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Authors

Peter Hodgins: Clinical Academic Fellow, Centre for Population Health Sciences, Usher Institute. University of Edinburgh. ORCID 0000-0002-3016-348X
Megan McMinn: Research Fellow, Centre for Population Health Sciences, Usher Institute. University of Edinburgh.
Anoop Shah: Associate Professor Clinical Epidemiology, London School of Hygiene and Tropical Medicine.
Matthew J Reed: Emergency Medicine Research Group Edinburgh (EMERGE), Royal Infirmary of Edinburgh, 51 Little France Crescent, Edinburgh, EH16 4SA, UK; Honorary Senior Lecturer, Acute Care Edinburgh, Usher Institute of Population Health Sciences and Informatics, College of Medicine and Veterinary Medicine, University of Edinburgh. ORCID 0000-0003-1308-4824.
Stewart W Mercer: Professor of Primary Care and Multimorbidity, Centre for Population Health Sciences, Usher Institute. University of Edinburgh.
Bruce Guthrie: Professor of General Practice and Director Advanced Care Research Centre, Centre for Population Health Sciences, Usher Institute, University of Edinburgh.

Corresponding author:
Bruce Guthrie
Professor of General Practice and Director Advanced Care Research Centre,
Doorway 3, Old Medical School,
Teviot Place,
Edinburgh EH8 9AG
bruce.guthrie@ed.ac.uk
07948 267 273

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Abstract

Objective: Treatment of acute myocardial infarction (MI) requires rapid transfer of people with chest pain to hospital, however unscheduled-care pathways vary in their directness (the minimal number of contacts to hospital admission). The aim was to examine unscheduled-care pathways and the associations with mortality in people admitted with MI.

Methods: Retrospective population study of all people admitted to Scottish hospitals with a diagnosis of MI between 1/1/15-31/12/17. Linked data for all National-Health-Service Scotland unscheduled-care services (NHS24-telephone-triage service, Primary-care-out-of-hours, ambulance, emergency-department (ED)) was used to define Continuous-Unscheduled-Care-Pathways (pathways), which were categorised by initial contact, and whether they were 'direct' (had minimum number of contacts between first contact and admission). Analysis estimated odds-ratios and 95% confidence-intervals in adjusted models in which all covariates were included.

Results: 26,325 people admitted with MI (63% men, median age group 65-59 years IQR-25), of whom 5.6% died from coronary-heart-disease within 28 days. For 47.0%, the first unscheduled-care contact was ambulance, 23.0% attended ED directly and 18.7% called telephone-triage. 92.1% of pathways were direct. Pathways starting with telephone-triage were more likely to be indirect compared to other initial contacts (aOR 1.97, 95%CI 1.61-2.40). Indirect-pathways starting with telephone-triage were associated with higher mortality than direct-pathways (aOR 1.97, 95%CI 1.61-2.40) and higher mortality than indirect-pathways starting with another service (aOR 1.55, 95%CI 1.19-2.01), but not for direct-pathways starting with telephone-triage (aOR 0.87, 95%CI 0.74-1.02).

Conclusion: Unscheduled-care pathways leading to admission with MI in Scotland are usually direct but those starting with telephone-triage were more commonly indirect. Those indirect-pathways were associated with higher mortality.

Key words

Myocardial Infarction, telemedicine, quality of healthcare, delivery of healthcare.

Key questions

What is already known about this subject?

- Myocardial infarction (MI) remains a significant cause of death despite improved diagnostics and reduced time to effective treatment.
- Unscheduled care pathways can be complex and have the potential to lead to treatment delays.
- The COVID-19 pandemic has led to increased use of telephone triage in unscheduled care.

What does this study add?

- Most care pathways had the minimum number of unscheduled care interactions expected between first service contacted and hospital admission with MI.
- Care pathways that involved more than a minimum number of unscheduled care contacts were associated with higher mortality from MI, particularly if the initial service was NHS 24.

How might this impact on clinical practice?

- In patients with atypical symptoms for MI, or complex care needs, caution is required to ensure telephone triage does not inadvertently lead to either an increase in unscheduled care contacts or delays to accessing appropriate treatment.

Introduction

Case fatality rate and overall mortality due to myocardial infarction (MI) have reduced over the past twenty years, although MI remains a significant cause of mortality.[1] Improved diagnostics[2,3] and reduced time to effective treatment have contributed to this reduction, through the standardisation of care pathways and treatment algorithms.[4] The UK National Institute of Clinical Excellence (NICE) recommends percutaneous coronary intervention (PCI) within 12 hours of symptom onset for patients with ST elevation myocardial infarction (STEMI) and immediate coronary angiography for unstable patients with non-STEMI or unstable angina.[5] All age groups are thought to benefit from an early invasive strategy[6,7] and delays to recommended care are associated with increased mortality.[8]

Atypical symptoms, multimorbidity and complex care needs impact both how care is accessed and timely diagnosis.[8-10] Older populations are less likely to get PCI despite proven benefits.[10] In addition, atypical symptoms may delay recognition of serious problems by patients and professionals, leading to treatment delays,[11-12] while increased use of telephone triage has the potential to increase the number of health care contacts and delay diagnosis.[13-15]

Sources of delay include how patients access unscheduled care and the number and pattern of service contacts they have prior to hospital admission. Many patients with chest pain choose to call an ambulance or attend emergency departments directly meaning they have rapid access to definitive diagnosis, but in the UK many use telephone triage services.[13] During the current pandemic there has been increased use of telephone triage,[16] and the National Health Service (NHS) in England now aims for NHS telephone triage to be the primary route into unscheduled care, with an 'expectation' that 70% of those triaged to attend the Emergency Department (ED) by NHS telephone triage will receive a booked time slot.[17] Similar changes have happened in other UK countries during the COVID-19 pandemic.

Understanding unscheduled care pathways for people diagnosed with MI, and associated outcomes, is important for informing future design of unscheduled care services, particularly if 'telephone first' strategies persist after the pandemic.[18] The aim of the study was, therefore, to examine direct and indirect pathways to care, in the context of the initial unscheduled care service contacted, and associations with mortality in all patients admitted to a hospital with a MI in the years 2015 to 2017.

Methods

Study design and data sources

The study is a retrospective, population study using the Scotland-wide Unscheduled Care DataMart (UCD) which links data from NHS24 telephone advice and triage (the Scottish NHS telephone triage service), the Scottish Ambulance Service, Primary-Care-Out-of-Hours (PCOOH), Emergency Departments (ED), emergency acute hospital admissions (Scottish Morbidity Records 01 [SMR01]), mental health admissions (SMR04), and National Records of Scotland (NRS) death registration. The Community Health Index (CHI - the NHS Scotland unique patient identifier) number was used to link episodes of care across all datasets. Linkage was carried out by NHS Scotland Information Services Division. Data on contacts is electronically collected by all services and is complete.[19] A Continuous-Unscheduled-Care-Pathway (pathway) is a series of unscheduled care contacts for a single person.[19] Pathways terminate when there is no further contact with any Unscheduled Care (UC) service for 24 hours. Each emergency and urgent care service is assigned a code letter: N=NHS24 telephone triage, O=Primary-care-out-of-hours, S=Scottish Ambulance Service, E=Emergency Department, A=Acute hospital emergency-admission. Pathway names are the chronological sequence of contacts. For example, the pathway NOSEA represents NHS24 telephone triage, followed by Primary-care-out-of-hours (O), then Scottish Ambulance Service, then ED attendance terminating with an acute hospital emergency admission.

Setting and patients

The cohort consisted of all patients admitted to Scottish hospitals between 1/1/15 to 31/12/17 with MI (defined as ICD 10 codes I21 and I22 recorded as the primary discharge diagnosis). Demographic information, the pathway before admission, whether the patient had been admitted with a previous MI, and mortality data from National Records Scotland were then linked.

Outcomes

Two outcomes were examined: (1) Whether the initial unscheduled care service was with NHS24 telephone triage or another unscheduled care service (ED, ambulance, Primary-care-out-of-hours or direct medical admission) and (2) Death from coronary heart disease (defined as ICD 10 code I20-I25 recorded as underlying cause of death) within 28 days of admission date.

Other variables

In both analyses, other variables examined were age (in five year increments but with <50 years and >80 years combined because of small numbers), sex, patient socioeconomic status (defined by the Scottish Index of Multiple Deprivation [SIMD] grouped into quintiles), urban/rurality (defined by the Scottish Executive Urban Rural Classification [SEURC] grouped into primary city/urban, accessible, remote and very remote, where the latter three categories are defined by drive time to an urban area of <30 minutes, 30-60 minutes, and >60 minutes respectively), and whether the patient had experienced a previous MI.

For the mortality analysis, pathways were categorised based on whether they were considered 'direct' or 'indirect'. The number of service contacts before admission varies depending on which service the patient initially accesses. The assumption was made that a higher number of contacts prior to diagnosis results in an increased time to treatment, and so pathways were defined as direct if they used the minimal number of contacts before admission for each type of initial contact, and otherwise as indirect (more than the minimal number of contacts). For example, the pathway 'SEA' is direct, as the patient calls an ambulance, attends ED and is admitted, whereas the pathway 'SEEA' is indirect as two separate ED attendances occur before inpatient admission. Similarly, the pathway 'NSEA' is 'direct' as the patient chooses to call NHS24 telephone triage and is then taken by ambulance to ED and admitted, whereas the pathway 'NOSEA' is 'indirect' as a Primary-care-out-of-hours attendance is an additional contact with a service which cannot make a definitive diagnosis (although it may help avoid unnecessary ED attendances by those without MI). Of the 370 unique patterns of pathway observed, 15 were direct and 355 indirect (table 1 and figure 1). Direct and indirect pathways were further categorised based on whether the initial service contacted was NHS24 telephone triage or another unscheduled care service.

Data Analysis

Data were managed and analysed using R v3.6.1 and SPSS v24. Demographics were described using summary statistics, and pathways between initial unscheduled care contact and admission with myocardial infarction examined. For the binary outcome variables (death, and NHS24 telephone triage initial contact vs another unscheduled care initial contact), logistic regression modelling examined associations between outcomes and sex, age group, SIMD, SEURC and previous MI; and for the mortality analysis, pathway type (direct vs indirect). The dataset was complete for all variables except SIMD and SEURC, for which

198 cases (0.75%) had missing data. These were excluded from analysis given the small number. Analysis estimated odds ratios and 95% confidence intervals in both univariate (unadjusted) models, and adjusted models in which all covariates were included. Multicollinearity and model-fit were assessed with Nagelkerke R squared and Akaike-information-criterion (appendix 1).

Patient and public involvement

No patient or public involvement.

Ethics and governance

The NHS Scotland Public Benefit and Privacy Panel for Health and Social Care approved the project (reference 1617/0307).

Results

Of 26,325 hospital admissions with a primary diagnosis of MI, 63.2% were for men (table 2). Almost ten percent (8.9%) of admissions were in people age <50 years (median age group for admission with MI 65-69 years IQR 25 years), increasing to 25.0% in those aged >80 (table 1). People living in the most deprived 20% of postcodes made up 24.1% of MIs, with a stepwise decrease to 15.3% in those in the least deprived quintile. Two-thirds (68.4%) lived in an urban area, compared to 4.2% living in a remote area. Previous MI was recorded in 16.6% (table 2).

For 47.0% of patients, the first contact with unscheduled care was an ambulance call, 23.3% attended the ED directly, 18.7% called NHS24 telephone triage, 10.1% had a direct inpatient admission (assumed to be the result of a daytime GP emergency referral), and 0.8% presented directly to Primary-care-out-of-hours (which is allowed in some areas although not encouraged) (table 3) (figure 1). Half of pathways were either 'SEA' (ambulance→ED→admission – 29.9%) or 'EA' (ED→admission – 20.1%) (table 3), 81.3% consisted of three or less unscheduled care contacts (including admission), 14.8% four contacts, and only 3.9% ≥5 contacts. In total, the 15 direct pathways accounted for 24,244 (92.1%) of all pathways, whereas the 355 indirect pathways accounted for 2081 (7.9%) (figure 1). Pathways beginning with an ED attendance were direct in 96.7% of cases, and those that began with an ambulance were direct in 94.9%. In comparison, 76.9% of pathways

starting with NHS24 telephone triage were direct, compared to 62.0% of those starting with a Primary-care-out-of-hours attendance (table 3).

Descriptive analysis showed a greater proportion of men with MI attended the ED directly whereas a greater proportion of women had an initial telephone triage contact. A higher proportion of people with MI living in very remote areas had a first contact with NHS telephone triage compared with urban counterparts. Proportionally more younger people with MI had a first contact with the ED compared with older patients, more of whom contacted NHS24 telephone triage or an ambulance (table 1). On logistic-regression analysis, people over 80 years of age were more likely to call NHS24 telephone triage as their first unscheduled care contact (compared to those aged 55-59, adjusted OR (aOR) 1.21, 95%CI 1.08-1.36) (table 4). Those living in the most deprived areas were less likely to call NHS24 telephone triage as their initial point of contact (aOR 0.86 [0.77-0.95] compared to those living in the least deprived areas), as were men (aOR 0.74 [0.75-0.89]) and those living in the most remote areas (aOR 0.70 [0.58-0.83] compared to those living in cities).

In total, 5.6% people admitted with MI died from coronary heart disease within 28 days of admission (table 3). Compared to direct pathways starting in any service except NHS24 telephone triage (Other Direct), direct pathways starting with NHS24 telephone triage were not associated with increased mortality (aOR 0.87 [0.74-1.02]) (table 5). Indirect pathways that began with another unscheduled care service were associated with increased mortality (aOR 1.55 [1.19-2.01]), with indirect pathways starting with NHS24 telephone triage having the highest odds of mortality (aOR 1.97 [1.61-2.40]). Increasing age was associated with large increases in mortality, with a stepwise increase from 1.3% aged <50 dying to 12.3% of those aged ≥80 (aOR 8.36, CI 6.16-11.35 compared to age group 55-59). In unadjusted analysis, there was no association between socioeconomic deprivation and mortality, but in adjusted analysis those living in the least deprived areas had lower odds of mortality (aOR 0.82 [0.69-0.98]) compared to those living in the most deprived areas. There was no association between remoteness from an urban centre and mortality. In unadjusted analysis women had an increased odds of mortality (OR 1.53 [1.37-1.69]), although this was smaller and not statistically significant after adjusting for other variables (aOR 1.07 [0.96-1.20]).

Discussion

Summary

One in twenty (5.6%) patients diagnosed with MI died from coronary heart disease within 28 days of hospital admission. Notably, indirect pathways that began with NHS24 telephone triage were associated with the highest mortality, followed by indirect pathways initiated by contact with another unscheduled care service. Increasing age was associated with higher mortality, as was living in the most deprived areas, but living in remote areas was not.

Most (92.1%) patients had a direct route to definitive care regardless of which service they chose to initially contact, with five direct pathways (SEA, EA, SA, NSEA, A), out of a total of fifteen direct pathways, accounting for 83.6% of all patient journeys. Differences in the characteristics of people with MI were noted in terms of choice of NHS24 telephone triage as the first point of unscheduled care contact. Men, people living in more deprived areas, those who had had a previous MI, and those living most remotely were the least likely to call NHS24 telephone triage as their first unscheduled care contact. In contrast older people (aged >80 years) were more likely to call NHS24 telephone triage first, although also more likely to call an ambulance first and less likely to attend ED first, compared with other age groups.

Strengths and limitations

The key strength of the study is that the Unscheduled Care Datamart allows for a comprehensive analysis of linked unscheduled care attendances for the entire Scottish population. However, we cannot be certain that linked episodes in a pathway are actually for the same problem, since pathways are defined as sequential episodes over a short period of time regardless of why the person calls or attends. This means that certain pathways may have been indirect in practice, such as separate attendances at an Emergency Department (Emergency Department→Ambulance→Emergency Department→Admission), but were considered direct as it was thought they more likely represented an inter-hospital transfer given the rural nature of many of Scotland's hospitals. A further weakness is that in only including patients admitted to hospital, those who die from MI prior to admission are not counted. Furthermore, in not including patients who have symptoms suggestive of MI but do not receive a diagnosis, a full analysis of the triage process is not possible. NSTEMI is commoner in older people with multimorbidity and has more atypical presentations, both of which would be expected to be associated with 'indirect' pathways and higher mortality. However, hospital discharge coding does not reliably distinguish between STEMI and

NSTEMI, meaning we cannot explore this. A further limitation is information on individual cardiovascular risk factors and presenting symptoms was not included, the prevalence of which may influence associations with mortality, underscoring the fact that claims of causality cannot be made. Previous MI was included but the risk of selection bias was present since such patients may be more likely so seek medical attention in the first place and more likely be assessed for potential MI. Finally, the exact time of a person's first contact with unscheduled was not available, meaning that while it may be inferred that indirect pathways can lead to treatment delays, this could not be precisely quantified.

Comparisons with existing literature

The mortality rate is in keeping with other studies[20-21] as is the ratio of men to women in terms of incidence of MI and mortality.[1,22,23] The associations between increasing age and lower SES have been found previously.[22-24] Differences include a previous finding that men with symptoms of MI were more likely to call an ambulance[25] as opposed to little difference in this study, and a previous study showing older patients had decreased use of NHS24 telephone triage, although it did include all calls.[26] Public health campaigns have been effective in raising awareness amongst the public of typical symptoms of MI, and the importance of seeking prompt treatment.[27] Men and younger people are more likely to experience typical symptoms[9] which likely explains some of the patterns of unscheduled care use observed here. However, other contextual factors are also likely to be at play, including transport and mobility issues which may underlie the observation that younger people were more likely to attend ED as first contact, whereas older people were more likely to call NHS24 telephone triage or call an ambulance. It is unsurprising that age is associated with increased odds of mortality given the increased levels of frailty, multimorbidity and increased likelihood of atypical symptoms making initial diagnosis more difficult.[1]

Implications for research and practice

As we emerge from the current COVID-19 pandemic, the findings have implications for how unscheduled care services are organised in the future. The NHS "Think 111" campaign is encouraging the public to use telephone triage as a single point of access for all unscheduled care services, with the aim of managing patient flow and avoiding crowded waiting rooms, and NHS England intends NHS telephone triage to be the primary route into unscheduled care in the future.[17] In a younger cohort, triage of chest pain by NHS24 telephone triage has been shown to be effective[13] but in higher-risk populations, caution is required to ensure

triage does not inadvertently lead to either more complex unscheduled care pathways and treatment delays in people with MI, or increasing numbers of people without MI being sent to the ED for urgent assessment.

The question of why pathways that begin with NHS24 telephone triage are more likely to be indirect with higher mortality, and whether this is related to patients having atypical symptoms, or to having complex multimorbidity and alternative anticipatory care plans, is an area for future research. The possibility of a causal relationship between telephone triage and higher mortality also requires further research. In addition, this paper has analysed those admitted to hospital with MI but research into the unscheduled care contacts of those who die from MI prior to admission is required to give a fuller picture of initial service contact in relation to mortality. Furthermore, NHS24 telephone triage and Primary-care-out-of-hours do not have access to diagnostic tools such as Troponin and ECG. Pre-hospital use of these investigations by emergency medical services has been shown to aid conveyance decisions,[28] but further research is needed as to whether access to point-of-care troponin in ambulance services and Primary-care-out-of-hours would improve outcomes and reduce referrals. Research is also needed into the patients that each service discharges as well as those that are referred to other unscheduled care services for further assessment, particularly if telephone triage is to become the single point of entry for those attempting to access unscheduled care. Finally, there are other service level factors which will influence mortality, such as rates of invasive coronary angiography and rates of prescription of medical therapy. Future research utilising data linkage to investigation and prescribing data may help further elucidate the impact of indirect pathways on mortality.

Conclusion

This study found that 92.1% of people admitted to hospital with MI have a direct pathway to inpatient admission irrespective of which service they first contact. Indirect pathways that began with NHS24 telephone triage were associated with the highest mortality, followed by indirect pathways initiated by contact with another unscheduled care service. Increasing age had the biggest overall influence on mortality. Further research to understand the safety and effectiveness of telephone triage services is required if they are to become the single point of access for unscheduled care.

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Provenance and peer review: Not commissioned; externally peer reviewed.

Data availability statement: Unable to share data. Access requires permission from the Public Benefit and Privacy Panel for Health and Social Care (HSC-PBPP).

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Table 1: Direct and indirect pathways

Direct pathways (15 in total)		Number of pathways
SEA	Ambulance→Emergency Department→Inpatient admission	7865
EA	Emergency Department→Inpatient admission	5277
SA	Ambulance→Inpatient admission	3496
NSEA	NHS24 telephone triage→Ambulance→Emergency Department→Inpatient admission	2725
A	Direct inpatient admission	2641
NSA	NHS24 telephone triage→Ambulance→Inpatient admission	628
ESA	Emergency Department→Ambulance→Inpatient admission	562
NEA	NHS24 telephone triage→Emergency Department→Inpatient admission	376
SESA	Ambulance→Emergency Department→Ambulance→Inpatient admission	389
ESEA	Emergency Department→Ambulance→Emergency Department→Inpatient admission	86
NA	NHS24 telephone triage→Inpatient admission	65
OA	Primary-care-out-of-hours→Inpatient admission	46
OSEA	Primary-care-out-of-hours→Ambulance→Emergency Department→Inpatient admission	31
OEA	Primary-care-out-of-hours→Emergency Department→Inpatient admission	29
OSA	Primary-care-out-of-hours→Ambulance→Inpatient admission	28
Indirect pathways (most common 15 out of 355 in total)		**Number of pathways**
SSA	Ambulance→Ambulance→Inpatient admission	169
NSESA	NHS24 telephone triage→Ambulance→Emergency Department→Ambulance→Inpatient admission	156
NOSEA	NHS24 telephone triage→Primary-care-out-of-hours→Ambulance→Emergency Department→Inpatient admission	148
NOEA	NHS24 telephone triage→Primary-care-out-of-hours→Emergency Department→Inpatient admission	103
NOSA	NHS24 telephone triage→Primary-care-out-of-hours→Ambulance→Inpatient admission	92
NOA	NHS24 telephone triage→Primary-care-out-of-hours→Inpatient admission	77
SSEA	Ambulance→Ambulance→Emergency Department→Inpatient admission	57
SOA	Ambulance→Primary-care-out-of-hours→Inpatient admission	42
NSSA	NHS24 telephone triage→Ambulance→Ambulance→Inpatient admission	40
EEA	Emergency Department→Emergency Department→Inpatient admission	38
NSOEA	NHS24 telephone triage→Ambulance→Primary-care-out-of-hours→Emergency Department→Inpatient admission	38
SASA	Ambulance→Inpatient admission→Ambulance→Inpatient admission	35
ESSA	Emergency Department→Ambulance→Ambulance→Inpatient admission	34
NSOA	NHS24 telephone triage→Ambulance→Primary-care-out-of-hours→Inpatient admission	31
SESEA	Ambulance→Emergency Department→Ambulance→Emergency Department→Inpatient admission	30

Table 2: Characteristics of patients admitted to hospital with myocardial infarction.

	No. (% of all pathways) N=26325	Initial unscheduled care service contacted				
		Admission(A) N=2666 (column%)	ED (E) N=6130 (column%)	NHS24 (N) N=4933 (column%)	PCOOH[c](O) N=216 (column%)	Ambulance(S) N=12380 (column%)
Sex						
Men	16624 (63)	1703 (63.9)	4240 (69.2)	2787 (56.5)	144 (66.7)	7750 (62.6)
Women	9701 (37)	963 (36.1)	1890 (30.8)	2146 (43.5)	72 (33.3)	4630 (37.4)
CHD death within 28 days of admission	1465 (5.6)	107 (4.0)	223 (3.6)	318 (6.4)	23 (10.6)	794 (6.4)
Age						
<50	2344 (8.9)	261 (9.8)	733 (12.0)	423 (8.6)	15 (6.9)	912 (7.4)
50-54	2152 (8.2)	229 (8.6)	691 (11.3)	343 (7.0)	17 (7.9)	872 (7.0)
55-59	2764 (10.5)	290 (10.9)	821 (13.4)	480 (9.7)	23 (10.6)	1150 (9.3)
60-64	2841 (10.8)	362 (13.6)	797 (13.0)	471 (9.5)	22 (10.2)	1189 (9.6)
65-69	3281 (12.5)	370 (13.9)	829 (13.5)	581 (11.8)	23 (10.6)	1478 (11.9)
70-74	3149 (11.9)	346 (13.0)	660 (10.8)	583 (11.8)	18 (8.3)	1542 (12.5)
75-79	3202 (12.2)	303 (11.4)	622 (10.1)	605 (12.3)	27 (12.5)	1645 (13.3)
80+	6592 (25.0)	505 (18.9)	977 (15.9)	1447 (29.3)	71 (32.9)	3592 (29.0)
SIMD[a]						
1 (most deprived)	6345 (24.1)	622 (24.2)	1502 (24.8)	1119(22.7)	38 (17.6)	3064 (24.8)
2	5934 (22.5)	534 (20.8)	1420 (23.4)	1114(22.6)	59 (27.3)	2807 (22.7)
3	5141 (19.5)	509 (19.8)	1142 (18.8)	963 (19.5)	55 (25.5)	2472 (20.0)
4	4677 (17.8)	496 (19.3)	1029 (17.0)	919 (18.6)	40 (18.5)	2193 (17.7)
5 (least deprived)	4030 (15.3)	406 (15.8)	968 (16.0)	813 (16.5)	24 (11.1)	1819 (14.7)
Missing	198 (0.8)					
Urban/Rural[b]						
Urban	18005 (68.4)	1733 (67.5)	4401 (72.6)	3374 (68.5)	127 (58.8)	8370 (67.7)
Accessible	5523 (21.0)	563 (21.9)	1188 (19.6)	1093 (22.2)	47 (21.8)	2632 (21.3)
Remote	1486 (5.6)	129 (5.0)	230 (3.8)	306 (6.2)	18 (8.3)	803 (6.5)
Very Remote	1113 (4.2)	142 (5.5)	242 (4.0)	155 (3.1)	24 (11.1)	550 (4.5)
Missing	198 (0.8)					
Previous MI						
No	21962 (83.4)	2184 (81.9)	5107 (83.3)	4237 (85.9)	195 (90.3)	10239 (82.7)
Yes	4363 (16.6)	482 (18.1)	1023 (16.7)	696 (14.1)	21 (9.7)	2141 (17.3)

a. SIMD: Scottish Index of Multiple Deprivation.
b. Measured by Scottish Executive Urban Rural Classification. Accessible = within 30 minute's drive time of an urban area; Remote = 30-60 minute's drive time from an urban area; Very remote = >60 minute's drive time from an urban area.
c. Primary-care-out-of-hours

Table 3: Characteristics of continuous unscheduled care pathways before admission with myocardial infarction.

	No. (% of all pathways) N=26325
Initial service contacted	
Inpatient Admission (A)	2666 (10.1)
Emergency Department (E)	6130 (23.3)
NHS 24 (N)	4933 (18.7)
Primary-care-out-of-hours (O)	216 (0.8)
Ambulance (S)	12380 (47.0)
Directness of CUP[c]	
Direct	24244 (92.1)
Indirect	2081 (7.9)
Five most common direct pathways[a]	
SEA	7865 (29.9)
EA	5277 (20.1)
SA	3496 (13.3)
NSEA	2725 (10.4)
A	2641[d] (10.0)
Five most common indirect pathways[a]	
SSA	169 (0.6)
NSESA	156 (0.6)
NOSEA	148 (0.6)
NOEA	103 (0.4)
NOSA	92 (0.4)
Initial service contacted	No of CUPs direct (%)
Inpatient Admission (A)	2666 (100)
Emergency Department (E)	5928 (96.7)
NHS 24 (N)	3793 (76.9)
Primary-care-out-of-hours (O)	134 (62.0)
Ambulance (S)	5819 (94.9)

a: Pathways are sequences of UC events. For example, the pathway 'SEA' represents a sequence consisting of: 'Scottish ambulance service' (S) -> 'Emergency Department visit' (E) -> 'Inpatient admission' (A). The pathway NOSEA represents 'NHS24 call' (N) -> 'Primary-care-out-of hours attendance' (O) -> Scottish ambulance service' (S) -> 'Emergency Department visit' (E) -> 'Inpatient admission' (A).
c: Direct pathway: the minimum number of steps between the first contact point chosen by the patient and inpatient hospital admission e.g. SEA is direct, NOSEA is indirect because Primary Care Out of Hours cannot make a definitive diagnosis (no access to troponin testing)
d: 25 pathways had an initial contact with A but the patient had subsequent contacts with other services prior to a further admission e.g. 'ASA'.

Table 4: Associations of patient characteristics with choice of NHS24 as first unscheduled care contact

	No. (%) calling NHS24 as first UC contact	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Sex			
Men	2787 (16.8)	Reference	Reference
Women	2146 (22.1)	1.41 (1.32-1.50)	1.36 (1.27-1.45)
Age Group			
<50	423 (18.0)	1.05 (0.91-1.21)	1.06 (0.92-1.27)
50-54	343 (15.9)	0.9 (0.78-1.05)	0.90 (0.77-1.05)
55-59	480 (17.4)	Reference	Reference
60-64	471 (16.6)	0.95 (0.82-1.08)	0.94 (0.82-1.08)
65-69	581 (17.7)	1.02 (0.90-1.17)	1.01 (0.88-1.15)
70-74	583 (18.5)	1.08 (0.95-1.24)	1.04 (0.91-1.19)
75-79	605 (18.9)	1.11 (0.97-1.27)	1.05 (0.92-1.20)
80 +	1447 (22.0)	1.34 (1.20-1.50)	1.21 (1.08-1.36)
SIMD			
1 (highest deprivation)	1119 (17.6)	Reference	Reference
2	1114 (18.8)	1.08 (0.99-1.18)	1.07 (0.97-1.17)
3	963 (18.7)	1.08 (0.98-1.18)	1.08 (0.98-1.19)
4	919 (19.6)	1.14 (1.04-1.26)	1.13 (1.02- 1.25)
5 (lowest deprivation)	837 (20.2)	1.18 (1.07-1.31)	1.16 (1.05-1.29)
Previous AMI			
No	4237 (19.3)	Reference	Reference
Yes	696 (16.0)	0.79 (0.73-0.87)	0.82 (0.75-0.89)
Urban/Rural			
Urban	3374 (18.7)	Reference	Reference
Accessible	1093 (19.8)	1.07 (0.99-1.15)	1.06 (0.97-1.14)
Remote	306 (20.6)	1.13 (0.99-1.28)	1.10 (0.96-1.26)
Very Remote	155 (13.9)	0.70 (0.59-0.83)	0.70 (0.58-0.83)

Table 5: Associations of patient characteristics and prior unscheduled care pathway with mortality from coronary heart disease within 28 days of admission.

	No. (%) dying from CHD within 28 days of admission	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Sex			
Men	784 (4.7)	Reference	Reference
Women	681 (7.0)	1.53 (1.37-1.69)	1.07 (0.96-1.20)
Age Group			
<50	30 (1.3)	0.77 (0.48-1.22)	0.75 (0.47-1.20)
50-54	33 (1.5)	0.92 (0.59-1.44)	0.93 (0.60-1.50)
55-59	46 (1.7)	Reference	Reference
60-64	66 (2.3)	1.41 (0.96-2.06)	1.42 (0.97-2.10)
65-69	107 (3.3)	1.99 (1.41-2.83)	2.02 (1.42-2.88)
70-74	152 (4.8)	2.99 (2.15-4.19)	3.07 (2.19-4.30)
75-79	217 (6.8)	4.30 (3.11-5.93)	4.33 (3.12-6.00)
80 +	814 (12.3)	8.32 (6.16-11.24)	8.36 (6.16-11.35)
SIMD			
1 (highest deprivation)	345 (5.4)	Reference	Reference
2	343 (5.8)	1.08 (0.92- 1.24)	0.88 (0.75-1.03)
3	277 (5.4)	0.99 (0.84- 1.17)	0.82 (0.69-0.98)
4	260 (5.6)	1.02 (0.87-1.21)	0.82 (0.69-0.97)
5 (lowest deprivation)	232 (5.8)	1.06 (0.90-1.26)	0.82 (0.69-0.98)
Previous AMI			
No	1249 (5.7))	Reference	Reference
Yes	216 (5.0)	0.86 (0.75-1.00)	0.96 (0.83-1.12)
Urban/Rural			
Urban	995 (5.5)	Reference	Reference
Accessible	288 (5.2)	0.94 (0.82-1.08)	0.97 (0.84-1.12)
Remote	96 (6.5)	1.18 (0.95-1.47)	1.10 (0.87-1.40)
Very remote	78 (7.0)	1.29 (1.02-1.64)	1.10 (0.84-1.39)
Pathway type[a]			
Other Direct	1077 (5.3)	Reference	Reference
NHS telephone triage Direct	189 (5.0)	0.94 (0.81-1.11)	0.87 (0.74-1.02)
Other Indirect	70 (7.4)	1.44 (1.12-1.97)	1.55 (1.19-2.01)
NHS telephone triage Indirect	129 (11.3)	2.30 (1.89-2.79)	1.97 (1.61-2.40)

a. NHS telephone triage indicates a Pathway starting with an NHS telephone triage contact; other indicates a Pathway starting with any other service

Figure 1. Unscheduled care pathways leading to inpatient admission with myocardial infarction.

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