) is therefore based on the difference in costs between the usual care support provided by the ambulance service throughout all services and sites (if available) and the new additional resources and associated costs required to provide the intervention of enhanced case management support for frequent callers. This includes the additional funding required to operate the case management intervention, which is predominantly driven by costs of staff operating and providing the case management intervention. This cost is expressed in relation to the number of patients supported by the scheme as the monthly cost per patient case-managed.

Logic model

A logic model is a linear graphical representation of the theory of how an intervention produces its intended outcomes; it can help to prioritise and structure data collection and analysis to explore the main aspects of an intervention.

We organised a stakeholder event to bring together patient representatives and professional staff involved in commissioning, planning and delivering case management for people who call emergency ambulance services frequently. We presented an overview of STRETCHED, an explanation of what a logic model is and its purpose, and then broke into small, mixed groups to discuss the four parts of the logic model – components, mechanisms, impacts and context. We then developed our logic model in the light of these discussions.

Outcomes

We finalised study data items following completion of the logic model, specifying items which would enable us to obtain data on:

1. further emergency contacts:
    - emergency ambulance calls
    - emergency department attendance
    - emergency admissions to hospital
    - declassification/reclassification as 'frequent caller'
2. effects on other health and social care services
3. adverse events, as available
    - deaths
    - injuries
    - serious medical emergencies
    - police arrests
4. costs of intervention and subsequent use of health and social care
5. patient experience of intervention.[1]

We further specified data items related to patient demographics, case mix and patterns of calls, for example, 'out-of-hours' (evenings/nights/weekends/holidays). Historical data about healthcare utilisation immediately prior to follow-up allowed us to adjust analyses for differences between cohorts, strengthening this study design.

Primary outcome

The primary outcome in STRETCHED is a composite hierarchical indicator of mortality; emergency hospital admissions; ED attendances; and emergency ambulance service calls.

Data collection

Blinding

STRETCHED was not blinded.

Natural experiment

Ambulance services provided NHS Digital and Digital and Health Care Wales (DHCW) (formerly, the NHS Wales Informatics Service; NWIS) with identifiable information on study patients, enabling matching to anonymised data from multiple sources. In parallel, the ambulance services submitted clinical and operational data on study patients to the SAIL databank. After linkage and anonymisation processes were complete, we created a single integrated study database for analysis within the SAIL Gateway, a Trusted Research Environment.

Patients could request that their data were not used in the study by contacting the appropriate ambulance service. Data 'opt-out' requests to NHS Digital and the SAIL databank were upheld.

Sample size

We expected to identify 158 eligible patients per study site (316 per ambulance service; 632 per arm; 1264 cases total). Assuming that no more than 5% of cases would be lost to follow-up (e.g. via opt-out requests to NHS Digital), we expected to include in analysis 300 patients per ambulance service ($n = 1200$), with 90% power to detect a standardised statistical effect of 0.2 at the 5% significance level.

Health economics

In costing the implementation of the intervention, ambulance services were asked to provide additional information on the delivery of the case management intervention that could not be retrieved from other sources using a resource use questionnaire sent by e-mail. The questionnaire was designed to provide an understanding of the composition of the team delivering the intervention and the percentage of staff contracted hours required to operate the enhanced case management intervention beyond usual care (if provided) and pay bands (to calculate costs). A simplified follow-up questionnaire was then sent to sites containing specific questions about the main staff previously identified. See *Report Supplementary Material 1* for further details on the two questionnaires.

Staff time required was converted into staff costs using the mean annual basic pay per full-time equivalent (FTE) for staff using NHS Agenda for Change pay scales[50] where the staff pay band was known. The mean annual basic pay per FTE for non-medical occupational groupings for NHS England was used for English sites and Wales NHS Agenda for Change pay scales 2018–9 for the Welsh Ambulance Service. Where no pay bands were available but professional occupation was known, NHS staffing costs were derived from the Unit Costs for Health and Social Care 2018–9,[51] which covers the 12-month period of earning estimates from May 2018 to April 2019. Where pay band information was unavailable but professional occupation was known (e.g. nursing clinician or administrator), the mean annual basic pay per FTE for non-medical occupational groupings for NHS England was used for English sites and Wales NHS Agenda for Change pay scales 2018–9 are used for the Welsh Ambulance Service.

Once all intervention components were costed, costs of all components were added up to arrive at a case management intervention implementation cost per site.

Healthcare resource utilisation and costs

Data on resource utilisation and the resulting costs to health care were collected for the period between 2017 and 2019 and assessed over a time horizon of 6 months from when a patient first became eligible for inclusion on the frequent caller list. Data were obtained from routinely collected healthcare data available within the Hospital Episode Statistics (HES) data sets for England and the SAIL databank for Wales. The healthcare resource use data available for analysis comprised emergency ambulance service calls, ambulance dispatches, ED attendances, emergency admissions, elective inpatient stays and outpatient visits.

For emergency admissions, all finished consultant episodes (FCEs) with length of stay of 1 day/overnight stay were considered non-elective short stay, whereas FCEs of 24 hours or more were costed as non-elective long stay. For non-elective hospital episodes with length of stay of zero, a short stay FCE cost was applied. ED attendances were costed based on Healthcare Resource Group (HRG) codes where possible. Similarly, emergency ambulance service calls were costed using the appropriate HRG codes.[52] In cases where it was impossible from the available data to distinguish between calls and hear and treat or refer cases, a weighted average unit cost of £10.29 was applied.

Unit costs were taken from the NHS Reference Costs;[52] HRG codes were requested for all healthcare components and data sets.

Costing resource use included in the primary outcome

As per the clinical effectiveness analysis, resource use included in the primary health economics outcome comprised emergency admissions, ED attendances and emergency ambulance service calls.

Secondary outcome resource use costing

Resource use collected for the secondary outcomes of the study included ambulance callouts, outpatient appointments and elective inpatient admissions.

As with the primary outcome resources, resource use for secondary outcomes was costed using HRG codes (if supplied with the data) or weighted average unit costs.[52] Ambulance callouts were costed using the appropriate HRG codes.[52]

Outpatient data retrieved from HES were costed using the HRG codes in conjunction with speciality service code supplied. Speciality service codes were used to cost Welsh data (retrieved from the Patient Episode Dataset for Wales, PEDW). For elective admissions, FCEs of 1 day or more were costed as elective inpatient stays, with episodes with length of stay of 0 considered to be day cases.

Total healthcare costs

Once costed, the total number of healthcare resources used and the total costs accrued over the 6-month follow-up period for primary and secondary outcomes and for both combined, as well as the mean resources used per patient and mean cost per patient (and standard deviation, SD), were calculated for intervention and control arms using SPSS (SPSS Inc., Chicago, IL, USA) and EXCEL (Microsoft Corporation, Redmond, WA, USA).

Costs were expressed in 2018–9 UK Great British pounds (GBP). No discounting was applied to either costs or consequences as the follow-up period did not exceed 1 year.

Qualitative elements

We collected qualitative data at the intervention site within each participating ambulance service to explore perceptions of how the intervention worked, what created its effect (if any), why it might function differently in different settings and for different groups of people, and any challenges to implementation and delivery of the intervention. In addition, we recruited people who identified as frequent callers via third-sector organisations and social media, as part of the STRETCH-UP substudy.

We conducted in-depth interviews with a range of service users who had been referred for case management within one of the ambulance service areas; although we originally planned to interview patients referred for case management in all ambulance service areas, we were not able to recruit in the other three sites. In order to gather additional user data on the user perspective, we added a supplementary qualitative study, STRETCH-UP, which recruited interview people with experience of frequent calling to ambulance services across the country. Data from STRETCH-UP are presented alongside data collected in line with the original STRETCHED protocol.

Service providers

We planned to conduct up to eight interviews (remotely via video or telephone) with a range of service providers in each ambulance service intervention site. Interview guides covered case management delivery processes, barriers and facilitators to changed working, perceived impact for patients, issues around diversity and terminology, strengths and weaknesses of the approach and wider organisational impact across health economies, such as information sharing, communication and continuity of care.

Patients

We aimed in each intervention site to interview people who had been referred for case management, to explore their own narrative about their circumstances, experiences and views regarding their needs, service use and care received before and after the case management intervention, and the intervention itself, including terminology used. We worked with participating services to identify and invite callers to this key patient-focused element of the study. We intended purposively to include a wide range of views and experiences, selecting individuals with differing demographic characteristics, length of time they have required care and management approach provided for them to include typical and atypical patient stories. We specifically sought to include patients from ethnic minorities.[1]

Interviews were conducted by a member of the study team (AK). With respondents' consent, we audio-recorded and transcribed all individual interviews.

People self-identifying as frequent callers (STRETCH-UP)

In an addition to the original protocol, we sought to boost the numbers of interviews exploring patient experience and circumstances by an open call recruitment process via third-sector organisations and social media. We recruited participants with the help of our existing networks, including the SUPER group and third-sector organisations such as Diabetes UK. We produced an illustrated flyer and asked organisations to share it on their social media accounts [e.g. Twitter (Twitter, Inc., San Francisco, CA, USA)], attach it to routine e-mailings to members, and feature it on their websites, as appropriate. Potential participants were invited to make contact directly with the study team; they would then be sent a more detailed information sheet and invited to discuss the study and see if they were eligible to take part, before being formally recruited and consented. Interviews were conducted remotely (via video) by members of the study team (AP, BAE, AT) and with respondents' permission were recorded and transcribed in full.

Please see *Report Supplementary Material 2* for consent forms and participant information sheets and *Report Supplementary Material 3* for focus group and interview topic guides.

Data analysis

Natural experiment

Our primary analyses used the treatment allocated (the 'intention to treat' principle), so patients that met the criteria for 'frequent caller' status in an intervention (case management) site were included in analysis in that arm of the study whether they were offered or received any intervention. The outcome measure time point was defined as 6 months from a patient's first eligibility for inclusion on a 'frequent callers' list and applied to patients at control sites as well as intervention sites. This time interval was regarded as appropriate, as case management is a targeted, time limited intervention designed to work within 6 months.

Arms were compared using two-sided tests at the 5% significance level, adjusted for patient characteristics (ambulance service, age in years, sex, ethnicity, Townsend deprivation quintile) and service use (number of emergency ambulance service calls, emergency admissions, elective admissions and outpatient appointments) during the 6 months before patients became eligible. No adjustment for multiplicity was required as the primary outcome had a pre-specified order of analysis. Ninety-five per cent confidence intervals (CIs) are reported where appropriate. Analysis was conducted using SPSS hosted within the SAIL Gateway, a Trusted Research Environment maintained by Swansea University.

We summarised patient recruitment via a CONSORT[53] flow chart, and provided descriptive data summaries for patients, by ambulance service and by site, for demographics, call patterns and volume. Numbers of events were dichotomised where contextually useful (for instance, to declassify or reclassify patients), and converted to rates when appropriate.

Outcomes for the 6 months after patients first became eligible for inclusion in STRETCHED were compared between arms using generalised linear models (logistic models for binary variables; negative binomial models for count variables; linear models for raw and transformed measurement outcomes) with appropriate linking functions. From these models, we obtained adjusted comparisons of outcomes in patients at intervention sites versus those in patients receiving usual care at control sites.[1]

Using linked routine data allowed us to gather retrospective data on service use for callers included in each cohort, strengthening comparisons by enabling adjustment for historical and contemporaneous differences in service use, case mix, and demographics. Reflecting an initial focus on comparing (any) case management approach with the within-service list approach, coding for sites initially assumed that outcomes by study arm were similar across ambulance services.[1] We also presented background information on ambulance service interventions and descriptive summaries of outcomes by ambulance service to test this assumption. The adjusted comparisons incorporated information on covariates and factors based on demographic and case-mix data.

We formalised our planned analyses in a combined Statistical and Health Economics Analysis Plan (SHEAP), compliant with the relevant Swansea Trials Unit (STU) standard operating procedures (SOPs); the SHEAP (see *Report Supplementary Material 4*) detailed conventions on model fitting (including inclusion and exclusion rules for covariates and factors), management of missing data and the reporting of outcomes.

Health economic evaluation

The health economic analysis framework consisted of a CCA of the costs and outcomes/consequences of case management from an NHS and Personal Social Services perspective.

A CCA is a form of economic evaluation where the full range of disaggregated costs and outcomes are reported separately in a format which allows a comprehensive summary of the different costs and negative and positive effects, covering health and non-health, both to patients and other parties. A CCA thus tends to take a broad perspective, and is considered to be not only more transparent and comprehensive but also easier to understand and apply for decision-makers, when compared with other methods of health economic evaluation.[54] The analysis follows a descriptive approach which presents effectiveness results (primary and secondary outcomes) separately to that of the costs, providing a disaggregated overview of return on investment. The CCA approach is recommended for complex interventions that look to observe a broad range of effects which are difficult to measure in a single common unit and is considered particularly appropriate in observational studies,[55,56] particularly when collection of the data on quality of life required for a cost–utility analysis is not practical or possible.

Using the CCA framework, we compared the implementation cost of case management approaches to the potential benefits of 'avoiding expenditure' in subsequent health and social care resource utilisation from a public sector perspective. The overall resource implications for case management approaches for frequent callers included intervention implementation costs, costs of further emergency ambulance service calls and the costs arising from utilisation of other health and care services in the 6-month follow-up period.

The utilisation of other health and care services by the study cohorts in the control and intervention sites was captured using routine data sources – NHS Digital for the three English ambulance services and the SAIL databank for WAST – and costed using appropriate published unit costs. The inclusion of mental health and social care resources were subject to the availability of routine data and assessment and validation of its quality. Where HRG cost codes were available, the accompanying unit cost per HRG code was applied on a per-event basis using a look-up algorithm (created in SPSS syntax) for the healthcare resource use costing for the study. If HRG codes were not available for some resource components (e.g. hospital inpatient stays), the available data were compared to the required field list for the NHS Digital Reference Cost Grouper[57] which can generate HRG codes for each activity record if certain mandatory fields are available within the data. In cases where no HRG codes were available and use of the Digital Reference Cost Grouper was not possible due to missing data in mandatory fields, overall weighted average unit costs across all HRG codes (excluding paediatrics) were used for costing.

We used linear models to adjust for baseline total number of healthcare service contacts and total baseline cost, as well as age, deprivation quintile, ethnicity (collapsed into white/non-white) and gender commensurate with the statistical analysis and to calculate adjusted mean difference with 95% confidence intervals (CIs) and *p*-values between the two patient groups. Healthcare costs associated with the primary and secondary outcomes were also analysed by site to assess differences in consequences of the various ways case management was employed in practice on secondary and emergency care use. The combined SHEAP (*Report Supplementary Material 4*) specified conventions on model fitting for health economics outcomes, consistent with the modelling of clinical outcomes in inclusion and exclusion rules for covariates and factors, management of missing data, and reporting of outcomes.

Cost–consequences analysis

The CCA approach separates costs and consequences and reports them in a disaggregated manner. A cost–consequences table was compiled to report the disaggregated costs and outcomes associated with case management compared to usual care for people who call the emergency ambulance service frequently comparing cumulative costs over the full period of follow-up against the outcomes.

Qualitative analysis

Analysis of focus group and interview transcripts was carried out by members of the research team with the two patient and public involvement (PPI) representatives, alongside input from the research paramedics. We removed all identifiable data from interview transcripts before analysis.[1] We used a data-driven thematic approach to analysis which generated themes from the implicit and explicit ideas within participants' accounts.[58] We followed six stages of analysis:[59] data familiarisation, generating initial coding, searching for themes, reviewing themes, defining and naming themes, producing a report. During analysis, we checked emerging coding and themes with the wider research team and members of the patient panel. We also assessed whether we had an adequate range of participants reflected in our purposive sample.[1] Analysis of data (transcripts, field and observation notes) generated by the interviews was supported by use of NVivo (QSR International, Warrington, UK), computer-assisted qualitative data analysis software.

Synthesis

The STRETCHED logic model (WP1) informed our synthesis and reporting of quantitative and qualitative findings. Quantitative data were used to draw conclusions about comparative costs and effects; qualitative data helped us to understand and interpret these results and to generate theories about how the new models of care were working. We gathered key themes from across all WPs on the effectiveness, attitudes, barriers and facilitators to case management. We interpreted overall effectiveness and cost-effectiveness results in the light of analysis from the qualitative data about which components of case management – for example, care plan, timing of interventions, shared decision-making – were perceived to work well and for whom. We used the logic model to inform the synthesis of results, considered and interpreted at a joint meeting of the RMG and the Lived Experience Advisory Panel (LEAP).

Changes to study design

The natural experiment in the four ambulance services was undertaken within the framework initially established; we extended the intervention sites in two ambulance services when it became clear we had initially overestimated the number of eligible callers within original sites.

Recruitment of patients for the qualitative work proved more challenging, particularly in the three English ambulance services – in Wales, we benefitted from a concurrent and related research initiative. We therefore extended our original design to include a small supplementary study (STRETCH-UP), in which we sought further interviews with people with experience of frequently calling ambulance services, identified via peer support/third-sector organisations. We intended to approach a variety of organisations, including National Users Survivor Network, National Voices, British Lung Foundation, British Heart Foundation, National Centre for Mental Health cohort. Participants could be self-selecting; they may or may not have had any experience of case management, but able to provide insight into why they made high-intensity use of services.

Public and patient involvement

We worked extensively with public contributors to develop a comprehensive approach to active involvement of patients and the public at all study stages.[60] We used a layered approach enabling people to be involved at strategic and local levels in line with their interest, experience and health. We aimed to enable active and meaningful involvement throughout to enhance research quality, rigour and ethical standards, in line with the STU SOP on service user involvement[61] and best practice.[62] Our public co-applicants (PG, BE) were actively involved in study design and shaping the proposal. They were also involved in proposal design to undertake interviews with patients, challenging biases and assumptions in the team and helping choose proper language to describe people who phone the emergency ambulance service.[1] They were members of the RMG and equal partners in decisions about study implementation and dissemination.

We also convened a patient advisory panel (subsequently retitled the Lived Experience Advisory Panel, LEAP) comprising individuals recruited through community groups, support agencies and third-sector networks. The panel reflected the range of people who make frequent calls to the emergency ambulance service including older people, those with chronic illness and people from lower socioeconomic levels. We sought to ensure that public contributors within STRETCHED matched as closely as possible the diverse population of people making frequent calls. LEAP provided a less formal route for people to contribute to specific tasks such as advising on patient-facing materials, sense-checking patient results and devising dissemination materials.[62–64]

We recruited a further two public members to the independent Study Steering Committee (SSC) to bring patient perspectives to oversight and scrutiny decisions. We offered honoraria for all involvement and reimbursed incurred expenses. We provided training for all public contributors, including induction at start of involvement and training in specific skills, such as Good Clinical Practice, analysis, meeting skills and dissemination skills, as required.[64,65]

Research and governance, ethical approvals and permissions, study oversight

STRETCHED was sponsored by Swansea University. We received approval from the Health Research Authority and R&D permissions at all participating NHS organisations. The Health Research Authority approval included a favourable opinion from an NHS Research Ethics Committee (19/WA/0216) and Confidential Advisory Group (CAG) support for accessing patient data without consent.

With this CAG support, it was not necessary to approach patients for consent to participate in the main effectiveness study (WP2); instead, STRETCHED used identifying information held within ambulance services only (and not shared with the wider research team). With information governance permissions in place at NHS Digital and the SAIL databank, retrospective routine data were linked using a split file approach, and an integrated study data set for analysis created within the SAIL Gateway.[66]

The relatively small sample of current patients calling frequently were invited by participating ambulance services to give consent and participate in one-to-one interviews. We recognised the potential vulnerability of these patients, and we took steps to ensure that interviews were conducted in a sensitive manner, at a place of the interviewee's choice or by telephone/video and by appropriately trained researchers at each site. We obtained Swansea University Research Committee approval for the supplementary STRETCH-UP extension, in which we sought to recruit further participants for the qualitative work.

We convened an independent Study Steering Committee, with members from: a non-participating ambulance service; the Frequent Caller National Network (FreCaNN); a range of third-sector healthcare-related organisations; the police service; and academia. Two members offered a PPI perspective; the SSC chair had links with a carers' trust.

Chapter 3 Logic model

Background

We developed the STRETCHED logic model to describe key components, mechanisms of change and expected impacts of cross-sectoral case management approaches to the management of people who call the emergency ambulance service frequently. We then used the logic model to inform later stages of the study – data collection; analysis; interpretation of findings.

Results

A total of 37 people from Wales, England and Northern Ireland attended our stakeholder event with participation from patient representatives and professional staff involved in commissioning, planning and delivering case management for people who call the emergency ambulance services frequently. At this face-to-face workshop we presented an overview of the STRETCHED study, an explanation of what a logic model is and its purpose, and then broke into small groups to discuss four elements of the logic model – components, mechanisms, impacts and context.

We sorted participants into mixed groups for these discussions and rotated the focus of the discussion between tables so that everyone had the opportunity to discuss all elements. A note taker was nominated by group members and was asked to jot down key elements, which were stuck to a board for further sorting and coding after the workshop day.

These aggregated responses from the participants were then used as the basis for developing the STRETCHED logic model (*Figure 1*).

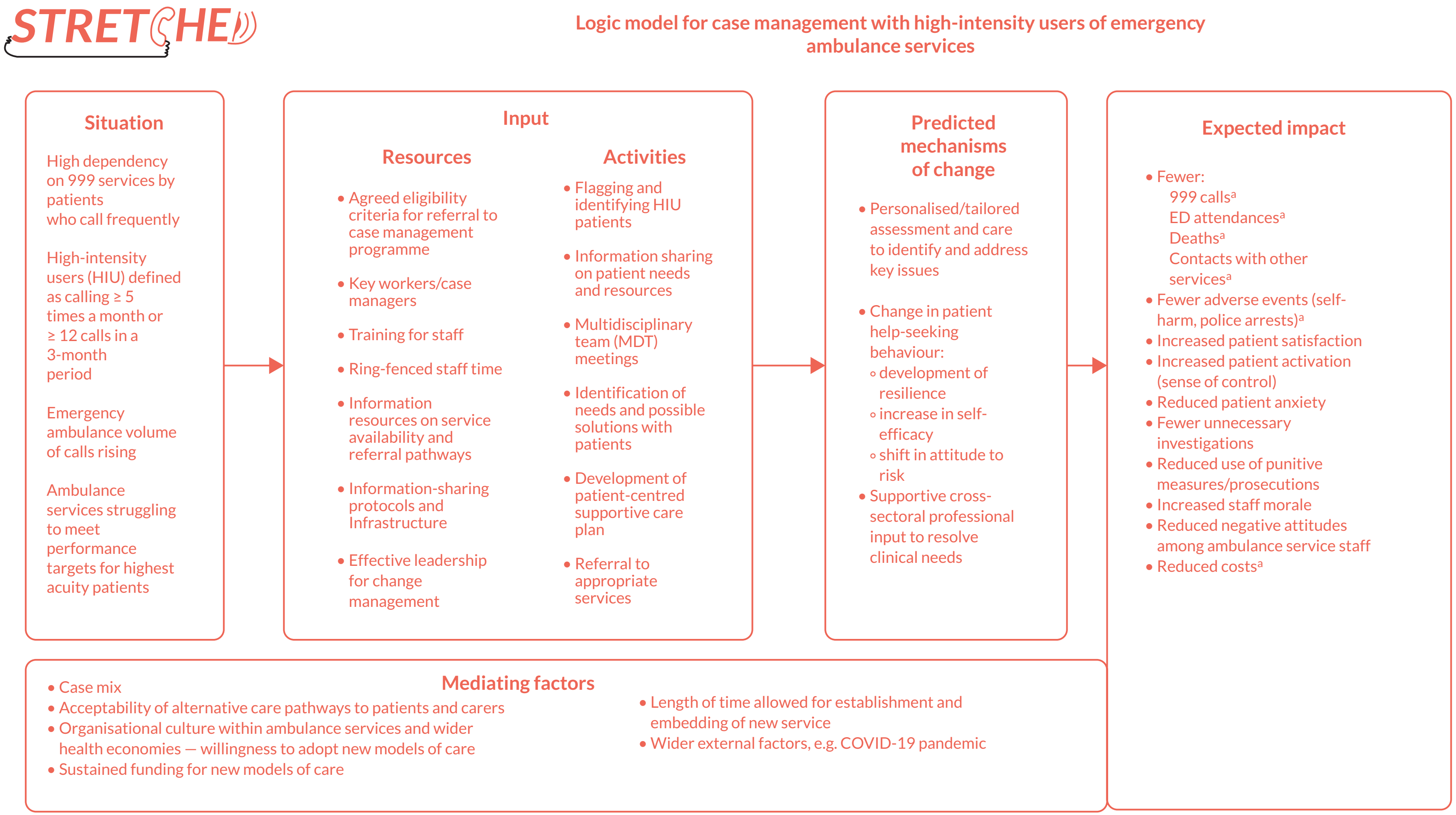

FIGURE 1 STRETCHED logic model. a, Outcomes included in STRETCHED study protocol.

Chapter 4 Clinical effectiveness

Participation identification and flow

Ambulance service researchers experienced difficulties in identifying study participants, as contemporaneous frequent caller lists were not available at all sites. While it was possible to identify eligible patients from call logs, it is not known how many of those patients were identified at the time (and therefore, how many of those patients in intervention areas were referred to case management, or received it), or if any eligible patients were missed.

Lower than anticipated case numbers meant three of the four ambulance services could not identify the anticipated number of eligible patients in case management areas after including patients already on the frequent callers list at the start of 2018. One ambulance service identified considerably more patients than anticipated in its intervention area. Ethical permissions did not allow data for all these patients to be extracted, nor was it feasible to do so. Instead, the list of eligible patients was sorted by postcode and date eligible for inclusion, then systematically sampled to ensure a wide geographic and temporal spread. A subsequent 'top-up' sample was selected the same way to compensate for the lower number of intervention patients identified in other sites. The remaining intervention cases were not included in analysis due to restrictions on data access.

Two ambulance services were unable to identify the number of patients expected in control sites, partially mitigated by extending these sites. Both extended sites were (individually) geographically contiguous. Another ambulance service identified more patients than anticipated in its control site; all of whom were included in the study.

Figure 2 shows the participant flow diagram for STRETCHED. Researchers at the participating ambulance services retrospectively identified a total of 1757 eligible patients (1103 intervention; 654 control) across 8 study sites (1 intervention and 1 control site per ambulance service).

Data including patient identifiers, demographics, emergency ambulance service calls, ambulance dispatches, serious case reviews, and (where available) data on arrests and convictions were extracted for 1220 of these patients (569 intervention, 651 control) and linked with routine electronic data from NHS Digital and the SAIL databank.

Linkage rates to routinely collected data were extremely high, with no patients lost to due to failures in the linkage process. In total, 37 patients (19 intervention, 18 control) were excluded during data cleaning, an attrition rate of 3%. Most of these patients (33 in total; 15 in the intervention arm, 18 in the control arm) were found not to meet study inclusion criteria, while 4 intervention patients were excluded for data quality reasons. Further details are not available due to the risk of inadvertent disclosure through low counts in some subgroups. After these exclusions, the primary outcome analysis included data on a cohort of 1183 patients (550 in the intervention arm; 633 in the control arm).

Demographic and baseline data

Table 2 shows patient characteristics at baseline by study arm and ambulance service. Overall, the study cohort were relatively elderly, with a median age of 65 years (lower quartile 45, upper quartile 81), with slightly more females (51.9%) than males, and were predominantly white (81.7%). Just under two-thirds of patients (65.1%) lived in areas classified in the two most socioeconomically deprived quintiles, while only 5.2% lived in areas classified in the least socioeconomically deprived quintile.

As noted above, there was considerable variation in numbers of patients classified by ambulance service and arm. This is particularly noticeable in the intervention arm, where over half the patients came from one site (AS4). Intervention site patients were also generally younger than control site counterparts in three out of the four participating ambulance services (AS2, AS3 and AS4). The proportion of female patients varied from 44.1% (AS2 intervention site) to 59.2%

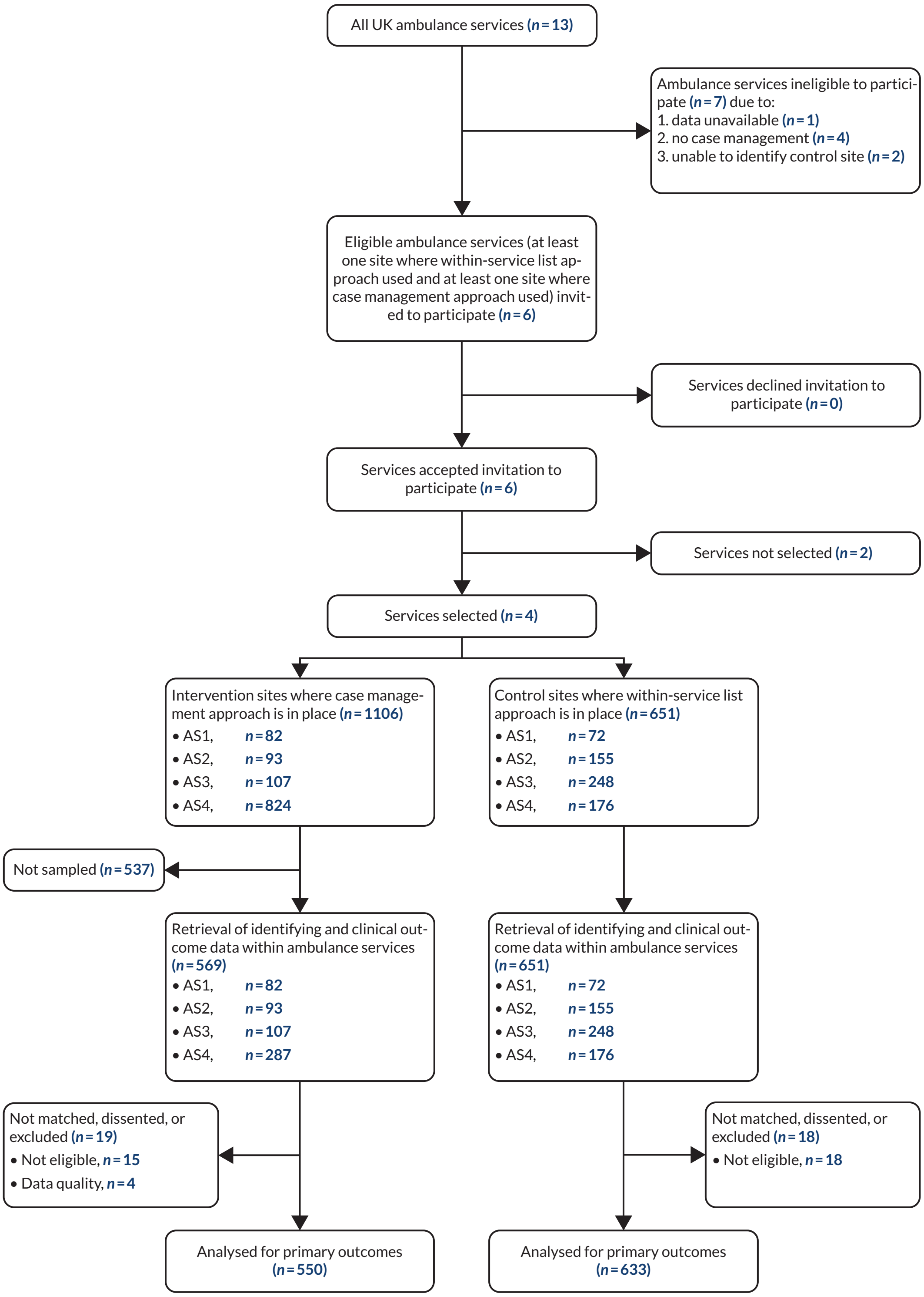

FIGURE 2 STRETCHED patient flow.

(AS1 intervention site) with no clear trend emerging across study arms or ambulance services. Data on ethnicity and deprivation quintile are not classified by ambulance service due to the risk of inadvertent disclosure from low counts in some subgroups.

There were more missing demographics data than anticipated. These data appear to be missing at random, but are not completely so – for instance, where demographics data were only sought from HES data sets, they were unavailable for those patients exercising the 'opt-out' option.

TABLE 2 Patient demographics at baseline, classified by study arm and ambulance service

	Intervention		Control	
Patients identified	***n* = 550**		***n* = 633**	
AS1	82	(14.9%)	72	(11.4%)
AS2	77	(14.0%)	137	(21.6%)
AS3	107	(19.5%)	248	(39.2%)
AS4	284	(51.6%)	176	(27.8%)
Age (years): median (lq – uq)	(*n* = 520)		(*n* = 583)	
Overall	60	(41–80)	69	(49–82)
AS1	62	(45–82)	58	(47–76)
AS2	50	(38–71)	63	(47–82)
AS3	65	(47–80)	73	(52–83)
AS4	60	(39–81)	69	(48–81)
Gender: *n* (%) female	(*n* = 499)		(*n* = 572)	
Overall	266/499	(53.3%)	290/572	(50.7%)
AS1	45/76	(59.2%)	30/60	(50.0%)
AS2	26/59	(44.1%)	48/104	(46.2%)
AS3	62/107	(57.9%)	123/248	(49.6%)
AS4	133/257	(51.8%)	89/160	(55.6%)
Ethnicity: *n* (%) non-white[a]	72/400	(18.0%)	75/412	(18.2%)
Townsend quintile[a,b]	(*n* = 504)		(*n* = 577)	
Q1	28	(5.6%)	28	(4.9%)
Q2	61	(12.1%)	55	(9.5%)
Q3	81	(16.1%)	126	(21.8%)
Q4	99	(19.6%)	189	(32.8%)
Q5	235	(46.6%)	179	(31.0%)

a Data not further classified by ambulance service due to low counts.
b Townsend UK deprivation score quintiles, with Q1 as the least deprived quintile and Q5 as the most deprived. lq, lower quartile; uq, upper quartile.

Baseline use

Table 3 shows emergency ambulance service use by patients for the 6 months before patients became eligible for inclusion in STRECHED. Call data are skewed towards lower numbers of calls with a small number of patients recording considerably more. Again, there was considerable variation in numbers of emergency ambulance service calls per patient classified by ambulance service and arm. The number of calls attended by ambulance and conveyed to hospital were both similar between arms, and with less variation across ambulance services.

Table 4 shows hospital use during the 6 months before each patient became eligible for inclusion in STRETCHED. Approximately two-thirds of patients recorded at least one emergency admission (753/1183; 63.7%), and/or outpatient appointment (804/1183; 68.0%). The proportion of patients recording emergency admissions, ED attendances, elective admissions and outpatient appointments were generally similar between arms; however, the overall mean number (per patient) of emergency admissions, elective admissions and outpatient appointments were all higher in intervention sites.

TABLE 3 Emergency ambulance service use by patients, classified by study arm and ambulance service, for the 6 months prior to eligibility for inclusion in STRETCHED

	Intervention (*n* = 550)		**Control (*n* = 633)**	
Emergency calls per patient: mean (SD)				
Overall	11.61	(17.13)	15.48	(88.93)
AS1	19.27	(28.92)	20.83	(37.79)
AS2	19.03	(28.73)	35.53	(187.86)
AS3	6.85	(2.63)	7.29	(2.87)
AS4	9.17	(7.71)	9.23	(9.24)
In-hours emergency calls per patient: mean (SD)				
Overall	3.18	(5.77)	4.19	(17.76)
AS1	4.59	(8.03)	6.00	(13.31)
AS2	5.87	(10.75)	8.71	(36.40)
AS3	2.10	(1.86)	2.32	(1.81)
AS4	2.46	(3.22)	2.57	(2.80)
Out-of-hours emergency calls per patient: mean (SD)				
Overall	8.42	(12.73)	11.22	(72.18)
AS1	14.68	(22.88)	14.83	(25.29)
AS2	13.16	(18.98)	26.82	(153.09)
AS3	4.75	(2.44)	4.97	(2.89)
AS4	6.71	(6.31)	6.42	(7.63)
Ambulance attendances per patient: mean (SD)				
Overall	6.37	(7.06)	6.92	(14.52)
AS1	7.60	(7.27)	7.07	(7.55)
AS2	9.06	(12.54)	11.04	(29.21)
AS3	4.15	(2.18)	4.52	(2.68)
AS4	6.11	(5.75)	7.02	(6.62)
Ambulance conveyances per patient: mean (SD)				
Overall	3.14	(4.39)	2.97	(3.67)
AS1	3.34	(4.29)	2.88	(2.97)
AS2	4.88	(7.21)	4.06	(6.20)
AS3	2.08	(1.58)	2.06	(1.78)
AS4	3.01	(3.99)	3.47	(2.88)

Comparison of outcomes

Primary outcomes

The primary outcome in STRETCHED is a composite indicator of mortality; emergency hospital admissions; ED attendances; and emergency ambulance service calls. Components were analysed individually and cumulatively by severity using logistic regression analysis adjusted for patient characteristics (ambulance service, age, sex, ethnic

TABLE 4 Hospital use by patients, classified by study arm and ambulance service, for the 6 months prior to eligibility for inclusion in STRETCHED

	Intervention		Control	
Proportion of patients with at least one emergency admission; n (%)				
Overall	351/550	(63.8%)	402/633	(63.5%)
AS1	51/82	(62.2%)	33/72	(45.8%)
AS2	36/77	(46.8%)	66/137	(48.2%)
AS3	69/107	(64.5%)	179/248	(72.2%)
AS4	195/284	(68.7%)	124/176	(70.5%)
Number of emergency admissions per patient: mean (SD)				
Overall	2.01	(2.80)	1.76	(2.27)
AS1	2.07	(2.84)	1.79	(3.27)
AS2	1.69	(2.73)	1.45	(2.34)
AS3	1.42	(1.65)	1.98	(2.21)
AS4	2.31	(3.11)	1.67	(1.72)
Proportion of patients with at least one ED attendance: n (%)				
Overall	458/550	(83.3%)	505/633	(79.8%)
AS1	66/82	(80.5%)	52/72	(72.2%)
AS2	62/77	(80.5%)	98/137	(71.5%)
AS3	92/107	(86.0%)	191/248	(77.0%)
AS4	238/284	(83.8%)	164/176	(93.2%)
Number of ED attendances per patient: mean (SD)				
Overall	5.10	(7.38)	4.40	(6.92)
AS1	5.89	(6.80)	5.17	(7.18)
AS2	8.31	(9.29)	6.09	(11.29)
AS3	3.24	(4.79)	2.48	(2.97)
AS4	4.69	(7.50)	5.49	(5.62)
Proportion of patients with at least one elective hospital appointment: n (%)				
Overall	90/550	(16.4%)	84/633	(13.3%)
AS1	13/82	(15.9%)	10/72	(13.9%)
AS2	12/77	(15.6%)	23/137	(16.8%)
AS3	13/107	(12.1%)	32/248	(12.9%)
AS4	52/284	(18.3%)	19/176	(10.8%)
Number of elective hospital appointments per patient: mean (SD)				
Overall	0.36	(2.71)	0.24	(1.18)
AS1	0.95	(6.74)	0.22	(0.61)
AS2	0.21	(0.57)	0.23	(0.54)
AS3	0.22	(0.81)	0.24	(1.02)
AS4	0.29	(0.88)	0.28	(1.79)

TABLE 4 Hospital use by patients, classified by study arm and ambulance service, for the 6 months prior to eligibility for inclusion in STRETCHED (*continued*)

	Intervention		Control	
Proportion of patients with at least one outpatient appointment				
Overall	387/550	(70.4%)	417/633	(65.9%)
AS1	59/82	(72.0%)	45/72	(62.5%)
AS2	50/77	(64.9%)	92/137	(67.2%)
AS3	61/107	(57.0%)	139/248	(56.0%)
AS4	217/284	(76.4%)	141/176	(80.1%)
Number of outpatient appointments per patient: mean (SD)				
Overall	4.12	(8.20)	3.38	(4.93)
AS1	7.06	(16.70)	2.71	(3.46)
AS2	4.06	(7.51)	4.89	(6.52)
AS3	1.80	(2.61)	1.77	(2.53)
AS4	4.16	(5.34)	4.76	(5.77)

group, deprivation quintile) and service use (number of emergency ambulance service calls, emergency admissions, ED attendances, elective admissions, and outpatient appointments) for the 6 months prior to eligibility for inclusion in STRETCHED. The proportion of patients where an event was recorded and the mean number of events per patient during the 6-month follow-up are presented at an overall level in *Table 5* (primary outcome components) and *Table 6* (composite outcome). Outcomes for individual ambulance services are presented in *Appendix 2*.

We did not detect any statistically significant difference between arms for the overall composite outcome, or the individual components of death, emergency admissions, ED attendances or further emergency ambulance service calls.

The proportion of patients recording at least one component of the composite primary outcome was very high (95.3% overall). While this is partly attributable to 86.9% of patients making at least one further emergency ambulance service call, almost as many patients (84.4%) recorded an event in at least one other component of the composite measure.

The proportion of patients that died within the 6-month follow-up period was relatively high (10.5% intervention, 14.1% control, 12.4% overall). Although mortality did not differ significantly with study arm, it was strongly associated with age ($p < 0.001$), which does differ between arms. The most frequently recorded reasons for death, consistent with the age of the study population, are reported in *Table 7*.

Secondary outcomes

Table 8 presents secondary study outcomes, including the proportion of patients referred for case management; the proportion of patients that no longer met the frequent caller threshold at any point (and the proportion of those patients that subsequently met the threshold), the proportion and mean number of outpatient appointments, elective appointments, the mean number of ambulance attendances and conveyances, and evidence of harm (defined as at least one adverse event, arrest, or conviction recorded, a complaint made by/on behalf of the patient, or a request for a serious case review). Outcomes were assessed for the 6 months after each patient was first eligible for inclusion in STRETCHED.

Where data were available, approximately two-fifths of eligible patients (40.2%) were referred for case management, of whom 69.2% are known to receive it. However, only one ambulance service was able to provide these data for all intervention area patients, and a second service provided data for a subset of patients only. The other two services

TABLE 5 Components of the primary outcome

	Intervention (*n* = 550)		Control (*n* = 633)		Adjusted comparison[a]	
					Difference (95% CI)	*p*-value
Mortality[b]: *n* (%)	58	(10.5%)	89	(14.1%)	OR = 0.713 (0.465 to 1.093)	0.121
At least one emergency admission recorded: *n* (%)	371	(67.5%)	422	(66.7%)	OR = 1.114 (0.831 to 1.492)	0.470
Emergency admissions recorded: mean (SD)	2.27	(3.31)	1.94	(2.85)	Λ = 1.152 (0.984 to 1.349)	0.083
At least one ED attendance: *n* (%)	423	(76.9%)	468	(73.9%)	OR = 1.088 (0.763 to 1.551)	0.642
ED attendances recorded: mean (SD)	5.96	(10.67)	5.13	(10.34)	Λ = 0.973 (0.848 to 1.115)	0.702
At least one emergency ambulance service call: *n* (%)	483	(87.8%)	545	(86.1%)	OR = 1.197 (0.794 to 1.805)	0.391
Emergency ambulance service calls; mean (SD)	17.17	(28.65)	15.35	(26.43)	Λ = 1.062 (0.930 to 1.212)	0.394

a Adjusted comparison: OR, odds ratio; Λ, incident rate ratio (IRR).
b All-cause mortality within 6 months.

TABLE 6 Primary outcomes

					Adjusted comparison[a]	
Composite	Intervention (*n* = 550)		Control (*n* = 633)		Difference (95% CI)	*p*-value
Mortality *or* emergency admission: *n* (%)	384	(69.8%)	446	(70.5%)	OR = 1.013 (0.748 to 1.372)	0.933
Mortality *or* emergency admission *or* ED attendance: *n* (%)	464	(84.4%)	535	(84.5%)	OR = 1.005 (0.675 to 1.495)	0.981
Mortality *or* emergency admission *or* ED attendance *or* emergency ambulance service call: *n* (%)	526	(95.6%)	601	(94.9%)	OR = 1.159 (0.595 to 2.255)	0.665

a The comparison between arms reflects the variable under consideration: odds ratios (OR) for binary outcomes analysed using logistic regression models, or incident rate ratios (Λ) for count outcomes analysed using negative binomial models.

TABLE 7 Recorded cause of mortality (based on groups of ICD10 codes)

Cause	Intervention (*n* = 58 deaths)		Control (*n* = 89 deaths)		Comparison
Diseases of the circulatory system: *n* (%)	12/58	20.7%	30/89	33.7%	$\chi^2 = 6.735$, degrees of freedom = 3, $p = 0.081$
Malignant neoplasms	19/58	32.8%	15/89	16.9%	
Diseases of the respiratory system	12/58	20.7%	15/89	16.9%	
Other	15/58	25.9%	29/89	32.6%	

TABLE 8 Secondary outcomes within the 6-month follow-up period

					Adjusted comparison[a]	
	Intervention (*n* = 550)		**Control (*n* = 633)**		**Difference (95% CI)**	***p*-value**
Referred for case management[b]: *n* (%)	39/97	(40.2%)	N/A	N/A	N/A	N/A
Patients declassified[c]: *n* (%)	538/550	(97.8%)	626/633	(98.9%)	OR = 0.619 (0.228 to 1.681)	0.347
Declassified patients subsequently meeting the frequent caller criteria: *n* (%)	179/538	(33.3%)	183/626	(29.2%)	OR = 1.075 (0.800 to 1.446)	0.631
Patients with at least one elective appointment: *n* (%)	81/550	(14.7%)	54/633	(8.5%)	OR = 1.802 (1.198, 2.711)	0.005
Number of elective appointments: mean (SD)	0.30	(1.65)	0.12	(0.48)	Λ = 1.720 (1.229 to 2.407)	0.002
Patients with at least one outpatient appointment: *n* (%)	390/550	(70.9%)	428/633	(67.6%)	OR = 1.056 (0.767 to 1.455)	0.737
Number of outpatient appointments: mean (SD)	4.91	(9.28)	3.61	(5.43)	Λ = 1.046 (0.905 to 1.210)	0.548
Ambulance attendances: mean (SD)	9.24	(13.90)	7.75	(11.96)	Λ = 1.050 (0.918 to 1.200)	0.493
Ambulance conveyances: mean (SD)	4.18	(7.49)	3.43	(5.39)	Λ = 1.055 (0.915 to 1.217)	0.469

[a] The comparison between groups reflects the variable under consideration: odds ratios (OR) for binary outcomes analysed using logistic regression models, or incident rate ratios (Λ) for count outcomes analysed using negative binomial models.
[b] Intervention areas only, where data on referral for case management were available.
[c] Patients no longer meeting the frequent caller criteria at some point during follow-up.

were unable to provide these data due to lack of access to contemporaneous frequent caller lists, as previously noted. This may impact the generalisability of study findings.

Almost all patients (98.4%) no longer met the frequent caller threshold at some point during follow-up (i.e. there was at least one point where the patient had not made 5 or more calls in the previous month or 12 or more calls over the previous 3 months). However, this does not take into account, for example, any extended hospital stays that may impact call frequency. Approximately one-third of these patients (intervention 33.3%; control 29.2%) subsequently met the call threshold again during the follow-up period, with no statistically significant difference observed between study arms.

The mean number of ambulance attendances and conveyances were similar between arms. Just over half of emergency ambulance service calls resulted in attendance (53.8% intervention; 50.4% control); < 25% of calls resulted in conveyance to hospital (24.3% intervention; 22.3% control). The most common reasons for calling were ‘fall’ (6.5%), ‘sick person’ (5.2%) and acute coronary syndrome (4.7%).

Similar numbers of patients recorded at least one outpatient appointment during the follow-up period in both arms. More patients recorded at least one elective appointment in intervention areas compared with control areas (14.7% intervention; 8.5% control; $p = 0.005$); the mean number of elective appointments was similarly higher in intervention areas (0.30 events per person in intervention areas; 0.12 events per person in control areas; $p = 0.002$).

There is only sparse data available on harms (adverse events, complaints made to the ambulance service, serious case reviews, arrests and convictions) both prior to and during the follow-up period – participating ambulance services reported that data for arrests and convictions were generally not available. On grouping together extremely low numbers of these different events, there are a total 5 such events in the intervention arm, and 11 in the control arm – no formal statistical comparison was undertaken due to uncertainty over the completeness of the data.

Further discussion of these results, in the context of findings from other strands of the study, is presented in the discussion chapter of this report. As STRETCHED was not powered to detect differences between arms within individual ambulance services, summaries of outcomes by ambulance service are presented in *Table 18* (primary outcome and components) and *Table 19* (secondary outcomes) in *Appendix 2*, while *Appendix 3* contains further details of data processing, multiple imputation methods and statistical modelling of the primary outcome.

Chapter 5 Health economics

Introduction

This chapter reports on the health economic component of STRETCHED, addressing part of the third study objective, namely, the evaluation of costs and consequences of case management for the care of people who call the emergency ambulance service frequently. The evaluation is based on further emergency contacts (emergency ambulance service calls, ED attendances, emergency admissions to hospital) and costs of intervention and usual care. This health economic evaluation is reported using key sections of the Consolidated Health Economic Evaluation Reporting Standards 2022[67] checklist applicable to the reporting of CCAs. The evaluation of costs and consequences was undertaken in accordance with the study's SHEAP (see *Report Supplementary Material 4*); no deviation from this plan occurred.

Deviation from originally planned analysis

In the original study design and published protocol paper, the use of a cost–benefit framework was initially mooted, with the intention of comparing the implementation costs of case management to the potential benefits of 'avoiding expenditure' in subsequent healthcare resource utilisation, and calculation of net present value and internal rate of return. However, the STRETCHED RMG agreed to widen the scope of the analysis to include a broader range of outcomes as part of a more comprehensive CCA that provided a less aggregated overview of all costs and consequences.

Intervention implementation and costs

Responses received to the initial resource questionnaire (see *Report Supplementary Material 1*) demonstrated that much of the data required were not recorded or available and services struggled to find the time to provide the detail required.

The following unit costs were identified and used in the costing:

- Band 7 mean annual basic pay per FTE for nursing, midwifery and health visiting staff by Agenda for Change band, NHS England is £39,994, corresponding to £3333 per month.
- Band 7 mean annual basic pay equivalent pay in Wales is £37,244, corresponding to £3104 per month.
- The electronic staff records system shows that the mean basic salary for a qualified community-based nurse (Band 5) is £32,949, corresponding to £2746 per month.
- The mean annual basic pay per FTE for administrative and clerical staff is £24,391, corresponding to £2033 per month.

While the aim and overall actions taken as part of case management are the same across sites (see *Table 1*), the ways these actions are delivered differ from site to site. Based on documents reviewed, interviews and information received from sites, the ambulance service frequent caller case management models differ in both staffing and case management strategies. *Table 9* shows the estimated staffing costs (for ambulance services only) per patient case-managed per month for the four intervention sites. While the number of patients who are case-managed per month is approximate depending on resources available and complexity of the support required, the number of cases appears consistent over the 12-month period, with some patients requiring support over many months and some patient cases resolved within the month. Therefore, many patients will be case-managed over several months with resolved cases closed and new patients added to the caseload each month. Data have not been collected measuring staff time taken or other resources required by various staff to case manage each individual patient. Therefore, annual pay rates and contracted

TABLE 9 Breakdown of staffing costs associated with the delivery of case management at each intervention site

Ambulance service	Frequent caller lead/ team	Contracted contact hours dedicated to the frequent caller intervention	Number of patients[a]	Monthly costs	
EEAS[b]	Clinical co-ordinator; frequent caller lead [both NHS Band 7]	Both assumed full time	n = 20 (assumed)	Clinical co-ordinator	£3333
				Frequent caller lead	£3333
				Staff total	£6666
				Per patient	£333
LAS[c]	Frequent caller lead [NHS Band 7] Clinician: nurse [NHS Band 5] Administrator	All assumed full time	n = 25 (based on 20–30 patients per month managed through MDT meetings)	Frequent caller lead	£3333
				Band 5 clinician	£2746
				Administrator	£2033
				Staff total	£8112
				Per patient	£324
WAST[d]	Clinical Support Officer (CSO) Frequent caller (FC) lead paramedic [both NHS Band 7 Wales]	CSO: 80% FC paramedic: up to 100%	n = 20	CSO	£2483
				FC paramedic	£3104
				Staff total	£5587
				Per patient	£279
WMAS[c]	Frequent caller lead CCG FC nurse [both NHS Band 7]	FC lead: 10% CCG FC nurse: 33%	n = 57 (FC lead n = 7; CCG FC nurse n = 50)	FC lead	£333
				CCG FC nurse	£1100
				Staff total	£1433
				Per patient	£25

a Number of patients on the frequent caller/high-intensity user list under review and with a care plan.
b Communications with EEAS frequent caller team; e-mails explained that the FC intervention was not fully developed during the study period, with approximately 50 patients on the frequent caller list at any one time, but no details on the number case-managed.
c Qualitative interviews.
d Communications with frequent caller lead; about 50 patients on the list and up to 20 will be case-managed at any given time.

hours dedicated to the frequent caller enhanced intervention are used in relation to number of patients supported by the intervention.

Partner agencies supporting case management following referral such as NHS services, social services, voluntary sector and police service staff contributing to MDTs engaged to manage such complex patients did not receive additional funding to facilitate such support. This work was absorbed as part of their workload and no data were available to estimate these opportunity costs.

Multidisciplinary team case management meetings

It was noted during the qualitative interviews that NHS partners contacted when a frequent caller is identified carry out their role for the care management plan as an add-on to their current workload/role, with no specific funding provided for the specific care of identified patients. While we acknowledge this to be an area of potential opportunity cost, no data are available to estimate these costs. *Table 10* shows the various NHS, social care, voluntary and police services that could potentially be engaged as part of a care management plan and attend MDT meetings, depending on the individual needs of each patient. It is also noted that, at MDT meetings, frequent users of other services (ED, out-of-hours GPs, police) can also be discussed in some areas, not just frequent caller patients referred by the ambulance service.

TABLE 10 Multidisciplinary team meetings: potential opportunity cost for outside agency partners between July 2017 and July 2019

Ambulance service	MDT meeting: list of potential healthcare professionals attending	Number of ambulance service referred patients discussed during the meeting
EEAS East of England Ambulance Service (North East Essex CCG)	The MDT meeting is attended by a doctor from the CCG, community matrons, a clinician from the 111 service and the out of hours (OOH) GP service, mental health team, local GP practice forum; also representation from local ED and ambulance service	The number of patients presented from the ambulance service varies at each meeting – from 0 to 2 or 3
LAS London Ambulance Service (Lewisham CCG)	Ambulance Service Manager chairs MDT meeting attended by GP, Social Worker, Mental Health Nurse, Consultant, Housing Officer, District Nurse	Operations manager reviews and manages between 20 and 30 patients a month through MDT meetings
WAST Welsh Ambulance Service Trust (Cardiff and Vale Health Board)	MDT chaired by ED frequent attender lead. Possible agencies involved: ambulance service, police, ED psychiatric liaison, OOH, voluntary sector, social services, support workers from assisted living accommodation, community mental health team	Approx. 15 patients per month brought to meeting but only 5 on average discussed
WMAS West Midlands Ambulance Service (Birmingham and Solihull CCG)	MTD can be **clinician-led:** e.g. community nurses, mental health team, ambulance service, social worker *or* **police-led**: police officers, ambulance service, alcohol and addiction services, housing services, etc.	Regular meetings take place to discuss 10–15 patients

Total intervention implementation cost

Intervention implementation cost varies between sites and is difficult to separate from usual care. Based on the information available, it is estimated that case management costs between £25 and £333 per patient per month. This does not include cost to other services and opportunity costs, which remain unquantified.

Healthcare resource utilisation and costs

Cost of resource use included in the primary outcome

A summary of total and mean per patient healthcare resource use and cost associated with healthcare contacts included in the primary outcome can be found in *Table 11*, with adjusted comparisons.

When adjusted for baseline total number of healthcare service contacts and total baseline cost, together with age, gender, deprivation quintile and ethnicity (collapsed into white/non-white), patients in the case management intervention sites had marginally lower mean per patient healthcare resource use and costs included in the primary outcome compared to patients in the usual care sites. Overall, patients in the intervention sites had −0.13 (95% CI −5.38 to 5.11; $p = 0.960$) more emergency healthcare contacts (including non-elective hospital admissions, ED attendances, emergency ambulance service calls) compared with control site patients over the 6-month follow-up period, at a slightly reduced mean cost of £243.57 (95% CI −£1972.93 to £1485.79; $p = 0.782$) per patient. However, there was no statistically significant difference between usual care and intervention groups at the 5% level for mean per patient healthcare service contacts or costs for any of the service use components included in the primary outcome.

Cost of resource use included in the secondary outcome

A summary of total and adjusted mean per patient healthcare resource use and costs associated with healthcare contacts included as secondary outcomes can be found in *Table 12*.

TABLE 11 Total and mean per patient healthcare resource use and costs for components of the primary clinical outcome

					Comparison	
	Intervention sites (*n* = 550)		Control sites (*n* = 633)		Estimate (95% CI)	*p*-value
Primary outcome						
Total cost (£)	5,483,397		5,861,193			
Cost (£) per patient: mean (SD)	9969.81	(12,521.71)	9259.39	(12,324.23)	Δ = −243.57 (−1972.93 to 1485.79)	0.782
Emergency admissions[a]						
Total cost (£); *n*	4,832,997	1251	5,205,947	1230		
Cost (£) per patient: mean (SD)	8787.27	(11,915.98)	8224.25	(11,744.46)	Δ = −86.76 (−1706.19 to 257.10)	0.916
Non-elective short stay						
Total cost (£)	221,464	376	199,671	339		
Cost (£) per patient: mean (SD)	402.66	(972.60)	315.44	(697.17)	Δ = 119.44 (−18.21 to 257.10)	0.089
Number per patient: mean (SD)	0.68	(1.65)	0.54	(1.18)		
Non-elective long stay						
Total cost (£); *n*	4,611,533	875	5,006,276	891		
Cost (£) per patient: mean (SD)	8384.61	(11,643.97)	7908.81	(11,602.15)	Δ = −206.20 (−1786.66 to 1374.26)	0.798
Number per patient: mean (SD)	1.59	(2.25)	1.41	(2.20)		
ED attendances[a]						
Total cost (£); *n*	555,930	3279	558,076	3247		
Cost (£) per patient: mean (SD)	1010.78	(1692.53)	881.64	(1533.45)	Δ = −147.59 (−402.47 to 107.29)	0.256
Emergency ambulance service calls[a]						
Total cost (£); *n*	94,470	9447	97,170	9717		
Cost (£) per patient: mean (SD)	171.76	(286.54)	153.51	(264.30)	Δ = −9.22 (−52.79 to 34.34)	0.678

[a] See *Table 4* for further details on and comparison of the mean number of events per patient.

When adjusted for baseline total number of healthcare service contacts and total baseline cost, together with age, gender, deprivation quintile and ethnicity (collapsed into white/non-white), total healthcare resource use and costs included as secondary outcomes were higher for patients in the intervention sites with an overall mean cost increase of £781.87 (95% CI −£198.40 to £1762.14; $p = 0.118$) per patient, equating to 2.20 more healthcare contacts (95% CI −0.35 to 4.77; $p = 0.091$) over the 6-month follow-up period. While the difference in total resource use and cost was not statistically significant, the increases in outpatient appointment numbers and costs as well as number of elective inpatient admissions and ambulance callouts were statistically significant, albeit small overall.

TABLE 12 Total and mean per patient healthcare resource use and costs for secondary outcomes

					Comparison	
	Intervention sites (*n* = 550)		**Control sites (*n* = 633)**		**Estimate (95% CI)**	***p*-value**
All secondary outcomes						
Total cost (£)	2,214,672		1,856,404			
Cost (£) per patient: mean (SD)	4026.68	(6392.06)	2932.71	(5223.90)	Δ = 781.87 (−198.40 to 1762.14)	0.118
Outpatient appointments[a]						
Total cost (£); *n*	516,838	2699	420,729	2282		
Cost (£) per patient: mean (SD)	939.71	(1523.33)	664.66	(1102.90)	Δ = 261.34 (45.74 to 476.93)	0.018
Elective admissions[a]						
Total cost (£)	525,666	163	306,627	78		
Cost (£) per patient: mean (SD)	955.76	(4930.64)	484.40	(4150.13)	Δ = 518.15 (−283.03 to 1319.32)	0.205
Day cases						
Total cost (£); *n*	94,000	125	43,616	58		
Cost (£) per patient: mean (SD)	170.91	(1184.72)	68.90	(325.88)	Δ = 125.63 (−21.31 to 272.57)	0.094
Number per patient: mean (SD)	0.23	(1.58)	0.09	(0.43)		
Elective admissions (1 or more nights)						
Total cost (£); *n*	431,666	38	263,011	20		
Cost (£) per patient: mean (SD)	784.85	(4550.11)	415.50	(4138.38)	Δ = 392.52 (−374.86 to 1159.89)	0.316
Number per patient: mean (SD)	0.07	(0.29)	0.03	(0.18)		
Ambulance attendances[a]						
Total cost (£); *n*	1,172,168	5080	1,129,048	4904		
Cost (£) per patient: mean (SD)	2131.21	(3182.14)	1783.65	(2687.96)	Δ = 2.39 (−463.21 to 467.99)	0.992
Ambulance attendances: 'treat' only						
Total cost (£); *n*	580,811	2779	571,615	2735		
Cost (£) per patient: mean (SD)	1056.02	(2034.74)	903.03	(1891.92)	Δ = 78.42 (−242.55 to 399.40)	0.632
Number per patient: mean (SD)	5.05	(9.74)	4.32	(9.05)		
Ambulance conveyances[a]						
Total cost (£); *n*	591,357	2301	557,433	2169		
Cost (£) per patient: mean (SD)	1075.19	(1924.60)	880.62	(1386.36)	Δ = −76.03 (−336.90 to 184.84)	0.567

[a] See *Table 8* for further details on and comparison of the mean number of events per patient.

Total healthcare costs

Table 13 summarises overall resource use and cost. On combining all healthcare resource use within primary and secondary outcomes, patients identified as frequent callers in the intervention sites had, on average, five healthcare contacts more than patients in the control sites, at an estimated additional cost of £538.30 (95% CI −£1641.53 to £2718.13; $p = 0.628$). This difference was not statistically significant at the 5% level.

Healthcare costs by ambulance service

A summary of costs of healthcare contacts by ambulance service can be found in *Table 22* in *Appendix 4*.

Cost–consequences analysis

The results of the CCA are presented in *Table 14*.

Adjusted and unadjusted comparisons

Given some imbalances observed at baseline (see *Chapter 4*), we provide here, for completeness, a summary of the differences in unadjusted and adjusted comparisons between study groups.

Without adjustment for baseline total number of service contacts and total baseline cost, age, deprivation quintile, ethnicity (white/non-white) and gender, patients in intervention sites, with an average of five additional healthcare contacts, incurred an average additional cost of £1804.39 (95% CI £107.56 to £3501.22; $p = 0.037$); this difference would be regarded as statistically significant at the 5% level. The difference in the number of contacts (weighted equally) would also be regarded as statistically significant ($p = 0.031$).

With adjustment, the estimated additional cost per patient in the intervention becomes £538.30 (95% CI −£1641.53 to £2718.13; $p = 0.628$).

Similar changes due to adjustment are seen in costs associated with primary and secondary outcomes (*Table 15*).

To the best of our knowledge, this is the first estimation of costs and consequences of case management for patients identified as frequent callers by ambulance services in the UK. We have transparently reported our analyses, but, as outlined in the discussion chapter, various limitations apply and the overall level of uncertainty in our findings remains high.

TABLE 13 Overall resource use and cost

	Intervention sites (*n* = 550)		**Control sites (*n* = 633)**		**Comparison**	
					Estimate (95% CI)	***p*-value**
Total cost (£); *n*	7,698,069		7,717,597			
Cost (£) per patient: mean (SD)	13,996.49	(15,330.33)	12,192.10	(14,394.07)	Δ = 538.30 (−1641.53 to 2718.13)	0.628
Total events	21,917		21,458			
Events per patient: mean (SD)	39.85	50.11	33.90	(44.50)		

TABLE 14 Cost–consequences table of case management for people who call 999 frequently compared to usual care

					Comparison			
Costs in 2018–9 (GBP)	**Intervention (*n* = 550)**		**Control (*n* = 633)**		**Estimated difference**	**(95% CI)**	***p*-value**	**Source table**
Implementation cost (per patient per month): minimum – maximum	25–333		0		25–333			*Table 9*
Emergency care cost per patient: mean (SD)	9969.81	(12,521.71)	9259.39	(12,324.23)	−243.57	(−1972.93 to 1485.79)	0.782	*Table 11*
Outpatient cost per patient: mean (SD)	939.71	(1523.33)	664.66	(1102.90)	261.34	(45.74 to 476.93)	< 0.001	*Table 12*
Elective inpatient cost per patient: mean (SD)	955.76	(4930.64)	484.40	(4150.13)	518.15	(−283.03 to 1319.32)	0.205	*Table 12*
Ambulance service call-out cost per patient: mean (SD)	2131.21	(3182.14)	1783.65	(2687.96)	2.39	(−463.21 to 467.99)	0.992	*Table 12*
Total secondary care cost per patient: mean (SD)	4026.68	(6392.06)	2932.71	(5223.90)	781.87	(−198.40 to 1762.14)	0.118	*Table 12*
Outcomes								
All-cause mortality within 6 months: *n* (%)	58	(10.5%)	89	(14.1%)	0.713	(0.465 to 1.093)	0.121	*Table 5*
Mortality or emergency admission: *n* (%)	384	(69.8%)	446	(70.5%)	1.013	(0.748 to 1.372)	0.933	*Table 6*
Mortality, or emergency admission, or ED attendance: *n* (%)	464	(84.4%)	535	(84.5%)	1.005	(0.675 to 1.495)	0.981	*Table 6*
Mortality, or emergency admission, or ED attendance, or emergency ambulance service call: *n* (%)	526	(95.6%)	601	(94.9%)	1.159	(0.595 to 2.255)	0.665	*Table 6*
Patient declassified[a]: *n* (%)	538	(97.8%)	626	(98.9%)	0.619	(0.228 to 1.681)	0.347	*Table 8*
Declassified patients subsequently meeting the frequent caller criteria: *n* (%)	179/538	(33.3%)	183/626	(29.2%)	1.075	(0.800 to 1.446)	0.631	*Table 8*

[a] Patients no longer meeting the frequent caller criteria at some point during follow-up.

TABLE 15 Adjusted mean difference in healthcare resource use and costs (£)

	Differences (95% CIs); *p*-value	
	Unadjusted	**Adjusted**
Primary outcome	710.42 (−709.61 to 2130.46) *p* = 0.327	−243.57 (−1972.93 to 1485.79) *p* = 0.782
Secondary outcomes	1093.97 (421.65 to 1766.29) *p* = 0.001	781.87 (−198.40 to 1762.14) *p* = 0.118
Overall	1804.39 (107.56 to 3501) *p* = 0.037	538.30 (−1641.53 to 2718.13) *p* = 0.628

Chapter 6 Qualitative findings

In this chapter, we report on three qualitative aspects of the study:

- Interviews with key service providers in each site in order to identify challenges and opportunities associated with using case management models, including features associated with success, and develop theories about how case management works in this population. We used the logic model developed in WP1 to structure the analysis of data and to present findings.
- Interviews with people who had been identified as recipients of case management in one of the ambulance service sites.
- Interviews with people with experience of frequently calling ambulance services, recruited through third-sector organisations and social media (the STRETCH-UP substudy).

Interviews with service providers

Respondents

We conducted 31 interviews with key service providers. In each site we interviewed the ambulance service frequent caller lead, plus between five and eight people involved in providing a response to frequent callers, working for the ambulance service or partner organisations. Details are shown in *Table 16*.

Inputs to case management

Identifying frequent callers

The first step in delivering case management was to identify the people classed as high-intensity users or frequent callers – both terms were used by respondents, sometimes interchangeably. There were various routes for identification: all ambulance services would routinely scan data from the call centre and flag people who met the FreCaNN threshold, and additionally referrals could be made by front-line ambulance clinicians.

> *Every day I wake up to new emails from staff who've attended a patient, signpost them to me, tell me it might be someone new, tell me it's someone old who's back on the radar … I probably get about five a day.*
>
> *AS3-3 Ambulance service frequent caller lead*

All respondents discussed the range of people classed as frequent callers, and there was some consensus that they could be grouped into three main categories: people with acute healthcare needs which were not being resolved, perhaps because they were not matched with the appropriate service providers; people with long-term health or social care needs with recurrent exacerbations triggering contact; and those who were described as 'traditional' (AS2-5 paramedic) frequent callers, that is, perceived as having issues with behaviour rather than what would be seen as legitimate healthcare needs. There was a range of perspectives on what proportion of people fell into each category.

TABLE 16 STRETCHED interview structure per ambulance service

AS1	8 interviews: FC lead; system escalation manager; HIUG chair; operational manger; triage centre manager; paramedics (x3)
AS2	6 interviews: FC lead; nurse in extra care team; support worker; GP lead for extra care team; paramedics (x2)
AS3	8 interviews: FC lead; operation support manager; therapeutic outreach practitioner; nurse, homeless service; GP; AS medical director; paramedic
AS4	9 interviews: FC lead; HISU medical lead; alcohol nurse; MH paramedic; ED consultant; HALO; police (x3)

Generally, the third category was regarded as making up the smallest group, with one paramedic suggesting that they might encounter one or two such patients a month; though in the opinion of another clinician, 80% of the frequent caller patients had behaviour which needed managing.

In other areas, senior clinicians identified the problem much more clearly as being about failure of health or social care systems to address people's needs. There was also sympathetic understanding from some that patients could respond in a range of way to physical symptoms:

> *They're unable to cope with their illness or they perceive it to be more severe than it might be.*
>
> *AS1-4 Ambulance service manager*

One respondent working directly in a support role described their understanding of the complexity and cyclical nature of many people's needs:

> *Frequent attenders tend to be, I think in a word lost … it's like a vicious cycle of you're in crisis, you're really struggling, you call an ambulance, you go down there you feel cared for, and then you're discharged, so you're rejected again. And then you're back with the family, they've had enough of you, so you drink again and you get into crisis, you feel like you're going to harm yourself, you ring an ambulance, you go back in, you feel cared for, you're rejected again during discharge, there's almost that rejection after. So, yeah, round and round it goes …*
>
> *AS3-2 Outreach worker, third sector*

Selection of people to work with

Although there were set procedures for putting people onto the list of frequent callers, this did not necessarily mean that they would all be selected for the frequent caller intervention. Before taking any further steps, some ambulance services might do further work to understand the person's needs, and identify them as potentially benefiting from a multidisciplinary response:

> *Once we find patients triggering the threshold for the frequent callers [frequent caller lead] goes into the history, and what we've found was that most of the calls were not ever going to be solved by sending an ambulance … a lot of them were loneliness and social problems.*
>
> *AS3-8 Ambulance service senior manager*

A certain number of those identified as frequent callers would be selected for putting forward to case management via MDT meetings; there was acknowledgement that numbers in need would always be greater than the capacity to offer a case management response. Decisions about who would be offered case management were informed in part by geography (case management tended to be delivered in localities much smaller than the territory of the ambulance service, and provision was uneven); and in part by the volume of calls, though there was an understanding that the highest users might not be the ones where there was some potential for change.

> *Don't look for the wins on the top ones. To me, you've just got to contain them.*
>
> *AS4-1 Ambulance service frequent caller lead*

For some respondents, processes for selection were unclear:

> *A lot of what's happening locally for me is very ad hoc. It doesn't seem to be based on, you know, regular reporting of presentations and identifying the … highest volume service users. Nor does there seem to be any system-wide approach in terms of marrying-up how people are accessing multiple services.*
>
> *AS4-6 Paramedic*

Multidisciplinary team meetings

A key component of case management is the MDT. This is an opportunity for different healthcare providers, sometimes alongside providers of social care and housing, and the police, to share experiences about high-intensity users and identify possible courses of action.

> *Case management is effectively a multidisciplinary team get together. So there'll be people from the ambulance service, from the primary care, district nurses, community matrons, GPs, mental health teams, that will discuss individual patients, try and understand the reason that they are reliant on, in our case, the ambulance service as much as they are and what things could be put in place that will lessen their demand on the ambulance service and try and get them the correct help that they generally do require.*
>
> *AS1-4 Ambulance service manager*

MDTs offer an opportunity to identify people who are having repeat contact with a range of providers:

> *At those groups we all might discuss maybe ten to fifteen patients each month, and they will be on a kind of rolling case management with the high intensity user group. So normally the patients that are discussed at those meetings are ones that are affecting a lot of services, so they're not only just ringing us but are ringing 111, they're also going to the hospital a lot, they might be ringing their GP a lot, and the high-intensity user group picks them up as high-intensity users and takes over the kind of case management from the day to day case management that maybe their own GP was doing.*
>
> *AS1-1 Ambulance service frequent caller lead*

For most of those taking part, the MDT was on top of the 'day job' and tended to demand a certain amount of commitment and enthusiasm. Some respondents identified that organisations would only be motivated to have staff attend if they could see direct benefit.

Pre-pandemic, MDTs would be face-to-face – challenging to arrange, and time-consuming. In all sites, there had been significant shift to online meetings, which has been positively received by respondents, as faster to arrange and more productive:

> *[W]ithin twenty-four to forty-eight hours we can get a full MDT of twenty professionals with the data in front of them … I've never elicited so many responses for MDTs.*
>
> *AS4-1 Ambulance service frequent caller lead*

Only on very rare occasions would the person at the centre of the discussion take part in the MDT; in many cases, the conversation was conducted by professionals who had no personal contact or relationship with the frequent caller, taking more of a strategic role, and this was identified as potentially problematical. A number of respondents identified the importance of trying to ensure that the caller is put at the centre of the conversation:

> *I think the main thing is to include the patient themselves, you know, get a very good understanding of what their needs are and why they are calling so frequently.*
>
> *AS1-5 Paramedic*

Creation of care plans

While the discussion process is multidisciplinary, care planning tends to be more single agency based. In some cases, the first step is finding out more about the patient's needs – for example, the HIUG intervention in the East of England would often begin with a community nurse or matron visiting the patient in their own home. There was an acknowledgement that any planned intervention needed to be informed by, and tailored to, the caller's needs:

> *It's quite hard to have like a blanket system about how you would support them and help them to stop calling.*
>
> *AS2-6 Paramedic*

There was a recurrent theme of the centrality of primary care to the provision of case management. Although there was also acknowledgement that access to primary care could be challenging, it was seen by many respondents that presentations by frequent callers were in many cases primary care sensitive conditions:

> *The vast majority of people should be rocking up on my door, not in the back of an ambulance.*
>
> *AS3-7 GP*

The interagency nature of the work can present its own challenges, particularly in terms of information sharing:

> *In order to send one email, we have to use six different areas of information from six different systems.*
>
> *AS-2 Ambulance service frequent caller lead*

Mechanisms of change

Identifying and responding to unmet needs

Case management has a crucial role in identifying where people are not accessing the health care which will benefit them, and in signposting, referral and active engagement with other providers. Problems with access may be, for some callers, to do with incomplete information or awareness on the part of the person making the calls:

> *[S]ome of them were just calling because … they don't understand how the health system worked, but we have shown … significant reductions and better patient care as a result.*
>
> *AS3-8 Ambulance service senior manager*

Problems were also seen as arising on the provider side:

> *[A] couple of real stunning successes where we actually have had people that have been labelled as, you know, they've come from really deprived areas and it's just one of these sort of patients and actually when you start digging down, they've been let down by the GP practice, they've been let down by secondary care, and actually when you plug all the holes and you get people what they need, they disappear completely. You don't see them on the list ever again, and that's the best bit.*
>
> *AS1-3 HIUG lead*

Personalised support

Respondents described a range of interventions which provided personalised support as required to people identified as potentially benefiting from case management. Sometimes this was as simple as just being at the end of the phone for regular contact; in other cases, support workers were able to introduce interventions which addressed people's social needs. Some of these were quite unexpected – beekeeping was an example.

The case management service in the LAS area was run by a primary care provider, where a nurse and a health coach were able to deliver personal support to those who might benefit:

> *We have these particular patients that we select have access to our nurse kind of Monday to Friday, nine to five but via phone, so hopefully instead of ringing 999 they'll ring the nurse instead. The nurse will kind of quickly triage it, if they're having central chest pain, sweating, vomiting, she'll say, actually we do need to call 999. If it's something social, or something related to trauma or stress she might be able to talk them out of it, and kind of calm the patient down, and kind of reduce the crisis, so that they don't need to ring 999 at all hopefully. And our health coach will put in strategies in the community, so link them with support groups, help with benefits, alcohol support groups, loneliness is very common, mental health groups as well.*
>
> *AS2-4 GP lead of HIU intervention*

Personalised support can only have an impact if people engage with it, and reluctance or inability to engage was described as presenting a major challenge to interventions:

> *Many of them don't engage with support services or they're sporadic, you know, they may involve with one particular person and then that might drop off again … They will tend to maybe engage initially and then completely disengage, or some just won't engage with any services at all.*
>
> *AS4-7 Police*

However, there was also acknowledgement that engagement was a two-way activity, in which it was necessary for providers to form relationships with frequent callers over a period of time.

Behaviour change

One potential mechanism of change appropriate for some callers was identified as encouraging the caller to change their behaviour. Tied in with this was work to manage patients' expectations, as well as helping them to recognise the impact of their actions. Some respondents presented their perspective on this as being in terms of moral responsibility:

> *So you try to make the patient responsible for their own actions before you go any further.*
>
> *AS4-9 HALO*

This process might involve direct face-to-face contact with the caller:

> *I'll give a general appraisal of calls, the numbers. I'll talk about sort of resources being involved to manage it and then I'll just sort of gently talk about, you know, there's sort of other patients out there that probably could do with an ambulance … I'll try and shock to a degree but I just try and point out, I try and say to the patient, look, I'm not saying never ring us, you know, because we're always there for somebody in an emergency, but what I'm telling you is that you could probably resolve most of your need through the doctor.*
>
> *AS3-3 Frequent caller lead*

Encouraging behaviour change is not necessarily a quick fix; it may need to be tied in with intensive support work over a long period of time:

> *The first thing is building trust, and that can take sometimes with some people quite a long time. It's taken me with one gentleman I think about [nine months] … And he over the past month has just actually started opening up to me about the actual crux of the problem that leads to the behaviour, that leads to the ambulance to be called. So now that we know what that is, we can address it and we'll work through it together. He knows I'm there to support him whereas before, he just said people hadn't listened, you know, they don't want to know, that sort of thing.*
>
> *AS4-2 Mental health nurse*

Behaviour change was not necessarily an approach to be applied alone, but could also be part of a programme of personalised support – with trust and engagement an essential component:

> *Being very clear and open about the interventions proposed and the support that was being provided, putting in place well-boundaried care to sort of give clarity to the individuals to what was appropriate and what would be provided … and what wouldn't be provided … So I think that where that kind of model's implemented there's a lot more sort of engagement and ownership by the patient of the process, which I think can be so beneficial.*
>
> *AS4-6 Paramedic*

Expected impact and identifying success

Respondents discussed their perspective on what the case management intervention could or should be achieving in terms of impact. Although there was some mention of positive impact on the quality of life of callers, for most respondents, the primary marker of success was identified as fewer healthcare contacts, such that the patient no longer met the FreCaNN definition. There was acknowledgement that for many patients this reduction in calling would not necessarily be immediate, or definitive:

> *The patients that we moved across to the closed list, they'll be monitored still, so we won't sort of discharge them completely so to speak, and they'll be there to be brought back up if they do sort of re-present to the service.*
>
> *AS1-2 Manager*

Being able to resolve the needs of callers over the telephone (a Hear and Treat response rather than sending out an ambulance) was also seen as a sign of success:

> *Not necessarily calling so much, cause I guess that's a bit out of their control, but limit the amount of resources that they get and the amount of time that they take up of the ambulance service.*
>
> *AS1-6 Ambulance service manager*

Reduction in healthcare contacts might be felt across the system – not just in terms of ambulance costs, but also, for example, attendances at the ED.

Reduction in costs for ambulance services and for other providers was also seen as a positive impact of case management, and something which was worth measuring and reporting in order to secure sustained funding for the intervention:

> *I don't think that until [frequent caller lead] started collecting the data, that it hadn't been really presented in a coherent way at that high level, was the amount of time and resource we were spending on a relatively small number of people that were calling the Ambulance Service very frequently. And when we started to look at those cases it became obvious that there were things that we could do … So the investment in the team then, you know, well [frequent caller lead] clearly was able to demonstrate a reduction in the resource. And of course, once you link that to the money, it becomes very cost-effective.*
>
> *AS3-8 Senior manager*

Context

Links with front-line ambulance crews

Across all the services, there seemed to be a disconnect between the experience of front-line ambulance clinicians and the frequent caller initiatives. Many seemed vague about the detail of what case management provision was and who delivered it, and in some cases even whether or not there was an initiative in place. Those who were aware of initiatives for frequent callers were likely to have a role in identifying people who might benefit from an intervention. In some areas, ambulance clinicians described making referrals to the frequent caller teams, but didn't find out what happens next to the patient:

> *It's a very opaque kind of process.*
>
> *AS2-5 Paramedic*

Links with caller management

Case management work (interventions to identify and respond to caller needs) takes place against the backdrop of 'traditional' ambulance service management responses to frequent callers (interventions to manage the workload of the service). These caller management interventions may include limiting the number of calls per day which the service will take, or operating a 'no send' policy for ambulances. Staff working in call centres would see a flag to identify the frequent caller on their system, alerting them that a particular response was expected in line with the action plan for that patient:

> *You have a warning system. So, if there is somebody who has an action plan against them … the warning marker would show you why they're a frequent caller.*
>
> *AS3-6 Paramedic*

This response might be asking people not to call again within a certain time period, or passing the caller to a clinical advisor for a telephone consultation before an ambulance was sent. Even with this response, access to triage might be controlled:

> *You can tell them that they're not going to have another triage for another eight hours. Some will call again [in] 10 minutes, some will try and call before you've even got off the phone, [from] another phone. And some will call eight hours on the dot, they'll call again, knowing that their time is up.*
>
> *AS1-7 Paramedic*

Ambulance services were aware that there was a risk attached to such responses, with the clinical advisor in the call centre having to make decisions about whether a physical (ambulance response) was needed. Some clinical advisors working in call centres would become familiar enough with frequent callers that their personal relationship would help to inform their judgement:

> *One of the frequent caller paramedics … that's specifically her job, and she's absolutely brilliant. She knows them by name, they know her, and because she knows them she can take – she knows what's normal and what's not normal [for them].*
>
> *AS1-7 Paramedic*

For some respondents, these caller management responses *were* case management, the two approaches getting conflated in their minds. Others described the two approaches to management as distinct but complementary:

> *For us it's kind of a two-stage process, do we set them on an internal to try and just manage the call impact to us whilst we then do the bigger piece of work which is linking with the other professions to try and find out what's going on with this patient and what we can do to help.*
>
> *AS1-1 Frequent caller lead*

Overlapping case management models

Case management of high-intensity users was not delivered in isolation, since organisations may at the same time be involved in other initiatives focused on responding to particular needs, as well as high-intensity user initiatives led by other emergency care providers such as EDs. Respondents described a range of needs-based case management, often multidisciplinary, including those targeting people with alcohol and drug issues, multiple deprivation (a 'postcode group' in an area of extremely high deprivation), older people who call, people experiencing homelessness and people with mental health problems. Some of these were explicitly aiming to reduce emergency healthcare contacts:

> *There are schemes in place to try and catch patients early before they go into full crisis and end up in an accident and emergency department.*
>
> *AS1-2 Systems escalation manager for HIUG*

Some respondents described how the work with frequent callers overlapped with their routine workload:

> *We've always got names that we know who are on the frequent flyer list.*
>
> *AS3-5 Nurse in homeless service*

Interviews with people referred for case management

Respondents

Six respondents were recruited for interview by an ambulance service (AS3) because they received case management having frequently contacted the emergency ambulance service. This group was recruited in line with our initial qualitative plan. Individuals are identified by the prefix AS3 (e.g. AS3-201). Respondent characteristics and calling behaviour are omitted to preserve participant anonymity. Two of the respondents had a partner present during the interview, who made minor contributions to the conversation.

These respondents all experienced mental health needs, usually alongside or exacerbated by physical symptoms linked to other conditions. One had a diagnosis of autism and attention deficit hyperactivity disorder (ADHD). Although they experienced acute health needs which prompted emergency ambulance service calls, their circumstances reflected a complex interaction of factors including long-term health needs, childhood trauma, bereavement, homelessness and unstable mental health.

Experience of calling the emergency ambulance service

All respondents provided accounts of their interactions with emergency health services which were often vivid for the level of dissatisfaction and despondency their reports conveyed. They said they called for emergency ambulance service help as a last resort, when access to other support was not available or because their situation seemed to overwhelm them.

A number of them identified inadequacies in other aspects of care provision, particularly not being listened to by regular care providers, as leading to them seeking emergency care to fill the gaps:

> *I've tried the GPs, and out of hours GPs, and solicitors, and other people that I've worked with that don't believe that I have it either but it's very hard to, like, tell the psychiatrist and stuff like that because, you know, they don't listen. They don't listen to me anyway, that's part of the problem – That I don't get listened to.*
>
> *AS3-208*

> *If they were there to help you, they should listen to what the people say, give me a chance … I think they've got to hear how I feel. They can't feel what's going on in my body, I can, they need to have a little bit of leeway and let me do what I've got to do to prove it.*
>
> *AS3-209*

One called a mental health helpline and another called 111 instead of 999 and it was these call-takers who alerted the emergency ambulance and police when they felt the situation warranted further action. Triggers to calling could be related to physical exacerbations of symptoms, but also to a sense of not being able to cope with symptoms, sometimes becoming panic. AS3-202 described his fear of dying and need for reassurance when experiencing a crisis.

> *I just want them to make sure I'm not on my deathbed. It's so easy for somebody to just lose their life, through something like epilepsy and stuff like that. So I get over-paranoid, it plays in with the psychosis, and I can start fitting and it's terrible.*
>
> *AS3-202*

Respondents said they felt criminalised by the way they were treated by emergency services. Four of the six were attended by police officers when calling for an emergency ambulance. One said she was arrested for violent behaviour linked to a psychotic and self-harming episode. Another was warned for wasting police time with regular 999 calls. A third recalled escaping from police and security guards when he discharged himself from hospital. These accounts, made within longer reports of their emergency calling, suggested that police involvement was a normalised element of their experiences. One respondent also said he was threatened by the ambulance staff for refusing treatment during a mental health crisis because of his fear of hospitals.

> *It's basically like refusing to be arrested, isn't it? It's like they threaten me for refusing to go there, isn't it? They start mentioning things like, 'Oh, you won't get benefit anymore because you're not taking our advice and our services'. And suddenly your back's, like, isn't it, it's just I'm petrified of hospitals.*
>
> *AS3-202*

Experience of case management and related support

Respondents did not appear to know they were receiving case management. Respondents said they relied primarily on family, friends or neighbours, because they felt alone and unsupported in their mental and physical health needs. Several reported self-medicating with alcohol or drugs. Their comments conveyed a strong sense that they felt unheard and ignored. One respondent, many months into an application to be rehoused, said she had a letter of support from the ambulance service and was helped by the charity MIND. She was the only person to mention the ambulance service role outside a 999 response. One person said she received a monthly call from a community psychiatric nurse, but this didn't prevent her making emergency ambulance service calls when experiencing panic attacks, and self-harming. Her husband could not reassure her either, she said.

> *He tries to put me off it, calling, he tries to talk me out of it because there's more serious cases than you, so don't you dare, but I – if I – it gives in – I give in then and say, 'Look, I've got to'.*
>
> AS3-203

Another said she had a support worker and management plan, but these were imposed on her and did not meet her needs when experiencing crisis.

> *I do have twenty-four-hour support workers where I live but again the management plan tells them they're not allowed to come and support me when I have suicidal feelings, or I've self-harmed, or I'm going to self-harm. They're not allowed to support me, so I don't understand who I'm meant to turn to.*
>
> AS3-208

It was clear during these interviews that some respondents were afraid of hospitals and health services, distrustful of therapies such as counselling which required them to regularly engage and communicate and also nervous of social and probation services. Even though they were in emotional and physical pain, fear appeared to shape their interaction with health providers and prevented them from taking care of themselves.

> *Like I'm not going to my appointments, I'm missing them all the time 'cause I won't go out. Like hospital, GP – anything like that, or dentist appointments, or anything … so I don't know my results from my CT scan neither.*
>
> AS3-202

They also felt angry and disillusioned that their problems were not acknowledged and addressed.

> *I'm just pissed off with like going back and forward to the hospital to these meetings, when they can just keep me in there, just like they do with anyone else, and see what the situation is … they would see my issue comes on every now and then, and my body feels like it's not working. They think I'm just being lazy.*
>
> AS3-209

If they were offered treatment, it often did not fit their needs or lifestyles. One respondent specifically asked for support so he didn't need to rely on family but said he was still waiting to receive help.

> *I'm looking to get another support worker. I just don't know how to go about it … I was meant to be going for counselling before, a long time ago, but I never heard nothing about it.*
>
> AS3-207

They usually wanted input at times of crisis rather than receive a programme of contacts at a set time which may not coincide with their symptoms. These respondents often felt their needs would be resolved by non-health interventions, such as better housing, training, paid or voluntary work.

> *[A]ll I want to do at the moment is get my own place, so my mental health issues can drop.*
>
> AS3-201

People who identified as making frequent or regular emergency ambulance service calls (STRETCH-UP)

Respondents

There were nine respondents in this group, recruited through social media and the third sector. They lived in a range of locations in England and Wales.

Three respondents reported mainly mental health problems which caused suicidal and self-harming behaviour. Three respondents – a mother, father and daughter – were from a family with a history of making emergency calls, for a range of physical health issues. One respondent was a carer looking after his sister with physical and mental health diagnoses. One respondent said a family member mostly made the emergency call because he was not usually conscious while another said 111 call handlers called the emergency ambulance. One respondent said that the local high-intensity user group was involved in his care planning, though he only found this out some time later, after his emergency calling ceased.

Experience of calling the emergency ambulance service

Although the respondents had long-term issues, it took particular triggers for them to call the emergency ambulance service. Respondents said their emergency call was made as a last resort. They, or someone calling on their behalf, genuinely believed the situation was urgent and they were a danger to themselves. Some respondents described steps they took to delay or avoid an emergency ambulance service call. These included taking extra medication, waiting to see if the problem would resolve, contacting a GP or pharmacist or phoning a helpline.

> *It's only when it's absolutely necessary that I ring 999 and ask for ambulance … We do not make demands on any public services including ambulance service unless it's absolutely necessary.*
>
> *SUP-04*

There was a consistent theme that people called for an emergency ambulance because they felt they had no other options:

> *A period of regular help seeking which had failed at every point. And really where I hadn't known where to turn. And so the ambulance service had kind of been the last resort … Well I exhausted – I tried all other options and repeatedly got nowhere …*
>
> *SUP-02*

Respondent SUP-02 also said the way her needs were dealt with was 'brutal' and undermined any sense of self-worth. She said she felt rejected when repeatedly discharged from the ED because her suicidal thoughts had not resulted in an injury which needed treatment.

Respondent SUP-05 experienced severe asthma which left him choking for breath if a flare-up did not respond to his usual medication. Out of hours, he was unable to access the emergency treatment which could resolve these attacks. An hour's drive to the ED was not feasible in this state and with very young children to care for, so he would call for an ambulance. But he was shocked by the off-hand manner of emergency ambulance service call handlers and waiting as long as 12 hours with symptoms which left him unable to breathe. As a regular caller, he queried how his needs were prioritised by the system.

> *I only call at the absolute latest, when I think I can't take it no more. That's the time I need the most support … There are times when I just can't breathe. I'm gasping for air. I can't breathe through my nose, I can't breathe through my mouth, I get palpitations and I'm gasping for air. That's no less than a heart attack in my view. So, what priority am I? Am I a one or am I a ten? If I'm a two, after a heart attack, then how long should I wait, and how is that allocated? It's happened before where I've fainted and blacked out when I couldn't breathe … There's no empathy, there's no compassion. And I think some of the staff are just admin staff. They read off a script. It's passed like a sausage factory to somebody else.*
>
> *SUP-05*

For the family group and the carer, the triggers to calling tended to be related to physical health and care needs. The carer (Respondent SUP-04) usually needed help to lift his sister or check her when her medication made her non-responsive.

The family group said they were encouraged to use 999 services when newly arrived in the UK and continued to seek emergency help, particularly if unable to get a GP appointment or access a pharmacist. They were full of praise for how their calls were addressed.

> *I think [999] is the best because if you have language, or you don't have language, they will still find a way to get contact with you, or to get the best care for you.*
>
> *SUP-06*

Experience of being managed as a frequent caller

Only one of the respondents reported experience of having a specific response to calls as a result of being identified as a frequent caller. Respondent SUP-01 realised he was flagged as a regular caller when call handlers deflected or terminated his emergency calls, made when feeling suicidal. He described how he started making high numbers of emergency calls after his regular community-based mental health support was stopped, in line with service policy that support could not be indefinite. He started calling the emergency ambulance service and 111 as he felt these were the only options open to him.

> *So I wasn't ever a person to call up begging for help in distress … my support was completely cut off and that was the trigger for me trying to call in services for other support … I was calling in both for support and to try and get a more long term solution.*
>
> *SUP-01*

Since the two services were both provided by the ambulance service in his area, calls to both numbers were linked as part of the service's monitoring of high levels of use. Respondent SUP-01 said his need for help was misinterpreted by emergency and mental health professionals and he felt labelled as a nuisance. When his case was taken on by the high-intensity user group without his knowledge, no one listened to his perspective or provided the support he wanted. He said he felt bullied and dehumanised by health professionals.

> *It's brutal – it's not having the flag, it's how you're treated because the flag is there … If they have a system whereby they want to say, anyone that's calling more than five times is a frequent caller, then I'm okay with that, put me up on the system as a frequent caller. But it's what you do with that flag – rather than have it as a label with a stigma attached that he's a nuisance, say we've got a vulnerable adult that's in distress and needing help. It's not the flag, it's what they do with it.*
>
> *SUP-01*

Respondent SUP-03 echoed this impression of isolation and desperation. He said he feared that a system which identified frequent callers to emergency ambulance service call handers could stop people receiving necessary treatment.

By contrast, Respondent SUP-04, caring for his sister, welcomed the idea of being identified by the ambulance service for additional support, seeing it as a way to remedy the uncoordinated and inadequate care he received from the health and social care sectors. His greatest wish, as a carer, was for some brief periods of respite in a clearly precarious domestic situation.

> *With the ambulance crew being the first contact, I think it's an excellent method for them to be using their eyes and ears to observe what needs to take place and then they make the referral to this support team who will then come and assess the needs of the person. That could only be a positive because they can make a referral to more appropriate services.*
>
> *SUP-04*

Similarly, Respondent SUP-02, despite having negative and distressing experiences in relation to emergency care, seemed to recognise that there was scope for care to be improved by identifying frequent callers and so being able to provide help for unresolved problems.

> *If someone is a frequent caller they often have unmet needs of some kind. So, you know, it should be a flag to indicate someone has unmet needs and that should be acted upon.*
>
> *SUP-02*

Chapter 7 Public and patient involvement

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Introduction

We have involved people with experience and healthcare backgrounds relevant to the STRETCHED study at all research stages; from project conception, through delivery and in dissemination of our findings. Building on our experience from other studies, we undertook a layered approach so that people could be involved at strategic and local levels in line with their interest, experience and health.[68] Our aim has been to enable active and meaningful involvement throughout STRETCHED to enhance research quality, rigour and ethical standards, in line with the Swansea Trials Unit SOP on service user involvement.[60] We summarise below (*Table 17*) how public contributors have been involved, the impact of their involvement and further reflect on process and experiences, in line with the GRIPP checklist.[69]

TABLE 17 Public involvement in STRETCHED

Section and topic	Item	Reported within chapter
1: Aim	To enable active and meaningful public involvement throughout STRETCHED to enhance research quality, rigour and ethical standards	2; pp. 5–6
2: Methods	We undertook a layered approach so that people could be involved at strategic and local levels in line with their interest, experience and health and recorded in a Public Involvement Role Description document.[1] These included: Research Development Group – 2 public contributor co-applicants [Penny Gripper (PG); Bethan Edwards (BE)] Research Management Group – 2 public contributor co-applicants (PG, BE) Lived Experience Advisory Panel – 8 public contributor members [PG (chair), SB, BE, KF, MK, MN, KR, JR] Study Steering Committee – 2 public contributor members (BMcA, AB) Involvement took place at all research stages, from bid development through implementation to dissemination	2; pp. 16–17
3: Study results	Public involvement through all research stages and at different levels Raised awareness among research team of service user perspectives to challenge assumptions and biases in order to retain a patient-centred approach Revised approach to service user recruitment and data collection to address low response rates Co-authors and co-presenters of peer-reviewed papers and conference presentations	7; pp. 52–53
4: Impact: influence and outcomes	Raised team awareness of service user perspectives Enhanced recruitment, data collection and analysis Contributed to parallel InFORM study Co-authors in conference presentations and written publications	7; pp. 53–54
5: Reflections/critical perspective	Maintained awareness of service user perspective Research team built trust and mutual respect to operate with honesty and through consensus	7; p. 54
6: Discussion and conclusions	Involvement undertaken and reported in line with best practice to inform future evidence about effective public involvement in research	7; p. 54

Results: how we undertook public involvement

We have involved public contributors in delivering STRETCHED in the following ways.

We recruited Penny Gripper (PG) and Bethan Edwards (BE) through networks supporting public involvement in mental health research and emergency care research. Both confirmed the importance of the topic and need for research on the question of supporting people who frequently call emergency ambulance services. They were active members of the STRETCHED research development group, contributed to drafting the proposal including our plan for public involvement and were named co-applicants.

When STRETCHED was awarded research funding, PG and BE joined the RMG and have been actively involved throughout implementation of the study. Alongside other co-applicants and co-opted experts, they have contributed to discussions and decisions at all stages through attending quarterly meetings and commenting on documents. They supported submission of our ethics application and other research permissions. They were involved in planning and recruiting for the stakeholder meeting to develop the logic model for case management. They worked within the qualitative research team on preparing participant-facing information to support recruitment. They were extensively involved in data analysis. Training about public involvement formed part of a 2-day training event for STRETCHED research paramedics to ensure they understood the role of public contributors in the study and could support recruitment and working with them. PG and BE have been involved in disseminating study findings and will continue this role as part of the research team.

We recruited eight people to join a patient advisory panel. We set up this panel to provide a second and less formal route for patient perspectives to inform implementation of the study. We identified people with characteristics and experiences reflective of the STRETCHED target population, such as callers with a history of chronic obstructive pulmonary disease (COPD), asthma, diabetes or mental health issues. We also sought people who lived in the participating ambulance service trusts. Working with PG and BE, we prepared a leaflet which we circulated through public involvement networks and site networks identified by the research paramedics. We also presented STRETCHED to, and took recruitment advice from, the Service Users for Primary and Emergency care Research (SUPER) group of patients, carers and public members. The group's remit is to support PRIME Centre Wales. They highlighted recruitment routes, the importance of being non-judgemental and building trust, the use of appropriate language, and ways to make use of social media.

The panel was chaired by PG to provide a link between its activities and the wider research team. PG and BE shared information about study activity and reported panel discussions to the RMG. When this group met, they decided to rename it the LEAP. The LEAP has contributed to specific study tasks including recruiting service users for interviews, sense-checking interview results and devising dissemination materials.

We recruited two people to be active members of the independent Study Steering Committee. We identified Bob McAlister (BMcA) and Alan Brown (AB) through the Public Involvement Community supported by Health and Care Research Wales. They brought a range of relevant experiences to the role. They were welcomed as equal members alongside other experts and contributed fully to all discussions and decisions of the SSC. They were invited to all meetings and provided with all relevant paperwork to enable their involvement.

We confirmed the priority and status of public involvement throughout the STRETCHED study in the Public Involvement Role Description document which was reviewed and agreed by the RMG at study start. We included Public Involvement as a standard agenda item to enable discussion on public involvement processes and topics, in addition to PG and BE contributing to all other agenda items. The Study Steering Committee charter also acknowledged the role of public contributors in its operation.

We named an experienced researcher (BAE) to support public involvement in STRETCHED. She oversaw processes including communication, liaison and co-ordinating involvement opportunities during the study. We also offered honoraria for all involvement and reimbursed incurred expenses.

Public involvement in dissemination of STRETCHED

In keeping with the principles of co-production, our public contributors are actively involved in dissemination activities.

PG and BE have both taken part in conference workshops to present STRETCHED and related issues.

In 2020, PG was among five panel members at a workshop on 'Who makes high use of the emergency ambulance services and how are services responding to meet the needs of these patients?' at the HSRUK Annual Meeting. BE was one of four speakers in a panel on 'How can the police and ambulance services collaborate in the provision of emergency healthcare?' at the 999 EMS Research Forum 2022 conference.

Both are also co-authors on peer-reviewed conference presentations and journal publications and will co-author further outputs in line with our Publication Plan.

LEAP members have advised on presentation of findings to the wider public to strengthen our communications about applicability of our results.

Impact of public involvement

Including public contributors throughout STRETCHED raised awareness among all research collaborators of the patient and service user perspective to ensure the research remained patient-centred and observed good governance. Early in our partnership, PG and BE highlighted sensitivity about appropriate language to describe people who phone the emergency ambulance service and constructively challenged biases and assumptions within the team. Their discussions, alongside the input of ambulance service collaborators, have helped us understand that the individuals calling the emergency ambulance service are a diverse group with potentially diverse stories and priorities. They have been keenly interested in accessing patient and service user experiences alongside recognising how challenging it is to reach our target population. They challenged the research team on ways to optimise recruitment and data collection. They worked closely within the team to update our service user recruitment and interview plans (STRETCH-UP). Their personal insights have been especially informative in guiding our analysis and interpretation of interview and focus group data. For example, when considering the mismatch between services and callers' expectations, PG identified how these could be low or unduly high and explained how respondents might hold these views. They also described how patients needing support for their mental health might feel and how they could perceive the system to be broken for them.

As link members of the RMG and LEAP, BE and PG also brought a wide range of public and patient perspectives to inform research implementation.

PG and BE extended their public involvement to contribute to the InFORM study, a parallel research project undertaken by some STRETCHED co-applicants, to co-produce guidance to improve care for people who frequently call the emergency ambulance service.[64]

Raised awareness and understanding also resulted from the LEAP input. Members highlighted relevant characteristics of the case management intervention, the extent of national variation and the effect of high staff turnover. They commented on a recruitment flyer for the service user interviews and advised on routes for disseminating this.

Public contributor members of the Study Steering Committee have brought the service user's perspective to discussions and an expert eye on the process of public involvement in STRETCHED.

Reflections on public involvement

Involving public contributors throughout developing, undertaking and disseminating the STRETCHED study has enabled all research team members to remain aware of service users' perspectives and motivations. Experience-based input ensured a service user focus during recruitment, interpretation and presentation of data. Our aim to undertake a relevant and high-quality study was embedded in the research application, which received positive feedback for the integrated approach to public involvement.

The research team has maintained an honest and respectful partnership throughout enabling differences to be aired and consensus to be achieved. Effective public involvement in research relies on building trust and operating with mutual respect while collaborating as a team to implement research.[70]

Discussion and conclusion

We involved service users as public contributors throughout the process of designing, delivering and disseminating STRETCHED. We used a layered approach, enabling people with a range of experiences and perspectives to contribute to study management, oversight and implementation. Our mixed approach provided opportunities for people to collaborate with other research team members in formal meetings, through a LEAP and by one-to-one contact with the Public Involvement Lead. Providing different routes for involvement in research supports people with diverse experiences, skills and availability to collaborate in a way which meets their needs and interests.[60] Comprehensive support, to include honoraria, reimbursement of expenses, accessible opportunities and a named contact, can contribute to effective public involvement through the years required to deliver high-quality research.[71] Reporting our processes and experiences helps build rigorous evidence, providing knowledge about effective processes, motivators and barriers and assess the impact of public involvement in research.[63,69]

Chapter 8 Discussion and conclusions

Summary of findings

Key findings

Comparison of outcomes at 6 months between patients attended in areas where cross-service case management approaches were available (n = 550) and control areas using within-service management (n = 633) did not show any consistent differences in mortality, emergency admissions to hospital, ED attendances or further calls to the emergency ambulance service. Within this follow-up period, mortality was higher than expected (10.5% in intervention sites; 14.1% in control sites); approximately two-thirds of patients experienced an emergency admission (68% in intervention sites; 67% in control sites); approximately three-quarters of patients attended ED (77% in intervention sites; 74% in control sites); and most patients called the emergency ambulance service at least once (88% in intervention sites; 86% in control sites), with an average of 17 calls in intervention sites and 15 calls in control sites. Overall, a high proportion (~ 95%) of patients in both arms were found to have experienced at least one of these outcomes.

Nearly all patients in both arms ceased to meet the criteria for inclusion on a 'frequent callers' list at some point in the 6 months following their first classification (98% in intervention sites; 99% in control sites), although about a third of these subsequently met the criteria once more during this 6-month period. Patients had an average of nine (in intervention sites) and eight (in control sites) emergency ambulance attendances, but fewer than half of these attendances resulted in conveyance to hospital (on average, four in both study arms).

Implementation costs of case management varied between different intervention sites, reflecting differences in staff mixes and in intervention management. Differences in costs per patient of healthcare resource utilisation linked to the primary (composite) clinical outcome were not statistically significant between study arms in both unadjusted and adjusted analyses; the latter also showed that costs per patient associated with secondary clinical outcomes were also not statistically significantly different.

Consistent with findings on implementation costs, models of case management were highly varied in terms of provision, resourcing and leadership, and most were subject to change over time. Service providers recognised the range of possible drivers for frequent calling, with some categories of need much more amenable to intervention than others. Many service users have deep-seated, complex needs, and contact emergency services because of a lack of more appropriate support.

Logic model

Following completion of all analyses, we revisited the logic model developed through a stakeholder event at the outset of the study; *Figure 3* shows this revised logic model.

Our epidemiological data showed high mortality (12.6% overall) and healthcare needs (68.2% overall with an emergency hospital admission) within 6-month follow-up. These outcomes do not appear to align with the predicted mechanisms of change in this patient group – in particular, the notion of case management achieving a change in patient help-seeking behaviour. This apparent responsibility on patients to reduce emergency ambulance service use thus seems to be an unreasonable expectation.

Natural experiment

Gender, ethnicity and proportion of patients with health service contacts in the 6 months before patients became eligible for inclusion were similar between arms. The patient cohort tended to be elderly (median age 65, upper quartile 81) and living in more socioeconomically deprived areas. However, patients in case management areas tended to be younger than in standard care areas (median age 60 vs. 69), and more likely to live in the areas classed in the most deprived quintile (47% vs. 31%).

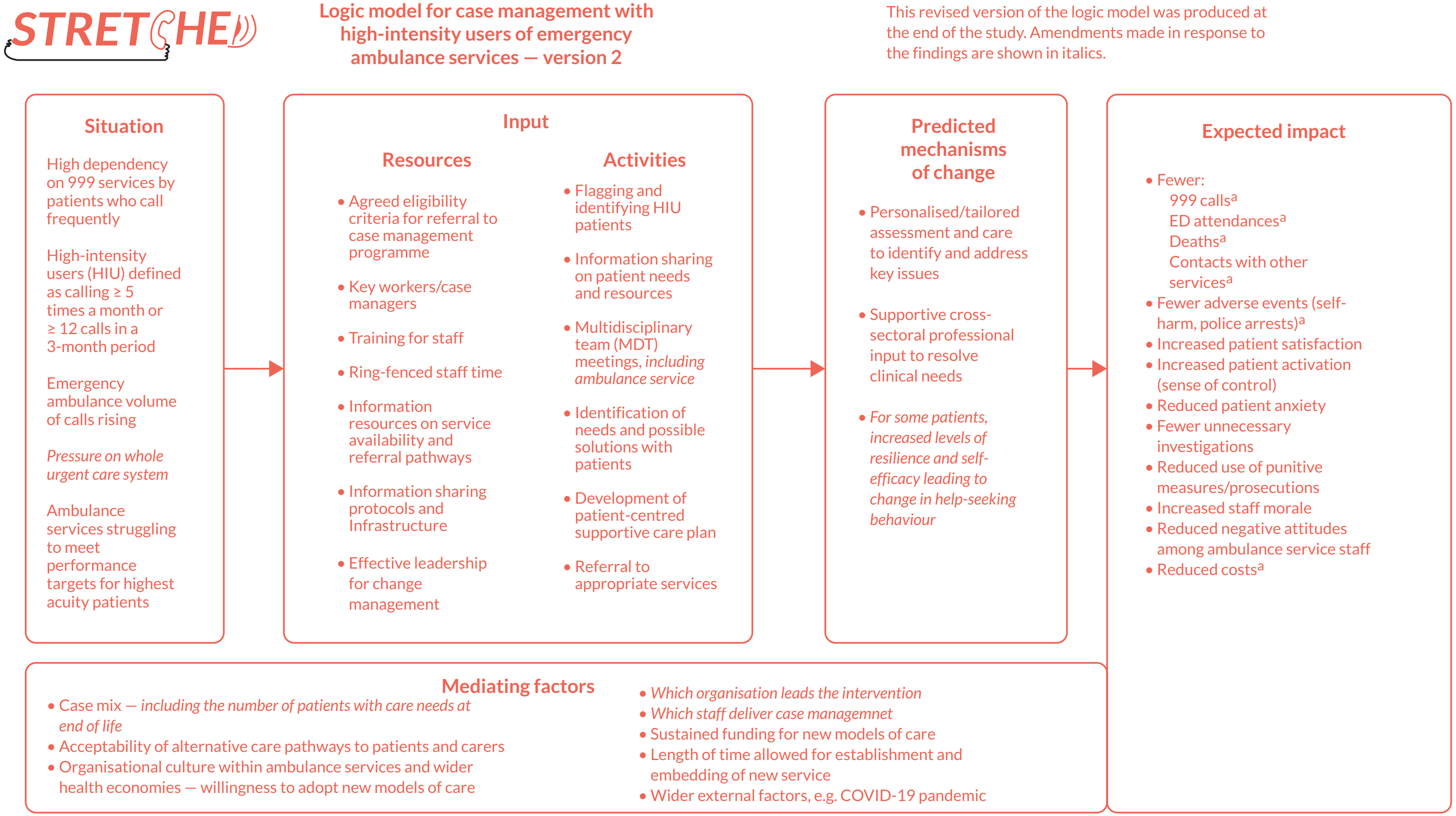

FIGURE 3 Revised STRETCHED logic model. a, Outcomes included in STRETCHED study protocol.

All eligible patients met the 5+ calls within 1 month eligibility criterion; some patients also met the 12+ calls criterion, but this was always in conjunction with (or subsequent to) the former.

Data on referral for case management and harms were generally unavailable. We were only able to ascertain the proportion of patients referred for or receiving case management (40%) in one ambulance service, with partial data available in a second. Data on police arrests and convictions were generally not held by ambulance services or were only collected if a member of ambulance service staff was directly involved. Due to low numbers of events, the available data were grouped with other recorded adverse events, including requests for serious case review. The routine data set available to the study did not provide complete information on the use of primary care, social care or other agency provided care.

Health economics

Due to the complexity and variability of intervention delivery and the fact that action plans are tailored to individual patients' needs, it was difficult to describe fully the intervention components for implementation costing. Furthermore, the pause of the study during the COVID-19 pandemic meant that, by the time data collection could start for the implementation costs, key members of staff had moved on and were unavailable and intervention delivery models had evolved from the models during the study period. As such, not all information provided referred to 2018–9 case management delivery and, where no information was available for 2018–9, information from 2020 onwards needed to be used to fill the gaps. Moreover, increased pressures on ambulance services post pandemic meant that the response from frequent caller teams to our questionnaire was low with information often incomplete which will cause uncertainty in the implementation cost, despite all efforts having been made to retrieve the required information. We encountered similar problems in obtaining case management set-up costs incurred by police and the wider care system.

Similarly, the healthcare resource use and related cost for this patient group are likely to have been underestimated – for instance, while most frequent callers are assumed to have had numerous contacts with (at least) a GP and social worker, once patients were referred to these other services, the composition and duration of contact with these services were reported to range massively depending on the support each patient requires with no data available to quantify this. It was therefore not possible to cost case management beyond referral to relevant services and the opportunity cost of managing these patients beyond referral from the frequent caller team could not be taken into account.

The cost–benefit approach originally planned was not pursued, as preliminary analyses showed no overall downstream effect of the intervention in aggregated form presented as net benefit. It was therefore decided to use a disaggregated cost–consequences approach to allow a more detailed overview of implementation costs and resource consequences, which was considered the best possible analysis approach for the case management intervention.

Qualitative work

Service providers

Interviews revealed a highly variable range of models of intervention for frequent callers. Although some key components of case management were in place in each site – such as the MDT – the interventions delivered varied. In some places primary care providers took a leading role in terms of 'ownership' of support for frequent callers, while in others the lead was taken by mental health providers. In all areas, case management interventions were area-based – in response to funding and local health service management organisations – and did not map onto the entire footprint of the ambulance service. There was a common theme of change over time, with short-term funding allocations and changes in staffing.

All three groups of respondents spoke of the complexities of needs among frequent callers, with awareness of medical presentations often manifesting as a result of long-term needs. There was acknowledgement from all three groups that emergency care was a default for those who – for whatever reason – had not received appropriate healthcare support through other routes.

Service users

Across the two service user groups of respondents, there were common issues in their perspectives. All said they called for emergency care as a last resort, because they had no other routes to access help. Their perception of their situation was that it was precarious and their health posed a danger to their life, or to the life of the person they cared for. Many of the service users felt demoralised that repeated contacts with health professionals had not reduced or cured their symptoms. They seemed to use the emergency services as a gateway to accessing better care and resolving their problems.

Except for the carer and family group, all respondents were dissatisfied with the way they were treated and that the emergency issue remained unresolved. Some of the emotions expressed included feeling ignored, judged, brutalised, rejected, dehumanised and threatened by the emergency services and clinicians who dealt with them. Instead of feeling flagged for tailored and co-ordinated support by health professionals, they felt labelled as troublemakers and nuisance callers. Even though some individuals received support – from clinical specialists, mental health teams, a third-sector organisation or a GP – respondents felt isolated and powerless. This contrasts with the perspective of service providers, who generally seemed to regard only a minority of frequent callers as 'nuisance' and were sympathetic to the unresolved needs of the majority.

Both groups of service users expressed anger and dissatisfaction. They appeared to be victims of a broken system and had run out of options for help. Communication between them and the healthcare system appeared to have broken down and they felt unsupported and unheard. Those who, according to service records, had been offered case management seemed not to be aware of this, and none spoke of any improvement in their lives as a result. If they had any experience to describe in the way of interventions for frequent callers, it was to do with caller management initiatives limiting contact with providers – as for many of the service provider respondents, these two approaches seemed to blur.

Our respondents in the two service user groups prioritised receiving judgement-free reassurance when experiencing acute health needs. Person-centred care is one component of multidisciplinary working aiming to improve quality of care and effective use of resources to support patients.[72,73] Those receiving case management seemed unaware that different organisations and care professionals were considering their situations, potentially making decisions about what happened to them. Nor did recipients report any changes in their experience of making frequent emergency calls. If healthcare professionals do not engage closely enough with selected individuals to understand motivators and barriers accessing effective health care, people are unlikely to feel or act differently.

Equality, diversity and inclusion

The methods of participant recruitment for this study did not proactively target specific groups other than on the grounds of clinical or self-reported healthcare need. Due to the nature of the study, participants were often marginalised and resident in relatively deprived socioeconomic areas.

Study limitations

In this natural experiment, we took advantage of the situation across many ambulance services where practice varied between Local Health Board or CCG areas. We asked participating ambulance services to identify 'control' CCG areas, using the traditional model of within-service response, that were as similar as possible to the identified intervention areas. Options were limited by the rapid and disparate spread of case management/high-intensity user models of care. While this allowed comparison within services of processes, costs and outcomes of care between areas with contrasting models of care, it also meant that there were differences both in care model provided and population, between and within services.

As we were not recruiting prospectively, we estimated sample sizes based on data provided by each service before study set-up. In practice, there was much more variation than expected between sites and services. Although we almost reached our overall total predicted sample size, recruitment was dominated by one service, with more than half of intervention arm patients recruited from AS4. We included site-level secondary analyses, with results broadly consistent with our primary analysis, although STRETCHED was not powered to detect effects at site level, especially with such variation in recruitment between sites and between intervention and control arms (particularly AS2 and AS3).

In this study design, we relied on routine data outcomes for patients – which is efficient but does not provide findings related to patient well-being or experience. We proposed this study design as we were not confident of achieving a reasonable response rate to questionnaires in this study population. There may be benefits or harms that did not show in our outcomes – we based our outcomes, and expected effect size, on those used to justify the provision of case management, for instance in funding requests. These outcomes may be too blunt, or the actual impact may be much smaller than predicted, and we could have missed a smaller impact on routine outcomes, or effects on patients that would need to be self-reported. A longer follow-up period might have been captured the effects of 'behavioural change', but with further delays in routine data provision.

We chose to include the patient voice through qualitative interviews but were unable to achieve these at three of four sites due to internal processes with some reluctance to identify patients for inclusion (gatekeeping). Issues with recruitment of people who call ambulance services frequently is not unique to this study.[74] Interviews were undertaken where a parallel project allowed these interviews to be carried out by a member of the research team, rather than relying on research paramedics at sites to undertake the interviews. We conclude that our decision to include routinely collected outcomes only in the quantitative study design was justified, but it does mean that we do not have evidence about effects of cross-service case management approaches on patient reported outcomes or experience.

Some data quality issues affected key outcomes – notably for outcomes that were not part of routinely collected data sets but were defined locally and were provided by ambulance services for the study. Improved harmonisation and completeness of data sets relevant to this patient group would facilitate further cross-service evaluation and comparisons. In particular, we were only able to retrieve partial data on referral for, and provision and costs of, case management, and other non-NHS outcome data, such as police arrests and convictions.

STRETCHED was carried out across the initial part of the COVID-19 pandemic; site activity was paused during the early months, and there were significant gaps in intervention provision and delays in data collection which resulted in some mismatch between routine data and qualitative data.

Patient and public involvement and engagement

Throughout the design, conduct and dissemination of STRETCHED, we involved public contributors with experience of accessing emergency ambulance services and the complex health conditions experienced by people making frequent emergency calls. We created different forums for involvement – strategic, managerial, oversight and implementation – to enable individuals with diverse backgrounds and perspectives to collaborate in this study. We ensured opportunities were accessible and named an experienced academic to lead public involvement in the research team. We established trust and worked in a mutually supportive way in our collaboration.

Public contributors ensured service users' issues remained at the forefront of team members' awareness. They highlighted the importance of language, advised on recruitment and data collection and provided rich insight into interpreting and presenting the findings. They have an active role in our dissemination strategy. We have reported our findings to contribute knowledge about processes and experiences to inform the growing evidence base about public involvement in research.[69]

Implications for policy practice and research

We do not believe that our findings mean that case management never works, or is not worth providing, but we found that expectations of impact based on advice and previous small-scale evaluations were unrealistic. This matches existing evidence, which is somewhat mixed on whether case management for people who frequently use healthcare services is able to reduce service use or lead to other outcomes.[75]

When considering the logic model, stakeholders agreed that clear criteria for referrals to case management intervention were needed. This was in addition to appropriately trained case managers who had ring-fenced time to dedicate to patients and case management. On an organisational level, the stakeholders emphasised the importance of information resources on service availability and referral pathways, better information sharing protocols and infrastructure within and across organisation under effective leadership for change management. These inputs could in turn aid in flagging and identifying high-intensity user patients and better identification of patient needs. This could also help in the development of a personalised assessment and care plan for the patient which in turn would lead to fewer adverse events, contacts with services, increased patient satisfaction, increased sense of control within the patient, and in ultimately fewer emergency ambulance service calls.

At the synthesis stage, with the results of quantitative and qualitative analysis available, the research team revisited the logic model developed with stakeholders at the outset of the study. We questioned some of the framing of the predicted mechanisms of change and some of the expected impacts. In particular, we noted that there had been an expectation that the cross-service case management approach would help to achieve a change in patient help-seeking behaviour that would be the mechanism that would lead to reduced calls to the emergency ambulance service as well as a range of other outcomes both for patients, the NHS and ambulance staff. This reflects existing theory of how case management works in primary care, based on the relationship between the case manager and the patient, with the patient being empowered to self-manage their condition as key mechanisms.[76] On reflection, the research team considered that this logic was too linear, oversimplified and unrealistic for this patient group, and also that too much emphasis was put on the responsibility lying with the patient to change. Instead, theory of how case management works, for whom and in which circumstances needs to include greater consideration of the complexity of patients' lives and their particular circumstances. Moreover, our data showed that the patient group is varied and had high needs for care – around one in eight patients had died within 6 months, approximately two-thirds of patients were admitted to hospital at least once during that 6-month period, and the most commonly recorded reason for calling was that the patient had fallen.

There is a common characterisation – within services and in the media – of people who call frequently needing to increase their resilience or ability to self-manage their problems which are often described as social, emotional or 'not coping'. Our quantitative and qualitative data show that many patients are calling with persistent clinical needs, sometimes compounded by challenging life circumstances and hardship or lack of family/community support. Although case management offers an attempt to provide holistic care to people who make high use of emergency health services,[20] in practice we have found, in common with other researchers in this area, that the patient group is diverse; given its heterogeneous nature, it is likely that improved strategies for the identification of individuals most likely to benefit are needed for case management to be successful.[77] Furthermore, this group includes a high proportion of patients who are very unwell, with a high level of clinical needs which may not be well matched to the service provided. In other cases, problems may be intractable and not amenable to simple, short-term solutions.[14,43]

Supporting and treating people with complex needs involves building trust and working flexibly with individuals – as service providers acknowledged – yet these service users felt they had no say in processes and decisions affecting them. There are intrinsic challenges when an emergency ambulance service – designed to provide an immediate and short-term curative response – becomes engaged with needs which are long term, multifaceted and often requiring care, or basic human services such as housing, and responses are often on an 'as needed' basis, rather than addressing underlying issues.[14] This tension is present in many aspects of emergency ambulance service work, but particularly apparent among the group of callers who meet the frequent caller threshold.

Services need to be provided in an accessible and relevant way to create genuine opportunities to resolve demand.[78] For example, mental health issues can present as inability to follow routine or attend structured support sessions, yet be judged as failing lifestyle behaviours. Many of the service providers talked about challenges of engagement with service users; from the perspective of service users, the issue may not be so much about engagement as to do with access and availability.

Conclusions

We did not find any reductions in deaths, emergency ambulance calls or other emergency healthcare contacts associated with case management. The patients classified as frequent callers had high and varied needs. We do not believe that our findings mean that case management never works, or is not worth providing, but we found that expectations of its impact, based on advice and previous small-scale evaluations, were unrealistic.

We have not been able to answer the question of whether case management should be commissioned and supported for the care of a subgroup of people who make high use of 999 emergency ambulance services. While we have found that outcomes were not improved across the whole cohort of patients in intervention sites, we found that the group is heterogeneous in nature. Lack of data prevented an assessment of opportunity costs to services beyond the ambulance service. We cannot rule out there being benefit for subgroups – for example, patients with mental health or social care needs – or that any benefit would be worth the investment (costs). We are therefore unable to make recommendations about whether case management should be introduced or continue to be supported, for defined groups. This question requires further study.

We recommend the following further research activity, in order of priority, be undertaken or commissioned on this very important topic:

1. Prospective evaluation of care options for this patient group – that is, 'what works for whom', with outcomes measured over a longer follow-up period – probably 1 year. A natural experiment design could be used to undertake this evaluation, with criteria for inclusion matched to those for referral to case management teams rather than for all patients meeting the 'frequent caller' definition.
2. Exploration of different forms of case management, tailored for different patient groups.
3. Data sets important for the care of people who call 999 frequently are defined and agreed across ambulance services in order to harmonise these data sets and allow cross-service evaluation and comparisons. This might be facilitated by FreCaNN.
4. To ensure in future research through early work with ambulance services that processes of care can be retrieved: in particular, detail of referrals for case management and adverse events, for example arrests; and for including patients in the research through qualitative study.
5. Investigation of the feasibility of obtaining self-reported outcomes from this patient group and appropriate methods for doing this.
6. Exploration of methods for including in qualitative research those patients judged by services to be vulnerable or high risk – that is, how best to navigate 'gatekeeping'.

Additional information

CRediT contribution statement

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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's important that there are safeguards to make sure that it is 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

STRETCHED data within SAIL are securely stored within its databank and held in compliance with data retention, archiving and data destruction policies. Applications to access data held within the SAIL databank require approval following independent review by their Information Governance Review Panel (IGRP), and access is subject to SAIL's terms, conditions and data disclosure and dissemination policies and procedures. All other inquiries on STRETCHED data should be addressed to the corresponding author.

Ethics statement

STRETCHED was approved on 27 May 2020 by the Health Research Authority and Health & Care Research Wales, based on a favourable opinion received on 1 October 2019 from Wales Research Ethics Committee 4 (19/WA/0216) and support on 27 May 2020 from the Confidential Advisory Group (19/CAG/0195).

Information governance statement

Swansea University is the sole Data Controller for STRETCHED and was the sole recipient and Data Processor of data from NHS England and the SAIL databank. The East of England Ambulance Service; London Ambulance Service; West Midlands Ambulance Service; and Welsh Ambulance Service each processed identifiable 999 call data in order to identify the study cohort. Although they are Controllers of the underlying data, they were Processors for the purpose of the STRETCHED study as cohort identification was undertaken under instruction from the Data Controller. Swansea University 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, and publishes information on how it handles personal data, including how to exercise individual rights and contact details for its Data Protection Officer.

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/PWGF6008.

Primary conflicts of interest: Alan Watkins was a member of HS&DR Funding Committee; Nigel Rees is a member of HTA Clinical Evaluation and Trials Committee; and Helen Snooks is a member of NIHR HTA and EME Editorial Board.

Publications

Snooks HA, Khanom A, Cole R, Edwards A, Edwards BM, Evans BA, Scott J. What are emergency ambulance services doing to meet the needs of people who call frequently? A national survey of current practice in the United Kingdom. *BMC Emerg Med* 2019;**19**:82. https://doi.org/10.1186/s12873-019-0297-3

Aslam RW, Snooks H, Porter A, Khanom A, Cole R, Edwards A, Watkins A. STRategies to manage Emergency ambulance Telephone Callers with sustained High needs: an Evaluation using linked Data (STRETCHED) – a study protocol. *BMJ Open* 2022;**12**:e053123. https://doi.org/10.1136/bmjopen-2021-053123

Evans BA, Khanom A, Edwards A, Edwards B, Farr A, Foster T, Watkins A. Experiences and views of people who frequently call emergency ambulance services: a qualitative study of UK service users. *Health Expect* 2023;**27**. https://doi.org/10.1111/hex.13856

Conference papers and talks

Case management of people who call 999 frequently – qualitative study of the perspective of people providing and receiving care (STRETCHED) – poster at 999EMS Research Forum Annual Conference, 2023.

Case management of people who call 999 frequently – qualitative study of the perspective of people providing and receiving care (STRETCHED) – oral presentation at PRIME Centre Wales Annual Meeting, 2023.

Effects of case management on emergency service usage and mortality of people who call 999 frequently (STRETCHED): emerging Results of linked data analysis – oral presentation at 999EMS Research Forum Annual Conference, 2023.

When is it wrong to ring 999 (again)? Constructing a moral narrative around frequent calls to emergency ambulance services (STRETCHED) – oral presentation at British Sociological Association Medical Sociology Conference, 2023.

Cohort identification for observational analysis: initial impressions from the STRETCHED study – oral presentation at HSR UK Annual Conference, 2021.

Co-design of a logic model describing components, mechanisms of change and expected impacts of case management for people who frequently call ambulance services – oral presentation at Health and Care Research Wales Conference, 2020.

STRETCHED STRategies to manage Emergency ambulance Telephone Callers with sustained high needs – an Evaluation using linked Data (London) – oral presentation at Frequent Caller National Network meeting, 2019.

STRETCHED: STRategies to manage Emergency ambulance Telephone Callers with sustained high needs – an Evaluation using linked Data (Nottingham) – oral presentation at Frequent Caller National Network meeting, 2019.

Panel session: Who makes high use of the emergency ambulance services and how are services responding to meet the needs of these patients? – chaired by Helen Snooks at HSR UK Conference, 2020.

Co-design of a logic model describing components, mechanisms of change and expected impacts of case management for people who frequently call ambulance services – poster at 999EMS Research Forum Conference, 2021.

Co-design of a logic model describing components, mechanisms of change and potential impacts of case management for people who frequently call ambulance services – poster at HSR UK Conference, 2020.

Co-design of a logic model describing components, mechanisms of change and potential impacts of case management for people who frequently call ambulance services – poster at PRIME Centre Wales Annual Meeting, 2020.

Pros and cons of using anonymised linked routine data to improve efficiency of randomised controlled trials in healthcare: experience in primary and emergency care – poster at 999EMS Research Forum Conference, 2020.

Strategies to manage emergency ambulance telephone callers with sustained high needs – an evaluation using linked data (STRETCHED) – poster at 999EMS Research Forum Conference, 2019.

What are emergency ambulance services doing to meet the needs of people who call frequently? A national survey of current practice in the United Kingdom – poster at HSR UK Conference, 2020.

What are emergency ambulance services doing to meet the needs of people who call frequently? A national survey of current practice in the United Kingdom – poster at 999EMS Research Forum Conference, 2020.

Seminars and workshops

Conference attendance and networking (Manchester) – HSR UK Conference, 2019.

Seminar attendance and networking (Manchester) – HSR UK Spring Seminar, 2019.

Stakeholder event (Bristol) – To develop logic model for case management, 2019.

Training course for paramedics (Swansea) – Research paramedic training, 2019.

References

1. Aslam RW, Snooks H, Porter A, Khanom A, Cole R, Edwards A, *et al*. STRategies to manage Emergency ambulance Telephone Callers with sustained High needs: an Evaluation using linked Data (STRETCHED): a study protocol. *BMJ Open* 2022;**12**:e053123.
2. Edwards MJ, Bassett G, Sinden L, Fothergill RT. Frequent callers to the ambulance service: patient profiling and impact of case management on patient utilisation of the ambulance service. *Emerg Med J* 2015;**32**:392–6.
3. HSCIC. *Ambulance Services England 2014–2015*. URL: www.gov.uk/guidance/cost-consequence-analysis-health-economic-studies (accessed 17 March 2023).
4. AACE. *AACE Annual Report 2014–2015*. 2015. URL: http://aace.org.uk/wp-content/uploads/2015/10/AACE-ANNUAL-REPORT-2014-2015-FINAL-W.pdf (accessed 27 April 2023).
5. Hugo G. *Ambulance Crews Deal with 20 Hoax Calls Every Day Putting Services at Risk*. *inews* 2020. URL: https://inews.co.uk/news/politics/ambulance-crews-hoax-calls-delays-lockdown-yorkshire-697560 (accessed 27 April 2023).
6. Matthew W. Ambulance target failures highlight NHS crisis, say health chiefs. *Guardian* 2016. URL: www.theguardian.com/society/2016/nov/30/ambulance-target-failures-health-chiefs-say-problem-system-wide (accessed 19 November 2024).
7. Scott J, Strickland AP, Warner K, Dawson P. Describing and predicting frequent callers to an ambulance service: analysis of 1 year call data. *Emerg Med J* 2014;**31**:408–14.
8. Hansagi H, Olsson M, Sjöberg S, Tomson Y, Göransson S. Frequent use of the hospital emergency department is indicative of high use of other health care services. *Ann Emerg Med* 2001;**37**:561–7.
9. Søvsø MB, Kløjgaard TA, Hansen PA, Christensen EF. Repeated ambulance use is associated with chronic diseases: a population-based historic cohort study of patients' symptoms and diagnoses. *Scand J Trauma Resus Emerg Med* 2019;**27**:46.
10. Scott J, Strickland AP, Warner K, Dawson P. Frequent callers to and users of emergency medical systems: a systematic review. *Emerg Med J* 2014;**31**:684–91.
11. Snooks HA, Khanom A, Cole R, Edwards A, Edwards BM, Evans BA, *et al*. What are emergency ambulance services doing to meet the needs of people who call frequently? A national survey of current practice in the United Kingdom. *BMC Emerg Med* 2019;**19**:82.
12. Brown JF, Raven MC, Tangherlini NL, Kennedy Hall M. Frequent users of 9-1-1 emergency medical services: sign of success or symptom of impending failure? *Prehosp Emerg Care* 2018;**23**:94–6.
13. Scott J, Pakpahan E, Marlow B, Daxner N. Defining a threshold above which an adult can be considered to frequently use ambulance services: a retrospective cross-sectional study of emergency calls to an ambulance service in England. *Br Paramed J* 2023;**7**:35–45.
14. Bronsky ES, McGraw C, Johnson R, Giordano K, Orlando A; Bar-Or D. CARES. A community-wide collaboration identifies super-utilizers and reduces their 9-1-1 call, emergency department, and hospital visit rates. *Prehosp Emerg Care* 2017;**21**:693–9.
15. Welsh Government. *Ambulance Services in Wales 2016–17*. 2107. URL: www.gov.wales/sites/default/files/statistics-and-research/2019-01/170628-ambulance-services-2016-17-en.pdf (accessed 30 January 2024).
16. Scottish Government. *NHS Scotland Performance: Ambulance Standard*. URL: www.gov.scot/About/Performance/scotPerforms/partnerstories/NHSScotlandperformance/ambulanceStandard (accessed 4 January 2017).
17. Department of Health. *Transforming NHS Ambulance Services*. National Audit Office. 2011. URL: www.nao.org.uk/wp-content/uploads/2011/06/n10121086.pdf (accessed 30 January 2024).

18. NHS England. *Ambulance Quality Indicators 2016*. URL: www.england.nhs.uk/statistics/statistical-work-areas/ambulance-quality-indicators/ (accessed 25 April 2023).

19. Mahmuda S, Wade-Vallance A, Stosic A, Guenter D, Howard M, Agarwal G, *et al*. Understanding why frequent users of EMS call 9-1-1: a grounded theory study. *Health Promot Pract* 2020;**21**:440–7.

20. Agarwal G, Lee J, McLeod B, Mahmuda S, Howard M, Cockrell K, Angeles R. Social factors in frequent callers: a description of isolation, poverty and quality of life in those calling emergency medical services frequently. *BMC Public Health* 2019;**19**:684.

21. Duncan EAS, Best C, Dougall N, Skar S, Evans J, Corfield AR, *et al*. Epidemiology of emergency ambulance service calls related to mental health problems and self harm: a national record linkage study. *Scand J Trauma Resusc Emerg Med* 2019;**27**:34.

22. Scharf B, Bissell R, Trevitt J, Jenkins J. Diagnosis prevalence and comorbidity in a population of mobile integrated community health care patients. *Prehosp Disaster Med* 2018;**34**:1–10.

23. Solberg RG, Edwards BL, Chidester JP, Perina DG, Brady WJ, Williams MD. The prehospital and hospital costs of emergency care for frequent ED patients. *Am J Emerg Med* 2016;**34**:459–63.

24. Aitavaara-Anttila M, Liisanantti J, Ehrola A, Spalding M, Ala-Kokko T, Raatiniemi L. Use of prehospital emergency medical services according to income of residential area. *Emerg Med J* 2020;**37**:429–33.

25. Department of Health. *Taking Healthcare to the Patient: Transforming NHS Ambulance Services*. 2005. URL: https://ircp.info/Portals/11/Future/NHS%20EMS%20Policy%20Recommendation2005.pdf (accessed 30 January 2024).

26. McClelland S. *A Strategic Review of Welsh Ambulance Services*. Public Health Wales. 2013.

27. Fletcher D, Fellow D. *Overview of Frequent Callers of London Ambulance Services*. 2016. URL: https://wiseowlresearch.com/wp-content/uploads/2019/08/FC-Overview-.pdf (accessed 30 January 2024).

28. Dale J, Williams S, Foster T, Higgins J, Snooks H, Crouch R, *et al*. Safety of telephone consultation for ‘non-serious’ emergency ambulance service patients. *Qual Saf Health Care* 2004;**13**:363–73.

29. Snooks HA, Anthony R, Chatters R, Dale J, Fothergill RT, Gaze S, *et al*. Paramedic assessment of older adults after falls, including community care referral pathway: cluster randomized trial. *Ann Emerg Med* 2017;**70**:495–505.e28.

30. Mason S, Knowles E, Freeman J, Snooks H. Safety of paramedics with extended skills. *Acad Emerg Med* 2008;**15**:607–12.

31. Mason S, Knowles E, Colwell B, Dixon S, Wardrope J, Gorringe R, *et al*. Effectiveness of paramedic practitioners in attending 999 calls from elderly people in the community: cluster randomised controlled trial. *BMJ* 2007;**335**:919.

32. Snooks H, Kearsley N, Dale J, Halter M, Redhead J, Cheung WY. Towards primary care for non-serious 999 callers: results of a controlled study of ‘Treat and Refer’ protocols for ambulance crews. *Qual Saf Health Care* 2004;**13**:435–43.

33. Porter A, Snooks H, Youren A, Gaze S, Whitfield R, Rapport F, Woollard M. ‘Should I stay or should I go?’ Deciding whether to go to hospital after a 999 call. *J Health Serv Res Pol* 2007;**12**:32–8.

34. Snooks HA, Kearsley N, Dale J, Halter M, Redhead J, Foster J. Gaps between policy, protocols and practice: a qualitative study of the views and practice of emergency ambulance staff concerning the care of patients with non-urgent needs. *Qual Saf Health Care* 2005;**14**:251–7.

35. NHS England. *High Quality Care for All, Now and for Future Generations: Transforming Urgent and Emergency Care Services in England – Urgent and Emergency Care Review*. 2013. URL: www.england.nhs.uk/wp-content/uploads/2013/06/urg-emerg-care-ev-bse.pdf (accessed 30 January 2024).

36. Welsh Government. *Six Goals for Urgent and Emergency Care: Policy Handbook for 2021 to 2026*. 2022. URL: www.gov.wales/six-goals-urgent-and-emergency-care-policy-handbook-2021-2026 (accessed 30 January 2024).
37. NHS England. *NHS Long Term Plan*. 2020. URL: www.longtermplan.nhs.uk/ (accessed 27 July 2023).
38. Snooks HA, Anthony R, Chatters R, Dale J, Fothergill R, Gaze S, *et al*. Support and assessment for fall emergency referrals (SAFER) 2: a cluster randomised trial and systematic review of clinical effectiveness and cost-effectiveness of new protocols for emergency ambulance paramedics to assess older people following a fall with referral to community-based care when appropriate. *Health Technol Assess* 2017;**21**:1–218.
39. Saron L. Providing streamlined multiagency care for high-intensity users of mental health and emergency services. *Ment Health Pract* 2018;**45**:e1190.
40. Tangherlini N, Villar J, Brown J, Rodriguez RM, Yeh C, Friedman BT, Wada P. The HOME Team: evaluating the effect of an EMS-based outreach team to decrease the frequency of 911 use among high utilizers of EMS. *Prehosp Disaster Med* 2016;**31**:603–7.
41. Kumar GS, Klein R. Effectiveness of case management strategies in reducing emergency department visits in frequent user patient populations: a systematic review. *J Emerg Med* 2013;**44**:717–29.
42. Smith DP, McNally A. Delivering enhanced safety, productivity and experience: early results from a frequent caller management system. *J Paramed Pract* 2014;**6**:634–41.
43. Tadros AS, Castillo EM, Chan TC, Jensen AM, Patel E, Watts K, Dunford JV. Effects of an emergency medical services–based resource access program on frequent users of health services. *Prehosp Emerg Care* 2012;**16**:541–7.
44. British Red Cross. *Nowhere else to turn: exploring high intensity use of Accident & Emergency services*. 2021. URL: www.redcross.org.uk/about-us/what-we-do/we-speak-up-for-change/exploring-the-high-intensity-use-of-accident-and-emergency-services (accessed 19 November 2024).
45. Schaad L, Graells M, Kasztura M, Schmutz E, Moullin J, Hugli O, *et al*. Perspectives of frequent users of emergency departments on a case management intervention: a qualitative study. *INQUIRY: J Health Care Organ Prov Financ* 2023;**60**:e11597.
46. Iglesias K, Baggio S, Moschetti K, Wasserfallen JB, Hugli O, Daeppen JB, *et al*. Using case management in a universal health coverage system to improve quality of life of frequent Emergency Department users: a randomized controlled trial. *Qual Life Res* 2018;**27**:503–13.
47. Lantz PM. 'Super-utilizer' interventions: what they reveal about evaluation research, wishful thinking, and health equity. *Milbank Q* 2020;**98**:31–4.
48. Malebranche M, Grazioli VS, Kasztura M, Hudon C, Bodenmann P. Case management for frequent emergency department users: no longer a question of if but when, where and how. *CJEM* 2021;**23**:12–4.
49. Reddy S, Mazhar S, Lencucha R. The financial sustainability of the World Health Organization and the political economy of global health governance: a review of funding proposals. *Global Health* 2018;**14**:119. https://doi.org/10.1186/s12992-018-0436-8
50. NHS Employers. *NHS Terms and Conditions Annual, Hourly and HCAS Pay Values Scales for 2018/19 (Agenda for Change)*. 2019. URL: www.nhsconfed.org/system/files/2021-05/annex-2-wales.pdf (accessed 17 March 2023).
51. Curtis LA. *Unit Costs of Health and Social Care 2019*. London: PSSRU, University of Kent; 2019.
52. NHS Digital. *2018/19 National Cost Collection Data Publication – National Schedule of NHS Costs 2018/19*. 2021. URL: https://digital.nhs.uk/services/national-casemix-office/downloads-groupers-and-tools (accessed 30 January 2024).
53. Schulz KF, Altman DG, Moher, D; CONSORT Group. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010;**340**:c332. https://doi.org/10.1136/bmj.c332

54. Mauskopf J. Prevalence-based economic evaluation. *Value Health* 1998;**1**:251–9.
55. Drummond M, Sculpher G, Torrance B, O'Brien G. *Methods for the Economic Evaluation of Health Care Programmes*. 4th edn. Oxford: Oxford University Press; 2005.
56. Office for Health Improvement and Disparities. *Cost Consequence Analysis: Health Economic Studies*. 2020. URL: www.gov.uk/guidance/cost-consequence-analysis-health-economic-studies (accessed 18 April 2023).
57. NHS Digital. *Downloads – Groupers and Tools*. 2023. URL: https://digital.nhs.uk/services/national-casemix-office/downloads-groupers-and-tools (accessed 18 April 2023).
58. Guest G, MacQueen KM, Namey EE. *Applied Thematic Analysis*. London: SAGE Publications Ltd; 2011.
59. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;**3**:77–101.
60. Evans BA, Bedson E, Bell P, Hutchings H, Lowes L, Rea D, *et al.*; On behalf of the West Wales Organization for Rigorous Trials in Health (WWORTH). Involving service users in trials: developing a standard operating procedure. *Trials* 2013;**14**:219.
61. Miles MB, Huberman AM. *Qualitative Data Analysis: An Expanded Sourcebook*. London: SAGE Publications Ltd; 1994.
62. Crowe S, Adebajo A, Esmael H, Denegri S, Martin A, McAlister B, *et al.* 'All hands-on deck', working together to develop UK standards for public involvement in research. *Res Involv Engag* 2020;**6**:1–9.
63. Staniszewska S, Brett J, Mockford C, Barber R. The GRIPP checklist: strengthening the quality of patient and public involvement reporting in research. *Int J Technol Assess Health Care* 2011;**27**:391–9.
64. Khanom A, Edwards A, Edwards B, Hughes H, John A, Petterson R, *et al.* InFORM: improving care for people who frequently call 999: co-production of guidance through an observational study using routine linked data and mixed methods. *Int J Popul Data Sci* 2019;**4**:1228.
65. Deaton A, Cartwright N. Understanding and misunderstanding randomized controlled trials. *Soc Sci Med* 2018;**210**:2–21.
66. Lyons RA, Jones KH, John G, Brooks CJ, Verplancke J-P, Ford DV, *et al.* The SAIL databank: linking multiple health and social care datasets. *BMC Med Inform Decis Mak* 2009;**9**:3.
67. Husereau D, Drummond M, Augustovski F, de Bekker-Grob E, Briggs AH, Carswell C, *et al.*; CHEERS 2022 ISPOR Good Research Practices Task Force. Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022) statement: updated reporting guidance for health economic evaluations. *BMJ* 2022;**376**:e067975.
68. The UK Public Involvement Standards Development Partnership. *UK Standards for Public Involvement*. 2019. URL: www.invo.org.uk/wp-content/uploads/2019/11/UK-standards-for-public-involvement-v6.pdf (accessed 30 January 2024).
69. Staniszewska S, Brett J, Simera I, Seers K, Mockford C, Goodlad S, *et al.* GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research. *BMJ* 2017;**358**:j3453.
70. Liabo K, Boddy K, Bortoli S, Irvine J, Boult H, Fredlund M, *et al.* Public involvement in health research: what does 'good' look like in practice? *Res Involv Engagem* 2020;**6**:11.
71. Evans BA, Gallanders J, Griffiths L, Harris-Mayes R, James M, Jones S, *et al.*; SUPER Group and PRIME Centre Wales. Public involvement and engagement in primary and emergency care research: the story from PRIME Centre Wales. *Int J Popul Data Sci* 2020;**5**:1363.
72. NHS England. *MDT Development: Working toward an Effective Multidisciplinary/Multiagency Team*. 2014.
73. NHS England. *Person-Centred Care*. 2021. URL: www.hee.nhs.uk/our-work/person-centred-care (accessed 1 November 2021).

74. Plishka M, Angeles R, Pirrie M, Marzanek F, Agarwal G. Challenges in recruiting frequent users of ambulance services for a community paramedic home visit program. *BMC Health Serv Res* 2023;**23**:1091.

75. Joo JY, Huber DL. Case management effectiveness on health care utilization outcomes: a systematic review of reviews. *West J Nurs Res* 2019;**41**:111–33.

76. Hudon C, Chouinard M-C, Aubrey-Bassler K, Muhajarine N, Burge F, Bush PL, *et al*. Case management in primary care for frequent users of health care services: a realist synthesis. *Ann Fam Med* 2020;**18**:218–26.

77. Hudon C, Chouinard M-C, Pluye P, El Sherif R, Bush PL, Rihoux B, *et al*. Characteristics of case management in primary care associated with positive outcomes for frequent users of health care: a systematic review. *Ann Fam Med* 2019;**17**:448–58.

78. Wenzel H. *Health Monitoring of Bridges*. New York: John Wiley & Sons; 2008.

Appendix 1 Key dates

2019:

1 April 2019	Formal start date
7 August 2019	Wales REC 4 review (19/WA/0216)
1 October 2019	Wales REC 4 favourable opinion
8 November 2019	CAG application review (19/CAG/0195)
18 November 2019	Stakeholder workshop (Bristol)
21 November 2019	Research paramedic training event (Swansea)

2020:

12 March 2020	Research activity suspended at LAS and WAST
17 March 2020	Research activity suspended at WMAS
20 March 2020	UK-wide COVID-19 lockdown announced
23 March 2020	UK-wide COVID-19 lockdown commenced
31 March 2020	Research activity at EEAS suspended
27 May 2020	CAG support confirmed; HRA and HCRW approval received:
28 July 2020	Ambulance service research activity resumed
7 September 2020	Pilot data abstraction at EEAS, LAS, WMAS
30 November 2020	Pilot abstraction completed at EEAS, LAS, WMAS
8 December 2020	Pilot data abstraction commenced at WAST
14 December 2020	NHS Digital agree Data Access Request

2021:

29 January 2021	NHS Digital Data Sharing Agreement signed off at SAIL
11 March 2021	Pilot data abstraction completed at WAST
21 June 2021	Ambulance data abstraction completed
14 July 2021	SAIL application submitted to IGRP
13 August 2021	WAST cohort data uploaded to SAIL databank and Digital Health and Care Wales
8 September 2022	Cohort identifiers upload from EEAS, LAS confirmed by NHS Digital
22 September 2021	EEAS data uploaded to SAIL databank
15 October 2021	LAS cohort file uploaded to NHS Digital
19 October 2022	LAS cohort file uploaded to SAIL databank
25 November 2021	WMAS cohort file uploaded to NHS Digital
13 December 2021	NIHR variation to contract agreed
16 December 2021	WMAS cohort file uploaded to SAIL databank

2022:

21 April 2022	STRETCH-UP proposal drafted
9 May 2022	HES data made available by NHS England
20 May 2022	STRETCH-UP proposal approved and operational
13 July 2022	HES data downloaded and made available in SAIL databank
11 August 2022	ONS mortality data made available in SAIL databank
30 September 2022	Formal (revised) end date

2023:

28 March 2023	Outcomes synthesis meeting
30 June 2023	First version of final report submitted

Appendix 2 Outcomes by ambulance service

TABLE 18 Primary outcome components[a,b] by ambulance service

					Adjusted comparison	
	Intervention		**Control**		**Difference (95% CI)**	***p*-value**
Patients with at least one emergency admission: n (%)						
AS1	67/82	81.7%	47/72	65.3%	OR = 2.477 (0.894 to 6.866)	0.081
AS2	37/77	48.1%	74/137	54.0%	OR = 0.678 (0.325 to 1.413)	0.299
AS3	75/107	70.1%	191/248	77.0%	OR = 0.237 (0.014 to 4.142)	0.315
AS4	192/284	67.6%	110/176	62.5%	OR = 1.450 (0.924 to 2.277)	0.106
Number of emergency admissions: mean (standard deviation)						
AS1	2.98	(3.33)	2.82	(4.32)	Λ = 1.349 (0.900 to 2.021)	0.149
AS2	1.88	(3.98)	2.14	(3.51)	Λ = 1.038 (0.672 to 1.603)	0.884
AS3	1.89	(2.51)	1.73	(1.96)	Λ = 0.653 (0.310 to 1.765)	0.526
AS4	2.32	(3.34)	1.74	(2.53)	Λ = 1.139 (0.894 to 1.450)	0.295
Patients with at least one ED presentation: n (%)						
AS1	72/82	87.8%	55/72	76.4%	Not available[c]	
AS2	59/77	76.6%	103/137	75.2%	OR = 0.632 (0.250 to 1.594)	0.331
AS3	88/107	82.2%	168/248	67.7%	Not available[c]	
AS4	204/284	71.8%	142/176	80.7%	OR = 0.799 (0.463 to 1.381)	0.422
Number of ED presentations: mean (standard deviation)						
AS1	9.01	11.42	7.10	9.08	Λ = 1.462 (1.015 to 2.106)	0.042
AS2	10.04	15.94	7.36	10.77	Λ = 1.325 (0.922 to 1.905)	0.151
AS3	2.90	4.10	2.27	3.31	Λ = 0.793 (0.347 to 2.654)	0.718
AS4	5.13	9.88	6.61	15.10	Λ = 0.590 (0.476 to 0.732)	< 0.001
Patients with at least one emergency ambulance call recorded: n (%)						
AS1	82/82	100%	72/72	100%	Not available[d]	
AS2	70/77	90.9%	131/137	95.6%	OR = 0.341 (0.073 to 1.603)	0.170
AS3	95/107	88.8%	197/248	79.4%	OR = 0.653 (0.008 to 55.800)	0.834
AS4	236/284	83.1%	145/176	82.4%	OR = 1.166 (0.658 to 2.065)	0.598
Number of emergency ambulance calls: mean (standard deviation)						
AS1	41.78	42.35	40.31	43.64	Λ = 1.124 (0.800 to 1.579)	0.504
AS2	24.01	38.95	24.38	32.40	Λ = 0.909 (0.639 to 1.291)	0.611
AS3	7.09	7.88	6.34	9.01	Λ = 0.636 (0.297 to 1.869)	0.549
AS4	12.01	19.57	10.81	19.08	Λ = 1.083 (0.882 to 1.330)	0.451

a Death data withheld due to low counts in some subgroups.
b Composite measure not reported due to low counts in some subgroups.
c Estimation failed due to numerical problem.
d Estimation not possible due to lack of variation.

Note

The comparison between groups reflects the variable under consideration: odds ratios (OR) for binary outcomes analysed using logistic regression models, or incident rate ratios (Λ) for count outcomes analysed using negative binomial models.

TABLE 19 Secondary outcomes by ambulance service[a]

	Intervention		Control		Adjusted comparison	
					Difference (95% CI)	*p*-value
Patients with one or more elective appointments recorded: n (%)						
AS1	14/82	17.1%	8/72	11.1%	OR = 1.941 (0.613 to 6.151)	0.260
AS2	9/77	11.7%	14/137	10.2%	OR = 1.327 (0.458 to 3.847)	0.603
AS3	18/107	16.8%	20/248	8.1%	OR = 1.776 (0.091 to 34.737)	0.703
AS4	40/284	14.1%	12/176	6.8%	OR = 2.498 (1.228 to 5.083)	0.012
Number of elective appointments: mean (standard deviation)						
AS1	0.67	3.89	0.18	0.59	Λ = 1.443 (0.585 to 3.559)	0.431
AS2	0.26	0.85	0.14	0.47	Λ = 2.371 (0.947 to 5.938)	0.072
AS3	0.26	0.81	0.10	0.42	Λ = 2.085 (0.326 to 33.156)	0.655
AS4	0.21	0.69	0.11	0.52	Λ = 2.003 (1.152 to 3.485)	0.014
Patients with one or more outpatient appointments recorded: n (%)						
AS1	60/82	73.2%	47/72	65.3%	OR = 1.072 (0.494 to 2.327)	0.860
AS2	51/77	66.2%	88/137	64.2%	OR = 1.396 (0.601 to 3.245)	0.437
AS3	58/107	54.2%	158/248	63.7%	OR = 0.626 (0.051 to 7.738)	0.709
AS4	221/284	77.8%	135/176	76.7%	OR = 1.172 (0.706 to 1.947)	0.539
Number of outpatient appointments: mean (standard deviation)						
AS1	7.91	17.77	3.43	5.55	Λ= 1.558 (1.062, 2.285)	0.024
AS2	5.35	10.27	4.99	7.54	Λ= 1.000 (0.686, 1.459)	0.997
AS3	1.93	3.08	2.37	3.54	Λ= 2.136 (0.633, 8.543)	0.477
AS4	5.04	6.24	4.35	5.30	Λ= 1.064 (0.857, 1.321)	0.576
Number of ambulance attendances: mean (standard deviation)						
AS1	16.83	15.47	15.06	12.41	Λ = 1.061 (0.749 to 1.503)	0.741
AS2	9.84	15.25	9.64	12.84	Λ = 0.962 (0.672 to 1.376)	0.834
AS3	4.78	5.92	3.97	4.81	Λ = 0.677 (0.315 to 1.908)	0.577
AS4	8.56	14.36	8.61	15.74	Λ = 0.989 (0.801 to 1.214)	0.894
Number of ambulance conveyances: mean (standard deviation)						
AS1	6.38	7.36	5.22	5.29	Λ = 1.283 (0.887 to 1.856)	0.189
AS2	5.62	8.51	4.98	7.35	Λ = 0.994 (0.689 to 1.433)	0.969
AS3	2.30	3.53	1.73	2.33	Λ = 0.772 (0.338 to 2.492)	0.695
AS4	3.87	8.11	3.88	6.05	Λ = 0.835 (0.669 to 1.043)	0.122

a Patients referred for case management, the number of patients declassified and subsequently reclassified; and the proportion of patients with an adverse event, arrest, conviction, complaint, or serious case review recorded are not reported by site due to low counts in some subgroups, and lack of data availability for declassification and reclassification.

Note

The comparison between groups reflects the variable under consideration: odds ratios (OR) for binary outcomes analysed using logistic regression models, or incident rate ratios (Λ) for count outcomes analysed using negative binomial models.

Secondary outcomes by ambulance service. Harms (a composite measure of adverse events, arrests, convictions, complaints made to the ambulance service, and serious case reviews) and cause of death are not reported for individual ambulance services due to small counts in some subgroups. The proportion of patients that no longer meet the frequent caller threshold is withheld as almost all patients are in this category, creating small subgroups of patients where this is not the case.

As with the primary outcome components, there is noticeable variation between sites in some outcomes (such as the proportion of patients recording outpatient appointments). However, outcomes are broadly similar between areas that do and do not use case management within each ambulance service, with the exception of elective admission in AS4, where differences are observed between the proportion of patients recording an elective admission and the mean number of elective admissions.

Appendix 3 Further details on data processing and statistical modelling

Summary of data

Table 20 shows each data source used in analysis, the data provider, number of rows of data and the data items in that source (other data items and metadata may also be present). Data were only obtained for patients in the study cohort, with opt-outs respected where applicable.

Data sets from NHS Digital were provided based on UK financial years (1 April to 31 March). Therefore, in order to obtain data for the entire period of 1 July 2017 (6 months before the first possible index date) to 30 June 2019

TABLE 20 Data providers, sources, items

Data provider	Source	Data items
Ambulance services	Frequent callers list	EMS name Area within EMS Date added to frequent callers list Referred for case management Received case management On frequent callers list on 1 January 2018
	999 calls	Date of incident Time of call AMPDS category NHS pathway Outcome of call
	Ambulance dispatches	Date of incident Time first vehicle dispatched Condition code(s) Disposition of ambulance call-out Time last vehicle clear
	Complaints	Date of complaint Anonymised narrative
	Arrests	Date of arrest
	Convictions	Date of conviction
	Adverse events	Date of adverse event Anonymised narrative Police informed
	Serious case review	Date requested Anonymised narrative of event
NHS Digital	HES A&E	A&E arrival date A&E arrival time A&E arrival mode A&E attendance disposal Diagnosis (all codes) Number of diagnoses Healthcare resource group Ethnic origin LSOA 2011 Index of Multiple Deprivation

continued

TABLE 20 Data providers, sources, items (*continued*)

Data provider	Source	Data items
	HES admitted patient care	Admission date Admission method Diagnosis (all codes) Discharge date Healthcare resource group Ethnic origin Sex Month and year of birth LSOA 2011 Index of Multiple Deprivation
	HES outpatients	Appointment date Attended Cause Diagnosis (all codes) Healthcare resource group Ethnic origin Index of Multiple Deprivation LSOA 2011 Month and year of birth
	ONS mortality	Date of death Cause of death Subsequent activity
SAIL Databank	Anonymised linking field	LSOA 2011 Week of birth Gender
	ADDE	Death date Death registration date Cause of death (all codes)
	EDDS	Arrival date Arrival time Ethnic group Birth year Age Sex LSOA 2011 Arrival mode Attendance group Diagnosis code(s) End date End time Discharge Presenting complaint
	OPDW	Gender Age at appointment LSOA 2011
	PEDW admissions	Start date End date Final discharge method First primary diagnosis Last primary diagnosis Admission method Admission source Admission specialty Discharge destination Discharge specialty
SAIL Databank reference tables	ICD10 codes	Diagnosis code (first three characters) Diagnosis description
	Townsend deprivation score	Geographic unit code Geographic unit label Townsend deprivation score Townsend deprivation quintile

(6 months after the last possible index date), data for financial years 2017–8, 2018–9, and 2019–20 were requested, and data outside the baseline/follow-up period for each patient were discarded.

Determination of index date and time intervals

Different ambulance services manage their frequent caller lists in different ways. For example, AS3 update their lists at the beginning of each calendar month.

For consistency between patients and ambulance services, all dates and time intervals are based on the 'index date' – defined as the day each patient first meets the emergency ambulance call threshold for inclusion in STRETCHED (or 1 January 2018 if they were eligible for inclusion on an ambulance service frequent caller list on this date). For example, age is calculated in full years on the index date. Patients were not necessarily added to ambulance service frequent caller lists (or referred for case management, if applicable), on this date.

When determining the index date, '1 month' does not necessarily mean 'calendar month': a patient making five calls between the 15 May and the 15 June, but only two/three calls in each calendar month, would still be considered to meet the call threshold.

The baseline period is the 6 months prior to, and including, the index date; the follow-up period starts on the day immediately after the index date and includes the subsequent 6 months. For example, for a patient with an index date of 15 June 2018, the baseline period would be 15 December 2017 to 15 June 2018, and the follow-up period would be 16 June 2018 to 16 December 2018. This ensures the call where the patient meets the inclusion threshold is not included as a follow-up event, and that patients would not be lost to follow-up were they to die between the index date and the next monthly update to an ambulance service frequent caller list.

Data cleaning

Raw data sets were imported into SPSS, and corresponding data sets from different providers merged to form a single common data set of each type (including any recoding to common schema where appropriate). For example, emergency ambulance call data sets from individual services were merged to form a data set containing all calls.

Index dates for each patient were determined by transforming the combined emergency ambulance call data set into wide format (so that rows represent individual patients rather than individual calls) and looping over call dates to find the first call that met the frequent caller threshold.

The index date was then merged to each outcome data set in turn using study ID, and the date of each event compared to the index date for that patient using the DATEDIFF function. Records outside the baseline/follow-up periods for each patient were discarded. Where appropriate, outcomes were also categorised (e.g. hospital admissions were flagged as emergency or elective, and day admissions or extended stays, or emergency ambulance calls categorised as in/out of hours). The number of events for each patient in each period were summed using the AGGREGATE command. Where no events of any given type were recorded, this was assumed to be 0 events and missing values recoded accordingly.

Aggregated data sets were then merged with the frequent caller list and demographics data sets to form the analysis data set. A dichotomised variable indicating the presence of at least one event was generated, and the composite primary outcome was determined by checking the dichotomised version of each component in turn. Finally, ineligible patients were flagged for exclusion.

Imputation

Higher than expected amounts of missing demographics data were managed using the SPSS Multiple Imputation command with a random seed of 230126. Default settings were used unless otherwise noted, with the imputed data saved as a new data set. In line with the default settings, a total of five imputations were generated for each missing value.

We imputed age (constrained to be between 18 and 110 years old, inclusive), gender, ethnicity (white/non-white only), Townsend deprivation quintile (constrained to be between one and five, inclusive). Ambulance service, local health board and study arm were included as indicator variables only; as metadata, these were complete for every record.

Modelling

Outcome analyses were conducted using the SPSS LOGISTIC (binary outcomes) and GENLIN (count variables) commands. Outcomes were analysed individually; covariates were study arm, ambulance service, age, gender, ethnicity, Townsend deprivation quintile, and the number of baseline emergency ambulance calls, emergency admissions, ED presentations, elective admissions and outpatient appointments. Study arm, ambulance service, gender, and ethnicity were set as categorical variables; the remainder were continuous. *Table 21* shows the full resulting model for the composite primary outcome.

TABLE 21 Pooled logistic regression model for the composite primary outcome

Variable	Coefficient	Adjusted odds ratio	95% CI	*p*-value
Study arm[a]	0.147	1.159	(0.595 to 2.255)	0.665
AS2[b]	−17.666	0	Undefined	0.995
AS3[b]	−17.314	0	Undefined	0.995
AS4[b]	−17.919	0	Undefined	0.995
Age[c]	0.005	1.005	(0.989 to 1.021)	0.562
Female[d]	−0.166	0.847	(0.435 to 1.652)	0.622
Non-white[e]	0.201	1.223	(0.494 to 3.028)	0.660
Townsend UK deprivation quintile[f]	0.042	1.043	(0.819 to 1.327)	0.735
Baseline emergency ambulance calls	0.215	1.24	(1.091 to 1.41)	0.001
Baseline emergency admissions	−0.012	0.988	(0.763 to 1.281)	0.930
Baseline ED presentations	0.329	1.389	(1.132 to 1.704)	0.002
Baseline elective admissions	0.228	1.256	(0.660 to 2.392)	0.488
Baseline outpatient appointments	0.058	1.06	(0.962 to 1.167)	0.238
Constant	17.546			

a Case management was coded as 1; the reference category is standard care (coded as 0).
b Ambulance Service 2 is coded as 2; AS3 is coded as 3; AS4 is coded as 4; the reference category was AS1 (coded as 1). Every patient recorded an event in AS1.
c Age in full years on the date the patient was first eligible for inclusion during 2018.
d Female is coded as 2; the reference category is male (coded as 1).
e Non-white is coded as 2; the reference category is white (coded as 1).
f Townsend deprivation quintile was coded 1 (least deprived) to 5 (most deprived). Quintiles represent UK-level deprivation.

Note
Raw counts were used for the number of emergency ambulance calls, the number of emergency admissions, ED presentations, elective admissions and outpatient appointments.

Appendix 4 Healthcare costs by ambulance service

TABLE 22 Healthcare costs by ambulance service

				Comparison	
		Intervention	**Control**	**Difference (95% CI)**	***p*-value**
Service		*n*	*n*		
AS1		82	72		
AS2		77	137		
AS3		107	248		
AS4		284	176		
Emergency admissions					
AS1	Total	789,340	602,003	Δ = 1264.95 (−2448.51 to 4978.40)	0.502
	Mean (SD)	9626.10 (10,758.73)	8361.15 (12,565.84)		
AS2	Total	909,431	516,554	Δ = 70.31 (−3130.83 to 3271.45)	0.966
	Mean (SD)	6708.49 (11,857.21)	6638.18 (11,139.01)		
AS3	Total	1,307,645	2,438,035	Δ = 2390.20 (−817.06 to 5597.45)	0.143
	Mean (SD)	12,220.98 (14,647.18)	9830.77 (12,559.64)		
AS4	Total	2,219,458	1,256,478	Δ = 675.91 (−1335.97 to 2687.80)	0.509
	Mean (SD)	7814.99 (10,836.11)	7139.08 (10,400.95)		
ED attendances					
AS1	Total	132,025	92,397	Δ = 326.77 (−225.01 to 878.55)	0.244
	Mean (SD)	1610.06 (1831.87)	1283.29 (1604.22)		
AS2	Total	129,079	172,477	Δ = 417.39 (−193.50, 1028.29)	0.179
	Mean (SD)	1676.35 (2724.76)	1258.96 (1797.56)		
AS3	Total	51,626	93,790	Δ = 104.30 (−42.38 to 250.98)	0.162
	Mean (SD)	482.49 (678.92)	378.19 (548.41)		
AS4	Total	240,046	197,088	Δ = −274.59 (−585.03 to 35.86)	0.083
	Mean (SD)	845.23 (1417.16)	1119.82 (1961.91)		
Emergency ambulance service calls					
AS1	Total	34,280	29,020	Δ = 14.99 (−122.06 to 152.04)	0.829
	Mean (SD)	418.05 (423.40)	403.06 (436.37)		
AS2	Total	18,490	33,400	Δ = −3.67 (−101.62 to 94.30)	0.941
	Mean (SD)	240.13 (389.49)	243.80 (324.00)		
AS3	Total	7590	15,720	Δ = 7.55 (−12.21 to 27.31)	0.453
	Mean (SD)	70.93 (78.82)	63.38 (90.09)		
AS4	Total	34,110	19,030	Δ = 11.98 (−24.93 to 48.89)	0.524
	Mean (SD)	120.10 (198.82)	108.12 (190.77)		

continued

TABLE 22 Healthcare costs by ambulance service (*continued*)

		Intervention	Control	Comparison Difference (95% CI)	*p*-value
Secondary outcomes					
Outpatient appointments					
AS1	Total Mean (SD)	80,975 987.50 (1688.08)	52,175 724.65 (1498.12)	Δ = 262.85 (−248.38 to 774.07)	0.311
AS2	Total Mean (SD)	81,443 1057.70 (1998.83)	142,290 1038.61 (1619.87)	Δ = 19.09 (−476.48 to 514.66)	0.940
AS3	Total Mean (SD)	30,751 287.39 (457.85)	94,465 380.91 (545.03)	Δ = −93.52 (−211.89 to 24.86)	0.121
AS4	Total Mean (SD)	323,669 1139.68 (1526.15)	131,799 748.86 (889.74)	Δ = 390.82 (169.37 to 612.28)	< 0.001
Elective admissions					
AS1	Total Mean (SD)	136,296 1662.15 (7892.38)	71,878 998.31 (4990.62)	Δ = 663.84 (−1472.55 to 2800.23)	0.540
AS2	Total Mean (SD)	26,192 340.16 (1831.76)	16,312 119.07 (689.09)	Δ = 221.09 (−209.92 to 652.10)	0.311
AS3	Total Mean (SD)	66,812 624.97 (2327.56)	169,019 681.53 (5995.12)	Δ = −56.56 (−1233.64 to 1120.52)	0.925
AS4	Total Mean (SD)	202,306 712.34 (4371.82)	5802 32.96 (437.34)	Δ = 679.38 (164.70 to 1194.05)	0.010
Ambulance conveyances					
AS1	Total Mean (SD)	313,524 3823.46 (3472.81)	244,604 3397.28 (2718.97)	Δ = 426.18 (−576.79 to 1429.16)	0.402
AS2	Total Mean (SD)	179,206 2327.35 (3568.14)	308,825 2254.20 (2947.55)	Δ = 73.15 (−820.78 to 967.08)	0.872
AS3	Total Mean (SD)	118,607 1108.48 (1382.57)	226,200 912.10 (1093.99)	Δ = 196.38 (−73.87 to 466.63)	0.154
AS4	Total Mean (SD)	560,831 1974.76 (3285.79)	244,604 1985.34 (3505.81)	Δ = −10.58 (−646.19 to 625.03)	0.974

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