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ORIGINAL RESEARCH

Emergency Medical Services

Call volume, triage outcomes, and protocols during the first wave of the COVID-19 pandemic in the United Kingdom: Results of a national survey

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Abstract

Objectives: During the first wave of the COVID-19 pandemic in the United Kingdom (UK), to describe volume and pattern of calls to emergency ambulance services, proportion of calls where an ambulance was dispatched, proportion conveyed to hospital, and features of triage used.

Methods: Semistructured electronic survey of all UK ambulance services (n = 13) and a request for routine service data on weekly call volumes for 22 weeks (February 1–July 3, 2020). Questionnaires and data request were emailed to chief executives and

2021 999 EMS Research Forum Conference: March 23, 2021, virtual event.

Poster presentation 1: Emergency ambulance service calls for COVID-19 during the pandemic first wave.

Poster presentation 2: 999 Emergency ambulance response during COVID 19 pandemic first wave: what triage models were used?

research leads followed by email and telephone reminders. The routine data were analyzed using descriptive statistics, and questionnaire data using thematic analysis.

Results: Completed questionnaires were received from 12 services. Call volume varied widely between services, with a UK peak at week 7 at 13.1% above baseline (service range -0.5% to +31.4%). All services ended the study period with a lower call volume than at baseline (service range -3.7% to -25.5%). Suspected COVID-19 calls across the UK totaled 604,146 (13.5% of all calls), with wide variation between services (service range 3.7% to 25.7%), and in service peaks of 11.4% to 44.5%. Ambulances were dispatched to 478,638 (79.2%) of these calls (service range 59.0% to 100.0%), with 262,547 (43.5%) resulting in conveyance to hospital (service range 32.0% to 53.9%). Triage models varied between services and over time. Two primary call triage systems were in use across the UK. There were a large number of products and arrangements used for secondary triage, with services using paramedics, nurses, and doctors to support decision making in the call center and on scene. Frequent changes to triage processes took place.

Conclusions: Call volumes were highly variable. Case mix and workload changed significantly as COVID-19 calls displaced other calls. Triage models and prehospital outcomes varied between services. We urgently need to understand safety and effectiveness of triage models to inform care during further waves and pandemics.

KEYWORDS
ambulances, COVID-19, pandemic, prehospital emergency care, triage

1 | BACKGROUND

Health services have experienced changes in demand for care as a result of the COVID-19 pandemic. UK emergency ambulance services (AS) are funded centrally by the National Health Service (NHS) with 10 services in England, and 1 each in Wales, Scotland, and Northern Ireland. Patient-carrying emergency ambulances are generally staffed by emergency medical technicians and paramedics, although there are a variety of alternative responding vehicles (rapid response cars, motorbikes, helicopters) and staffing arrangements, including advanced or specialist paramedics and doctors. Patients seeking care for suspected coronavirus disease symptoms were advised to contact NHS 111 or call the emergency ambulance service via 999.[1,2]

2 | IMPORTANCE

Callers are triaged according to the severity and urgency of their health care needs in order to determine treatment. Triage is key to appropriate care provision and resource allocation[3]. Calls made to the emergency ambulance service are triaged at 2 points—in the call center, to decide on appropriate response and timing; and on scene with patients who are attended. Callers can be offered telephone advice, signposting, or referral or dispatch of a vehicle for face-to-face assessment and transportation to hospital if judged as clinically necessary by the attending clinician. Undertriage of emergency calls for COVID-19 symptoms may result in avoidable serious or critical illness or death; overtriage adds unnecessary increased pressure on secondary care services, diverts resources away from the most seriously ill, and may expose patients to unnecessary risk of hospital-acquired infection. Little is known about the models of triage, their application, and effects on attendance and conveyance by emergency ambulances during the pandemic in the United Kingdom.

2.1 | Goals of the investigation

As the first phase of the TRIM study (What TRiage model is safest and most effective for the Management of 999 callers with suspected COVID-19? A linked outcome study), we aimed to describe, during the first wave of the 2020 COVID-19 pandemic in the United Kingdom:

1. Volume and pattern of all emergency calls and emergency calls categorized as suspected COVID-19
2. Prehospital triage outcomes—proportion of callers sent an ambulance response; proportion of callers conveyed to the emergency department (ED)
3. Triage models and protocols used.

3 | METHODS

3.1 | Data collection

Survey of all (n = 13) UK Ambulance Services (AS) emailed to chief executives (June 2022) and copied to research and development leads for each service, with email and telephone reminders. Each recipient received a letter, information sheet, template data sheet, and questionnaire (in Word). The survey was designed to answer study aims and was comprised of the following:

1. A request for weekly data on total emergency calls received, those coded as suspected COVID-19 and attendance and conveyance outcomes for all calls. Data were requested for 22 weeks, with week 1 commencing February 1, following the first confirmed UK case on January 31, and week 22 commencing June 27, after the first wave of the pandemic.[4]
2. Structured and semistructured questions (n = 11) related to triage tools and models used in the emergency operations call center and at scene for suspected COVID-19 patients between February and August 2020.

3.2 | Analysis

Descriptive statistics summarizing: volume of calls per week, totals across the study period, proportion of calls coded as suspected COVID-19, and temporal variation in ambulance service peak demands. Proportions for prehospital triage outcomes across the study window for calls coded as suspected COVID-19, and for other calls, are compared using unadjusted odds ratios (OR), which is 1 for equal proportions and greater (less) than 1 when the proportion for suspected COVID-19 calls is greater (less) than the proportion for other calls. Finally, time series of weekly data on triage outcomes within the study window were examined for linear and quadratic temporal trends (fitted by least squares and summarized by adjusted R^2 for trend), and for any evidence of trade-off in call outcomes for those coded as suspected COVID-19 and other calls (summarized by correlations).

Findings related to triage tools and models have been collated around the themes of (1) identification and coding of suspected COVID-19 calls; (2) triage used in the ambulance call center to allocate response; (3) triage used on-scene to make conveyance decisions.

3.3 | Public and patient involvement

We have long-standing and effective links with patients and public members.[5] A recurring research priority for them is the delivery of prompt and appropriate 999 emergency response and treatment. When COVID-19 appeared to change 999 response priorities, they confirmed the urgency of understanding new practices, implications and learning for the future. Two public contributors (J.G. and R.H-M.) were involved in the TRIM research development process and commented on all bid drafts. They are active members of the Research Management Group (RMG), equally involved in decision-making processes and dissemination outputs; and co-authors of this paper. J.G. chairs a TRIM patient panel of 10 members whose views on key study stages (eg, data collection, analysis, dissemination) are reported back to the RMG for discussion. We provide support and a named individual (B.A.E.), in line with best practice, to facilitate their effective involvement.[6]

3.4 | Study permissions

Ethical approval was not required for this survey.

4 | RESULTS

We received data and completed questionnaires from 12 of the 13 UK ambulance service trusts.

4.1 | Call volume

4.1.1 | All calls

Weekly volumes of emergency calls varied widely between AS and across the study period, with a peak at week 7 (March 14–20) of 13.1% above baseline across all services combined; an additional 28,288 emergency calls received (Figure 1, Table 1). Some AS experienced much more variation than others, but all services ended the study period with a lower call volume than at baseline, with an overall decrease of 14.6%, varying between 3.7% (AS5) and 25.5% (AS3), a reduction across services of 31,478 calls.

4.1.2 | Suspected COVID-19 calls

The total volume of calls coded as suspected COVID-19 across the study period was 604,146 (13.5%) of all emergency calls, with considerable variation between AS from 3.7% (AS4) to 25.7% (AS12) and over time (Table 2, Figure 2). The standardized population call rate was 911/100,000 for the period, ranging from 155/100,000 (AS7) to 1752/100,000 (AS11). Services experienced local peaks between weeks 8 and 10, ranging from 11.4% (AS4) to 44.5% (AS12) (Table 1).

4.2 | Prehospital outcomes

Key triage outcomes for emergency calls coded as suspected COVID-19 and other calls are summarized in Tables 2, 3, and 4.

For suspected COVID-19 calls, the proportion of calls to which an ambulance response was dispatched ranged from 59.0% (AS3) to 100.0% (AS8), with 10 of the 12 services recording a

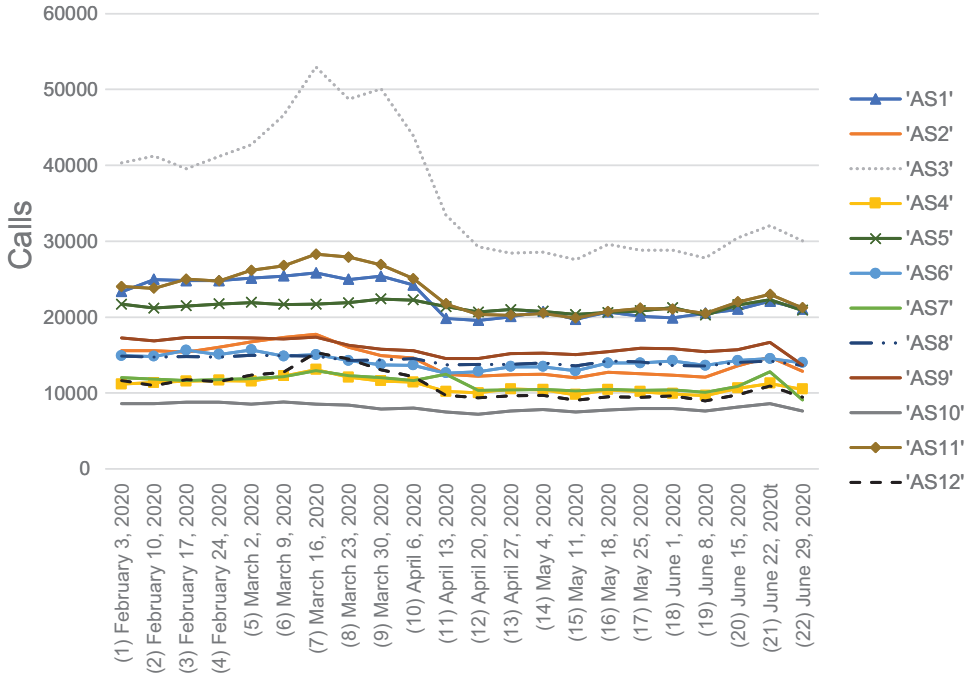

FIGURE 1 Total emergency calls by ambulance service (AS) and week of study

proportion > 75%. In most services (n = 10) the proportion of calls to which an ambulance was dispatched was higher for suspected COVID-19 calls than others. Overall, calls coded as suspected COVID-19 were more likely to be triaged to dispatch of an ambulance (OR 1.183) (Table 2).

In most AS, dispatch rates for emergency calls categorized as suspected COVID-19 varied within relatively narrow ranges across the study period, although AS3 and AS12 were exceptions. There was some evidence of an upward trend over time, although not in all services (AS5 and AS12 were exceptions). The service dispatch rates for emergency calls not categorized as suspected COVID-19 varied within similar ranges, with no evidence of trends; correlations between the 2 dispatch rates were weakly or strongly positive in 10 services and negative in only 2 (AS5, AS6), showing little evidence of trade-off (Table 3).

The proportion of calls coded as suspected COVID-19, which resulted in a patient conveyance to hospital ranged from 32.0% to 53.9%, and in contrast to dispatch, these rates were lower in most AS (n = 9) than corresponding rates for non-suspected COVID-19 calls. Overall, calls coded as suspected COVID-19 were less likely to be conveyed to hospital (OR 0.879) (Table 4). In most services, conveyance rates for emergency calls categorized as suspected COVID-19 also varied within relatively narrow ranges over time, although AS3, AS11, and AS12 were exceptions. Again, there was some evidence of an upward trend over time in some services, most notably in AS1, AS2, AS9, and AS12. Conveyance rates for emergency calls not categorized as suspected COVID-19 varied within similar ranges, with only weak evidence for trends; correlations between the 2 conveyance rates were positive in all cases, often strongly so—again showing no evidence of any trade-off.

4.3 | Call center classification and initial triage for suspected COVID-19 calls

Figure 3 shows the various pathways patients could take following their emergency 999 call. Table 5 summarizes the questionnaire results for classifications and triage. Two call categorization and prioritization systems were in use by all UK AS during the COVID-19 pandemic: Advanced Medical Priority Dispatch (AMPDS)[7] (n = 8) and NHS Pathways[8] (n = 4). A new protocol for coding a patient as "suspected COVID-19" was agreed nationally by all users of AMPDS —"Card 36"— and this was introduced by most services using AMPDS in early April. The Emerging Infectious Diseases Surveillance tool within AMPDS was used before Card 36 became available by some services and later by others. Within NHS Pathways there was no specific protocol, although services reported that they largely adhered to advice issued from NHS England as the pandemic progressed.

4.4 | Some services made modifications to the nationally agreed protocols, with all changes being service-wide

- AS1 upgraded their response to some calls, for example, for reported "ineffective breathing."
- AS3 added a number of questions specified by the medical director to the pandemic protocol, including questions about travel and symptoms to highlight patients who might have COVID-19.
- AS5 noted a significant increase in ST-segment elevation myocardial infarction (STEMI) patients in some clinical groups and therefore offered a higher response priority to these incidents.

TABLE 1 Variation in total emergency ambulance calls and proportion coded as suspected COVID-19 over time

Ambulance Service (AS) (population, millions)	Overall call volume during survey period	Weekly call counts and proportions						Suspected COVID-19 calls	
		Survey start baseline, (week 1)		Highs and lows during survey period			Survey end (week 22)	Service peak volume (% of all calls)	Service peak proportion (week)
		Volume		@ UK peak (week 7)	Service maximum	Service minimum			
		Raw	Per 100,000						
AS1 (6.2m)	494,016	23,361	377	25,829 (+10.6%)	@ UK peak	19,557 (-16.3%, week 12)	21,053 (-9.9%)	4847 (19.1%, week 9)	@ peak volume
AS2 (4.8m)	312,358	15,555	324	17,733 (+14.0%)	@ UK peak	11,997 (-22.9%, week 15)	12,835 (-17.5%)	3575 (24.5%, week 10)	@ peak volume
AS3 (8.6m)	802,195	40,315	469	52,979 (+31.4%)	@ UK peak	25,572 (-31.6%, week 15)	30,029 (-25.5%)	19,998 (39.9%, week 9)	@ peak volume
AS4 (2.7m)	241,047	11,153	413	13,072 (+17.2%)	@ UK peak	9643 (-13.5%, week 19)	10,469 (-6.1%)	1298 (11.4%, week 10)	@ peak volume
AS5 (7.5m)	469,749	21,700	289	21,708 (+0.0%)	22,375 (+3.1%, week 9)	20,227 (-6.8%, week 19)	20,894 (-3.7%)	7905 (35.3%, week 9)	35.3% (week 8)
AS6 (5.5m)	311,232	14,915	271	15,046 (+0.9%)	15,671 (+5.1%, week 5)	12,603 (-15.5%, week 11)	13,963 (-6.4%)	4614 (33.8%, week 10)	@ peak volume
AS7 (7.0m)	248,042	12,018	172	12,944 (+7.7%)	@ UK peak	9082 (-24.4%, week 22)	9082 (-24.4%)	2374 (19.3%, week 8)	19.7% (week 9)
AS8 (4.7m)	313,147	14,881	317	14,839 (-0.3%)	14,964 (+0.6%, week 5)	13,560 (-8.9%, week 19)	13,623 (-8.5%)	2917 (20.4%, week 8)	@ peak volume
AS9 (5.5m)	351,419	17,224	313	17,366 (+0.8%)	@ UK peak	13,666 (-20.7%, week 22)	13,666 (-20.7%)	4907 (31.5%, week 10)	@ peak volume
AS10 (3.2m)	178,121	8573	268	8530 (-0.5%)	8813 (+2.8%, week 6)	7196 (-16.1%, week 12)	7639 (-10.9%)	2012 (25.1%, week 10)	@ peak volume
AS11 (5.6m)	510,953	24,025	429	28,294 (+17.8%)	@ UK peak	19,846 (-17.4%, week 15)	21,199 (-11.8%)	11,685 (43.4%, week 9)	@ peak volume
AS12 (5.0m)	241,068	11,656	233	15,314 (+31.4%)	@ UK peak	8958 (-23.1%, week 19)	9446 (-19.0%)	6450 (44.5%, week 8)	47.7% (week 9)
All (66.3m)	447,3347	215,376	325	243,654 (+13.1%)			183,898 (-14.6%)		

TABLE 2 Prehospital triage outcomes February–July 2020

Ambulance Service (AS)	Suspected COVID-19 calls				Non-suspected COVID-19 calls			Odds ratios	
	Calls received [a] (%)	Calls per 100,000	Response dispatched (% of [a])	Conveyed to Hospital (% of [a])	Calls received [b] (%)	Response dispatched (% of [b])	Conveyed to Hospital (% of [b])	Response dispatched (95% CI)	Conveyed to Hospital (95% CI)
AS1	49,292 (10.0%)	795	37,276 (75.6%)	21,037 (42.7%)	444,724 (90.0%))	300,385 (67.5%)	177,869 (40.0%)	1.491 (1.459, 1.523)	1.117 (1.096, 1.138)
AS2	26,127 (8.4%)	544	20,180 (77.2%)	11,437 (43.8%)	286,231 (91.6%)	199,532 (69.7%)	131,489 (45.9%)	1.474 (1.431, 1.519)	0.916 (0.893, 0.940)
AS3	150,690 (18.8%)	1752	88,833 (59.0%)	51,468 (34.2%)	651,505 (81.2%)	366,524 (56.3%)	231,183 (35.5%)	1.117 (1.104, 1.129)	0.943 (0.932 0.954)
AS4	8801 (3.7%)	326	6206 (70.5%)	2862 (32.5%)	232,246 (96.3%)	163,089 (70.2%)	107,104 (46.1%)	1.014 (0.968, 1.063)	0.563 (0.538, 0.589)
AS5	78,650 (16.7%)	1049	70,344 (89.4%)	42,105 (53.5%)	391,099 (83.3%)	349,113 (89.3%)	230,099 (58.8%)	1.019 (0.993, 1.044)	0.806 (0.794, 0.819)
AS6	42,292 (13.6%)	769	36,815 (87.0%)	22,782 (53.9%)	268,940 (86.4%)	214,138 (79.6%)	150,009 (55.8%)	1.720 (1.670, 1.772)	0.926 (0.907, 0.945)
AS7	10,866 (4.4%)	155	8478 (78.0%)	3480 (32.0%)	237,176 (95.6%)	214,860 (90.6%)	111,197 (46.9%)	0.369 (0.352, 0.387)	0.534 (0.512, 0.556)
AS8	15,063 (4.8%)	320	15,062 (100.0%)	7281 (48.3%)	298,084 (95.2%)	277,237 (93.0%)	167,812 (56.3%)	>1000	0.726 (0.73, 0.751)
AS9	47,241 (13.4%)	859	42,412 (89.8%)	21,496 (45.5%)	304,178 (86.6%)	289,217 (95.1%)	164,473 (54.1%)	0.454 (0.439, 0.470)	0.709 (0.696, 0.723)
AS10	14,764 (8.3%)	461	12,006 (81.3%)	6622 (44.9%)	163,357 (91.7%)	128,121 (78.4%)	80,633 (49.4%)	1.197 (1.147, 1.250)	0.834 (0.807, 0.863)
AS11	98,471 (19.3%)	1758	93,889 (95.3%)	43,820 (44.5%)	412,482 (80.7%)	337,777 (81.9%)	180,116 (43.7%)	4.532 (4.395, 4.673)	1.034 (1.020, 1.049)
AS12	61,889 (25.7%)	1238	47,137 (76.2%)	28,157 (45.5%)	179,179 (74.3%)	113,292 (63.2%)	73,430 (41.0%)	1.858 (1.820, 1.897)6	1.202 (1.180, 1.224)
All	604,146 (13.5%)	911	478,638 (79.2%)	262,547 (43.5%)	386,9201 (86.5%)	295,3285 (76.3%)	180,5414 (46.7%)	1.183 (1.175, 1.191)	0.879 (0.874, 0.883)

Notes: Odds ratios (ORs) are unadjusted; OR = 1 corresponds to equals proportions; an OR > (<) 1 indicates a greater (smaller) proportion for calls coded as suspected COVID-19 compared with the corresponding proportion for non-suspected COVID-19 calls

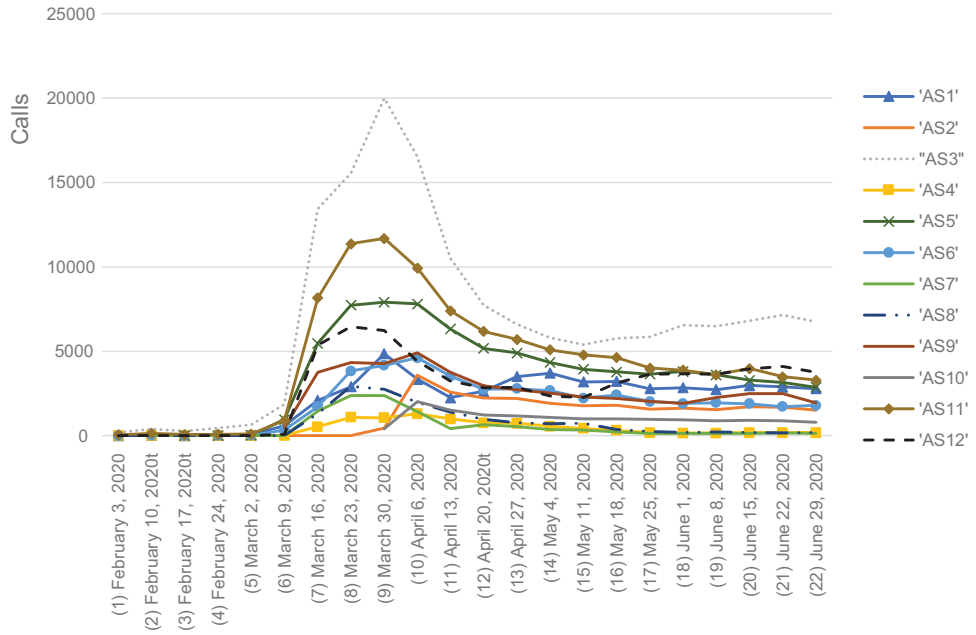

FIGURE 2 Calls identified as suspected COVID-19 by ambulance service (AS) and week of study

- AS6 introduced a new question for all calls as a surveillance tool: "Have you or the patient had a high temperature or new continuous cough in the last 14 days?"

4.5 | Secondary triage

Most ambulance services reported that calls were further triaged by clinical staff—including paramedics, nurses, advanced or specialist paramedics, and general practitioners (GPs) or other medically trained staff. This was usually in a "Clinical Hub" within the call center and sometimes through links with on- or off-site services such as national telephone advice lines including NHS 24 (Scotland) and 111 (England).

Various tools were used for triaging less acute cases, including Manchester Triage System[9] (AS6,8,9,10,12); Lowcode[10] (AS1,8,9), NHS Pathways (AS3), Odyssey[11] (AS2), and NHS Inform[12] (AS6).

4.6 | On-scene (face-to-face) decision making

Ambulance services reported a range of generic and COVID-specific protocols that were used by attending ambulance clinicians to support decision making in relation to whether patients should be transported to hospital. These included a national early warning score (NEWS2),[13] Manchester Triage System (9), and national ambulance clinical practice guidelines (JRCALC App).[14] Senior clinical advice was made available remotely (by telephone or radio) to attending ambulance clinicians by most services (n = 9) to support decision making; these were provided within the ambulance service itself or through external arrangements, for example, through 111 telephone advice line "Consultant Connect," a national GP online service.[15]

Patients who were not transported to hospital by ambulance were directed to other sources of advice, including the NHS website (nhs.uk) or 111 for advice, or referred to their GP. One ambulance service (AS8) also provided written patient advice leaflets.

4.7 Changes within study period

Numerous changes were reported as implemented during the study period - for example in coding calls, and protocols for assessment or care. All AS reported changes, one reported "too many" to list (AS9), and another that there have been more than 100 changes that were all documented and implemented (AS3). Most of these changes were reported to have been in response to nationally mandated instructions from Public Health England/Wales, for example, or agreements made between AS at national level (eg, Card 36).

4.7 | Limitations

We present results reported by UK AS during a period of intense operational and clinical pressure. Although we clarified certain aspects of the data provided, we did not further burden services with requests for details to supplement responses provided. Results presented in this paper are summarized from responses provided and vary between services in terms of level of detail. We will further explore these topics in phase 2 of the TRIM study, which includes semistructured interviews with clinical and managerial staff.

TABLE 3 Trends and associations in prehospital triage outcomes (weekly) February–July 2020 (dispatch)

Ambulance Service (AS)	Proportion of calls with response dispatched									
	Suspected COVID-19 calls					Non-suspected COVID-19 calls				
	Weeks included	Range		R^2 for trend		Range		R^2 for trend		Correlation
		Minimum	Maximum	Linear	Quadratic	Minimum	Maximum	Linear	Quadratic	
AS1	17	63.9% (week 6)	79.8% (week 15)	0.577	0.817	58.3% (week 7)	74.8% (week 12)	0.498	0.473	0.785
AS2	14	68.8% (week 10)	82.6 (week 15)	−0.010	0.485	61.1% (week 5)	77.9% (week 15)	0.571	0.610	0.845
AS3	22	26.0% (week 2)	72.0% (week 20)	0.783	0.774	37.3% (week 7)	66.9% (week 19)	0.377	0.379	0.550
AS4	16	61.6% (week 8)	81.3% (week 20)	0.322	0.410	59.0% (week 7)	76.9% (week 19)	0.397	0.373	0.741
AS5	17	83.4% (week 6)	93.0% (week 22)	0.792	0.933	86.7% (week 9)	91.6% (week 1)	0.465	0.762	−0.443
AS6	17	83.5% (week 21)	91.4% (week 9)	0.661	0.638	72.9% (week 7)	82.3% (week 19)	0.025	0.088	−0.490
AS7	16	72.7% (week 8)	89.2% (week 16)	0.513	0.557	84.9% (week 7)	92.4% (week 14)	0.047	0.098	0.766
AS8	16	100.0% (week 8)	100.0% (all others)	0.071	0.094	89.4% (week 8)	94.6% (week 16)	0.085	0.169	0.541
AS9	17	80.2% (week 6)	93.0% (week 9)	0.071	0.012	92.7% (week 9)	96.4% (week 11)	0.478	0.472	0.088
AS10	14	74.5% (week 11)	84.1% (week 15)	0.022	−0.067	73.1% (week 6)	82.5% (week 15)	0.521	0.629	0.087
AS11	18	90.8 (week 6)	97.2% (week 18)	0.636	0.772	72.2% (week 7)	86.5% (week 19)	0.399	0.403	0.756
AS12	16	54.1% (week 7)	86.5% (week 22)	0.697	0.899	50.8% (week 8)	70.1% (week 15)	−0.049	−0.056	0.762

Notes: Weeks included: weeks with fewer than 100 emergency calls classed as suspected COVID-19 cases are excluded.

R^2 for trend: the figures provided are the adjusted R^2 for trend, which depends on the degree of trend (1, 2 for linear, quadratic) and the proportion of variation explained by it (the raw, unadjusted R^2 for trend); the adjusted R^2 for trend can be negative when the fit is poor

TABLE 4 Trends and associations in prehospital triage outcomes (weekly) February–July 2020 (conveyance)

Ambulance Service (AS)	Proportion of calls with conveyance to hospital									
	Suspected COVID-19 calls					Non-suspected COVID-19 calls				
	Weeks included	Range		R^2 for trend		Range		R^2 for trend		Correlation
		Minimum	Maximum	Linear	Quadratic	Minimum	Maximum	Linear	Quadratic	
AS1	17	32.0% (week 6)	50.4% (week 19)	0.824	0.820	30.2% (week 9)	46.0% (week 19)	0.226	0.498	0.893
AS2	14	33.7% (week 10)	49.8% (week 18)	0.777	0.937	39.3% (week 8)	51.2% (week 22)	0.210	0.414	0.951
AS3	22	22.9% (week 9)	50.2% (week 20)	0.488	0.649	20.2% (week 8)	43.9% (week 19)	0.136	0.354	0.745
AS4	16	27.1% (week 8)	41.2% (week 20)	0.609	0.640	37.3% (week 7)	51.8% (week 19)	0.016	0.317	0.867
AS5	17	46.3% (week 6)	61.8% (week 22)	0.625	0.622	48.7% (week 9)	65.3% (week 2)	0.003	0.586	0.913
AS6	17	47.9% (week 8)	60.0% (week 22)	0.419	0.446	44.9% (week 8)	60.7% week 1)	−0.050	0.458	0.930
AS7	16	29.1% (week 8)	48.6% (week 16)	0.325	0.274	38.6% (week 10)	50.9% (week 22)	−0.039	0.593	0.540
AS8	16	42.9 (week 11)	57.9% (week 21)	0.531	0.497	47.8% (week 10)	62.1% (week 2)	−0.041	0.641	0.791
AS9	17	37.9% (week 6)	56.9% (week 22)	0.870	0.900	44.0% (week 9)	58.1% (week 4)	−0.049	0.531	0.673
AS10	14	36.2% (week 11)	52.6% (week 22)	0.703	0.681	40.2% (week 8)	54.5% (week 22)	0.046	0.461	0.775
AS11	18	37.7% (week 8)	81.2% (week 2)	−0.057	0.488	32.9% (week 8)	49.3% (week 2)	−0.049	0.497	0.786
AS12	16	31.4% (week 10)	57.8% (week 20)	0.918	0.920	26.2% (week 9)	50.3% (week2)	0.021	0.316	0.659

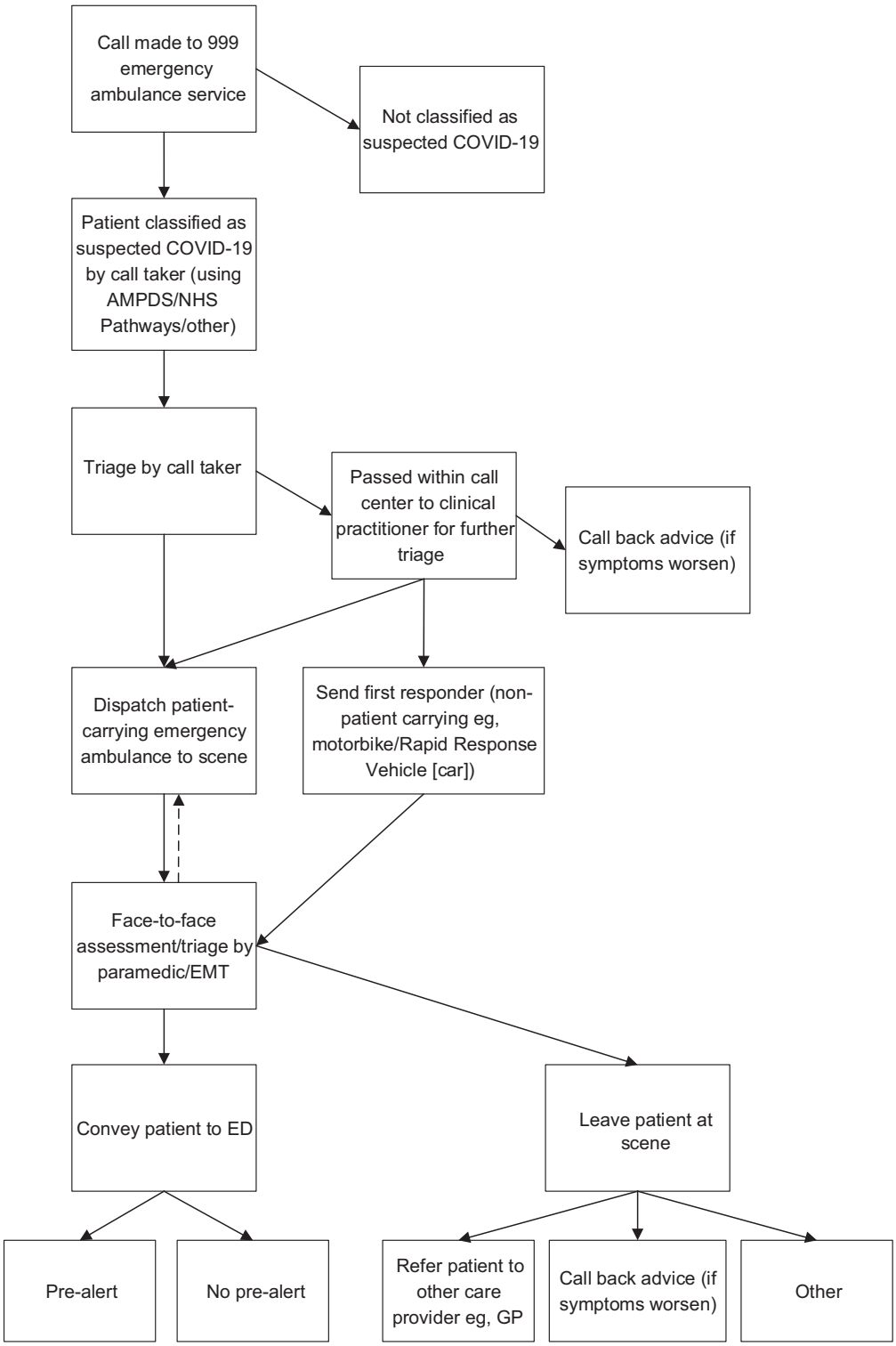

FIGURE 3 TRIM flow chart 999 suspected COVID 19 patient flow

Abbreviations: AMPDS, Advanced Medical Priority Dispatch; ED, emergency department; EMT, emergency medical technician; GP, general practitioners; NHS, National Health Service; TRIM, What TRiage model is safest and most effective for the Management of 999 callers with suspected COVID-19? A linked outcome study

TABLE 5 Ambulance service COVID-19 triage models in place between February and July 2020

Ambulance Service (AS)	Protocol for identifying COVID-19 caller; Date of introduction; local modifications	Further triage in call center	Triage on scene	Changes during period?
AS1	AMPDS Card 36; April 4, 2020; Response to some AMPDS determinants upgraded from national guidance, for example, in pandemic protocol ineffective breathing is category 2, but this was upgraded to category 1.	Lowcode. Paramedic, nurse, or doctor.	Initially, all suspected COVID-19 calls for conveyance were routed through Clinical Advice Line (CAL) for specialist advice prior to conveyance. Ambulance clinicians could access 111 or GP services by telephone to discuss cases on an individual basis to determine whether the patient could stay at home. Re: which hospital to convey to - this decision would be made based upon patient's clinical condition. Patients not conveyed were signposted to 111 or their GP.	Use of Protocol 36, implementation of Standard Operating Procedure (ESOP69), creation of an emergency call handler module within call prioritisation.
AS2	AMPDS Card 36; April 3, 2020; No modifications.	Odyssey TeleAssess for lower acuity symptom calls. The Case Transport Response Service (CTRS) was staffed by paramedic/nurse to help decide whether to send a response and what response to send.	The CTRS Desk was available to provide advice and support to crews and liaise with other health care professionals/hospitals. The CTRS desk was initially staffed by paramedic/nurse. At the peak of COVID-19 Doctors were rostered into the Emergency Operations Centre to provide additional support.	On March 3, 2020 access given to Emergency Operations Centre clinicians via videoconferencing. Reviewed use of voluntary responders and GoodSAM (location app) alerts, introduced a change to telephone advice for CPR - not to give mouth-to-mouth and to cover the patient's mouth and nose with a cloth prior to compressions.
AS3	AMPDS Card 36; April 2020; Added medical director's specific questions and introduced process flow for call handlers to identify possible COVID-19 patients – asking about travel, symptoms and highlighting patients as COVID-19 possible / unlikely.	Possible COVID-19 patients were transferred to an NHS Pathways service advisor through 111 once critical illness was ruled out, to decide whether to send emergency response. Paramedic/nurse/advanced paramedic in Clinical Hub decided what response to send.	NEWS2 assessment. Clinical Directorate flowchart for decision making which was updated regularly as case definition and processes changed.	There were approximately 100 changes during this period – to definitions, processes, actions for different patient groups. Discharge on scene and conveyance decision-making guidance were changed regularly during this period.
AS4	NHS Pathways Release 19.3.5; March 27, 2020; No local modifications.	No details of secondary triage or staffing provided.	Use of JRCALC App if appropriate, for example, ear, nose and throat also set up 24/7 Clinical Support Desk in Control.	Call center only – COVID-19 specific updates to NHS Pathways

(Continues)

TABLE 5 (Continued)

Ambulance Service (AS)	Protocol for identifying COVID-19 caller; Date of introduction; local modifications	Further triage in call center	Triage on scene	Changes during period?
AS5	AMPDS Card 36; April 3, 2020; A significant increase in STEMI patients in subprotocols was noted and therefore offered a higher response priority (Category 2).	No secondary triage reported.	Used the Manchester Triage System (MTS), in both face-to-face and telephone triaged variants to aid clinicians in their decision-making surrounding care planning and conveyance. Used advice from NHS England and National Ambulance Service Medical Directors (NASMED) to provide clinicians with awareness of COVID-19 and appropriate decision making.	Introduced Card 36, which provides a specific protocol for triage of patients who appear to be suffering from COVID-19. Did not use the Emerging Infectious Diseases (EIDS) tool, which offers screening from call taking staff for COVID-19 specific symptoms until its use was mandated by NHS England (May 28, 2020)
AS6	EIDS then AMPDS Protocol 36 on its UK release; April 3, 2020; Implemented a question "Have you or the patient had a high temperature or new continuous cough in the last 14 days" as an all calls surveillance tool.	Manchester Triage and NHS Inform. A large number of patients were treated by telephony or video consultations. A range of clinical acuities presented, some for immediate ambulance dispatch and others who would benefit more from additional telephone triage. A large number of lower acuity callers were signposted to NHS24 and some higher (but non-life threatening) acuity callers were passed to clinical advisors and advanced practitioners.	Crews were able to contact Regional Clinical Hubs within each of the regions. These hubs provided decision support for crews in light of the patient's presentation, severity of symptoms, and probability of deterioration.	Initially used the EIDS tool only, this evolved to Card 36 and then EIDS again July 20, 2020.
AS7	NHS Pathways; No specific pandemic protocol, no local modifications.	No secondary triage tool used. Nurse, specialist paramedic, or paramedic provided clinical support in call center to decide whether to send response and what response.	Consultant Connect - provided access to GPs across the UK via telephone for Clinical Support Desk and frontline crew advice and GP triage process already in place for frontline crews.	Changes in line with national guidance implemented, all new NHS Pathways versions implemented within required timelines: March 16, April 10, May 21, June 4, and July 22, 2020.

(Continues)

TABLE 5 (Continued)

Ambulance Service (AS)	Protocol for identifying COVID-19 caller; Date of introduction; local modifications	Further triage in call center	Triage on scene	Changes during period?
AS8	NHS Pathways COVID-19 workarounds and system updates; January 24, 2020; Locally adapted triage support guidance based on national guidance and tools.	Lowcode, MTS. Paramedic/nurse/GP/pediatrician provided support for decision whether to send and what response to send. NHS Pathways care advice was provided following telephone triage. 999/111 clinicians were encouraged to use existing triage tools. They were provided with an additional clinical guidance document to supplement their assessment skills and decision making.	Senior clinical advice available via emergency operations centre, paramedic practitioner "hubs" and from operational team leaders. Routine clinical assessment, no specific tool used. Patients directed to nhs.uk for ongoing care advice and management, or an advice leaflet was provided following face-to-face triage.	Additional guidance was provided to support telephone assessment skills and decision making April 17, 2020; and face-to-face decision making April 28, 2020. Frequent changes to NHS Pathways triage model: initially paper-based system "workarounds,", then changes hard coded into the triage system (NHS Pathways 19.3.3 – 19.3.9); supplemented with paper-based COVID-19 "criteria," that were updated according to the latest government definition of COVID-19, for example, V7 introduced May 20, 2020 added loss or change in taste or smell to the criteria.
AS9	EIDS March 19, 2020 and then AMPDS Card 36.	Lowcode and MTS. Clinical supervisor/team leader, GP (depending on resourcing) provided support for decision making on whether to send response and what response to send.	No details supplied.	EIDS was updated in March to reflect coronavirus, as the previous wording related to Ebola. There have been several iterations of Card 36 since March 2020, with the latest update August 11, 2020. Enhancements and software updates very fluid, too many to mention.
AS10	AMPDS Card 36; April 2, 2020; Discontinued EIDS and instead added screening questions to CAD to include household.	Manchester Triage Tool Nurses and paramedics, Clinical Support Desk.	Crews could contact the receiving hospital for advice. Crews could also contact the normal advice lines for COVID-based advice. Senior clinician on call, Clinical Support Desk, clinical team leader.	Changed pandemic levels 0 – 1 – 0.
AS11	NHS Pathways; COVID Level 1 & 2 & 3 January 23, 2020 No local modifications.	No secondary triage or Clinical Support Desk. Paramedics supported dispatch decision making.	Referral to COVID "cell" (no further details provided	Repeated changes from NHS Pathways as per government changes, changes on scene again due to government changes re PPE.
AS12	AMPDS Card 36; May 4, 2020; No local modifications.	MTS by paramedics, nurses, and bespoke COVID-19 assessment tool for use in 111 and 999 clinical hub.	Bespoke assessment tool based on National Institute for Clinical Excellence, Public Health England, NHS Executive. Senior Clinical Support Cell staffed by senior paramedics and GPs.	National code changes where category changes were required and sent on a version control document May 4, May 13, and May 27, 2020.

Abbreviations: AMPDS, Advanced Medical Priority Dispatch; CAD, computer aided dispatch; CPR, cardiopulmonary resuscitation; GP, general practitioners; PPE, personal protective equipment; STEMI, ST-segment elevation myocardial infarction.

5 | DISCUSSION

5.1 | Key findings and implications

Emergency Ambulance Services in the United Kingdom bore the brunt of variable and, at times, unprecedented call volumes related to COVID-19 during the height of the first wave of the pandemic between March and July 2020. Some variation in call volume may be accounted for by varying patterns of caller behavior, differences in coding between services or over time, and changes in the composition of patients.[16] However, patterns overall appear to reflect known hotspots and confirmed COVID-19 hospitalizations during this period.[17]

In relation to workload management, challenges arose in the volatility of overall emergency call volume as well as case mix. COVID-19 calls were new demand, which to some extent displaced "usual" emergency calls—both in terms of volume, but also type of call.

The NHS generally saw more dramatic drops in patients presenting for STEMI and stroke because of fears about risk of infection and desire to avoid overburdening,[18] although evidence related to effects on ambulance service demand has been equivocal with no effects reported in West Midlands, but a very large increase in out of hospital cardiac arrests reported in London during March and April 2020.[19] International evidence is limited and also mixed, with for instance a reduction noted in admissions for stroke in Spain but no reduction in serious injuries and fatalities from road traffic accidents in Missouri.[20,21] The proportion of suspected COVID-19 calls approached half of all calls in some UK AS, at their local peak. As a potentially highly infectious, life-threatening condition, patients calling with suspected or actual COVID-19 brought a high additional workload, in the call center—with new protocols for primary and secondary triage and advice; and on scene, with infection control and personal protective equipment requirements. These practical considerations were against a backdrop of high levels of media attention and fear.

AS were significantly affect by staff becoming unavailable for work owing to self-isolation following contact, symptoms, or confirmed COVID-19 infection.[22,23] National telephone advice lines were overwhelmed, with many calls left unanswered.[24,25] AS recruited or transferred very large numbers of clinical and non-clinical staff, including military staff,[26,27] into call centers to help answer the large volume of calls[23] and to drive response vehicles, although rapid deployment of additional front-line clinical staff to crew vehicles was more problematic and was not reported.

During periods of high demand, ambulances were held ("ramped") at the ED and, therefore, unavailable for next dispatch. In addition, turnaround times were increased owing to the need to sterilize after transporting a suspected COVID-19 positive patient, creating more "down time" and less "response time."[28,29]

Although there were some national initiatives during this period, AS varied widely in their models of identification, triage, response, and patterns of conveyance. Triage models and prehospital outcomes varied between services and over time and cannot be explained simply by capacity. The proportions of patients suspected to have contracted COVID-19 that were sent an ambulance response for face-to-face assessment and that were conveyed to hospital varied widely between services, from 59% to 100% and 32% to 54%, respectively.

Variation in care provided means that individual processes and outcomes of care will be different, depending on where the patient presents, and is a marker of concern for quality and safety, as recently highlighted in a review of ambulance service provision[30,31].

As nations experience further hospitalizations and deaths from COVID-19, gaining greater understanding of patterns of demand for the emergency ambulance service and the safety and effectiveness of the different models of triage and response is crucial in order to inform policy and patient safety.

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CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTIONS

The study was designed by HS in collaboration with AW, MB, ED, BAE, RH-M, RL, AN, TF, AP, NS, RS, and TQ. MK undertook the data collection, with analysis led by HS and AW supported by MK and AN. HS and AW drafted the initial manuscript with contributions from all authors. All authors read and approved the final document.

TRANSPARENCY STATEMENT

The lead author (the manuscript's guarantor) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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