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Training and education

Characteristics of Restart a Heart 2019 event locations in the UK

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Abstract

Introduction: Restart a Heart (RSAH) is an annual CPR mass training initiative delivered predominantly by ambulance services in the UK. The aim of this study was to identify to what extent voluntary participation in the 2019 initiative delivered training to the population with the highest need.

Methods: A cross-sectional observational study of location characteristics for RSAH training events conducted by UK ambulance services. Descriptive statistics were used to analyse event and area characteristics. National cardiac arrest registry data were used to establish proportions of training coverage in "hot spot" areas with above national median incidence of cardiac arrest and below median bystander CPR rates. The significance of observed differences were tested using chi-square for proportions and t-test for means.

Results: Twelve of 14 UK ambulance services participated, training 236,318 people. Most of the events (82%) were held in schools, and schoolchildren comprised most participants (81%). RSAH events were held in areas that were less densely populated ($p < 0.001$), were more common in affluent areas ($p < 0.001$), and had a significantly lower proportion of black residents ($p < 0.05$) and higher proportion of white residents ($p < 0.05$). Events were held in 28% of known "hot spot" areas in England.

Conclusion: With mandatory CPR training for school children in England, Scotland and Wales there is an opportunity to re-focus RSAH resources to deliver training for all age groups in OHCA "hot spots", communities with higher proportions of black residents, and areas of deprivation. In Northern Ireland, we recommend targeting schools in areas with similar characteristics.

Keywords: Basic life support, Resuscitation, Education, Bystander CPR, Out of hospital cardiac arrest

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Introduction

Members of the public have a vital role in the chain of survival.[1] There is an association between improved survival rates for cardiac arrest and greater numbers of people with basic life support skills.[2] They can help save lives by recognising a cardiac arrest, calling for help, starting cardiopulmonary resuscitation (CPR), and fetching and using an automated external defibrillator (AED) before the arrival of emergency medical services (EMS).[3] In England, the bystander CPR rate in 2018 for out-of-hospital cardiac arrest (OHCA) cases was 61.4% [4] This lags behind international exemplars such as King County (Seattle) and Norway from which bystander CPR rates of 70%[5] and 79%[6] were reported respectively. There is clearly potential for further improvement and this has resulted in large scale initiatives to improve community bystander CPR training.

International evidence shows that higher rates of bystander CPR and OHCA survival are associated with multifaceted national initiatives. The Take Heart programme in the United States, which includes training school children in CPR, was associated with a rise in bystander CPR rates from 20% to 29% and survival from 8.5% to 19% between 2005 and 2009.[7]

One of the most innovative and successful UK-wide approaches to increase the number of people with CPR skills is the annual Restart a Heart (RSAH) initiative, which was launched nationally in 2016. RSAH is overseen by a strategic group co-ordinated by Resuscitation Council UK (RCUK) and including British Heart Foundation, St John Ambulance, British Red Cross and Yorkshire Ambulance Service. This initiative primarily targeted schoolchildren as it has been shown that mass training of children has a positive effect on bystander CPR rates and patient survival. [2] Participation in RSAH is voluntary in nature with no targeted geographic or socio-economic populations identified. There is no specified training curriculum and events can include a range of interventions from information giving and awareness sessions to face-to-face training. Historically, the only evaluation was overall reported numbers of people trained through face-to-face training and practice with a manikin, with 238,000 trained in 2018 alone.[8]

Demographic and socioeconomic factors are associated with the likelihood of training in CPR,[9] with older people and those from lower income households less likely to be trained compared with younger people and those from more affluent households. It is currently unknown if UK RSAH events are located in areas of greater affluence or deprivation. In particular, it is also unknown what proportion of training is delivered to residents in cardiac arrest "hot spots". These are defined as postcode districts (PCD) with a lower than national median bystander CPR rate and a higher than national median incidence of cardiac arrest rates.[10] These are arguably the areas in most need of CPR training provision.

The aim of this study, therefore, was to identify to what extent voluntary participation in the 2019 UK RSAH initiative delivered training to the population with the highest need. In order to achieve this aim, our objectives were to map RSAH event locations to assess coverage of high need locations including known "hot spots", and to describe the demographic and socio-economic characteristics of locations where RSAH training events occurred.

Methods

Study design

This was a cross-sectional observational study of location characteristics for training events conducted for RSAH by UK ambulance services in 2019.

Data sources

Event data

Ambulance services provided the post code district (PCD) of the location for each training event, the type of location (e.g. school, youth group, church, public, workplace), age group of participants (primary school, secondary school, adults, mixed), the type of training provided (hands on, CPR and AED awareness, information only), and the number of people trained. Ambulance services provided information on events they held for RSAH during the study period (September 2019 to end of November 2019). Hands on training events and information giving and awareness raising events were included. Ambulance services were also asked if they were purposefully targeting training in areas with a high incidence of OHCA and a low bystander CPR rate.

Population data

Information on the neighbourhood characteristics of event locations was obtained from the Office for National Statistics (www.nomisweb.co.uk); the information related to that collected during the 2011 Census. Data collected included the normal residential population, area covered by the PCD (in hectares), and the proportion of people from different ethnic groups in each PCD. Ethnicity was categorised according to the UK Government list of ethnic groups as white, mixed or multiple ethnic groups, Asian or Asian British, black, African, Caribbean or black British, and other.[11] Population density was calculated as the normal residential population divided by the area covered.

The Index of Multiple Deprivation (IMD) for 2019 for each lower-level super output area (LSOA) in England (n=32,844), Wales (n=1908) and Northern Ireland (n=890) was obtained from government sources.[12–14] IMD ranks every LSOA from most deprived to least deprived area on a country basis. Deciles were created by ranking these small areas from most deprived to least deprived and dividing them into ten equal groups. The IMD of the event locations were identified by linking the event PCD to the appropriate LSOA, and then assigning the corresponding IMD decile.

Previously published data from the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry data was used for the identification of "hot spots"; data was for OHCAs that occurred between 2013 and 2015[10]. Only data for English Ambulance Services were available.

Study setting and population

The study setting comprised all locations where 2019 RSAH events were delivered by UK ambulance services. All other events (e.g. those run by the public, voluntary sector, community and commercial organisations) were excluded from our analysis as we did not have access to their event location data. The included events accounted for

the majority of UK training events that the study group were aware of, delivering over 78% of the total numbers trained for RSAH 2019. The remaining events were run by other organisations and members of the public and trained 65,000 people (data supplied by Resuscitation Council UK). Included events ranged from small group face-to-face sessions to mass event awareness sessions (e.g. CPR demonstration to crowds at major sporting events). Trainers ranged from volunteer first aid providers to ambulance personnel. In regions where ambulance services did not purposefully select "hot spot" areas, events that were held in schools relied purely upon voluntary registration.

Statistical analysis

Descriptive statistics were used to characterise training events by type of location and age groups attending. The location of RSAH events was geocoded and mapped using ArcGIS mapping software (www.arcgis.com) to show their distribution across the UK and to establish whether CPR training was provided equally by neighbourhood characteristics, or whether it could be a source of health inequality. We compared the neighbourhood characteristics where training was delivered against "hot spot" areas, using data generated by the OHCAO registry.[10] A "hot spot" area was defined as a PCD where the

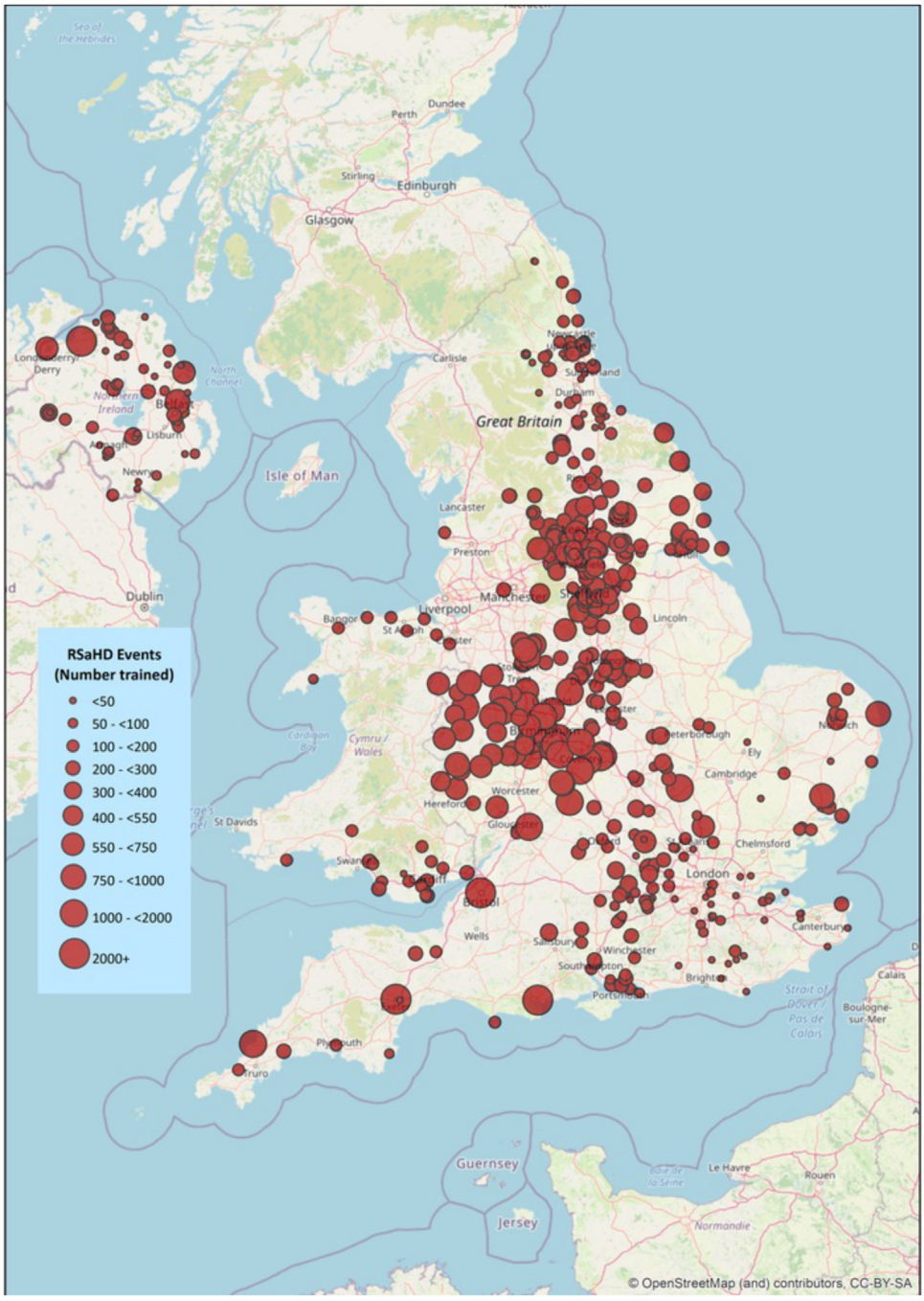

Fig. 1 – RSAH events, location and size (i.e. numbers trained).

OHCA incidence was greater than the 2013–2015 national median (127.6 events per 100,000 population) and the bystander CPR rate (where the event was witnessed by a bystander) was less than the 2013–2015 national median (60%).[10] OHCAO Registry data was unavailable for Northern Ireland and Wales and so they were excluded from this analysis of "hot spot" coverage. Data previously used to generate the "hot spot" information was also used to calculate the quartiles for OHCA incidence, and comparisons made of the proportions of events held overall and by different ambulance services in each of the quartiles. We compared proportions of events held overall and by different ambulance services in areas with below median and those at or above the national median bystander CPR rate of 60%. Significance of observed differences were tested using Chi-square for proportions. Mean population density and IMD were compared using t-test.

Ethical considerations

Ethical and research governance approvals were given by the University of Warwick Biomedical and Scientific Research Ethics Committee (reference BSREC 40/18-19), the Health Research Authority (reference 19/HRA/3499), and by participating ambulance services.

Results

Twelve of the fourteen UK National Health Service (NHS) ambulance services delivering RSAH training in 2019 agreed to participate in this study. These twelve ambulance services, covering Northern Ireland, Wales and England, trained over 236,000 people (Supplementary Fig. 1) at 641 events. Most events (n=579, 90.3%) provided hands on training and the remainder were awareness raising or information giving events. Over two-thirds (68%) of people were trained by three ambulance services (Supplementary Fig. 1). Eighty one percent (517/641) of training events were held for school pupils with 67% (430/641) for those aged between 11 and 18 and 14% (87/641) for primary schools aged pupils (under 11). Thirteen per cent (85/641) of training events were held for all age groups and 0.2% (27/641) for adults only.

Event locations

School premises accounted for 82% (522/641) of event locations; and 13.4% (86/641) were public events. Other locations, all of which individually accounted for less than 1.5% (between 1 and 9/641) of events, were youth organisations, fire stations, church halls, colleges/universities, work settings, pubs, community runs, and shops. The geographical spread and relative size of events (i.e. numbers of people trained) is shown in Fig. 1.

Socioeconomic and demographic characteristics of event locations

Socioeconomic characteristics of RSAH event locations were identified and compared with overall national characteristics using 2011 census data (Table 1).[15] To assess coverage of areas according to national proportions of socioeconomic characteristics, a comparison was made of mean figures for PCDs where RSAH events were held with national mean figures. RSAH events were held in PCDs that were less densely populated ($p<0.001$), had a significantly lower proportion of black residents ($p=0.042$), and a higher proportion of white residents ($p=0.018$). Proportionately more RSAH events were held in PCDs that were more affluent, as indicated by higher IMD decile scores; however, events were held in all IMD deciles. Over a quarter of events (26.35%) were held in PCDs classified in the three most deprived deciles (Fig. 2). This varied by individual ambulance service from 9.8% to 34.9% of events.

Table 1 – Comparison of socio-demographic characteristics between RSAH event locations and the national picture (2011 census data).

Variable	RSAH event locations Mean (SD)	National picture Mean (SD)	Significance of difference
Population density (/ha)	23.1 (21.4)	41.0 (41.6)	$p<0.001$
Ethnicity (%):			
• White	90.5 (14.6)	87.0 (18.2)	$p=0.018$
• Mixed	1.6 (1.5)	2.1 (1.9)	NS*
• Asian	5.7 (10.8)	6.9 (12.4)	NS*
• Black	1.6 (4.1)	3.1 (6.4)	$p=0.042$
• Other	0.6 (1.3)	0.9 (1.8)	NS*
Index of Multiple Deprivation Decile	5.8 (2.9)	5.0 (3.0)	$p<0.001$

* not significant.

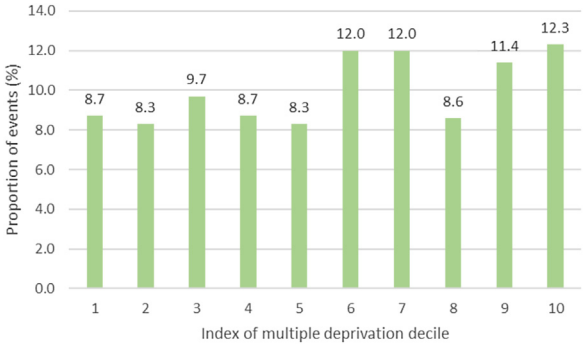

Fig. 2 – Proportion of RSAH events by IMD decile (1 = most deprived, 10 = least deprived).

Characteristics of event locations compared with OHCAO registry data on bystander CPR and incidence of cardiac arrest

Approximately 47% of events were held in areas with an OHCA incidence at or above the national median (127.6/100,000). About 23.5% of events took place in PCDs where the incidence was over 162.45 per 100,000, with considerable variation between services (0–60%) (see Table 2).

The proportion of events held by each ambulance service in areas below as opposed to 'at or above' the median national bystander CPR rate is presented in Table 3. Again, there is variation between services in the percentage of events held in areas with lower than median bystander CPR rates (from 33% to 99%). Overall 71% of events were held in areas with a lower than median bystander CPR rate.

Table 2 – Number and proportion of events held in postcode districts covered by each ambulance service, by quartile of OHCA incidence (2013–2015 data).

Ambulance service	Quartile of incidence (/100,000) within postcode district				
	<87.7 n(%)	87.71–127.6 n(%)	127.6–162.5 n(%)	>162.5 n(%)	Unknown
E	2 (6.1)	11 (33.3)	11 (33.3)	9 (27.3)	0
I	11 (28.2)	22 (56.4)	5 (12.8)	0 (0.0)	1 (2.6)
A	1 (14.3)	0	5 (71.4)	1 (14.3)	0
D	3 (7.5)	13 (32.5)	15 (37.5)	9 (22.5)	0
L	0	0	2 (33.3)	3 (50.0)	1(16.7)
F	40 (81.6)	8 (16.3)	0	0	1 (2.1)
B	2 (8.3)	3 (12.5)	10 (41.7)	9 (37.5)	0
H	15 (83.2)	1 (5.6)	1 (5.6)	1 (5.6)	0
K	4 (6.5)	7 (11.3)	14 (22.6)	37 (59.7)	0
J	16 (14.2)	43 (38.1)	31 (27.4)	23 (20.4)	0
Total	94 (24.0)	108 (27.6)	94 (24.0)	92 (23.5)	3 (0.9)

Note: Data for Wales and Northern Ireland was not available for 2013–2015.

Table 3 – Number and proportion of events held in postcode districts in area covered by each ambulance service, according to whether bystander CPR rate was below of above median rate (2013–2015 data).

Ambulance service	Bystander CPR rate		
	<60% n(%)	>=60% n(%)	Unknown n(%)
E	13 (39.4)	20 (60.6)	0
I	30 (76.9)	8 (20.5)	1 (2.6)
A	4 (57.1)	3 (42.9)	0
D	34 (85.0)	6 (15.0)	0
L	1 (16.7)	4 (66.7)	1 (16.7)
F	30 (61.2)	18 (36.7)	1 (2.0)
B	18 (75.0)	6 (25.0)	0
H	6 (33.3)	12 (66.7)	0
K	30 (48.4)	32 (51.6)	0
J	112 (99.1)	1 (0.9)	0
Total	278 (71.1)	110 (28.1)	3 (0.8)

Note: Data for Wales and Northern Ireland was not available for 2013–2015.

"Hot spot" areas, which combine PCDs with higher rates of OHCA incidence and lower bystander CPR rates, could be argued to be most in need of CPR training. Overall, RSAH events were delivered in 151 of the 524 "hot spots" in England (28.8%). The map in Fig. 3 shows areas where events did and did not take place. Only three ambulance services (services D, H and K in supplementary Fig. 1) reported purposively targeting "hot spots", with events occurring in 44 of 143 (30.8%) "hot spots" located in the geographical areas covered by these services. There was no significant difference when compared with the proportion events occurring in "hot spot" areas in the remaining nine geographical areas (107 out of 381, 28.1%). Only English OHCA data was available for this analysis.

Discussion

The UK RSAH initiative was first introduced nation-wide in 2016 to address the lack of any other coordinated mass training for CPR. It was an annual event that was used to purposefully target school-children in the absence of any inclusion of CPR training on the curriculum. RSAH has grown over the years and, combined with other initiatives, English bystander CPR rates for all EMS treated OHCA cases have risen from 55% in 2014 to 61.4% in 2018.[4] However, there is variation in different areas, which means people from areas with lower bystander CPR rates are in greater need of accessible training. RSAH has the potential to address some of these observed disparities, not only by training children themselves but encouraging them to pass on their skills. Work in Norway has shown that children who took CPR training went on successfully to train an average of 2.8 older people with a home manikin and video kit.[16]

A greater number of young people report receiving training in CPR than older people in the UK,[17] in Scotland,[18] and the USA.[9] However, older people are more likely to have an OHCA with the median age being 71 years in 2018 and most (71.5%) happening in a private residence,[4] where many bystanders may be older too. Offering more training to a broader range of the population including adults could contribute to increasing bystander interventions. Offering specific training to relatives of people at risk of cardiac arrest is another potentially impactful initiative.[19]

The preference of most ambulance services to deliver training in schools relates to the original aims and objectives of RSAH and explains why the majority of those trained at RSAH events were young people in schools. Despite this, due to the voluntary nature of school participation, there were still disparities in provision to areas in greatest need. Equally, although the UK ambulance services are part of the NHS, support for RSAH is a voluntary and unfunded activity. This would explain the variation in provision with three ambulance services delivering the majority of training events. The voluntary nature of participation by both ambulance services and schools almost certainly accounts for the variation in the numbers, geographical spread of events, numbers of people trained, and proportions of events held in area of high OHCA incidence or low bystander CPR rates. Overall, the 2019 RSAH events were delivered in predominantly white, affluent, low population density areas that are predominantly not "hot spot" areas. Whilst the majority of events occurred in areas with low levels of reported bystander CPR rates, only 47% of events occurred in areas with high incidence rates of OHCA. We may theorise that competing needs and priorities, and possibly a lack of awareness and lack of resources for schools in more deprived areas may play a part in this finding. However, without further research and evaluation we cannot be sure.

It is currently unknown whether the proportions of people from black, Asian and minority ethnic (BAME) backgrounds who have

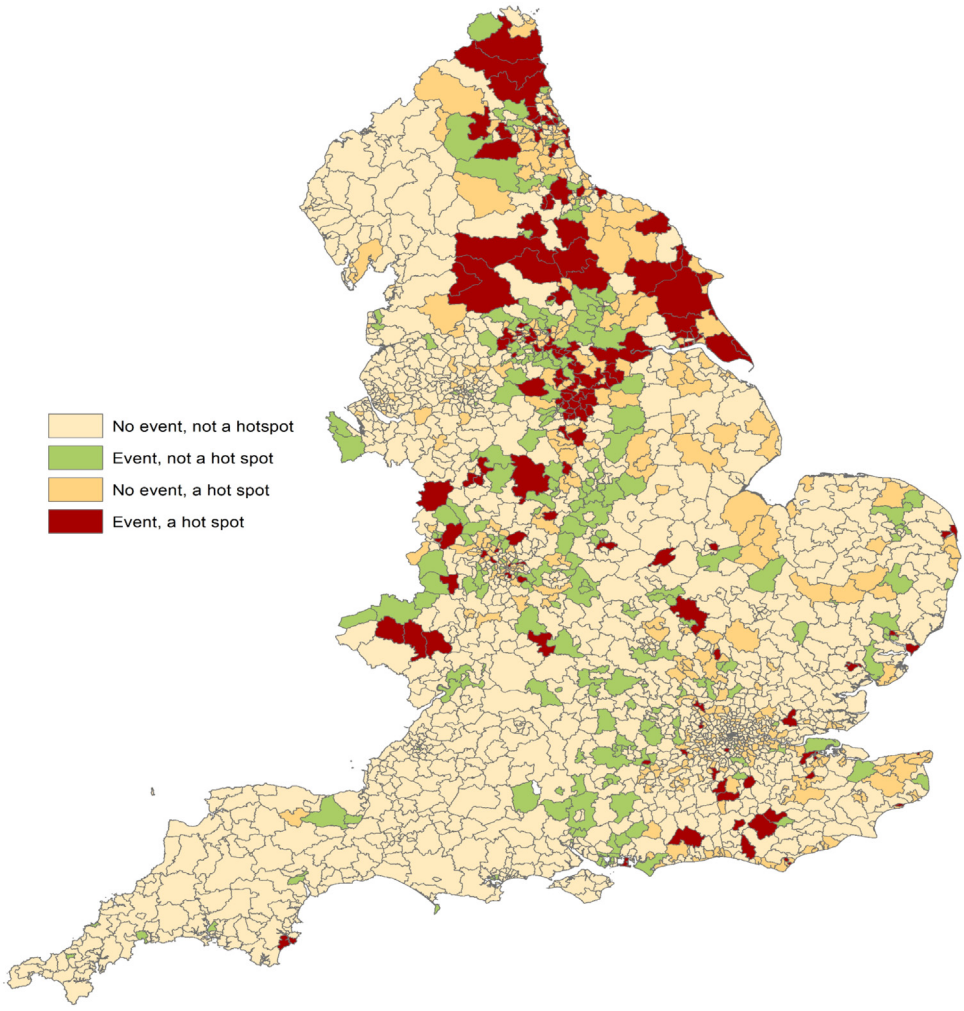

Fig. 3 – RSAH events coverage of hot-spot areas and non-hot spot areas.

received training in CPR differs from rates in the white population in the UK. Our findings indicate that RSAH events were held in areas that had a significantly lower proportion of black residents when compared to the proportion of black people in the census. This is of significant concern given the existing health inequalities in people from BAME groups, which have been placed in sharper focus by the coronavirus pandemic. Evidence from London (UK) reported an 81% increase in the number of OHCA cases at the height of the pandemic's first wave (March and April 2020) compared to the same time in the previous year. They reported cautiously, because of data quality issues, that the proportion of those patients who were from BAME backgrounds had increased.[20] Efforts to increase CPR training opportunities for people from ethnic minority backgrounds clearly needs addressing and our findings indicate that the RSAH initiative in 2019 was not providing training equally to areas with high proportions of black residents.

In a previous study that reported on the "hot spot" areas in England, areas with a high OHCA incidence combined with a low bystander resuscitation rate had the following characteristics: populations with a greater proportion of BAME ethnic backgrounds, a greater level of deprivation, a higher proportion of people in intermediate and routine occupations, fewer people with higher educational qualifications and higher population density and increased urbanization.[10] Other similar "hot spots" have been reported in Canada,[21] USA,[22–25] Australia,[26] Taipei,[27] New Zealand,[28] and Scotland.[29] RSAH training was delivered in over a quarter of identified English "hot spots",[10] with slightly more coverage (non-significant) by the three ambulance services who purposefully targeted these areas. One of the ambulance services (service J in supplementary Fig. 1) coincidentally delivered training in 100 out of their 168 "hot spots" (59.5%).

There is little evidence to inform training providers' decisions about how best to provide training and increase uptake in communities with higher deprivation and higher proportions of BAME residents. A recent review of barriers to performing CPR identified only three studies that specifically considered deprived communities.[30] The transferability of research findings from one country also provides challenges for stakeholders when assessing relevance in another when the ethnic backgrounds of communities or the issues they face may be different. Evidence from Denver in the United States indicates that barriers to training and performing CPR include training accessibility and costs, distrust of emergency services, and knowledge about why CPR is important.[31,32] Barriers identified in a study in deprived Scottish areas were a lack of confidence and elements of the physical environment, e.g. concerns for personal safety and fear of reprisal from gangs or the police.[33] Incentives to learn CPR in the US studies included child care provision, grocery cards for participants, free full certification classes,

and transportation cards. Further work is needed to understand the barriers and enablers to delivering training in a variety of deprived and ethnically mixed areas. Diversity in demographic and socioeconomic factors will need to be taken into account by RSAH providers in the knowledge that there will be no single national solution.

In September 2020, in line with World Health Organisation support of training children aged 12 and over,[34] CPR training became mandatory in English state funded schools,[35] it will be in Wales in 2022 and is also supported for training in schools by all local councils in Scotland. This is not yet the case Northern Ireland, and it is important that their Government follow this exemplar approach to prevent even further health inequalities.

The study had several limitations. It included only ambulance service events. Approximately 65,500 people were trained at events delivered by other organisations and members of the public (personal communication from Resuscitation Council UK). These other events may have covered "hot spot" areas, or different populations. The definition of "hot spots" used data from the OHCAO registry from 2013 to 2015.[10] It is possible that "hot spots" have changed since then (e.g. higher rates of bystander CPR), however as the data is fairly recent and calculated over three years it gives a good indication of such areas. Similarly, the neighbourhood characteristic analysis utilised data from the 2011 census and there is a small possibility that they may have changed by 2019. We asked ambulance services whether they were targeting areas with high incidence of cardiac arrest and low rates of bystander CPR, however they may have targeted areas with only one of these characteristics, which may account for the high proportion of events (71%) held in areas with low bystander CPR rates.

Conclusions

With CPR training now or soon to be compulsory in secondary schools in England, Wales and Scotland, it is timely to consider more targeted use of RSAH training resources to cover more "hot spots" and areas with higher proportions of ethnic minority residents and deprivation. Partnering with representatives from these communities could help improve access and uptake of training. More research is needed to identify and evaluate these initiatives and their impacts. There is also an opportunity now to train more adults, including older adults. In other areas of the UK where CPR training is not delivered as a mandatory requirement in schools, it is important that RSAH continues to focus on training school children until it is part of the curriculum. We would recommend, however, that ambulance services review where their local "hot spot" areas are and purposefully recruit schools in these areas.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Hawkes C.A – is employed by The University of Warwick which received a grant for the conduct of this research.

Brown T – is employed by The University of Warwick which received a grant for the conduct of this research. Terry Brown is affiliated to the National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) West Midlands. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.resplu.2021.100132.

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