Scottish Ambulance Service

NHS SCOTLAND

Scotland's Out-of-Hospital Cardiac Arrest Report

2019 - 22

Contents

Preface

This report is published by the Scottish Ambulance Service on behalf of the Delivery Group for Scotland's Out-of-Hospital Cardiac Arrest Strategy and provides a summary of activity and outcomes after out-of-hospital cardiac arrest (OHCA) in Scotland from 1st April 2019 to 31st March 2022.

This document should be read in conjunction with Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026, (1) which provides details of our programmes of work intended to improve neurologically intact survival after OHCA, care for those affected — including patients, their families and those who are involved in resuscitation attempts — and ensure that these benefits are available to all communities across Scotland.

Who is the intended audience for this report?

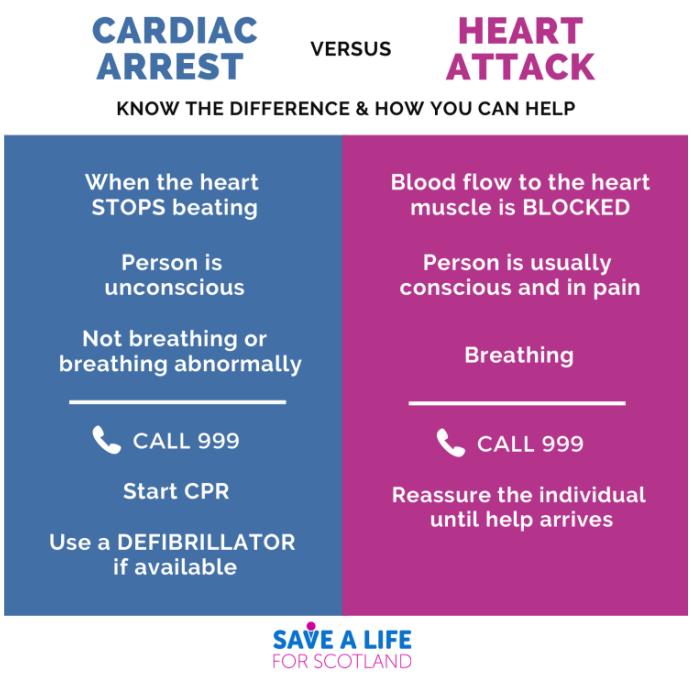
The public — one of the central recommendations of the Global Resuscitation Alliance's Ten Programmes is to develop accountability by publishing an annual report of OHCA outcomes. (2) This report seeks to do that.

Those interested in variations in healthcare across communities in Scotland — this report seeks to facilitate greater understanding of differences in the system of care for OHCA across the country and stimulate discussion about how we can do better.

Healthcare professionals — those wishing to ensure a data driven approach to improving the delivery of realistic medical care, as well as those working on the 'front line' who want to understand the performance of the system to which they contribute.

Third sector organisations and policy makers — those who want a deeper understanding of the challenges facing communities across Scotland and how best to deploy resources to meet them.

The resuscitation community — others engaged in building systems to save lives after OHCA who seek to understand our approach to and benchmark against our progress. We present this report in an effort to be transparent about our challenges as well as our progress, in the spirit of 'work[ing] with the garage door up'. (3)



On average, there are 3,140 out-of-hospital cardiac arrest (OHCA) every year, with people in the most deprived areas twice as likely to have an OHCA

Thanks

This work represents the hard work of a number of individuals. We would like to publicly acknowledge the contribution of the following people in enabling the production of this report, whilst being mindful of the help of many others who are not listed here.

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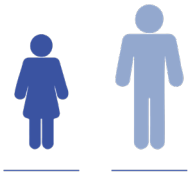
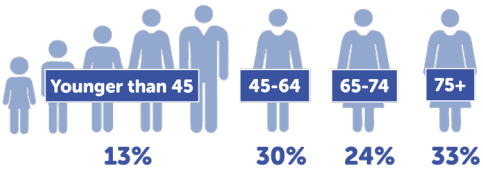
Improving Outcomes from OHCA
Where we are 2021-2022

Average number of OHCA

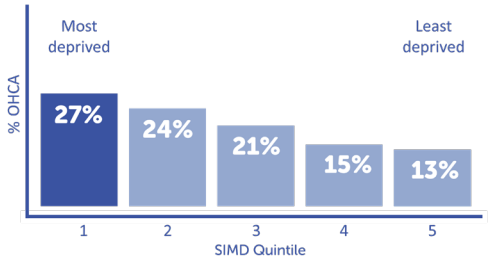
3,140 per year



OHCA can affect anyone of any age at any time.



People in the most deprived areas are twice as likely to have an OHCA.



Before Strategy*

Bystander CPR was received by

41%

Latest Statistics

Bystander CPR is received by

66%

Public Access Defibrillator deployment before the arrival of the Ambulance Service rose from **2.5%** before the Strategy* to:

8%

During COVID-19 restrictions **1 in 14** people with OHCA survived to leave hospital. This has improved to:

1 in 10

*Baseline figures are from 2011-2015 prior to the launch of Scotland's Strategy for OHCA in March 2015.

Summary of Main Findings in 2021-22

1. From 1st April 2021 to 31st May 2022 there were 3,140 cardiac arrests where resuscitation was attempted. This represents an incidence rate of 573.0 OHCA per million population of Scotland.

2. Overall, 30-day survival was 9.7% (Strategy aim 15%), representing 55.5 survivors per million population. This is less than in 2018-19 (11.9%), but significantly recovered after a drop in survival to 7.5% during the COVID-19 pandemic.

3. Return of Spontaneous Circulation (ROSC) rate in patients with a shockable initial rhythm (Utstein comparator) was 52.3%, with a 30-day survival rate of 26.1%, the highest recorded level since 2011-12.

4. Bystander CPR rate was 66.1% (Strategy aim 85%), the highest recorded since 2011-12 and having continued to rise during the COVID-19 pandemic.

5. The number of Public Access Defibrillators (PAD) in communities across Scotland that are registered on the national defibrillator network (The Circuit) has more than doubled since 2019 and is now at almost 5,000. The rate of PAD deployment by the public was 8% (Strategy aim 20%).

6. Scottish Index of Multiple Deprivation (SIMD) associated inequalities remain, with those living in the most deprived areas in Scotland (SIMD1) more than twice as likely to have an OHCA and 40% less likely to be alive 30 days after the event when compared to people living in the least deprived areas in Scotland (SIMD5).

7. The COVID-19 pandemic had a significant impact on OHCA outcomes but we have made a substantial recovery.

OHCA — A Patient's Story

A woman who had a cardiac arrest in the Botanic Gardens in Edinburgh has been reunited with one of the Scottish Ambulance Service (SAS) staff members who saved her life.

Jeanne Reilly, of Berkshire, recently returned to Edinburgh with family and friends to attend the unveiling of a new defibrillator installed at the same location where she collapsed on July 30 last year.

Her friend Jane Wood, who was with Jeanne when she went into arrest, instigated the efforts to have the defibrillator installed, and raised £2,086 through family and friends.

A retired GP and an off-duty doctor performed CPR immediately and used a nearby defib while an emergency call was placed with the SAS, which was received by Lindsey Brady, of West Ambulance Control Centre (ACC) in Glasgow.

Aidan Colliar and Audrey Michie, of the East ACC in Edinburgh, then dispatched Nickie Crowe, on a Paramedic Response Unit, and ambulance crew Ian Harwood and Ricky Moffat, of Dalkeith Station.

They arrived within two minutes of the call being received and Jeanne was transported to hospital and "kept alive" in the ambulance on the way to Edinburgh Royal Infirmary.

Jeanne said: "I was very pleased to see the newly installed defibrillator at the Terrace Café and it was a privilege to meet ambulance crew member Ian in person.

"We have all since spoken so fondly of the opportunity to meet together. Shiona Mackie, the retired GP, met us all again shortly after and gave us a tour of the Botanics in her capacity as a volunteer tour guide — that was special too.

"I was thrilled that Ian had driven so quickly from the Botanics to the Hospital. Putting names to faces and filling in some gaps in my experience has given me a sense of peace."

Speaking of the cardiac arrest, she said she was given CPR and a defibrillator was used prior to the crew arriving. She added: "They arrived very quickly and then took me to Edinburgh Royal Infirmary, giving me another shock in the ambulance. I spent 12 days in hospital, had a stent and ICD fitted and I am on the mend to lead a normal life again. I owe my life to all involved. I have been able to thank others personally, and my family and myself send thanks and more to the crew."

She said it was vital for people to learn CPR skills for this year's Restart a Heart Day on Sunday."Had it not been for the quick thinking of everyone, I would not be back to enjoying life. The expertise of the ambulance paramedics kept me alive while I made the journey to the Edinburgh Infirmary. The medical team in ICU took over from there.

"I hope that more people are educated about where to find a defibrillator and how to use one, so that the percentage of those who survive a cardiac arrest out of hospital can increase."

Introduction

OHCA in Scotland — the shape of the challenge

Caring for patients and bystanders who experience an out-of-hospital cardiac arrest (OHCA) in the community requires a whole system of care. The necessary sequence of events starts with community readiness, including anticipatory care planning for those known to be at higher risk of cardiac arrest, along with community awareness of what to do in the event of OHCA.

After recognising OHCA and calling for help, bystander action is crucial, this includes delivery of bystander CPR and use of a public access defibrillator (PAD) if available. The chain continues with the arrival of trained community responders and paramedics, and ends with in-hospital care and aftercare on returning to the community. This time-critical sequence is often described as the 'Chain of Survival' (Figure 1).

Figure 1

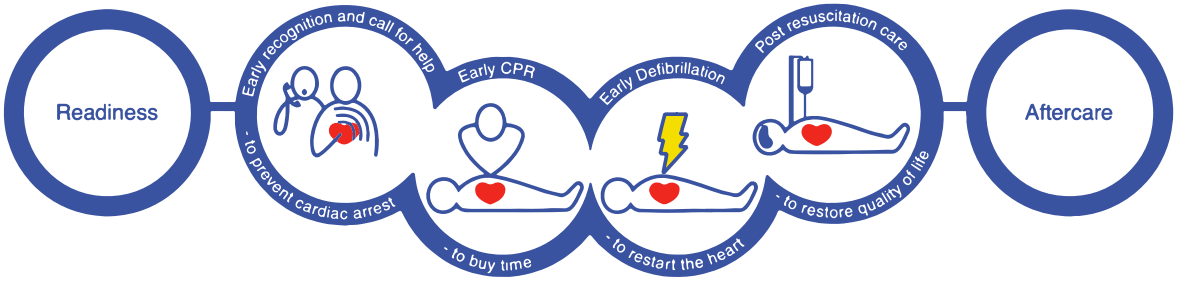


Figure 1 shows the 'Chain of Survival' including Early recognition and call for help, Early CPR, Early Defibrillation, and Post resuscitation care. (4) This has been extended to include Readiness and Aftercare forming the 'Augmented Chain of Survival'. (5)

Prioritising early links in the 'Chain of Survival'

Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 continues to place particular emphasis on the activities at the start of the 'Chain of Survival' such as bystander CPR. We seek to consolidate and amplify work already being carried out to promote CPR and PAD use by community groups and third sector organisations across the country. To achieve this, key stakeholders work together as the Save a Life for Scotland (SALFS) partnership.

Save a Life for Scotland

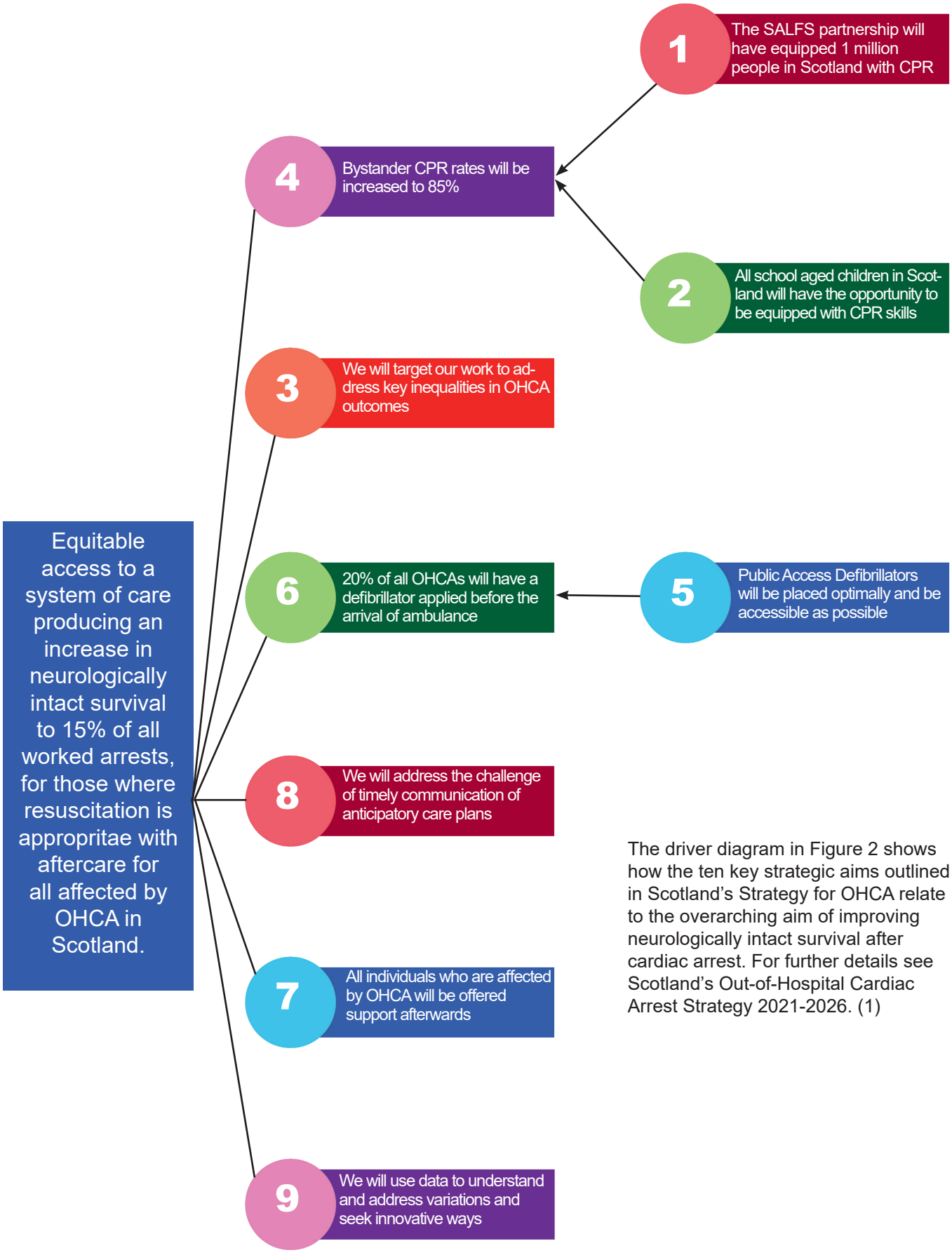
SALFS is a campaign which brings together the work of a range of partners committed to saving lives by changing the way we think about OHCA in order to get Scotland CPR ready.

It is a collaboration between the emergency services, third sector organisations, Scottish Government and academic researchers. The partnership is directed by the Resuscitation Research Group at the University of Edinburgh. A full list of the partners can be found at www.savealife.scot.

In addition to the public facing work of SALFS, the OHCA Strategy Delivery Group partners work together on a range of interconnected projects to improve OHCA survival nationally and regionally.

Aims of Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 and how they relate to this document

Figure 2



The driver diagram in Figure 2 shows how the ten key strategic aims outlined in Scotland's Strategy for OHCA relate to the overarching aim of improving neurologically intact survival after cardiac arrest. For further details see Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026. (1)

How to read this report

The report is structured to provide a background to the challenge of OHCA, Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 (1) and key metrics charting the progress of implementation of that strategy.

Key clinical outcomes and process measures are given first including 30-day survival, ROSC, bystander CPR and PAD usage. These terms are defined in the appropriate sections. Each measure is shown as a geographic snapshot of the current state of affairs using a health board map and a funnel plot of data from the last 12 months. There is then a timeline showing the variation of each measure over time of both the national average over the last three years as well as the data for each health board over the last ten years. Analysis is provided which examines key dimensions of inequality and an update on the work of the Save a Life for Scotland Partnership.

Timelines

The longitudinal timelines in this report are presented as control charts in order to highlight how various system elements are changing over time. In each case the average value (mean) is shown by a grey dotted line, and upper and lower control limits (at two and three standard deviations) are shown as red dotted lines. In general, control lines can be used to highlight areas that would benefit from further investigation. (6)

Funnel Plots

A funnel plot is a scatter plot showing a cross-sectional 'snapshot' in time. We have used this type of plot to illustrate the variation in key OHCA measures across health board areas in Scotland while taking into account the number of OHCA that occur within each health board. We include two sets of boundary lines on each plot: one set for 95% confidence intervals and 99.7% confidence intervals. These lines can be used to identify areas that would merit closer investigation because the metrics are outwith the confidence intervals. (7)

Deprivation analysis — the Scottish Index of Multiple Deprivation (SIMD)

SIMD is the Scottish Government's official tool for identifying areas in Scotland with concentrations of deprivation by incorporating seven different domains of deprivation (income, employment, education, housing, health, crime, and geographical access) and combining them into a single index. (8)

Data zones are geographic areas in Scotland each containing a population of between 500 and 1,000 people. Where possible, they have been made to respect physical boundaries and natural communities, have a regular shape and contain similar households. (9) The SIMD is calculated for each data zone in Scotland using census data, and data zones are then ranked. This process facilitates the use of quintiles, with approximately 20% of the Scotland population in each quintile: quintile 1 (SIMD1) has the greatest deprivation while quintile 5 (SIMD5) has the least deprivation.

The SIMD can be used to target policies and resources at the places with greatest need. It is important to remember that the SIMD is an area based measure and therefore identifies deprived areas, not deprived individuals.

For this report, SIMD is derived from the postcode of the OHCA incident location and uses lookup files from Public Health Scotland. (9) Because SIMD varies with each census and changes to data zone boundaries, we have used the date of each OHCA incident to ensure that the relevant SIMD is applied.

COVID-19 restrictions in Scotland

This report considers OHCA that occurred in Scotland from 1st April 2019 to 31st May 2022. This timeframe includes the onset of the COVID-19 pandemic, ensuing lockdown measures enacted in Scotland, and eventual easing of such measures. Throughout the report, time series are marked to indicate the period from the first day of 'lockdown' in Scotland on 24 March 2020 to the move to level 3 restrictions on 20th April 2021. (10)

In 2021/22 the bystander CPR rate was 66.1%, the highest recorded since 2011-12

Setting the Scene

The Size of the Challenge: Number of Worked Arrests

BOX 1: Worked Arrests

'Worked arrests' are OHCA that have a cause which does not involve major physical trauma and where resuscitation was attempted by the Scottish Ambulance Service (SAS). This number forms the denominator for all subsequent outcome calculations unless otherwise specified. There are a number of reasons why SAS may not attempt resuscitation including obvious death (i.e., the patient shows obvious signs of having been dead for some time) or the confirmation that resuscitation was not the patient's wish (e.g., by the presence of a 'do not attempt CPR' order as part of an anticipatory care plan).

The figures below indicate that the number of worked OHCA (see BOX 1 for definition) in Scotland has been relatively stable over the last decade, reaching a peak in 2016-17 (Figure 3). The number of OHCA calls where resuscitation was attempted did not change significantly during COVID-19 restrictions compared to the previous two years (Figure 4).

Figure 3: Number of worked OHCA patients in Scotland 2011-12 to 2021-22

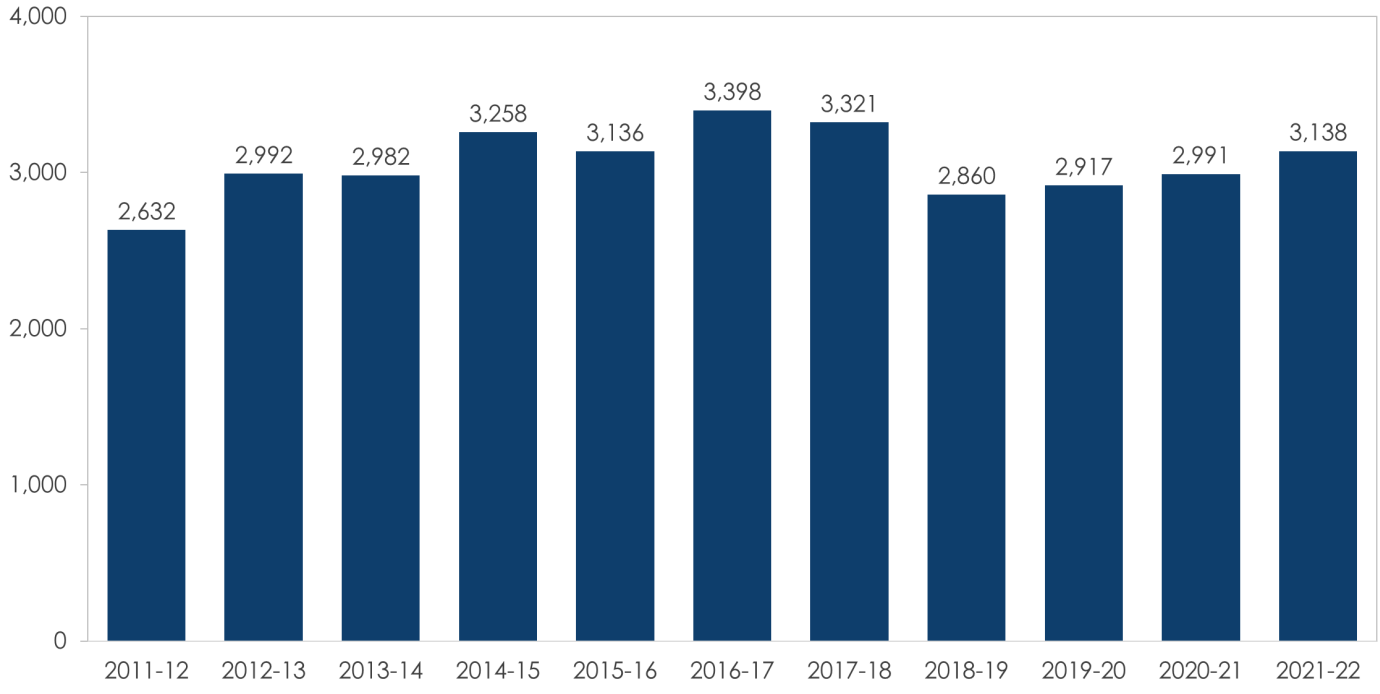


Figure 3 shows the number of worked OHCA in Scotland by year from 2011-12 to 2021-22.

Figure 4: Number of worked cardiac arrest patients in Scotland April 2019- March 2022

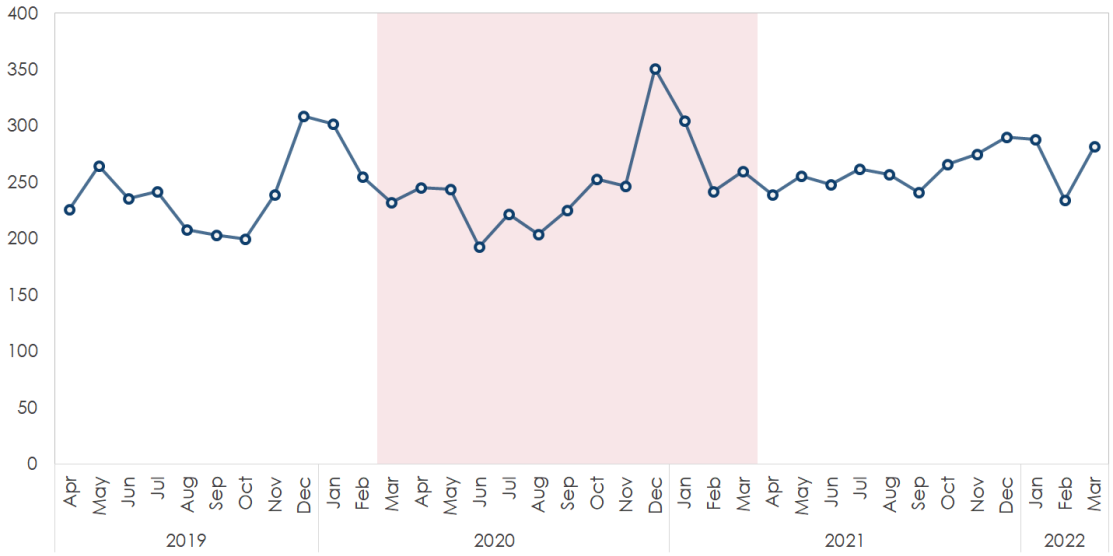


Figure 4 shows the number of worked OHCA in Scotland by month from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 5: Number of worked cardiac arrest patients in Scotland in 2021-22 by health board

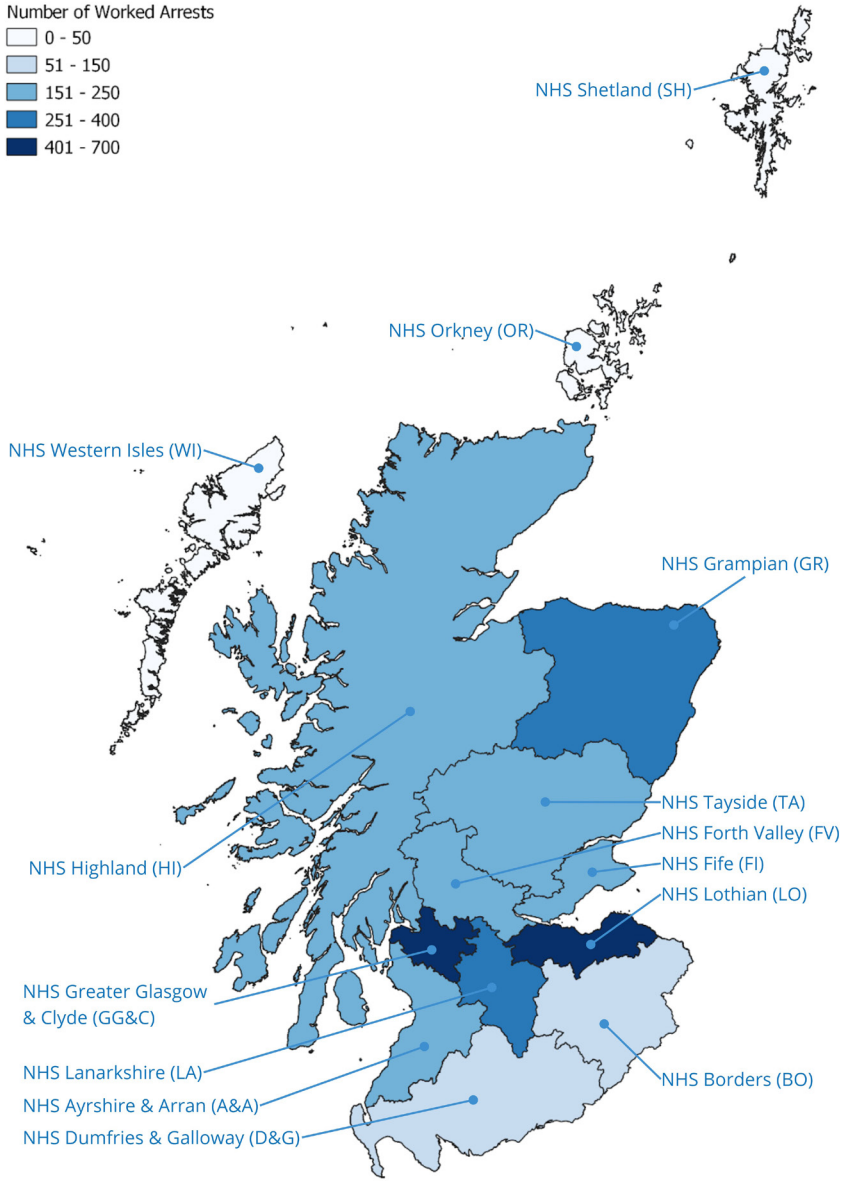


Figure 5 shows the volume of worked OHCA by NHS Health Board across Scotland during the single year 2021-22. These are unadjusted figures and show the absolute number of incidents where resuscitation was attempted by the SAS after OHCA during this time period.

Connecting Scottish Ambulance Service OHCA incidents to patient outcomes

The collection and preparation of data contained in this report follows the same methodology of our previous report. (11) In brief, the SAS provided data on all worked OHCA incidents during the reporting period. Where possible, the patients involved in each incident were linked to survival outcome data via their Community Health Index (CHI) number by Public Health Scotland. (12) In addition, components such as the SIMD were applied to the dataset to allow further analysis. For the preparation of this report, we have applied an enhanced linkage process to all OHCA occurring in the past ten years, which is reflected in improved linkage not only for current data, but also enhancement of our historic dataset. Further details can be found in Appendix 1.

The percentage of linked, worked OHCA cases increased from 87.4% in 2011-12 to a peak of 96.7% in 2021-22. Incidents which could not be linked to outcome data were assumed to be deaths (a worst case scenario assumption) and included in the denominator for the calculation of the percentage of 30-day survival.

Patient characteristics: age, sex, initial heart rhythm and SIMD

The characteristics of patients with worked OHCA in Scotland have remained stable over the last ten years. Headline figures can be seen in Table 1. Similar to previous years, the mean age of patients in the 2019-22 time period was 64.6 years with males making up 64.2% of patients. A shockable heart rhythm (see BOX 2 for definition) was recorded on the initial electrocardiogram (ECG) in 23.2% of patients. The distribution of OHCA across SIMD quintiles remains roughly the same, with approximately double the number of OHCA occurring in SIMD1 (most deprived) compared to in SIMD5 (least deprived). These data are shown in Table 1 and graphically in Figure 6 below.

Table 1:

Period	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Age	66.7	67.0	66.1	67.1	66.9	65.9	66.1	65.5	65.1	64.4	64.4
(SD)	17.7	17.8	17.7	17.7	17.1	18.3	17.8	17.9	18.0	17.5	18.7
Shockable Rhythm %	26.9%	25.2%	25.6%	22.9%	24.1%	22.5%	23.9%	28.6%	25.6%	21.5%	22.5%
Males %	62.8%	63.8%	63.3%	62.5%	62.7%	63.5%	64.2%	64.3%	62.7%	64.4%	65.6%
SIMD - 1	26.6%	25.7%	26.1%	26.4%	26.9%	27.5%	26.2%	26.8%	27.0%	27.4%	26.9%
SIMD - 2	24.4%	24.2%	23.1%	24.0%	24.2%	23.5%	23.3%	24.3%	24.5%	23.6%	24.0%
SIMD - 3	19.2%	19.2%	20.0%	19.6%	18.6%	20.0%	20.9%	18.2%	19.3%	19.7%	20.5%
SIMD - 4	16.7%	16.8%	17.1%	17.0%	16.7%	16.4%	16.8%	17.3%	16.2%	16.6%	15.6%
SIMD - 5	13.2%	14.1%	13.8%	13.0%	13.6%	12.6%	12.9%	13.4%	13.0%	12.7%	13.0%

Table 1 shows the age, sex and SIMD distribution of patients with worked OHCA from 2011-12 to 2021-22.

Figure 6:

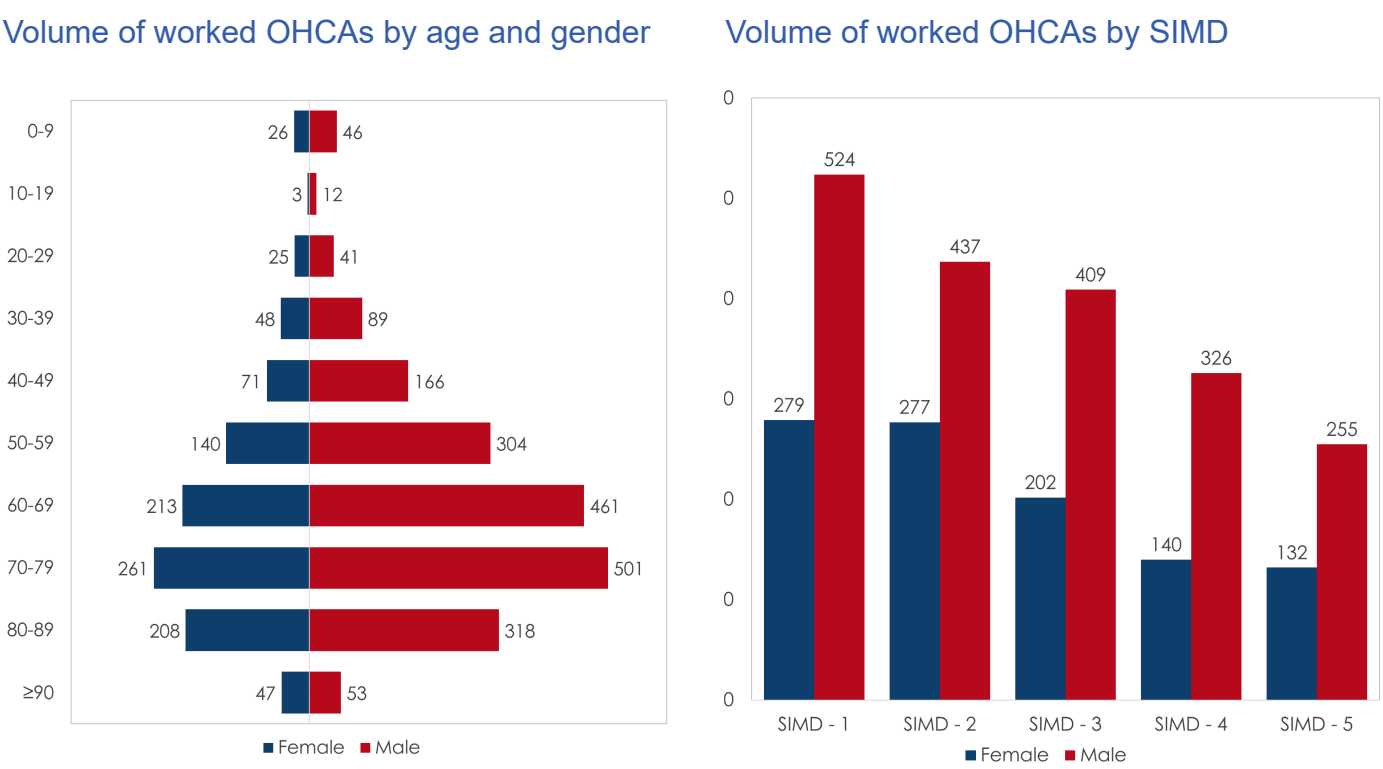


Figure 6 shows the distribution of worked OHCAs by age (left panel) and SIMD (right panel) in the single year 2021-22. In both charts female patient distribution is shown in blue, male patients in red.

BOX 2: Initial heart rhythm

The initial heart rhythm recorded on the electrocardiogram (ECG) on arrival of SAS is important. A patient may have a **shockable rhythm** (i.e., ventricular fibrillation or ventricular tachycardia) which may be treatable by delivering an electric shock using a **defibrillator**, or **non-shockable rhythm** (i.e., asystole, pulseless ventricular activity, or bradycardia). The initial treatment and prognosis depends on the initial heart rhythm: survival is more likely for OHCA with a shockable initial rhythm. The outcomes for patients with a shockable initial rhythm are used as a benchmark for systems of OHCA care (see BOX 4).

Key Outcome Data

30-Day Survival

The goal of resuscitation after OHCA is long-term neurologically intact survival. The number of patients still alive at 30 days after their arrest is a commonly used proxy for this measure. The table below shows a snapshot of 30-day survival by health board in 2021-22. Health board-specific survival percentages can be difficult to interpret because the number of worked OHCA in each area varies greatly; the same data are therefore shown in the funnel plot in Figure 7. Here we see that none of the health boards lie outside the 95% control limits, suggesting that the range of outcomes are within expected variation.

The timeline shown in Figure 8 includes the mean 30-day survival percentage across Scotland from April 2019 to March 2022. In order to highlight the effect of the COVID-19 pandemic on OHCA outcomes, the shaded red area shows the 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021. (10) It can be seen that 30-day survival peaked at 11.9% in Scotland in 2019, and decreased as the COVID-19 pandemic took hold to a low of 7.5% in 2020-21, with subsequent recovery to near pre-pandemic levels of 9.7% by the end of March 2022. The individual health board timelines for 2011-12 to 2021-22 in Figure 9 illustrate a trend towards a modest increase in 30-day survival over the last 10 years, with the exception of the period during lockdown in all health boards (the small number of cases in Orkney, Shetland and the Western Isles make the data difficult to interpret for these health boards).

Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 (1) articulates the aim that we increase 30-day survival to 15% of all worked OHCA by 2026. This will require a series of improvement measures to optimise the links in the 'Chain of Survival' across Scotland. The remaining data presented in this report track some of the key system elements required to deliver that improvement.

Figure 7 shows a cross-sectional snapshot of 30-day survival by health board for 2021-22: the underlying data for this chart are in Table 2. None of the health boards fall outwith the upper or lower control limits indicating that the variation in survival outcomes between boards falls within the expected range.

BOX 3: 30-Day Survival

The definition of 'survival' used in this report is survival to 30 days after the date of the OHCA. We have counted survival as the percentage of worked OHCA where patients were still alive at 30 days. Worked OHCA which were not linked to outcome data have been assumed to be deaths and included in the denominator when calculating survival rates.

Snapshot of 30-Day Survival

Table 2: Snapshot of 30-Day Survival across Scotland by Health Board 2021-22

Health Board	Worked Arrests	Survived	Percentage	Survivors Per 100k Population
Ayrshire & Arran (A&A)	226	25	11.1%	6.8
Borders (BO)	67	8	11.9%	6.9
Dumfries & Galloway (D&G)	123	14	11.4%	9.4
Fife (FI)	213	15	7.0%	4.0
Forth Valley (FV)	192	17	8.9%	5.5
Grampian (GR)	306	25	8.2%	4.3
Greater Glasgow & Clyde (GG&C)	657	71	10.8%	6.0
Highland (HI)	214	23	10.7%	7.1
Lanarkshire (LA)	375	29	7.7%	4.4
Lothian (LO)	452	46	10.2%	5.1
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	224	24	10.7%	5.7
Western Isles (WI)	*	*	*	*

Table 2 shows 30-day survival after worked OHCA for each of the health boards across Scotland for the single year 2021-22. Included in the table are the total number of worked OHCA, the number of survivors at 30 days, the percentage of patients alive at 30 days and the number of survivors per 100,000 population. (* data suppressed due to low numbers)

Figure 7: Percentage of 30-day survival for worked cardiac arrest patients by health board

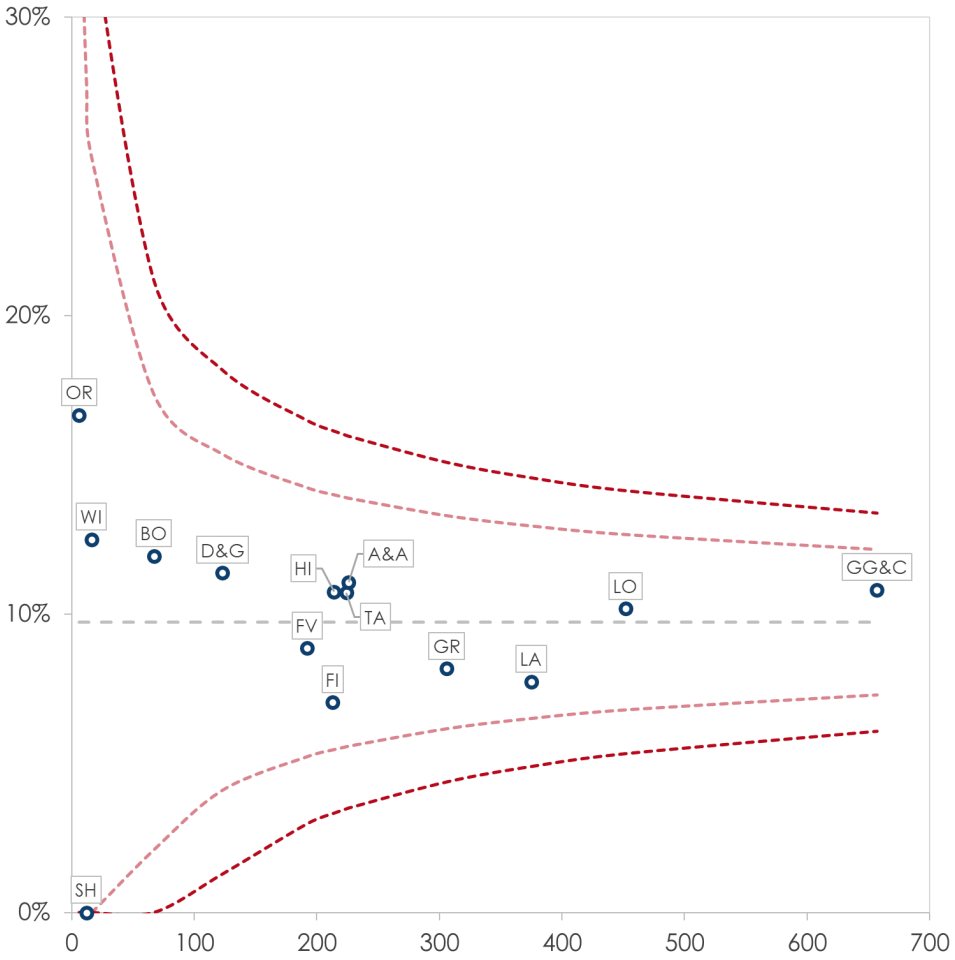


Figure 7 shows a funnel plot of 30-day survival vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given above in the Introduction section.

Timeline of 30-Day Survival

Percentage of 30-day survival for worked OHCA patients

Figure 8

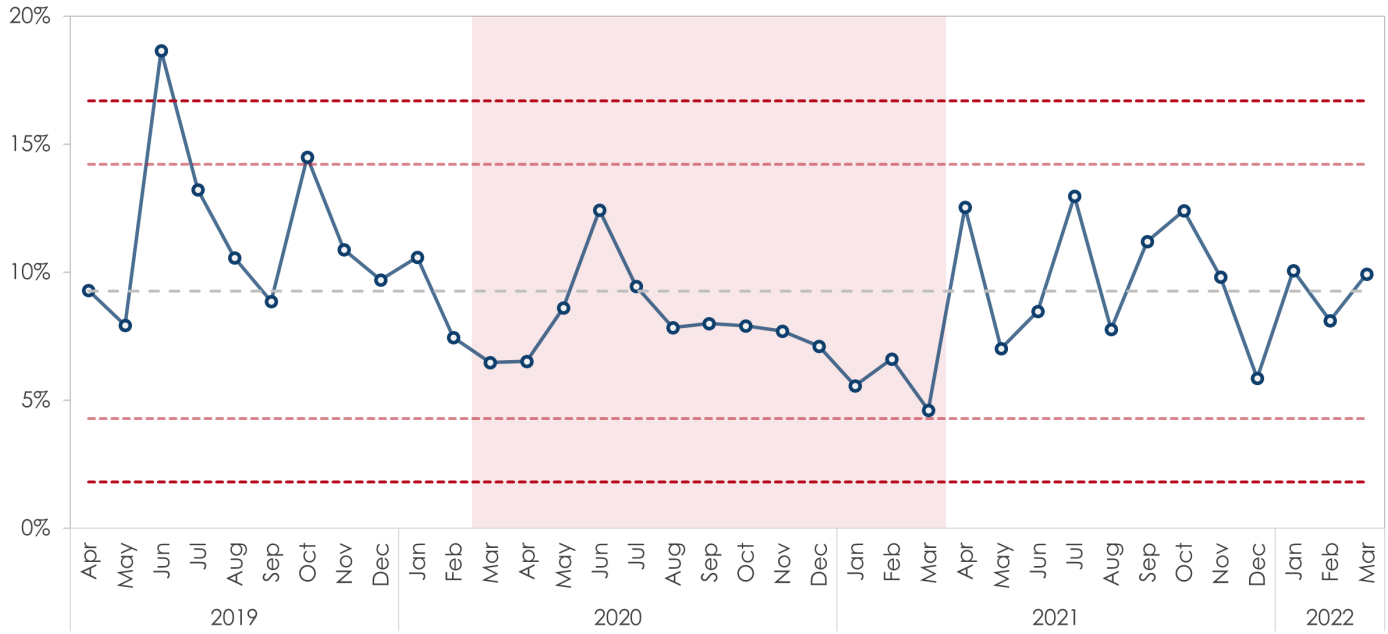


Figure 8 shows the percentage of survival at 30 days after OHCA for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 9

Figure 9 shows the trend in survival at 30 days after OHCA for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

Number of 30-day survivors per million of the population

Much reporting of OHCA outcomes relies on the calculation of the percentage of people with worked OHCA who survive for 30 days. This measure is useful for tracking system performance but is vulnerable to potentially misleading variation in the denominator value. The proportion of OHCA patients who have resuscitation attempted by the ambulance service can vary significantly between emergency services depending on a range of factors, such as the extent of prior anticipatory care planning in order to avoid futile resuscitation attempts. A Canadian study in 2017 examined 86,912 OHCA incidents attended by 129 different Emergency Medical Service agencies over a five-year period. A key finding was that the proportion of patients receiving a resuscitation attempt varied from 23.9% to 100% across agencies. (13) This variation results in the use of very different denominators when reporting percentage survival. Adjusting the number of survivors by the population can account for differences in rates of resuscitation initiation, providing a more useful measure of the system of OHCA care.

BOX 4: 30-day survivors per million

Reporting the number of 30-day survivors per million of the population is a useful measure which is not as dependent on rates of initiation of resuscitation. If we assume that the population of Scotland and the incidence of OHCA remain relatively stable, then monitoring the change in the absolute number of 30-day survivors per million is a more useful measure of the system of OHCA care than reporting changes in the proportion of patients who survive after resuscitation is attempted. (14)

Number of 30-day survivors and 30-day survivors per million for worked OHCA patients

Figure 10

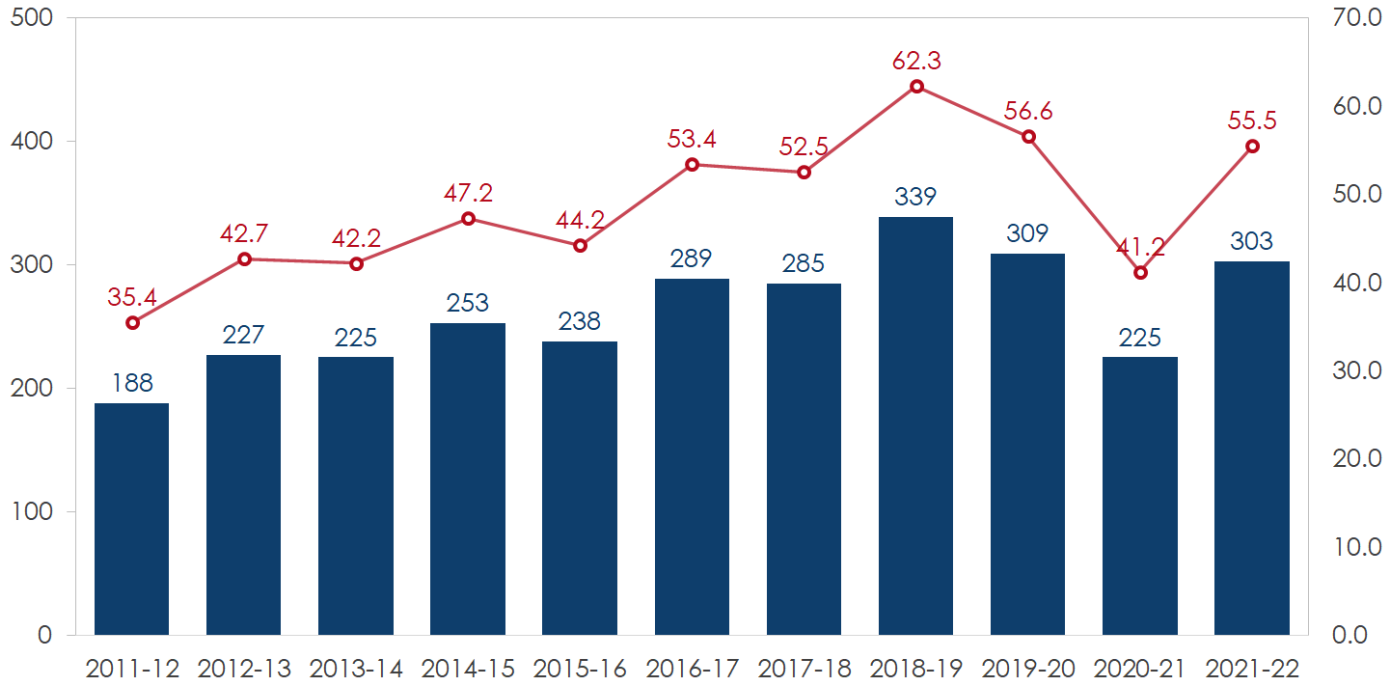
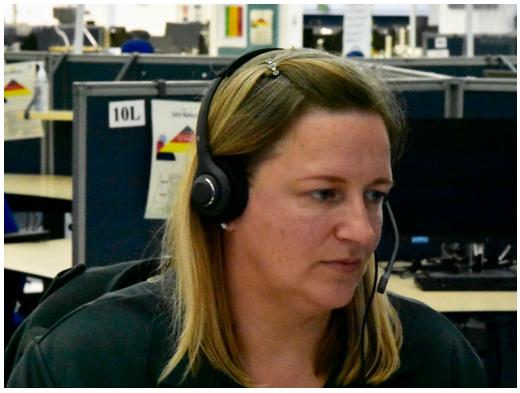


Figure 10 shows the number of patients alive at 30 days after worked OHCA for the whole of Scotland between the years 2011-12 to 2021-12 (blue bars) and the number of 30-day survivors per million of the population (red line).

30-day survival in patients with a shockable initial rhythm — the Utstein Comparator group

BOX 5: The Utstein Comparator

The Utstein templates aim to provide uniformity to OHCA data definitions. One element of this is the use of the 'Utstein Comparator group' (bystander-witnessed cardiac arrest with a shockable initial heart rhythm). (15) We have referred to this group as '**patients with a shockable initial rhythm**' in this report.



The 'Utstein Comparator group' provides a benchmark for the emergency medical systems that respond to OHCA. (15) Whilst the majority of patients suffering OHCA do not fall into this group (see BOX 5), by focusing on those patients who are most likely to survive, the comparator seeks to eliminate as far as possible all the other variables that influence outcome independently of the efficiency of the systems under review.

It is of note that the 30-day survival rate for worked OHCA with a shockable initial rhythm was 26.1% in 2021-22, a little higher than the previously highest recorded value of 25.7% in 2019-20. This signals an encouraging upturn after the impact of COVID-19 on the 2020-21 mean of 23.3%.

Figure 11 shows a snapshot of 30-day survival for patients with a shockable initial rhythm by health board in 2021-22. No health board was outside of the upper or lower control limits. The underlying data are shown in Table 3. The 2019-2022 timeline in Figure 12 and ten-year timelines by health board in Figure 13 show a similar pattern to 30-day survival for all initial rhythms described above.

Snapshot of 30-day survival in patients with a shockable initial rhythm

Snapshot of 30-day survival in worked OHCA patients with a shockable initial rhythm 2021-22

Table 3

Health Board	Worked Arrests	Survived	Percentage	Survivors Per 100k Population
Ayrshire & Arran (A&A)	48	11	22.9%	3.0
Borders (BO)	*	*	*	*
Dumfries & Galloway (D&G)	30	9	30.0%	6.0
Fife (FI)	56	11	19.6%	2.9
Forth Valley (FV)	41	7	17.1%	2.3
Grampian (GR)	64	17	26.6%	2.9
Greater Glasgow & Clyde (GG&C)	163	45	27.6%	3.8
Highland (HI)	63	18	28.6%	5.6
Lanarkshire (LA)	78	16	20.5%	2.4
Lothian (LO)	105	32	30.5%	3.5
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	43	15	34.9%	3.6
Western Isles (WI)	*	*	*	*

Table 3 shows Utstein Comparator 30-day survival after OHCA for each of the health boards across Scotland for the single year 2021-22. Figures are shown for the total number of worked OHCA, the percentage alive at 30 days and the number of survivors per 100,000 population. (* data suppressed due to low numbers)

Percentage of 30-day survival for worked OHCA patients with a shockable Initial rhythm by health board

Figure 11

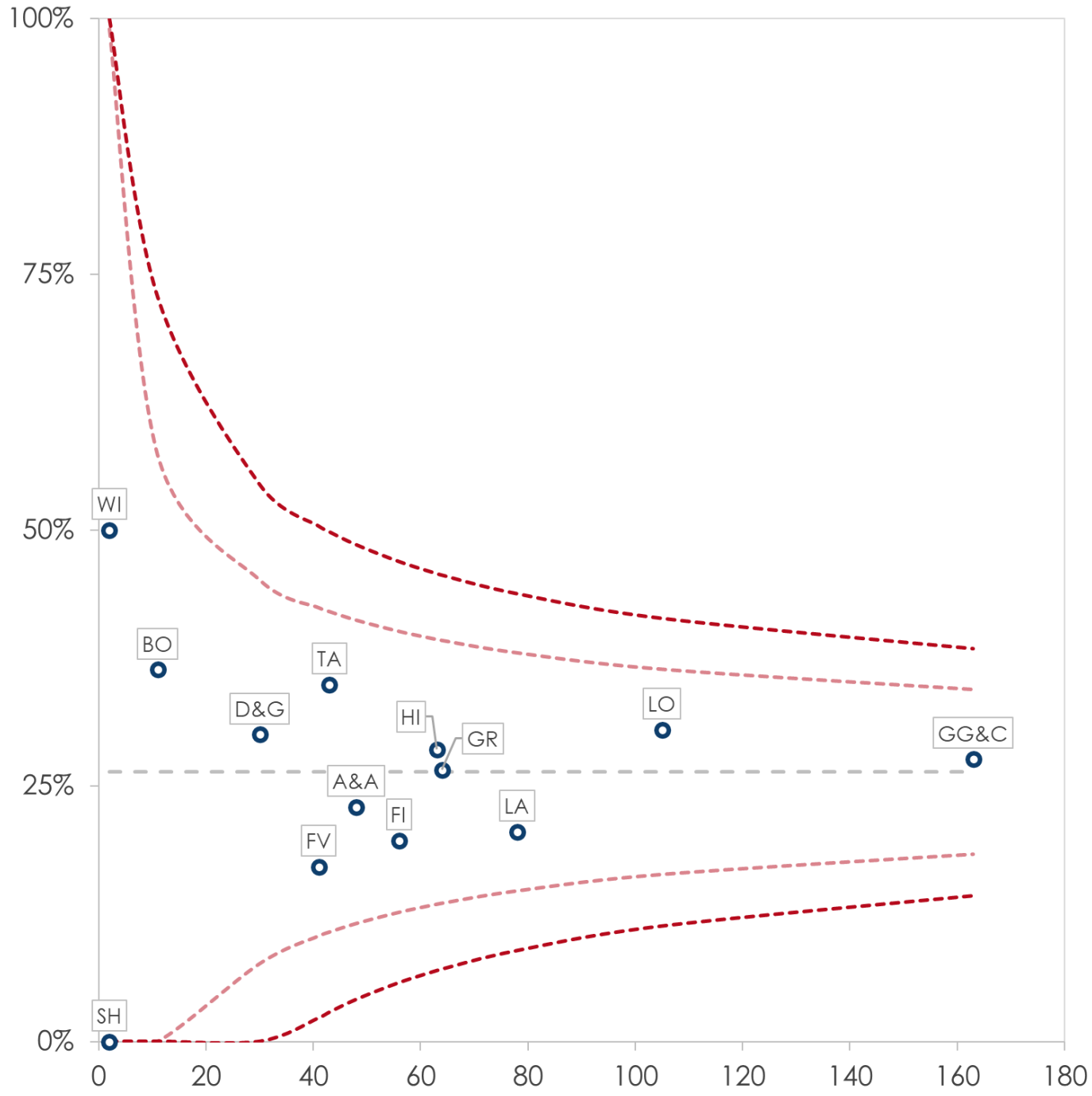


Figure 11 shows a funnel plot of Utstein Comparator 30-day survival vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section.

Timeline of 30-day survival in patients with a shockable initial rhythm

Figure 12: Percentage of 30-day survival for worked OHCA patients with a shockable initial rhythm

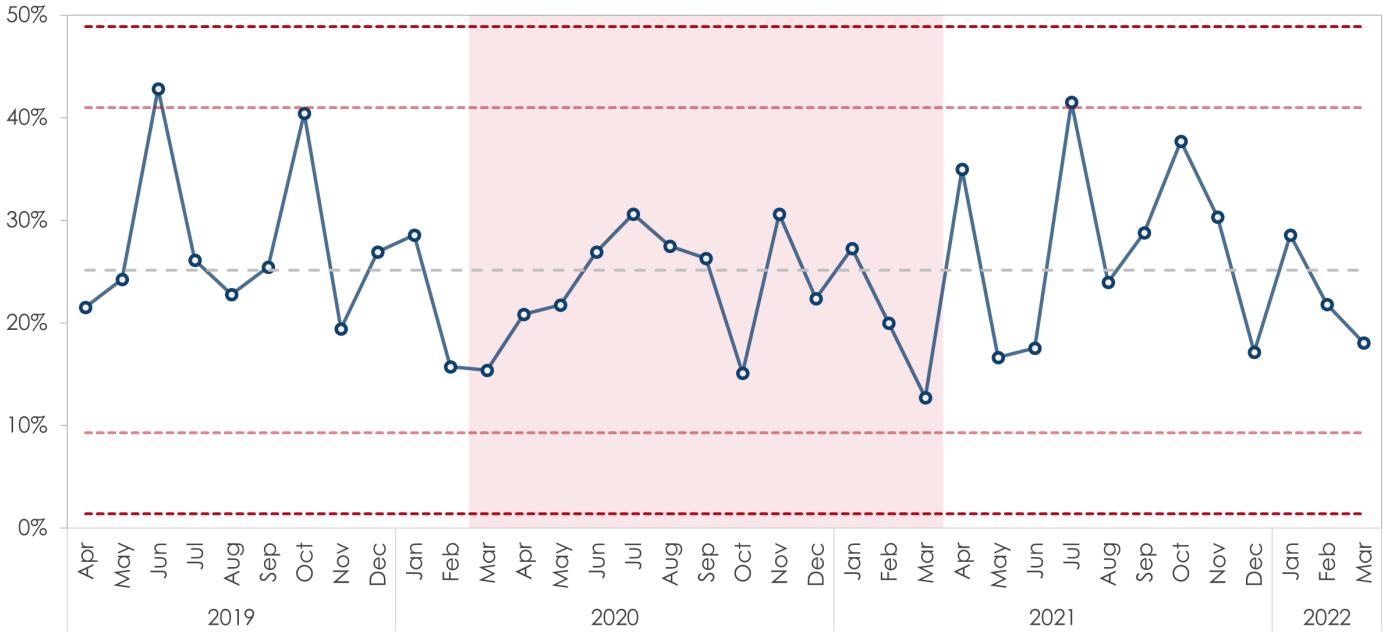


Figure 12 shows the percentage of 30-day survival after worked OHCA in patients with a shockable initial rhythm for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 13

Figure 13 shows the trend in 30-day survival after worked OHCA in patients with a shockable initial rhythm for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

Return of Spontaneous Circulation (ROSC)

BOX 6: Return of Spontaneous Circulation (ROSC)

Definitions for ROSC vary. The Scottish Ambulance Service records ROSC if a patient with OHCA regains a palpable pulse during resuscitation which is sustained until arrival at the Emergency Department. This includes those patients who are successfully resuscitated by members of the public using Public Access Defibrillators before the arrival of the ambulance service. The proportion of worked OHCA with ROSC is sometimes referred to as '**survival to hospital**' or '**number of hearts restarted**'. ROSC does not equate to 30-day survival.

The key clinical outcome after OHCA is long term, neurologically intact patient survival. An important precursor to this is ROSC. The snapshot of ROSC by health board in 2021-22 shown in Table 4 and associated funnel plot in Figure 14 show that none of the data showed significant deviation from the national mean of 27.7%.

Figure 15 shows ROSC for Scotland from April 2019 to March 2022. In order to highlight the effect of the COVID-19 pandemic on OHCA outcomes, the shaded red area shows the 'lockdown' time period as previously described. In common with 30-day survival, ROSC peaked at 32.2% in Scotland in 2019, and decreased to a low of 25.9% in 2020-21, with subsequent partial recovery to 27.7% by the end of March 2022. The individual health board timelines for 2011-12 to 2021-22 in Figure 16 illustrate a gradual increase in ROSC over the last decade — punctuated by the COVID-19 pandemic — in all areas of Scotland (the small number of cases in Orkney, Shetland and the Western isles make the data difficult to interpret for these health boards).

Table 4: Snapshot of ROSC after OHCA

Health Board	Worked Arrests	ROSC	Percentage	ROSC Per 100k Population
Ayrshire & Arran (A&A)	222	65	29.3%	17.6
Borders (BO)	64	20	31.3%	17.3
Dumfries & Galloway (D&G)	120	35	29.2%	23.5
Fife (FI)	208	49	23.6%	13.1
Forth Valley (FV)	188	55	29.3%	17.9
Grampian (GR)	296	78	26.4%	13.3
Greater Glasgow & Clyde (GG&C)	633	187	29.5%	15.8
Highland (HI)	203	50	24.6%	15.5
Lanarkshire (LA)	364	94	25.8%	14.2
Lothian (LO)	438	128	29.2%	14.1
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	219	57	26.0%	13.7
Western Isles (WI)	*	*	*	*

Table 4 shows ROSC after worked OHCA for each of the health boards across Scotland for the single year 2021-22. Figures are shown for the total number of worked OHCA, the percentage alive at 30 days and the number of survivors per 100, 000 population. (* data suppressed due to low numbers)

Figure 14: Percentage of ROSC for worked OHCA patients by health board

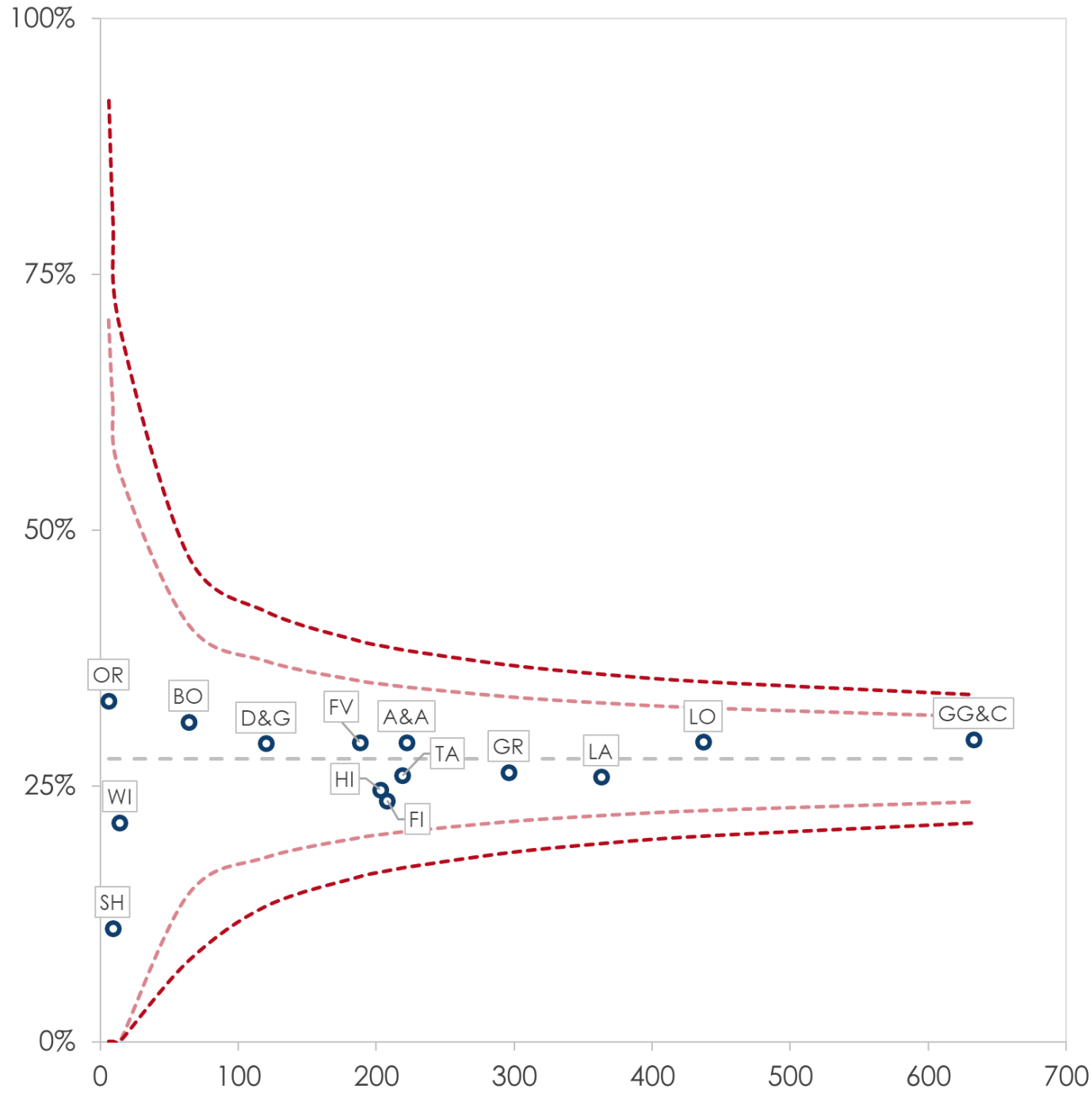


Figure 14 shows a funnel plot of ROSC vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given above in the introduction section.

Timeline of ROSC after OHCA

Figure 15: Percentage of ROSC for worked OHCA patients

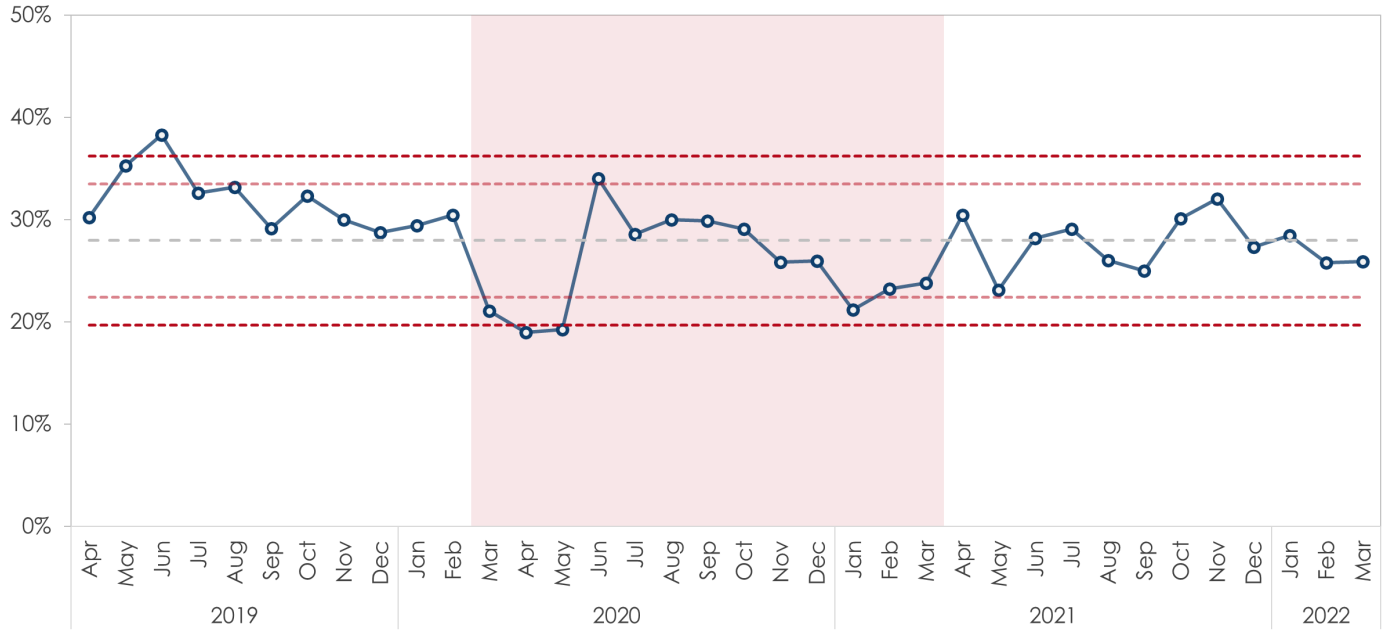


Figure 15 shows the percentage of ROSC after OHCA for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 16

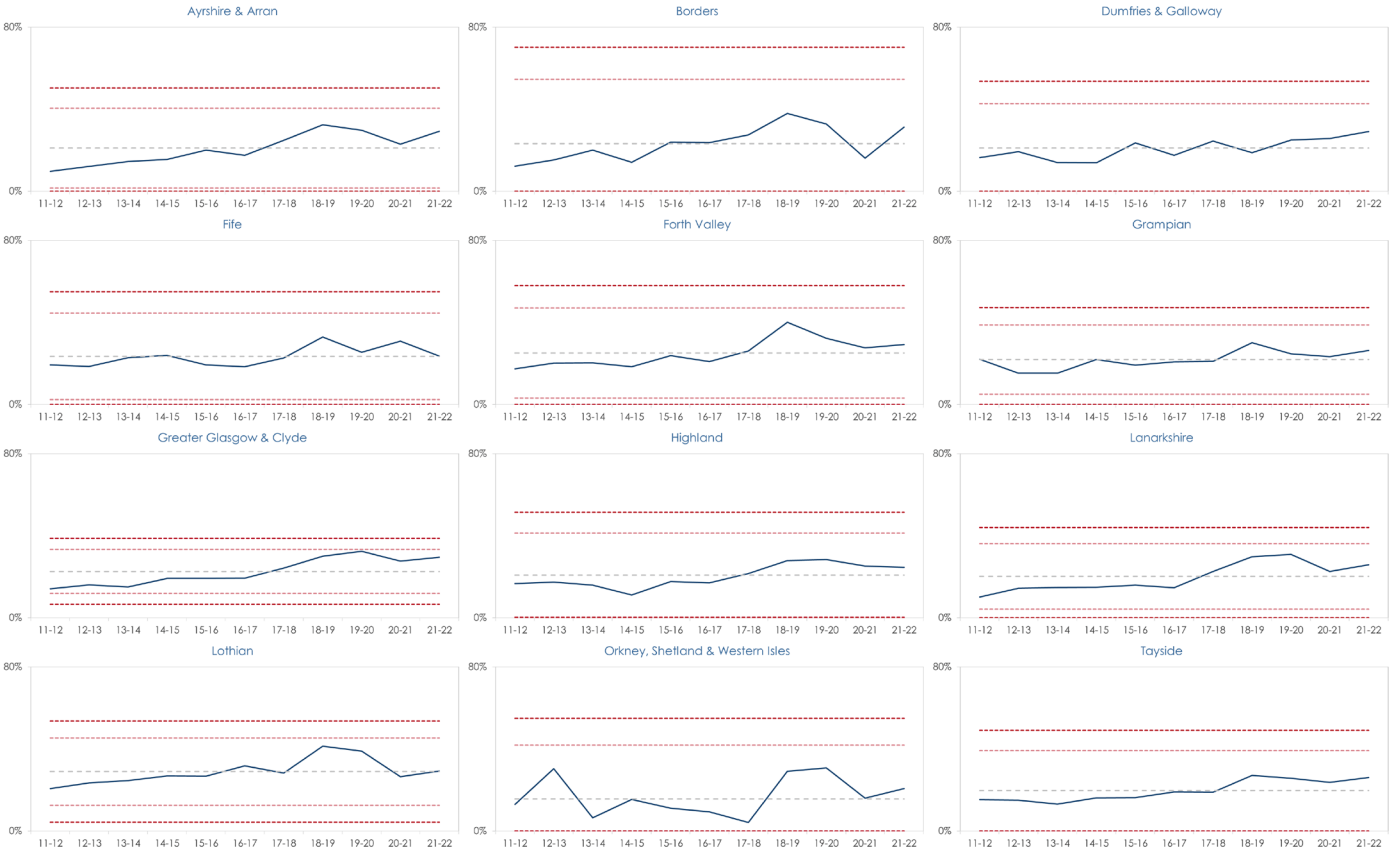


Figure 16 shows the trend in ROSC after OHCA for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

ROSC in patients with a shockable initial rhythm

This section describes the 2021-22 snapshot of ROSC in worked OHCA patients with a shockable initial rhythm (i.e., those in the Utstein Comparator group) in Table 5 and in the funnel plot in Figure 16. For a description of the Utstein Comparator group see BOX 5 in the section above. The national average rate of ROSC was 52.3% during 2021-22 and there are no boards with outcomes lying outwith the upper or lower control limits. It is encouraging to note that this is the highest annual mean value recorded since 2011-12 and is an improvement on the 2020-21 figure of 48.7% during the COVID-19 pandemic.

Unsurprisingly, the 2019-2022 timeline graph and individual health board ten-year plots of ROSC for patients with a shockable rhythm in Figures 17 and 18 show similar patterns to the 30-day survival and ROSC data already described. Utstein Comparator ROSC shows the highest percentages of all of the outcome metrics shown so far. These data represent rates of initial success in the group of patients most likely to respond favourably to resuscitation. Further detail can be found in the data tables in Appendix 2.

Snapshot of ROSC in patients with a shockable initial rhythm

Table 5: Snapshot of ROSC in patients with a shockable initial rhythm

Health Board	Worked Arrests	ROSC	Percentage	ROSC Per 100k Population
Ayrshire & Arran (A&A)	222	65	29.3%	17.6
Borders (BO)	64	20	31.3%	17.3
Dumfries & Galloway (D&G)	120	35	29.2%	23.5
Fife (FI)	208	49	23.6%	13.1
Forth Valley (FV)	188	55	29.3%	17.9
Grampian (GR)	296	78	26.4%	13.3
Greater Glasgow & Clyde (GG&C)	633	187	29.5%	15.8
Highland (HI)	203	50	24.6%	15.5
Lanarkshire (LA)	364	94	25.8%	14.2
Lothian (LO)	438	128	29.2%	14.1
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	219	57	26.0%	13.7
Western Isles (WI)	*	*	*	*

Table 5 shows ROSC for patients with a shockable initial rhythm for each of the health boards across Scotland for the single year 2021-22. Figures are shown for the total number of worked OHCA, the percentage alive at 30 days and the number of survivors per 100,000 population. (* data suppressed due to low numbers)

In 2021-22 Utstein comparator ROSC rate was 52.3%, with a 30-day survival of 26.1%, the highest recorded level since 2011-12.

Figure 17: Percentage of ROSC for worked OHCA patients with a shockable initial rhythm by health board

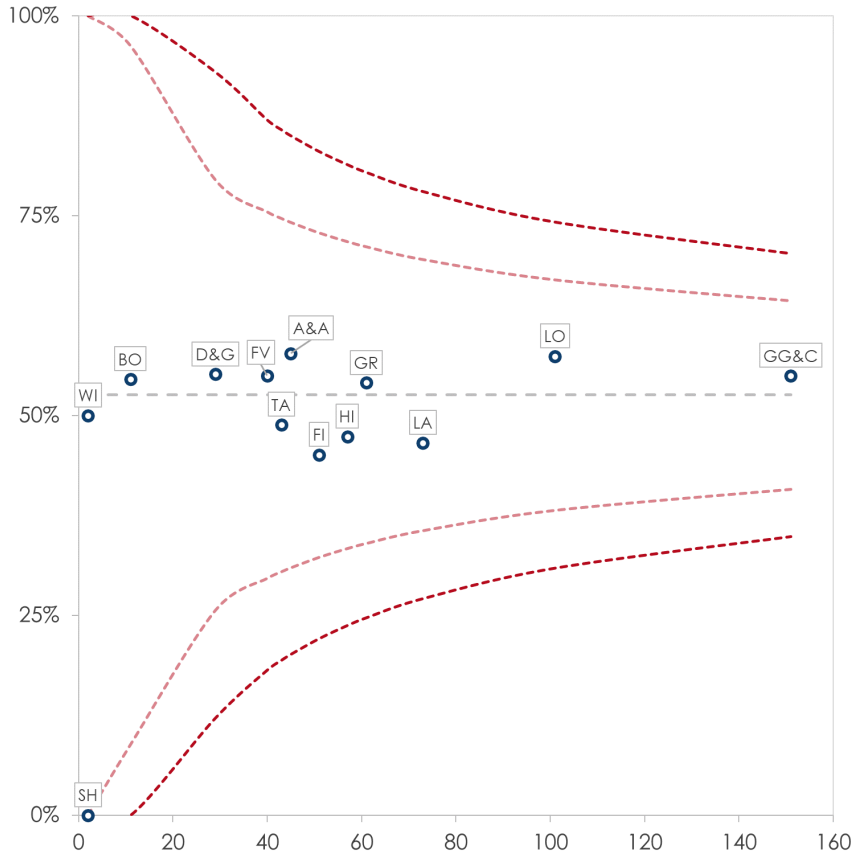


Figure 17 shows a funnel plot of Utstein Comparator ROSC vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section above.

Timeline of ROSC in patients with a shockable initial rhythm

Figure 18: Percentage of ROSC for worked OHCA patients with a shockable initial rhythm

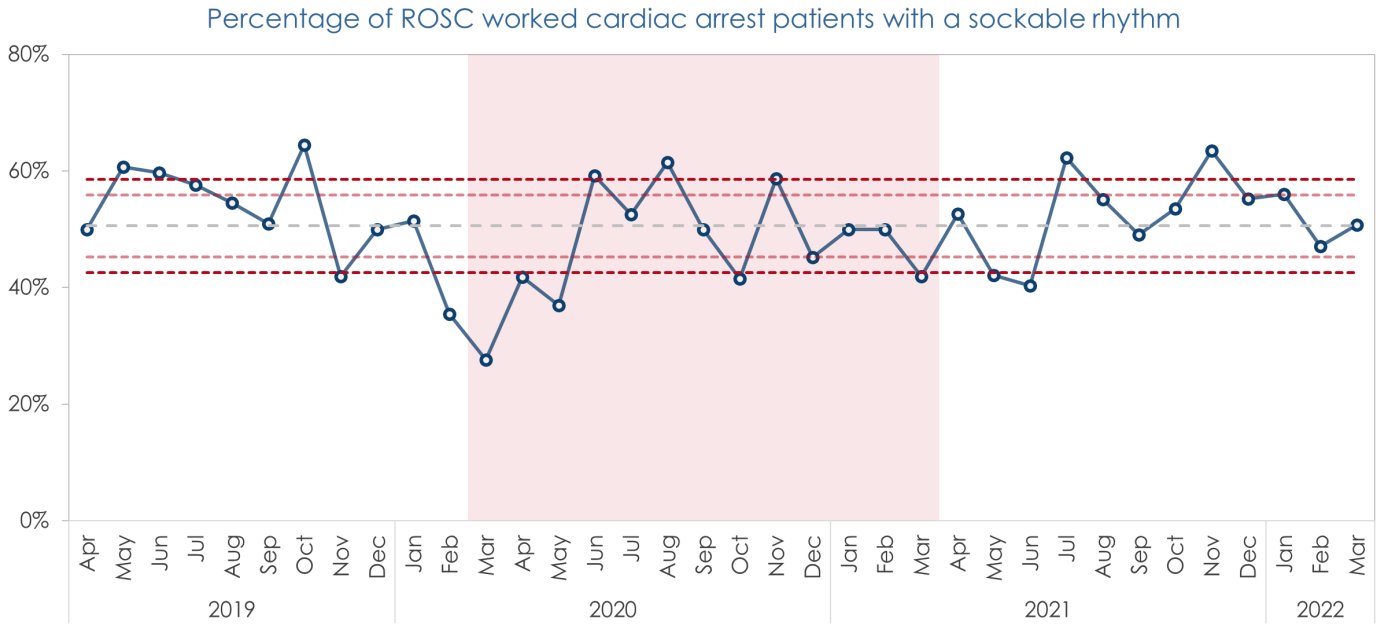


Figure 18 shows the percentage of ROSC after worked OHCA in patients with a shockable initial rhythm for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 19

Figure 19 shows the trend in ROSC after worked OHCA in patients with a shockable initial rhythm for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

Bystander CPR

BOX 7: Bystander CPR

The bystander CPR rate is the proportion of worked OHCA where a member of the public ('bystander') is performing CPR when the ambulance crew arrive. Whilst CPR can include both chest compressions and rescue breaths, the definition of CPR as used in this report is whether any chest compressions were performed.

Bystander CPR is one of the few interventions consistently demonstrated to make a difference to neurologically intact survival after OHCA. (16) Chances of survival after OHCA in cases where CPR has not been performed are very low.

Increasing the proportion of patients receiving prompt and effective CPR continues to be a key objective of Scotland's Strategy for OHCA. The implementation of CPR telephone instructions from Ambulance Centre call handlers, public awareness raising and the delivery of CPR training across Scotland have all been a key focus for the Save a Life for Scotland partnership since 2015. (5)
The snapshot of bystander CPR across Scotland shown in Table 6, and the funnel plot in Figure 19 show that bystander CPR rates averaged 66.1% in 2021-22, the highest recorded to date in Scotland. There is no unexpected variation in average CPR rates between health boards.

The 2019-21 timeline of bystander CPR after OHCA shown in Figure 20 is interesting in that it is difficult to discern any significant impact of the COVID-19 pandemic on rates of CPR. The ten-year health board timelines in Figure 21 demonstrate a rise in bystander CPR rates in all areas since 2011-12.

Snapshot of Bystander CPR

Snapshot of bystander CPR across Scotland

Table 6

Health Board	Worked Arrests	Bystander CPR	Percent-age	Bystander CPR Per 100k Population
Ayrshire & Arran (A&A)	222	140	63.1%	37.9
Borders (BO)	64	46	71.9%	39.8
Dumfries & Galloway (D&G)	120	75	62.5%	50.4
Fife (FI)	208	154	74.0%	41.2
Forth Valley (FV)	188	123	65.4%	40.1
Grampian (GR)	296	187	63.2%	31.9
Greater Glasgow & Clyde (GG&C)	633	403	63.7%	34.1
Highland (HI)	203	127	62.6%	39.5
Lanarkshire (LA)	364	239	65.7%	36.1
Lothian (LO)	438	303	69.2%	33.4
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	219	151	68.9%	36.2
Western Isles (WI)	14	9	64.3%	33.7

Table 6 shows the proportion of worked OHCA where bystander CPR is ongoing on arrival of the SAS crew for each of the health boards across Scotland for the single year 2021-22. Figures are shown for the total number of worked OHCA, the percentage bystander CPR and the number of arrests where bystander CPR ongoing per 100,000 population. (* data suppressed due to low numbers)

Figure 20: Percentage of bystander CPR for worked OHCA patients by health board

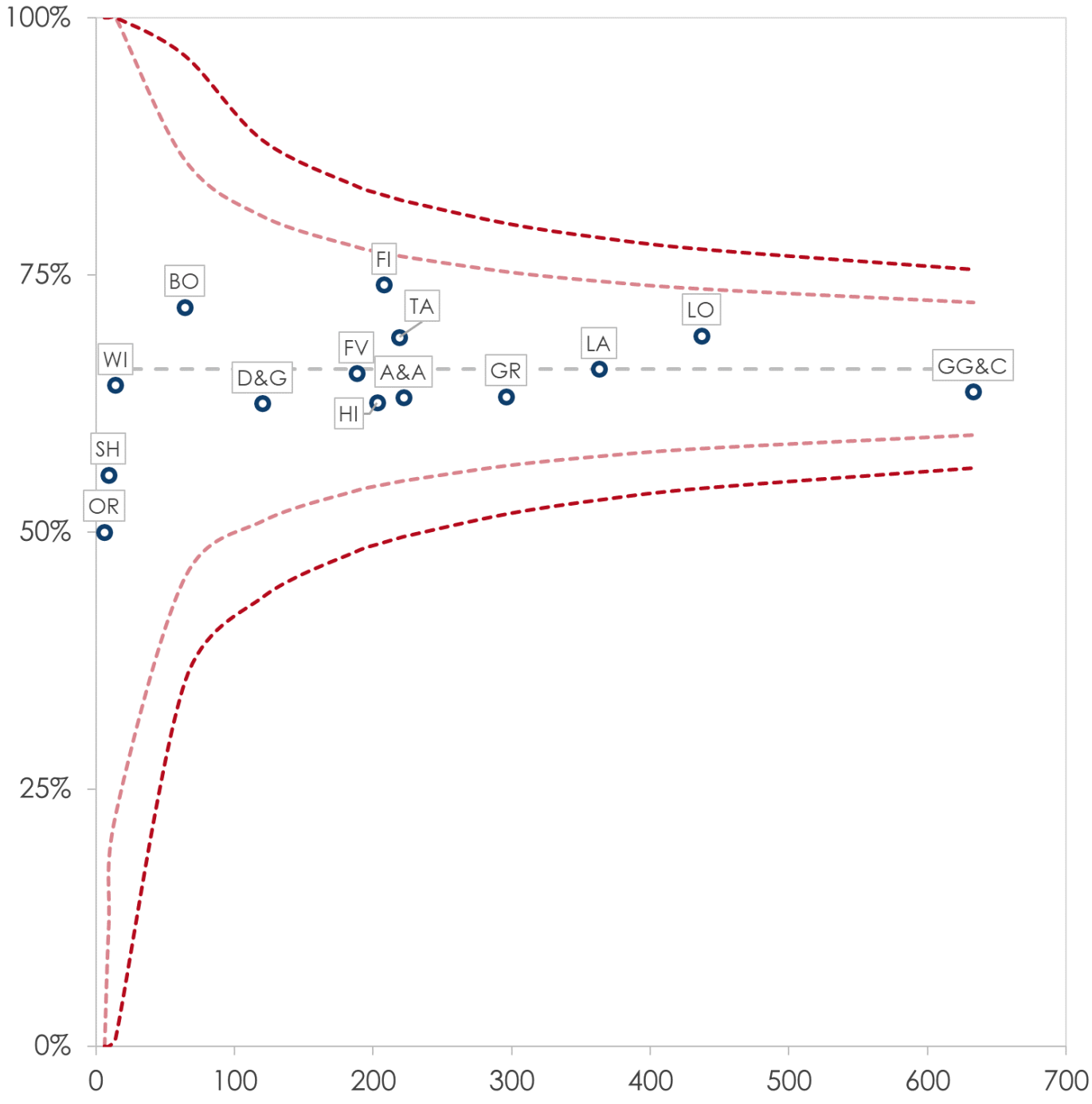


Figure 20 shows a funnel plot of bystander CPR vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the introduction section above.

Timeline of bystander CPR after OHCA

Figure 21: Percentage of bystander CPR for worked OHCA patients

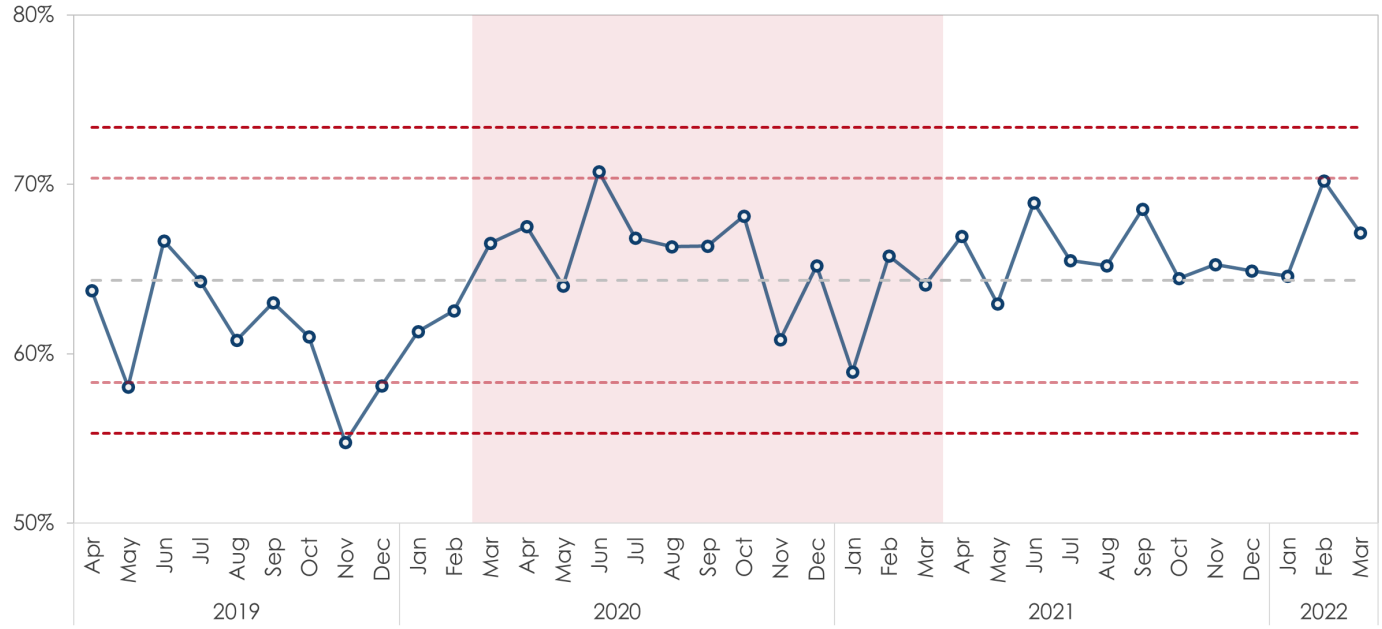


Figure 21 shows the percentage of worked OHCA where bystander CPR is ongoing on arrival of the SAS crew for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 22

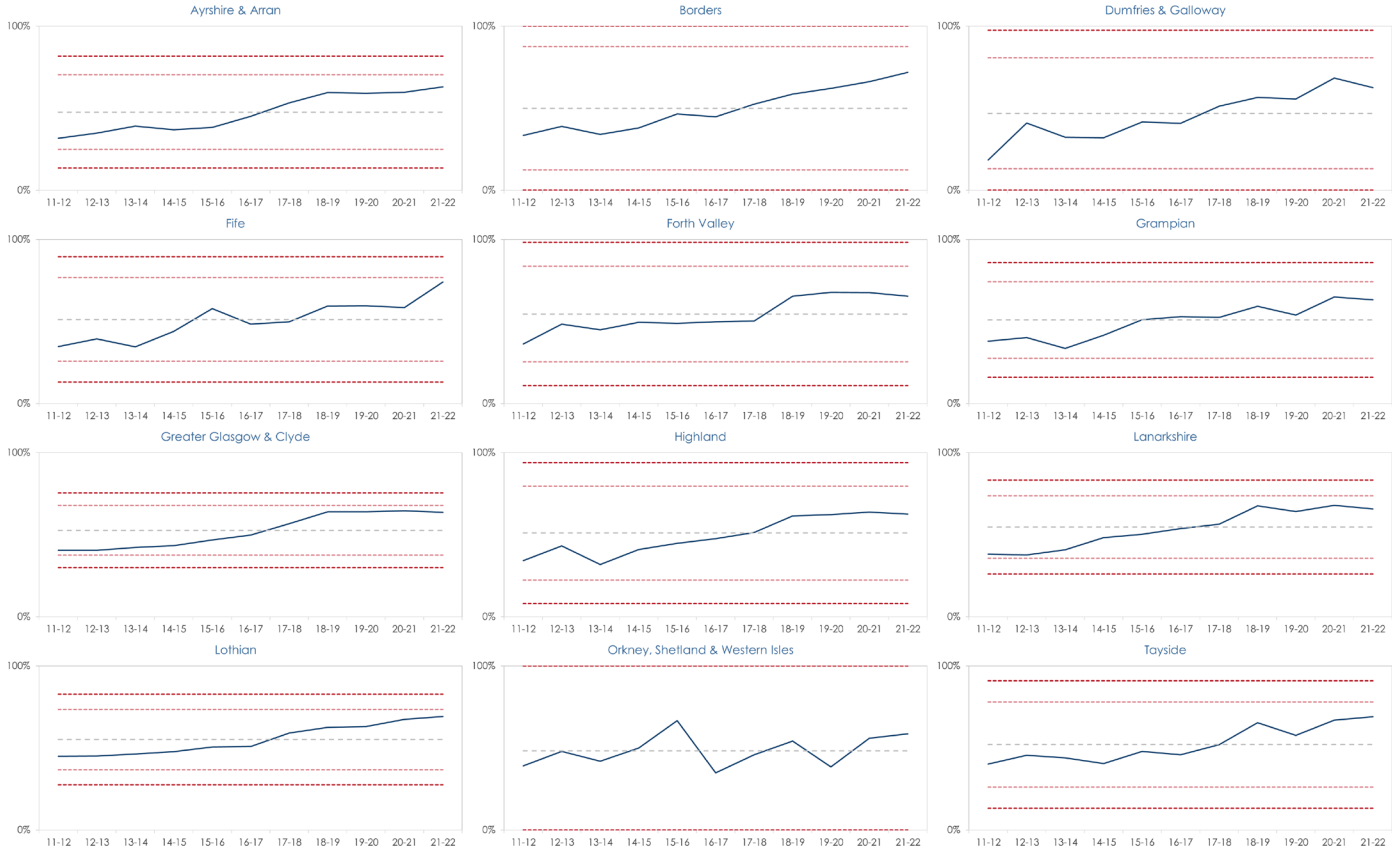


Figure 22 shows the trend in bystander CPR after worked OHCA for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

Public Access Defibrillator Usage Before SAS Arrival

BOX 8: Public Access Defibrillator (PAD)

A PAD is an Automated External Defibrillator (AED) which is available for use by the general public in case of OHCA emergencies. AEDs are used to automatically detect an abnormal cardiac rhythm and deliver a lifesaving shock to reset and restart the heart. PAD should be located in areas where they are likely to be available to treat OHCA, well signposted and registered so that the SAS can direct a bystander to fetch one in an emergency.

AEDs are electrical devices that can detect a heart rhythm and determine whether an electric shock should be applied to correct an abnormal rhythm (this process is called defibrillation). Successful defibrillation can dramatically improve an OHCA patient's odds of survival; however, the likelihood of survival decreases by >10% per minute if no bystander action is taken. (17,18) PAD (see BOX 8) are a useful strategy of placing AEDs in public areas so that anyone can retrieve them in the event of nearby OHCA.

In order for PAD to save lives they need to be available nearby at the time of an OHCA and registered on the national defibrillator network (also known as 'The Circuit') so that a SAS Call Handler can direct an available bystander to go and fetch a PAD. Timely defibrillation is a cornerstone of improving survival after OHCA, but has remained stubbornly difficult to achieve in most systems of prehospital care. An aim of Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 is to increase the number of worked OHCA where a PAD is applied to the patient before the arrival of SAS to 20%.

In this section we detail the current proportion of worked OHCA where a PAD was retrieved and applied to the patient by a member of the public. In 2021-22 the Scottish average was 8% of worked OHCA where a PAD was used. Table 7 shows the variation in PAD use across health boards in 2021-22. It can be seen that there is wide variation in the percentage of OHCA where a PAD is used. When these data are shown on the funnel plot in Figure 24, we can visualise this variation in the context of the number of OHCA in each area. None of the health boards have a PAD usage percentage outside the 99.7% confidence interval (outer dotted lines) but Borders sits just above the 95% upper confidence limit, and Lanarkshire and Greater Glasgow and Clyde sit just below the 95% lower confidence limit. These are areas that may merit closer investigation — in particular, of which elements in the 'Chain of Public Access Defibrillation' may be contributing to these findings.

Figure 23

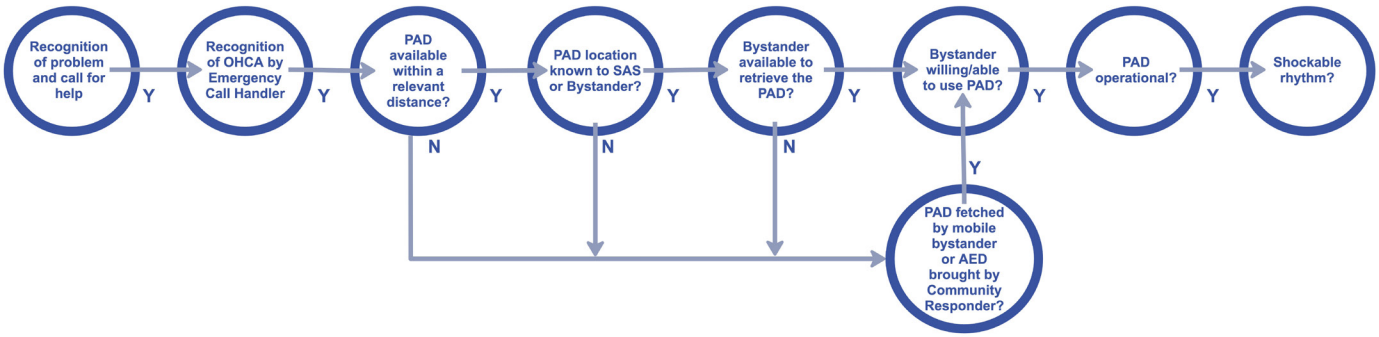


Figure 23 shows the 'Chain of Public Access Defibrillation' adapted from the "chain of public access AED" conceptualised by Ringh and colleagues (19)

The 'Chain of Public Access Defibrillation', in a similar way to the 'Chain of Survival' (see Figure 1) is a convenient metaphor to describe the elements which need to be in place for a patient with OHCA to be successfully resuscitated by a member of the public ('Bystander') using a PAD, before the arrival of the ambulance service. Some analysis of these elements is offered later in this document (see 'Analysis of the System of Care for OHCA — Addressing Inequalities').

The 2019-22 timeline (Figure 22) shows that there has not been a significant rise in the proportion of worked OHCA where PAD were applied by the public, with an apparent drop in PAD usage during COVID-19 restrictions. The ten-year time series by health board appears to show an increase in PAD usage in some areas, but numbers are small and care should be taken in interpreting these data.

Snapshot of PAD usage

Table 7: Snapshot of PAD usage in Scotland

Health Board	Worked Arrests	PAD Used	Percentage	PADs Per 100k Population
Ayrshire & Arran (A&A)	222	13	5.9%	3.5
Borders (BO)	64	10	15.6%	8.7
Dumfries & Galloway (D&G)	120	11	9.2%	7.4
Fife (FI)	208	21	10.1%	5.6
Forth Valley (FV)	188	11	5.9%	3.6
Grampian (GR)	296	29	9.8%	5.0
Greater Glasgow & Clyde (GG&C)	633	34	5.4%	2.9
Highland (HI)	203	23	11.3%	7.1
Lanarkshire (LA)	364	16	4.4%	2.4
Lothian (LO)	438	35	8.0%	3.9
Orkney (OR)	*	*	*	*
Shetland (SH)	*	*	*	*
Tayside (TA)	219	25	11.4%	6.0
Western Isles (WI)	*	*	*	*

Table 7 shows the proportion of worked OHCA where a PAD was applied to the patient before the arrival of the SAS crew for each of the health boards across Scotland for the single year 2021-22. Figures are shown for the total number of worked OHCA, the percentage of PAD use and the number of arrests where a PAD was used per 100,000 population. (* data suppressed due to low numbers)

Figure 24: Percentage of worked OHCA with PAD usage by health board

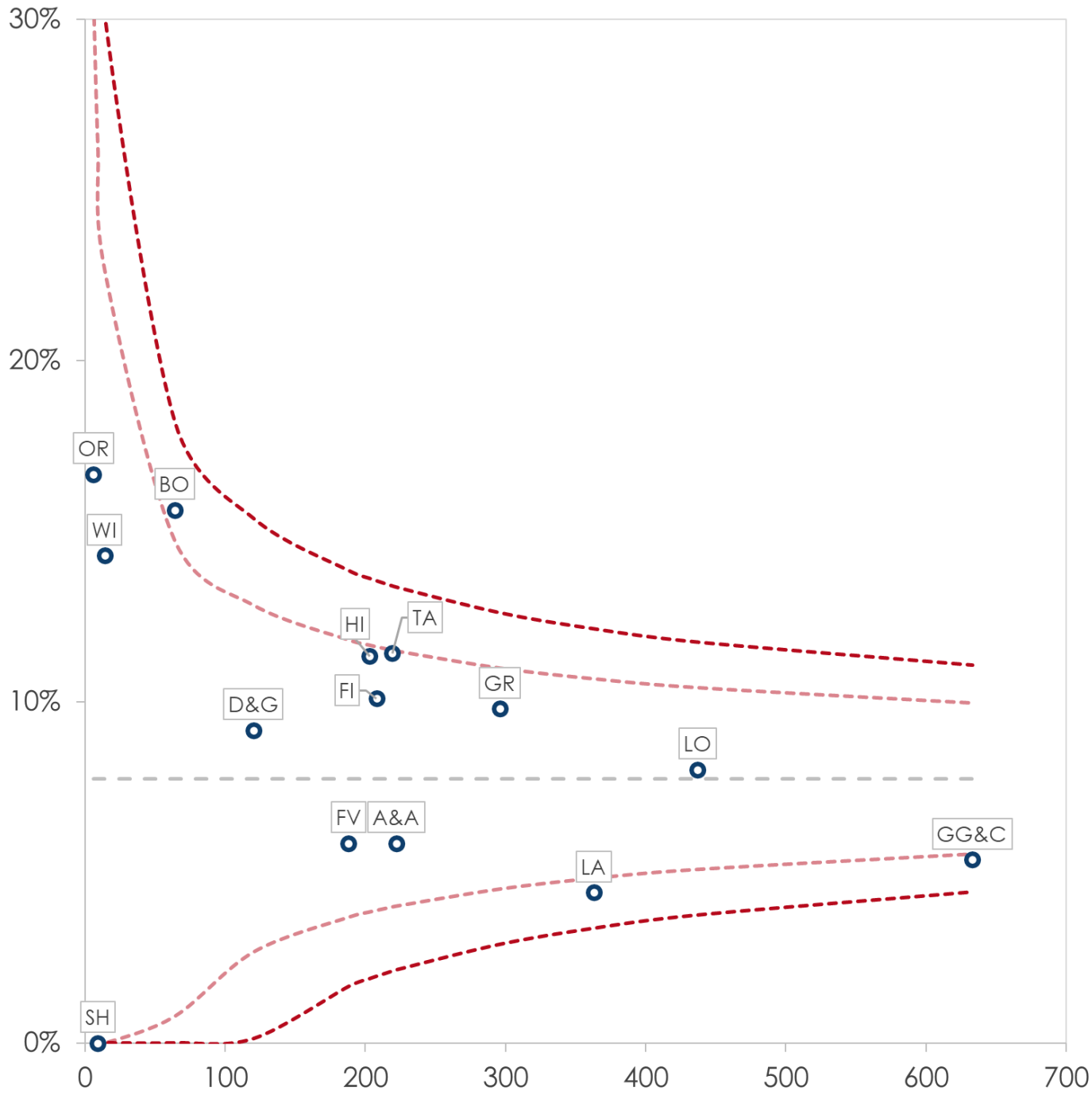


Figure 24 shows a funnel plot of PAD usage during worked OHCA vs number of worked OHCA for each of the health boards across Scotland during the single year 2021-22. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section above.

The number of Public Access Defibrillators in communities across Scotland which are registered on the Circuit has more than doubled since 2019

Timeline of PAD Usage

Figure 25: Percentage of OHCA with PAD usage before SAS arrival

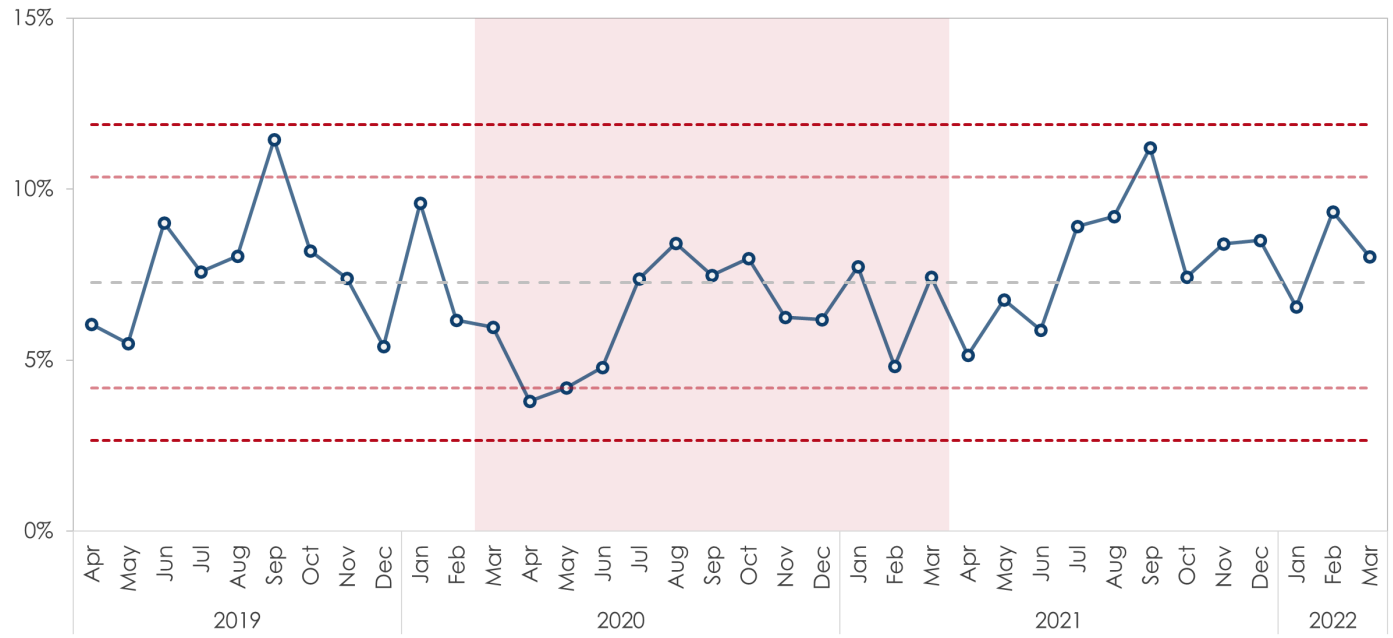


Figure 25 shows the percentage of worked OHCA where a PAD was used before arrival of the SAS crew for the whole of Scotland from April 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 26

Figure 26 shows the trend in PAD usage before the arrival of SAS for each of the individual health boards across Scotland over the last decade from 2011-12 to 2021-22.

Ten-year Timeline

This section is designed to give a high-level view summarising the progress of key outcomes and primary drivers of those outcomes over the last decade. The charts have been annotated with significant timepoints.

It can be seen that bystander CPR rates have increased steadily over the last ten years, with some signal that the use of PAD is also increasing. This has been accompanied by a parallel increase in ROSC and 30-day survival overall and in patients with a shockable initial rhythm. During the COVID-19 pandemic restrictions all of these measures decreased, excluding bystander CPR rates. All of the measures shown have made a degree of recovery post COVID-19 lockdown (for further discussion of COVID-19 see below).

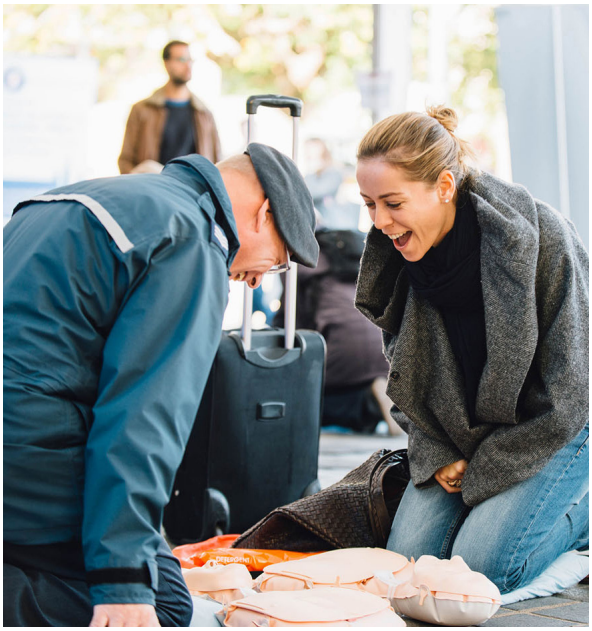


Figure 27

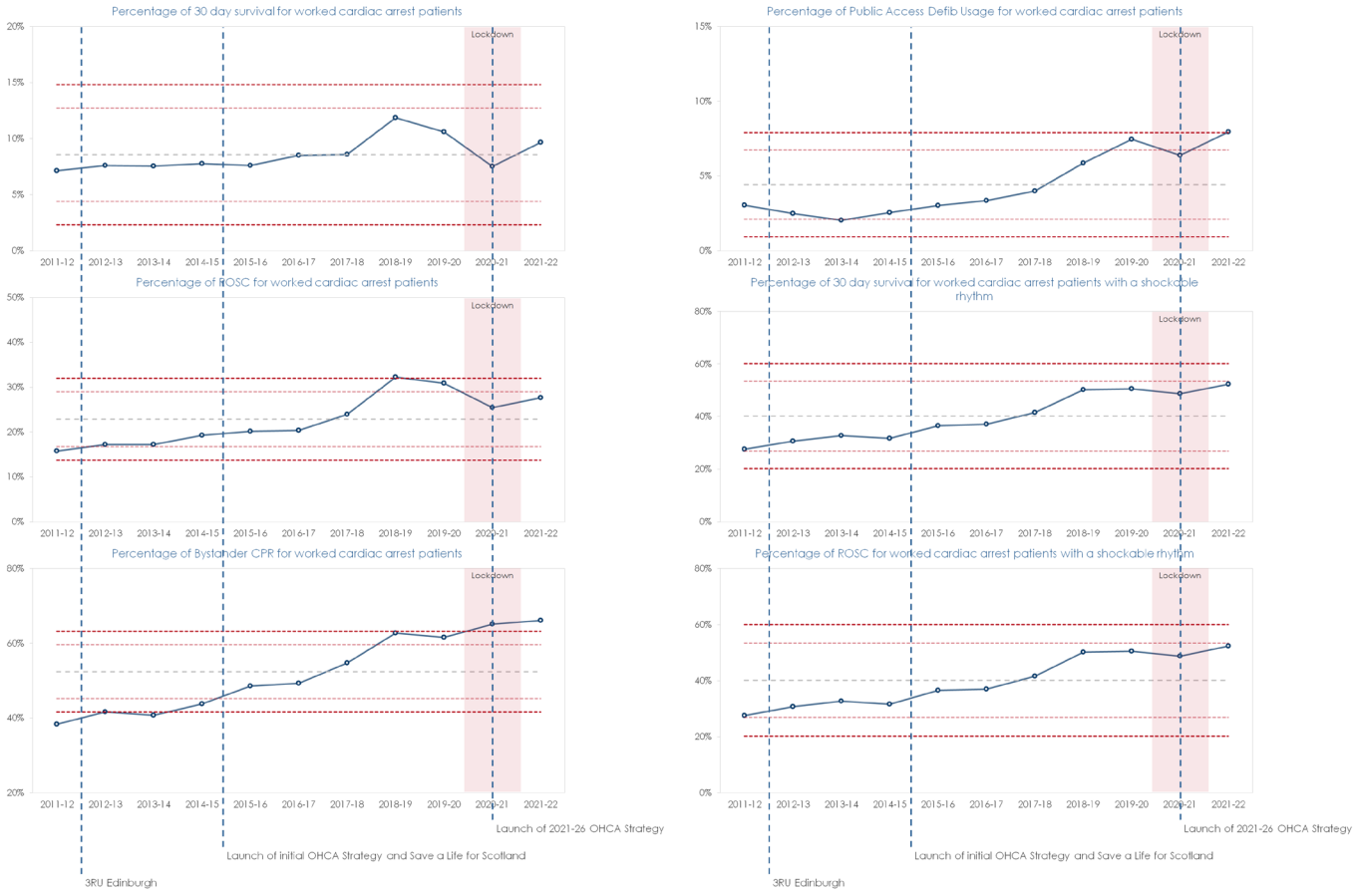


Figure 27 shows the ten-year period from 2011-12 to 2021-22. Each timeline shows an outcome or primary driver in the system of care for OHCA. Key time points are marked, such as the launch of the 2015 National OHCA strategy and Save a Life for Scotland, and the COVID-19 lockdown (pink shaded area). Data are national averages shown as percentages with the ten-year average shown as a dotted grey line. Upper and lower control limits are also shown as red dotted lines.

Analysis of the System of Care for OHCA

Save a Life for Scotland

Save a Life for Scotland (SALFS) is a campaign that brings together the work of a range of partners committed to saving lives by changing the way we think about OHCA in order to get Scotland CPR ready. (20) It is a collaboration between the Emergency Services, third sector organisations, Scottish Government and academic researchers. The partnership is directed by the Resuscitation Research Group at the University of Edinburgh. SALFS aims to promote CPR readiness in young people and across a range of communities while shaping perceptions of OHCA among people living in Scotland.

During the period of this report the face-to-face public engagement work of SALFS partners was paused during the COVID-19 pandemic. We were able to re-commence CPR sessions in the community and schools as soon as COVID-19 restrictions permitted.

All partners remain committed to pursuing the aims of Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026 through an emphasis on young people, communities, equality and culture change. The campaign now aims to equip 1 million people with CPR skills by the end of 2026. The focus for this next phase is two-fold: reaching all young people through working with schools and young people's organisations, and working together to build relationships with communities of people who live in areas of deprivation and those who are identified using the OHCA data as receiving lower rates of bystander CPR in Scotland.

COVID-19 and OHCA

COVID-19 had a significant effect on outcomes after OHCA, reducing the number of survivors to levels seen before the launch of the 2015 improvement strategy. The reason for this change is likely to be multifactorial reflecting disruption to elements of the system of care across the 'Chain of Survival'.

Our experience is in keeping with many of our colleagues across the globe. A comprehensive meta-analysis published by Masuda and colleagues in 2022 attempted to relate the impact of COVID-19 on the care delivered by ambulance services to changes in OHCA survival. (21) Across the ten countries studied, it was found that during the pandemic a greater proportion of OHCA occurred in the home with lower rates of bystander defibrillation. Changes in bystander CPR rates were not uniform, with some centres experiencing marked reductions, while no difference was observed between pre-COVID-19 and COVID-19 bystander CPR rates in other centres.

Public Access Defibrillation

In this section we analyse some of the components of the 'Chain of Public Access Defibrillation' (Figure 23) to determine potential sources of variation in PAD use and identify possible solutions. It is extremely important to note that early defibrillation can be a lifesaving intervention in many OHCA, but that PAD are not the only way this can be achieved. Whilst retrieving an AED from a fixed, publicly accessible location is a demonstrably effective solution in a high footfall environment such as an airport or casino, (22,23) it is likely that other approaches (e.g., community responders carrying AEDs) will be required to ensure the opportunity for early defibrillation across the range of settings where OHCA occur in Scotland. (24,25)

Registered PAD available in the community

BOX 9: The Circuit — the national defibrillator network

The national defibrillator network, also referred to The Circuit, was developed by the British Heart Foundation and provides the NHS ambulance services with information about defibrillators across the UK so that after a cardiac arrest, they can be accessed quickly to help save lives. Registration on the Circuit makes PAD visible to the Scottish Ambulance Service and alert emergency call handlers that there is a PAD near to an OHCA. In order to stay 'active' on the database the PAD must have a named individual ('guardian') responsible for regular checking to ensure the defibrillator is 'emergency ready' if needed. (26)

The availability of PAD in the community is a necessary precursor to their use in an emergency. Availability requires that there is an accessible PAD within a relevant distance to the OHCA, and that the location of the device is known to a bystander or known to the emergency call handler who can direct a bystander (Figure 23).

For a SAS call handler to be able to direct a bystander to a PAD in the event of an OHCA it must be registered with the UK national defibrillator network ('The Circuit', see BOX 9). The Circuit is visible to SAS and will automatically alert emergency call handlers if there is a PAD nearby the location of an arrest. In order to stay 'active' on the database the PAD must have a named individual ('guardian') responsible for regular checking to ensure the defibrillator is 'emergency ready'. (26)

Some PAD are available at all hours of day, usually those located on the outside of buildings in heated cabinets; they are indicated below as PAD (24/7). Other PAD have limited availability for emergency use, such as those inside a building that is only accessible during business hours. Table 8 shows the number of PAD registered as active on The Circuit for each of the health boards across Scotland on 15th July 2022.

Table 8: Snapshot of PAD availability in Scotland by health board

Health Board	PADs (Total)	PADs (24/7)	24/7 PADs Percentage	PADs (Total) Per 100K	PADs (24/7) Per 100K
Ayrshire & Arran (A&A)	272	139	51.1%	74	37.6
Borders (BO)	143	121	84.6%	124	104.8
Dumfries & Galloway (D&G)	204	170	83.3%	137	114.2
Fife (FI)	248	173	69.8%	66	46.3
Forth Valley (FV)	289	198	68.5%	94	64.6
Grampian (GR)	739	480	65.0%	126	82.0
Greater Glasgow & Clyde (GG&C)	538	231	42.9%	45	19.5
Highland (HI)	571	416	72.9%	177	129.3
Lanarkshire (LA)	314	151	48.1%	47	22.8
Lothian (LO)	646	329	50.9%	71	36.3
Orkney (OR)	64	50	78.1%	287	224.5
Shetland (SH)	41	33	80.5%	179	144.0
Tayside (TA)	381	267	70.1%	91	64.0
Western Isles (WI)	28	21	75.0%	105	78.6

Table 8 shows the number of PAD registered as active on the national defibrillator network ('The Circuit') for each of the health boards across Scotland (data correct as of 15th July 2022). Figures are shown for the total number of active PAD as well as the number and percentage of PAD available 24/7. These figures are also shown per 100,000 population

Timeline of registered PAD available in communities across Scotland

Figures 28 and 29 show the change in the number of PAD in Scotland registered as active on The Circuit from August 2019 to March 2022 both for the national total (Figure 28) and for each individual health board (Figure 29). The number of active PAD in Scotland has more than doubled during this time period, but the proportion of registered PAD that are not available 24/7 is also increasing. This trend towards PAD which are less available is not uniform across health boards but is more marked in some areas. Some of the increase in PAD numbers on The Circuit is likely to represent the registration of existing unregistered AEDs rather than new installations.

Figure 28

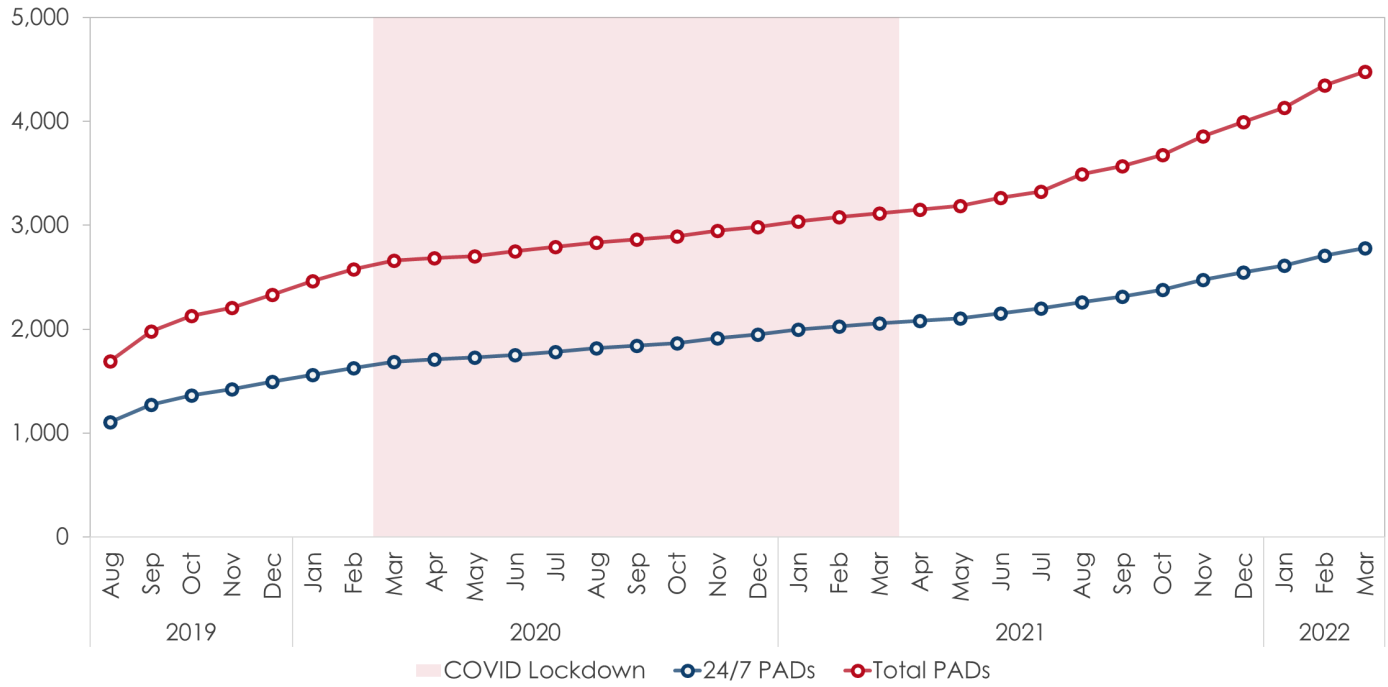


Figure 28 shows the number of PAD registered and active on the national defibrillator network ('The Circuit') from August 2019 to March 2022. The red line shows the total number of PAD while the blue line shows the number of PAD available 24/7. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Figure 29

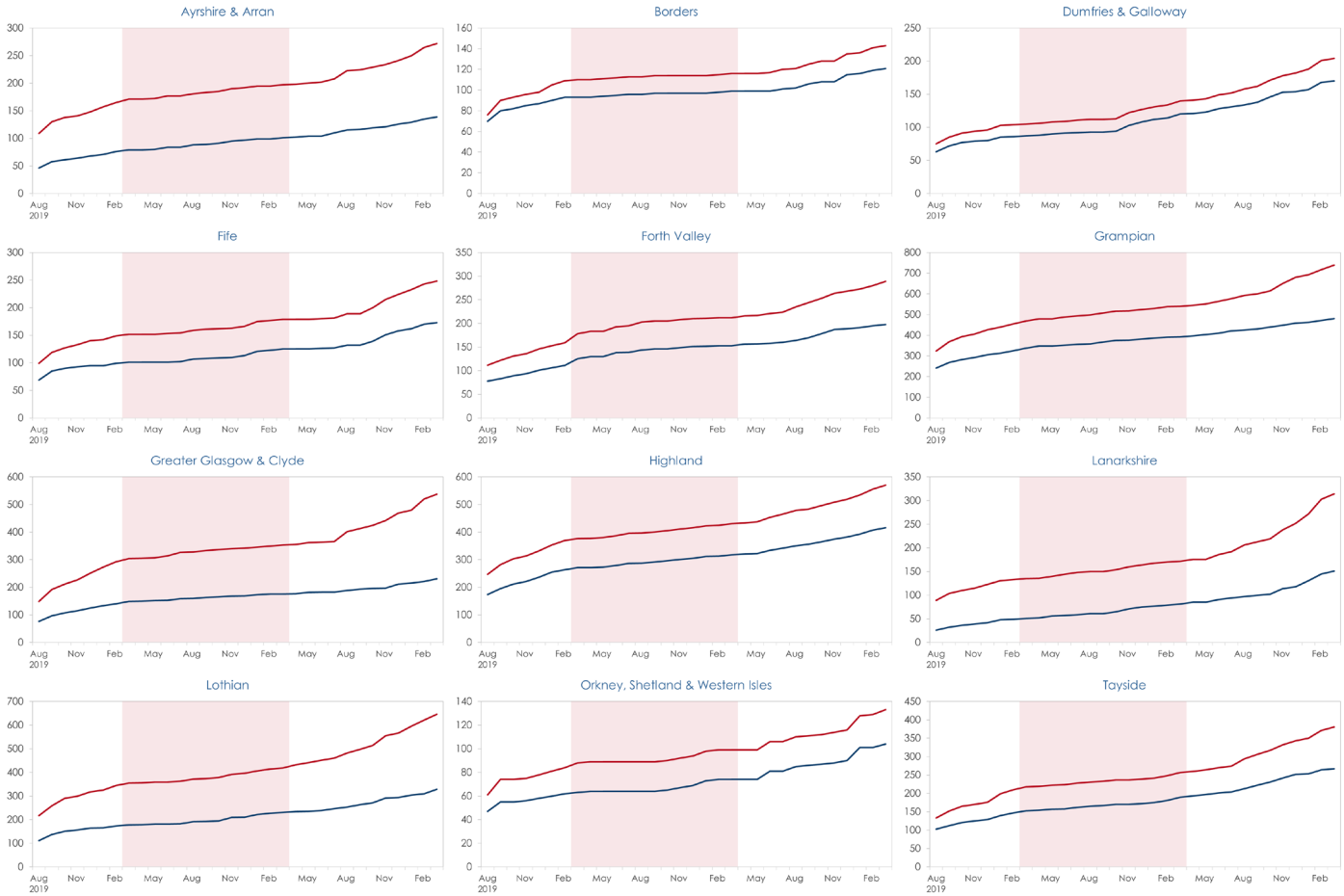


Figure 29 shows the number of PAD registered and active on the national defibrillator network ('The Circuit') from August 2019 to March 2022 for each health board in Scotland. The red line shows the total number of PAD while the blue line shows the number of PAD available 24/7. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

Pattern of PAD usage and proximity to OHCA

For a PAD to be effective in OHCA it must be available and within a relevant distance of the arrest. Here, 'relevant distance' means close enough that a bystander will be able to get to the PAD, retrieve it (which may mean unlocking a cabinet), get back to the patient and deploy it before the arrival of the ambulance service. This distance is not well defined and depends on a number of factors including the speed at which the bystander can travel, whether the PAD is in a locked cabinet and the response time of the ambulance service. (27) It has been argued that a distance equating to 1.5 mins brisk walk — or around 100 m — is optimal, (28 - 30) though longer distances may be relevant in some circumstances. The SAS computer aided dispatch system will currently alert call handlers to the presence of a PAD up to 500 m (as the crow flies) from an OHCA which is aligned with most ambulance services across the UK.

The data in Table 9 show the number of worked OHCA occurring within 500 m of a PAD as a percentage of the total number of worked OHCA and per 100,000 population for each health board. The same data are shown in the funnel plot in Figure 30 (note: all of the distances used in Figures 30 to 35 are 'as the crow flies'; actual distances travelled to retrieve PAD will be farther than this). Grampian and Lothian both sit above the 99.7% control line, indicating that they have higher than expected proportions of arrests occurring within 500 m of a PAD, while Fife sits below the 95% control line and Lanarkshire sits below the 99.7% control line, indicating that they have lower than expected proportion of OHCA occurring within 500 m of a PAD (Western Isles is also below the 95% control line but the low number of OHCA makes the data difficult to interpret).

These data suggest that variation does exist across health boards in terms of PAD proximity to OHCA. Potential causes for this variation include the physical geography of communities that are home to PAD, the level of rurality of the health board that may affect whether PAD are placed in concentrated areas or are spread out, as well as the preferences of individuals who choose to place PAD in their communities. However, the specific effect of each of these potential causes (or any other potential cause) on PAD proximity to OHCA remains unclear.

An ongoing study by the Resuscitation Research Group at the University of Edinburgh is being conducted that seeks to understand the decision-making process of individuals and organisations that place PAD in Scotland and across the UK in order to determine factors that determine where and how PAD are actually placed. This may help groups such as the Save a Life for Scotland partnership advocate for placement of PAD in locations where OHCA are likely to be in close proximity, which may in turn lead to increased PAD usage prior to SAS arrival on scene.

Table 9: Snapshot of worked OHCA occurring within 500m of a PAD in Scotland

Health Board	Worked Arrests	Accessible within 500m	Percentage	Accessible 500m per 100k
Ayrshire & Arran (A&A)	222	106	47.70%	29
Borders (BO)	64	30	46.90%	26
Dumfries & Galloway (D&G)	120	56	46.70%	38
Fife (FI)	208	85	40.90%	23
Forth Valley (FV)	188	100	53.20%	33
Grampian (GR)	296	172	58.10%	29
Greater Glasgow & Clyde (GG&C)	633	298	47.10%	25
Highland (HI)	203	100	49.30%	31
Lanarkshire (LA)	363	128	35.30%	19
Lothian (LO)	437	260	59.50%	29
Orkney (OR)	6	3	50.00%	13
Shetland (SH)	9	2	22.20%	9
Tayside (TA)	219	109	49.80%	26
Western Isles (WI)	14	3	21.40%	11

Table 9 shows the number of PAD registered as active on the national defibrillator network ('The Circuit') for each of the health boards across Scotland (data correct as of 15th July 2022). The number of worked OHCA occurring within 500 m of a PAD is also shown as a raw figure, as a percentage of worked OHCA and per 100,000 population for each health board.

Figure 30: Proportion of worked OHCA occurring within 500 m of a registered PAD in Scotland

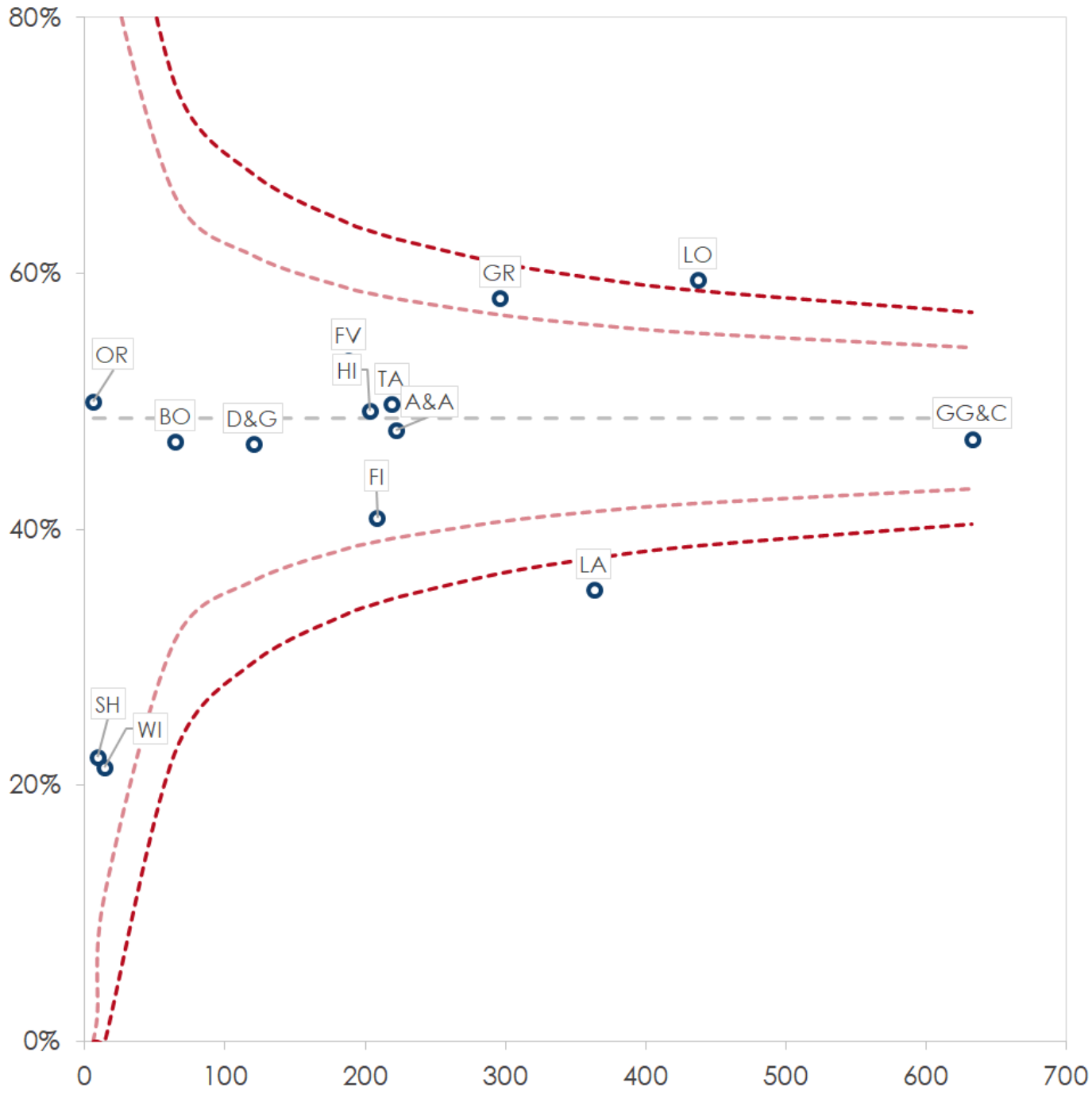


Figure 30 shows a funnel plot of the proportion of worked OHCA occurring within 500 m of a registered PAD in Scotland. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section above.

Figure 31: Worked OHCA occurring within 100 m, 200 m or 500 m of a PAD in Scotland

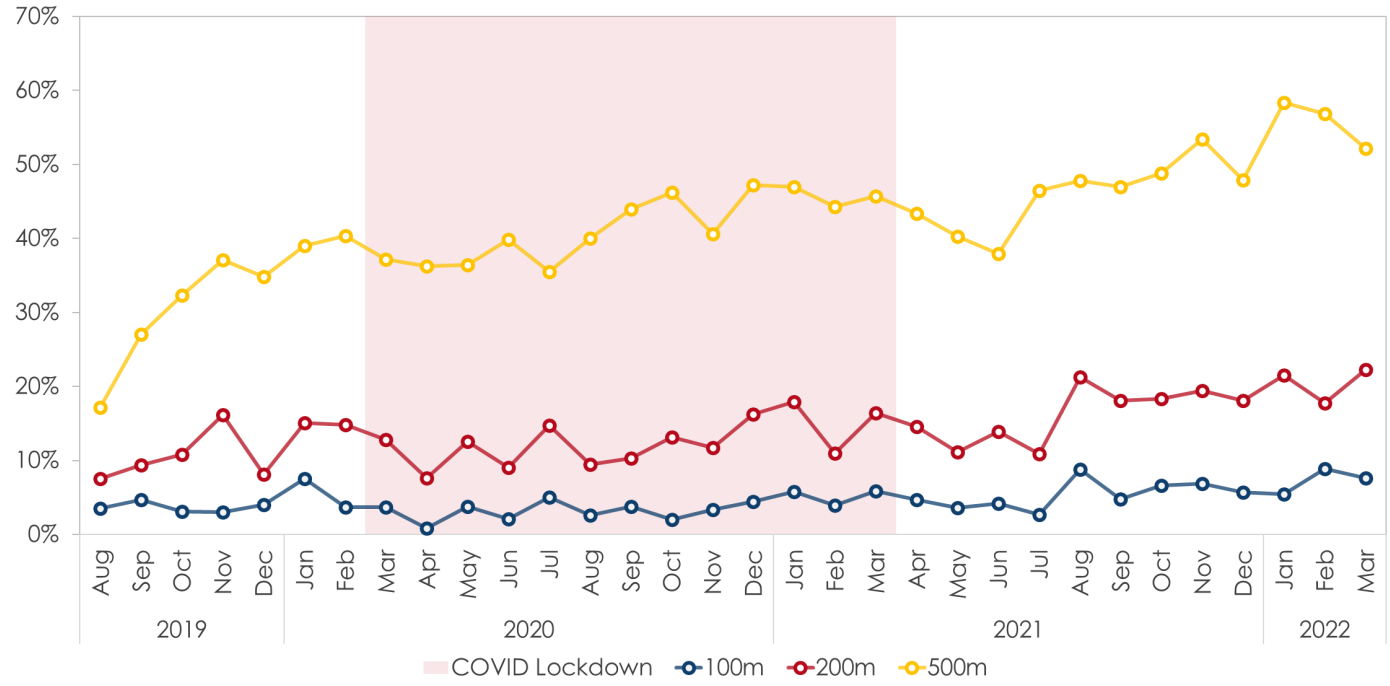


Figure 31 shows the change in the proportion of worked OHCA occurring within 500 m (upper, yellow line), 200 m (middle, red line) and 100 m (lower, blue line) of a registered PAD in Scotland from August 2019 to March 2022. The shaded red area shows the COVID-19 'lockdown' time period from the first day of lockdown in Scotland on 24th March 2020, to the move to level 3 restrictions on 20th April 2021.

To increase the likelihood of there being a PAD available in the community for use after OHCA they must be installed and registered in sufficient numbers, but also placed in optimal locations.

Figure 31 shows the proportion of worked OHCA occurring within 500 m (upper, yellow line), 200 m (middle, red line) and 100 m (lower, blue line) of a registered PAD in Scotland from August 2019 to March 2022. When read in conjunction with Figure 28, the timeline in Figure 31 shows that although the number of registered PAD in Scotland more than doubled from August 2019 to March 2022, the proportion of OHCA occurring within the optimal 100 m range of a PAD showed only a modest increase. The chart in Figure 33 emphasises that PAD are more likely to be used if they are located within 100 m or 200 m of worked OHCA rather than 500 m. This is in agreement with data from other countries suggesting that closer PAD proximity to OHCA results in higher rates of PAD usage. (27,28) This suggests that a large proportion of PAD placed in recent years are not in optimal proximity to locations of worked OHCA, and that a more data-driven approach is needed for PAD to be placed where OHCA are most likely to occur.

The charts in Figures 32 and 33 indicate that there are minor differences in availability or usage of PAD when comparing SIMD quintiles, though there is a trend towards greater PAD availability and usage in SIMD3 and SIMD4 particularly at the 100 m and 200 m levels. This is consistent with previous data showing that there are a higher proportion of Scotland's PAD in these two quintiles compared to the other three. (30) Further analysis is required to understand the causes of differences in PAD availability and usage across SIMD quintiles and whether they are associated with OHCA patient outcomes.

Lastly, the funnel plots in Figures 34 and 35 show the distributions of the proportion of worked OHCA occurring within 200 m or 100 m of a PAD. These plots are generally consistent with the patterns in the 500 m plot (Figure 30)

Remarkably, these funnel plots do not follow the same pattern as the 500 m plot in Figure 30. In the 200 m plot (Figure 34), Lothian is above Highland and Grampian are above the 99.7% control line while Dumfries and Galloway is above the 95% control line; in contrast, Lothian is below the 99.7% control line. In the 100 m plot (Figure 35), Lanarkshire sits below the 99.7% control line, while several health boards sit above or near the 95% control line. Although some variation between the distance across health boards

Further research is ongoing and is being conducted by SAS in collaboration with the Centre for Healthcare Engineering at the University of Toronto in Canada to understand causes of the substantial variation between health boards and whether they are associated with variations in PAD usage and other key outcomes.

Figure 32: Worked OHCA occurring within range of a PAD in Scotland by SIMD quintile

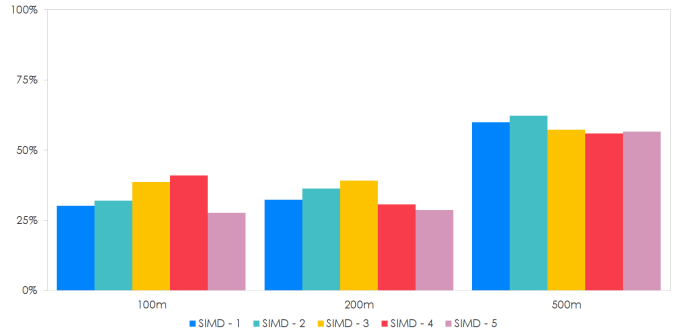


Figure 32 shows the proportion of worked OHCA occurring within 100 m, 200 m and 500 m of a PAD from April 2021 to March 2022. Within each distance category, the five coloured bars show the proportion for each of the five SIMD quintiles.

Figure 33: Worked OHCA where a PAD was used by SIMD quintile

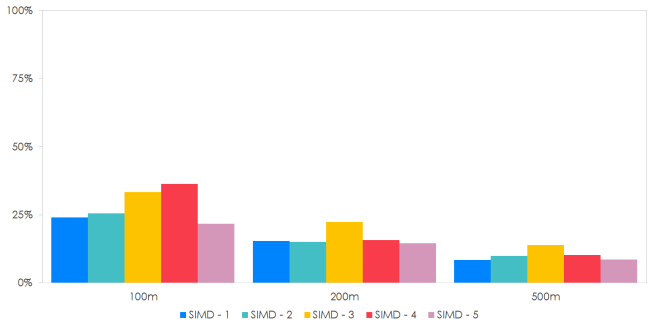


Figure 33 shows the proportion of worked OHCA occurring within 100 m, 200 m and 500 m of a PAD where a PAD was actually used by a member of the public from April 2021 to March 2022. Within each distance category, the five coloured bars show the proportion for each of the five SIMD quintiles.

Figure 34: Worked OHCA within 200 metres of a PAD by health board

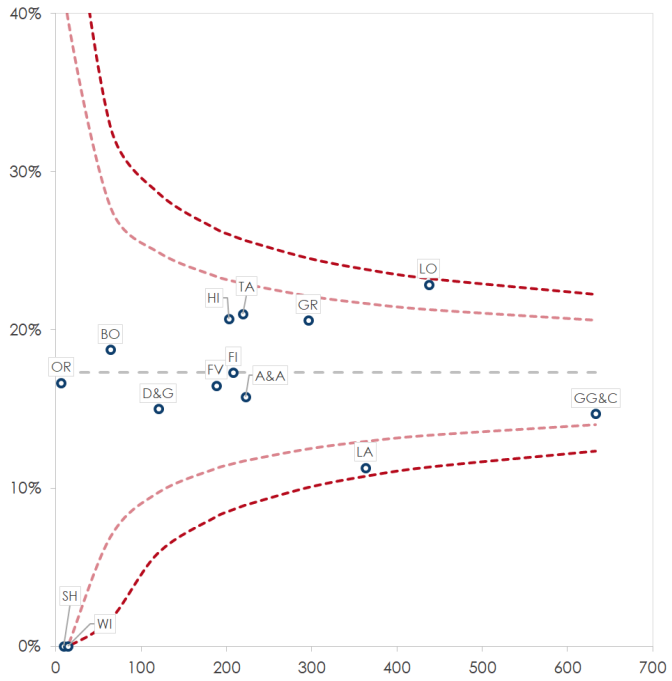


Figure 34 shows a funnel plot of the proportion of worked OHCA occurring within 200 m of a registered PAD in Scotland from April 2021 to March 2022. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section above.

Figure 35: Worked OHCA within 100 metres of a PAD by health board

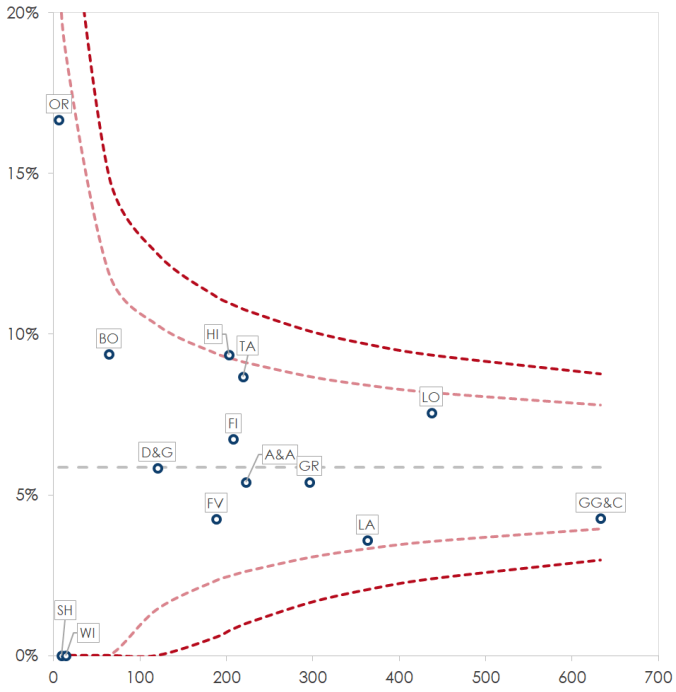
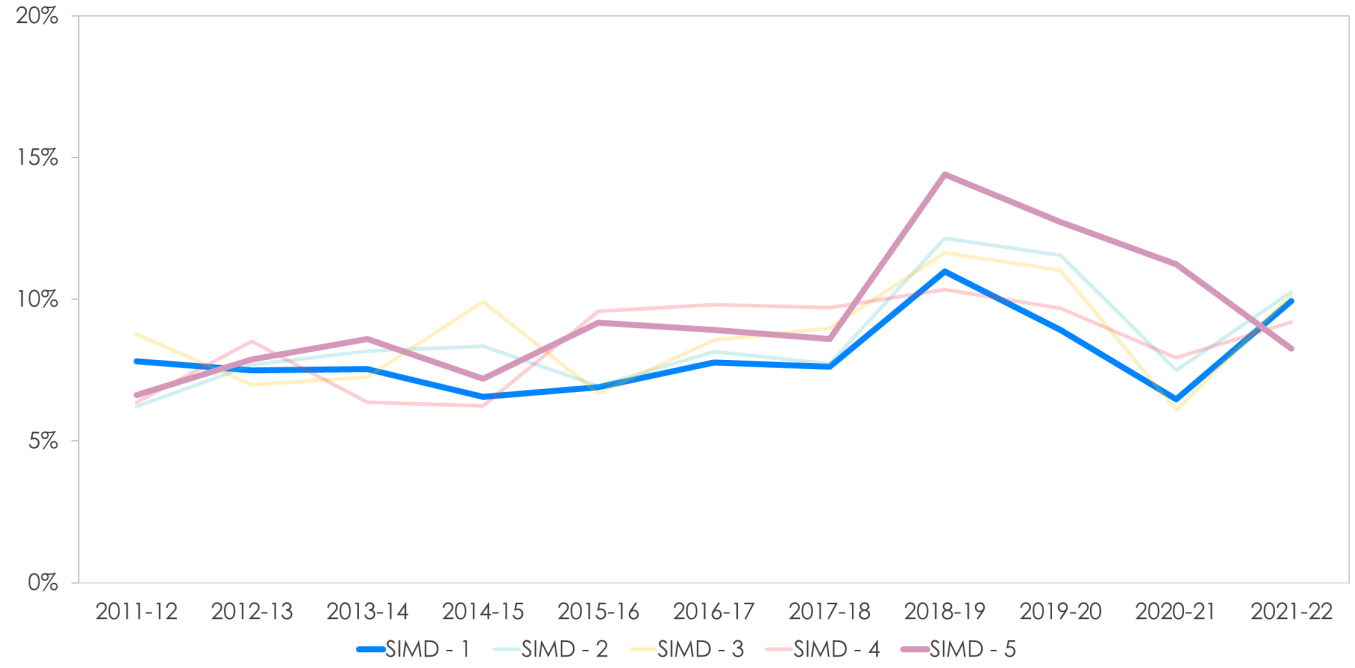


Figure 35 shows a funnel plot of the proportion of worked OHCA occurring within 100 m of a registered PAD in Scotland from April 2021 to March 2022. The dotted grey line shows the national mean, with the upper and lower 95% and 99.7% control limits shown as dotted red lines. Further explanation of funnel plots is given in the Introduction section above.

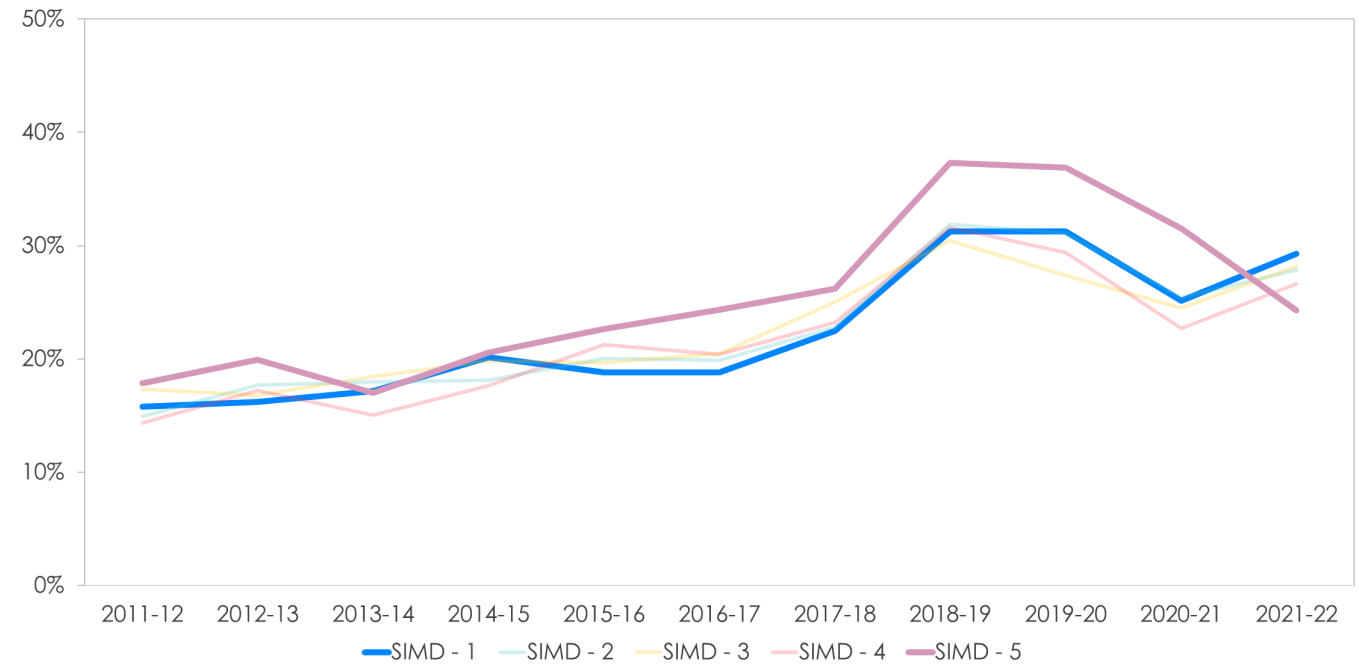
Scottish Index of Multiple Deprivation (SIMD) and OHCA

Percentage of 30-day survival for worked cardiac arrest patients



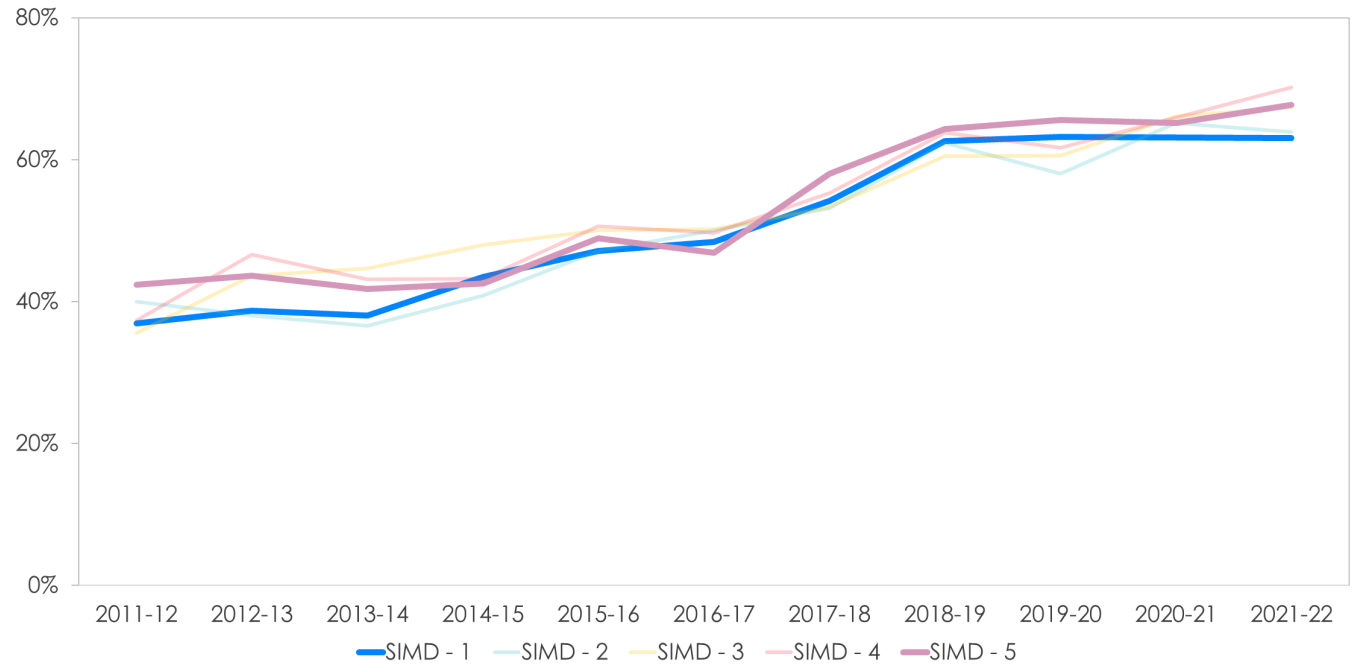
SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	7.80%	7.50%	7.50%	6.60%	6.90%	7.80%	7.60%	11.00%	8.90%	6.50%	10.00%
SIMD - 2	6.20%	7.70%	8.20%	8.40%	7.00%	8.20%	7.70%	12.20%	11.60%	7.50%	10.30%
SIMD - 3	8.80%	7.00%	7.30%	9.90%	6.70%	8.60%	9.00%	11.70%	11.00%	6.10%	10.20%
SIMD - 4	6.40%	8.50%	6.40%	6.30%	9.60%	9.80%	9.70%	10.30%	9.70%	7.90%	9.20%
SIMD - 5	6.60%	7.90%	8.60%	7.20%	9.20%	8.90%	8.60%	14.40%	12.70%	11.20%	8.30%

Percentage of ROSC for worked OHCA patients



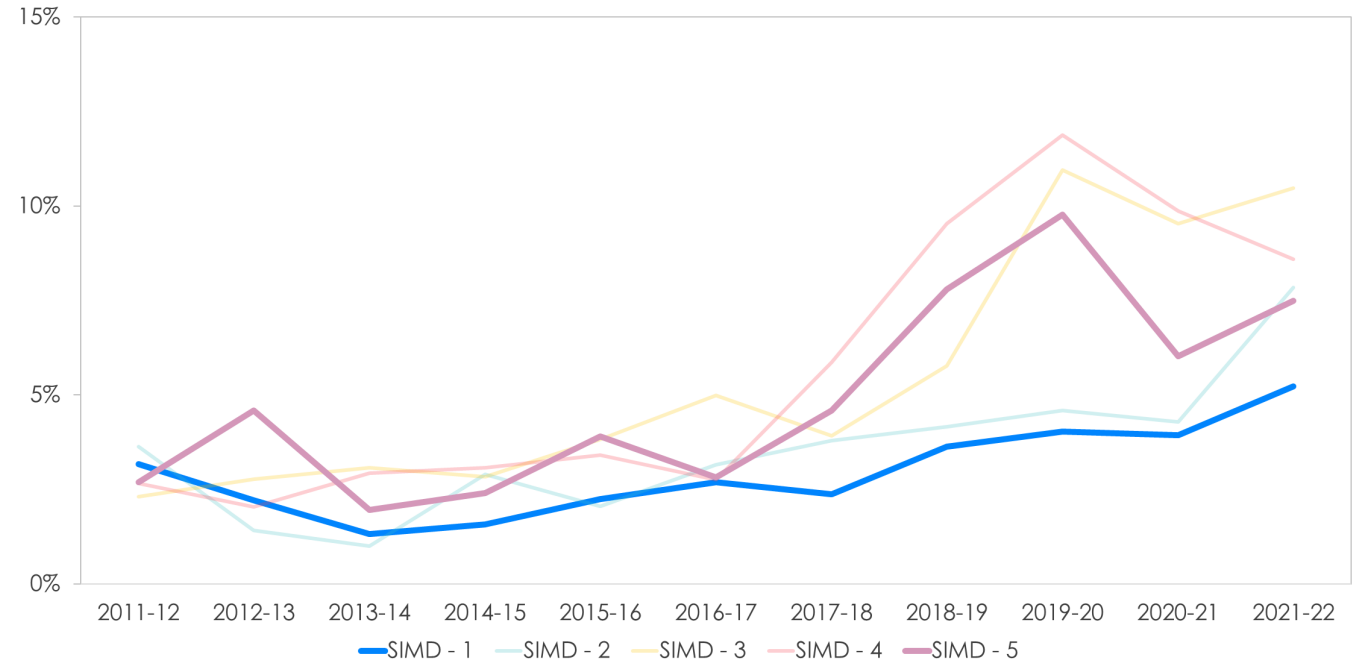
SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	15.80%	16.20%	17.20%	20.20%	18.80%	18.80%	22.50%	31.20%	31.30%	25.20%	29.30%
SIMD - 2	14.90%	17.70%	18.00%	18.10%	20.10%	19.90%	22.80%	31.90%	31.10%	25.30%	27.80%
SIMD - 3	17.30%	16.80%	18.40%	19.80%	19.70%	20.50%	25.00%	30.50%	27.30%	24.50%	28.10%
SIMD - 4	14.30%	17.20%	15.10%	17.60%	21.30%	20.40%	23.20%	31.60%	29.40%	22.70%	26.60%
SIMD - 5	17.80%	19.90%	17.00%	20.60%	22.70%	24.40%	26.20%	37.30%	36.90%	31.50%	24.30%

Percentage of bystander CPR for worked OHCA patients



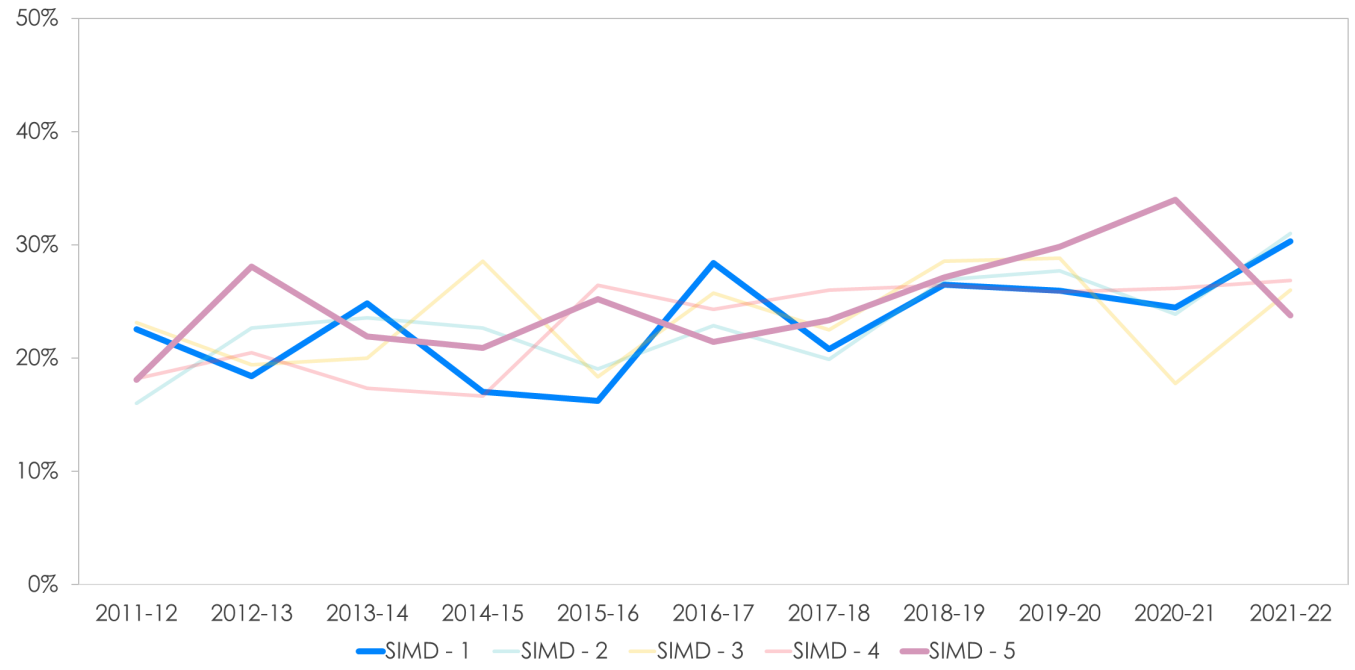
SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	36.90%	38.70%	38.00%	43.50%	47.10%	48.40%	54.20%	62.60%	63.20%	63.20%	63.00%
SIMD - 2	40.00%	38.00%	36.60%	40.90%	47.10%	50.10%	53.20%	62.40%	58.00%	65.20%	63.80%
SIMD - 3	35.60%	43.70%	44.70%	48.00%	50.00%	50.20%	53.40%	60.50%	60.60%	66.10%	67.50%
SIMD - 4	37.40%	46.60%	43.10%	43.20%	50.60%	49.70%	55.30%	63.90%	61.70%	66.00%	70.20%
SIMD - 5	42.40%	43.70%	41.80%	42.50%	49.00%	46.90%	58.00%	64.30%	65.60%	65.20%	67.70%

Percentage of PAD usage for worked OHCA patients



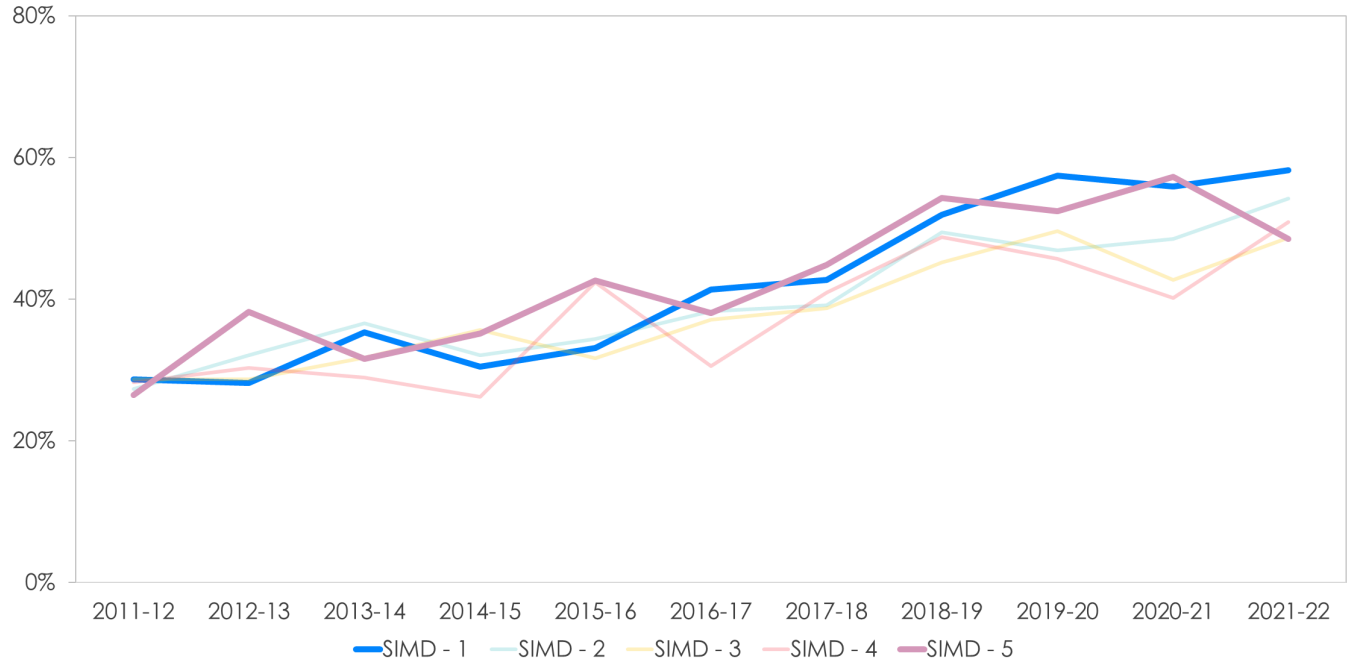
SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	3.20%	2.20%	1.30%	1.60%	2.20%	2.70%	2.40%	3.60%	4.00%	3.90%	5.20%
SIMD - 2	3.60%	1.40%	1.00%	2.90%	2.00%	3.20%	3.80%	4.20%	4.60%	4.30%	7.80%
SIMD - 3	2.30%	2.80%	3.10%	2.80%	3.80%	5.00%	3.90%	5.80%	10.90%	9.50%	10.50%
SIMD - 4	2.70%	2.00%	2.90%	3.10%	3.40%	2.80%	5.90%	9.50%	11.90%	9.90%	8.60%
SIMD - 5	2.70%	4.60%	1.90%	2.40%	3.90%	2.80%	4.60%	7.80%	9.80%	6.00%	7.50%

Percentage of 30-day survival for worked OHCA patients with a shockable initial rhythm



SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	22.60%	18.40%	24.80%	17.00%	16.20%	28.40%	20.80%	26.50%	25.90%	24.50%	30.30%
SIMD - 2	16.00%	22.60%	23.50%	22.60%	19.00%	22.80%	19.90%	26.90%	27.70%	23.90%	31.00%
SIMD - 3	23.10%	19.40%	20.00%	28.60%	18.30%	25.70%	22.50%	28.60%	28.80%	17.70%	26.00%
SIMD - 4	18.20%	20.50%	17.40%	16.70%	26.40%	24.30%	26.00%	26.40%	25.90%	26.20%	26.90%
SIMD - 5	18.10%	28.10%	21.90%	20.90%	25.20%	21.40%	23.40%	27.10%	29.80%	34.00%	23.80%

Percentage of ROSC for worked OHCA patients with a shockable initial rhythm



SIMD	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	28.70%	28.20%	35.30%	30.50%	33.10%	41.40%	42.80%	52.00%	57.40%	55.90%	58.20%
SIMD - 2	27.30%	32.10%	36.60%	32.10%	34.40%	38.30%	39.10%	49.50%	46.90%	48.50%	54.20%
SIMD - 3	28.70%	28.70%	31.70%	35.70%	31.70%	37.10%	38.80%	45.20%	49.60%	42.70%	48.70%
SIMD - 4	28.30%	30.30%	28.90%	26.20%	42.40%	30.60%	40.90%	48.80%	45.70%	40.20%	50.90%
SIMD - 5	26.50%	38.20%	31.60%	35.20%	42.60%	38.10%	44.90%	54.30%	52.40%	57.30%	48.50%

Figure 36 shows a series of timelines from 2011-12 to 2021-22. In each chart SIMD1 (most deprived) is shown in blue and SIMD5 (least deprived) in red), the other SIMD quintiles are shown in the background for reference (SIMD2 green, SIMD3 yellow, SIMD4 pink). The data table for each chart is shown to its right.

Previous research has revealed evidence of a socioeconomic gradient in the incidence of OHCA in Scotland, with 28% of OHCA where resuscitation attempts were made between January 2011 and March 2015 occurring in the areas with the greatest socioeconomic deprivation (SIMD1), and only 14% in the quintile with the least socioeconomic deprivation (SIMD5). (11) A similar pattern was seen in subsequent reports (31,32) and is consistent with the findings of a recent systematic review of the literature. (33)

New analyses were conducted on worked OHCA occurring from April 2011 to March 2020 to determine the effect of SIMD quintile on key outcomes. OHCA after March 2020 were not included for this analysis as the COVID-19 pandemic was likely to have perturbed the strength of the effects. Analyses were adjusted for relevant variables that might disturb the relationship between the variable of interest, SIMD quintiles and 30-day survival. The association between SIMD1 and 30-day survival relative to SIMD5 is stronger after adjusting for age, sex, and urban/ rural domicile, (34) revealing that people living in SIMD1 areas are around 40% less likely to be al ive at 30 days after OHCA than people living in SIMD5.

A series of timelines from 2011-12 to 2021-22 in Figure 36 illustrate the changes in key outcome measures. In each chart SIMD1 (most deprived) is shown in bold blue and SIMD5 (least deprived) in bold red for reference. From 2011-12 to 2020-21, the gap between 30-day survival in SIMD1 and SIMD5 was widening; however, this was not the case in 2021-22 as the gap narrowed.

This narrowing of the gap is also reflected in the percentages of worked OHCA with ROSC or with a shockable initial rhythm, though the same change in pattern is not seen in the case of PAD usage. This may potentially indicate that concerted efforts by those involved in improving the system of care after OHCA are starting to bear fruit; however, further analysis is required to understand the long-term significance of this apparent shift.

Sex and OHCA

Existing literature has shown mixed and often conflicting results regarding the effect of patient sex and resulting OHCA outcomes. Similar to the analyses conducted between SIMD quintiles and key outcomes, analyses are being conducted to determine the relationship between patient sex and key OHCA outcomes in Scotland using worked OHCA from April 2011 to March 2020 (thus excluding cases potentially affected by the COVID-19 pandemic).

Preliminary results show that males in Scotland were 33% more likely than females to survive to 30 days after worked OHCA. These differences may be due to variation in the other links of the 'Chain of Survival'. For instance, males were more likely than females to receive bystander CPR (56.5% versus 53.4% respectively), while a shockable initial rhythm was also more common in males than in females (28.8% versus 17.1% respectively). Further analyses of these findings are ongoing and being conducted by SAS in collaboration with the Usher Institute at the University of Edinburgh.

Mental health and OHCA

Mental health disorders are considered a major public health burden in most countries and have an economic, social and human impact on both individual and population levels. (35) It is estimated that in 2019 more than 13% of the world population were living with a mental disorder. (36) Furthermore, the COVID-19 pandemic appears to have increased the prevalence of mental health illnesses, which is predicted to further increase in the future. (37) Approximately one in every four people living in Scotland are affected by mental illness in any given year. (38)

In Scotland, people with mental health disorders can face substantial health inequalities throughout their life. (39) The life expectancy of people with mental health disorders is 10-20 years shorter than that of the general population, which may reflect the excess burden of cardiovascular disease in this vulnerable group. (35,40–43)

A systematic review of the literature describing the incidence, characteristics and outcomes after OHCA in patients with psychiatric illness was recently conducted. (44) OHCA patients with psychiatric illness were more likely than those without psychiatric illness to have an arrest in a private location, less likely to have a bystander-witnessed arrest, more likely to have pre-existing comorbidities, less likely to receive bystander CPR; and an initial non-shockable rhythm, all of which suggest higher risk of OHCA and lower likelihood of survival.

There is also evidence that after OHCA, people with mental health disorders are less likely to undergo coronary angiography or receive an implantable cardioverter-defibrillator in-hospital after accounting for age, sex, comorbidities, socioeconomic status and OHCA characteristics. (45,46) This suggests that even for those with mental health disorders who survive an OHCA, the aftercare they receive is also less favourable than for those without mental health disorders.

Given the growing recognition of mental health challenges facing the Scottish population, exploring this area in relation to OHCA has the potential to improve our understanding of the reduced life expectancy of people with mental health disorders, and to illuminate avenues for improving health outcomes for this group. Further analyses are underway in collaboration with the Usher Institute at the University of Edinburgh.

Conclusion

This report details current outcomes after OHCA in Scotland and how these have changed over the last decade. We have demonstrated some aspects of the impact of the COVID-19 pandemic on survival outcomes, and subsequent recovery after the lifting of restrictions. The information and analyses contained here outline some of the challenges we still face in order to achieve the ambitious aims outlined in Scotland's Out-of-Hospital Cardiac Arrest Strategy 2021-2026. We will continue to gather and reflect on data describing the 'Chain of Survival' and supporting system of care, monitoring key outcomes and process measures in order to inform and support all those working hard to improve survival after OHCA in Scotland.

People in the most deprived areas in Scotland are more than twice as likely to have an OHCA and 40% less likely to be alive 30 days after the event when compared to the least deprived

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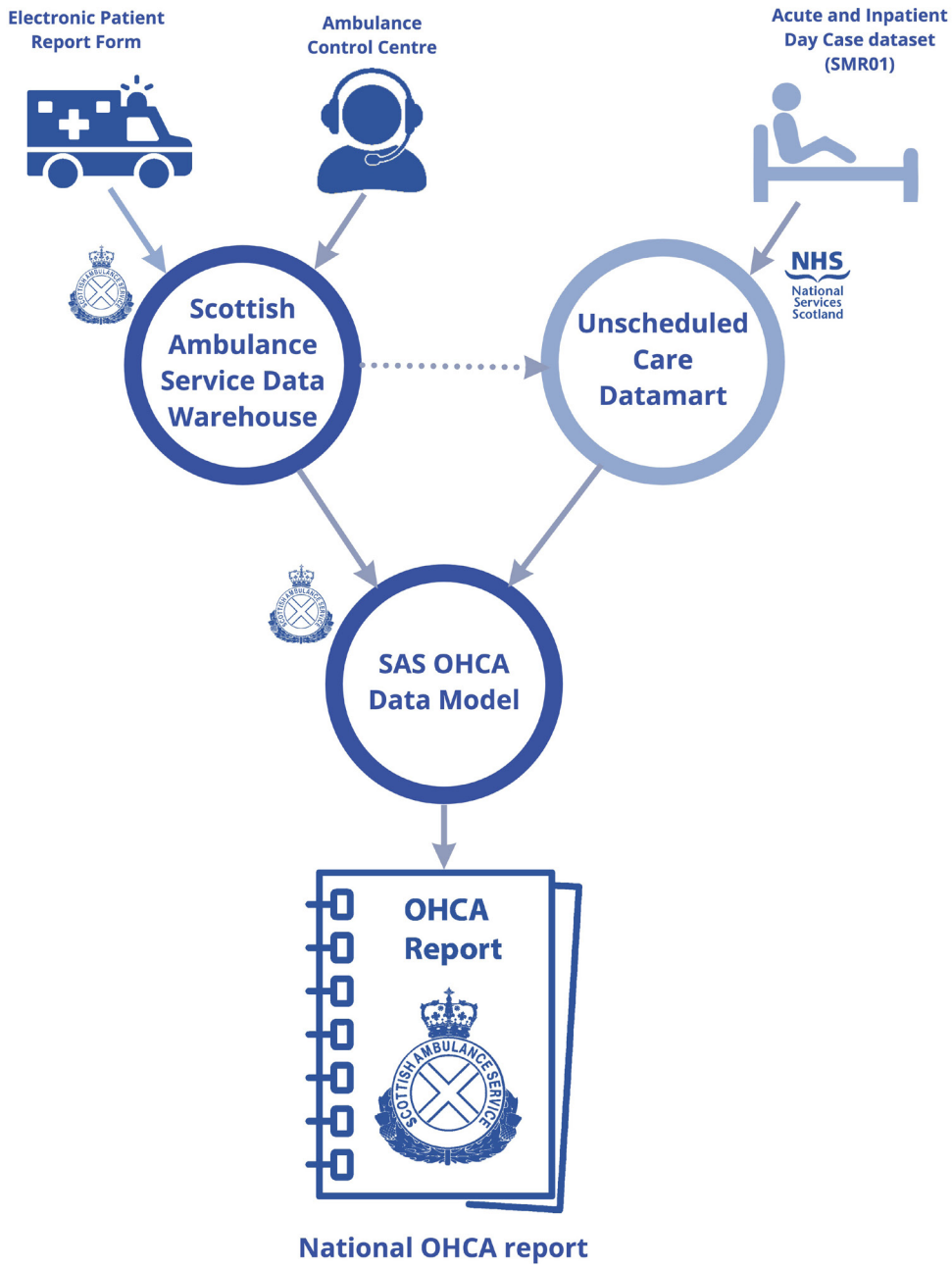
Glossary

ACC	Ambulance Control Centre
BHF	British Heart Foundation (www.bhf.org.uk)
Bystander	A lay person or non-Emergency Medical Service personnel
Cardiac arrest	A condition in which the heart suddenly stops pumping blood around the body
Chain of Survival	The sequence of events required for best chance of survival after OHCA
CHI	Community Health Index
COVID-19	Coronavirus disease (COVID-19): an infectious disease caused by the SARS-CoV-2 virus
CPR	Cardio-Pulmonary Resuscitation: chest compressions and breaths delivered to a person who has suffered a cardiac arrest
Defibrillation	The administration of a controlled electric shock to the heart in order to reset a normal heart rhythm
ECG	An electrocardiogram (ECG) is a simple test used to check the heart's rhythm and electrical activity. Sensors attached to the skin detect the electrical signals produced by the heart each time it beats
GRA	Global Resuscitation Alliance (www.globalresuscitationalliance.org)
Health Board	NHS Health Boards are the senior decision-making structure for NHS Scotland, making key decisions including strategic direction and overseeing delivery of services
Heart Attack	Damage to the heart caused by a clot in the coronary arteries — requires emergency treatment in hospital
Non-shockable rhythm	Pulseless electrical activity or asystole — not treated with defibrillation
OHCA	Out-of-Hospital Cardiac Arrest
PAD	Public Access Defibrillators
Presenting Rhythm	The first ECG rhythm recorded at an OHCA
ROSC	Return of Spontaneous Circulation
RRG	Resuscitation Research Group at the University of Edinburgh (www.rrg.scot)
SAS	Scottish Ambulance Service (www.scottishambulance.com)
Save a Life for Scotland	SALFS is a campaign which brings together the work of a range of partners committed to saving lives by changing the way we think about OHCA in order to get Scotland CPR ready (www.savealife.scot)
Shockable heart rhythm	Ventricular fibrillation or ventricular tachycardia — treated by delivering an electric shock using a defibrillator
SIMD	Scottish Index of Multiple Deprivation.
SMR01	Standardised Mortality Ratio 01: a record of episodes of inpatient care
The Circuit	The national defibrillator network, developed by the British Heart Foundation
UCD	Unscheduled Care Datamart

Utstein	Internationally recognised criteria for uniform reporting of cardiac arrest
Utstein Comparator	Bystander-witnessed cardiac arrests with a shockable initial heart rhythm
VF	Ventricular Fibrillation: a condition in which there is uncoordinated contraction of the heart muscle, which can potentially be corrected by early defibrillation
Worked Arrests	'Worked arrests' are OHCA that have a cause which does not involve major physical trauma and where resuscitation was attempted by the Scottish Ambulance Service (SAS)

Appendices

Appendix 1: Data linkage diagram



The diagram above shows the data sources included in the linked dataset which informs the current report. Calls received by the Scottish Ambulance Service which were determined to be OHCA generated incidents in the SAS data warehouse containing information from the Ambulance Control Centre (ACC) and the Electronic Patient Form (EPRF) for each patient. A list of incidents relating to worked OHCA (i.e., where resuscitation was attempted by SAS crews, see BOX 1) was then converted to a series of patient records in the SAS OHCA Data Model by matching each incident to a patient Community Health Index (CHI) in the Unscheduled Care Datamart (UCD). The UCD is a collaboration between Public Health Scotland and Unscheduled Care Providers including SAS, and facilitates the linkage of SAS records to other health data including time of hospital discharge or death. Improvements in data quality and linkage methodology has meant an increase in the proportion of incidents where outcome data is available from 87.4% in 2011-12, to 96.7% in 2021-22. Note that these percentages are slightly higher than those previously reported because improved linkage methodology has been applied retrospectively to all of the data collected since 2011-12 in order to maximise the accuracy of charts showing timelines and trends.

Number and proportion of worked OHCA successfully linked via the UCD

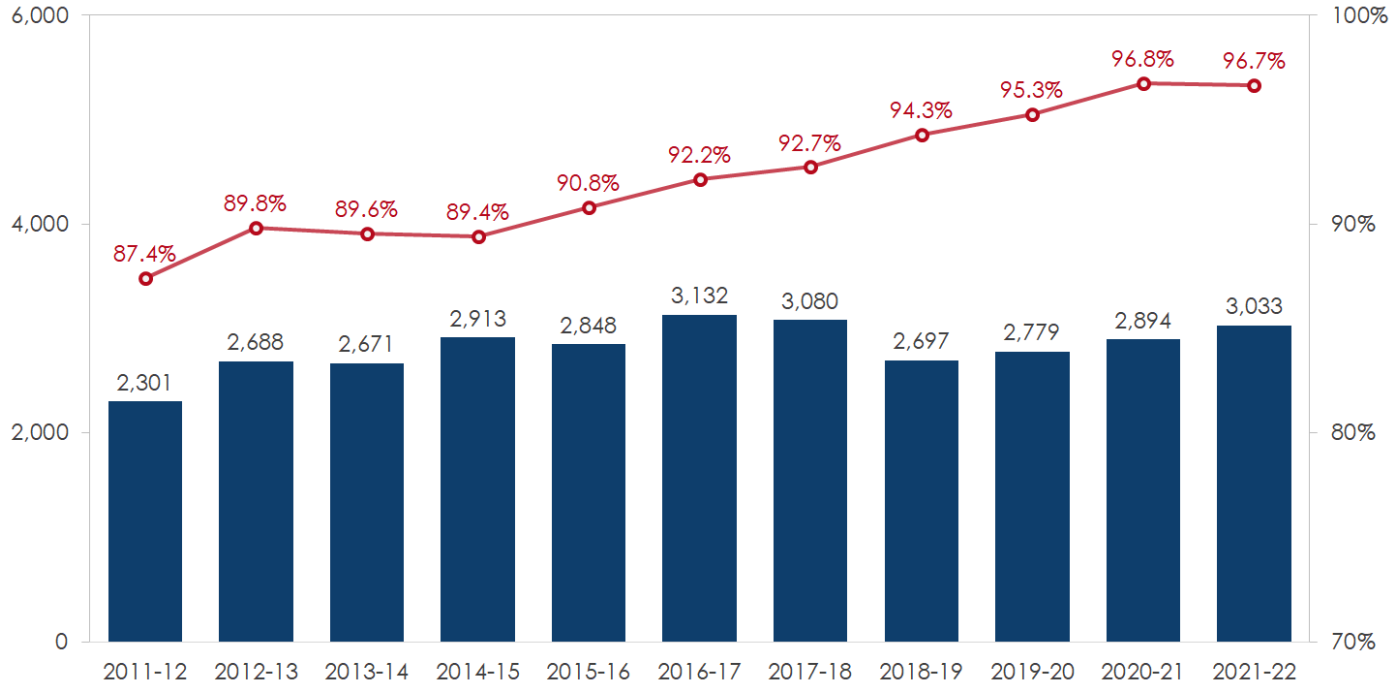


Figure A1 shows the number of worked OHCA in Scotland by year from 2011-12 to 2021-22 with the proportion of OHCA that were successfully linked to outcome data shown by the red line.

Appendix 2: Data Tables

All Worked Arrests	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
All Incidents	2,632	2,992	2,982	3,258	3,136	3,398	3,321	2,860	2,917	2,991	3,138
Incidents matched to a patient record	2,301	2,688	2,671	2,913	2,848	3,132	3,080	2,697	2,781	2,896	3,035
Data Linkage Percentage	87.40%	89.80%	89.60%	89.40%	90.80%	92.20%	92.70%	94.30%	95.30%	96.80%	96.70%
Bystander CPR	883	1,120	1,088	1,275	1,382	1,544	1,686	1,692	1,712	1,886	2,007
Bystander CPR Percentage	38.40%	41.70%	40.70%	43.80%	48.50%	49.30%	54.70%	62.70%	61.60%	65.10%	66.10%
PAD Usage	70	67	54	74	86	105	123	158	207	185	241
PAD Usage Percentage	3.00%	2.50%	2.00%	2.50%	3.00%	3.40%	4.00%	5.90%	7.40%	6.40%	7.90%
ROSC	362	463	459	561	575	639	737	869	858	738	839
ROSC Percentage	15.70%	17.20%	17.20%	19.30%	20.20%	20.40%	23.90%	32.20%	30.90%	25.50%	27.60%
30 Day Survivors	188	227	225	253	238	289	285	339	309	225	303
30 Day Survival Percentage	7.10%	7.60%	7.50%	7.80%	7.60%	8.50%	8.60%	11.90%	10.60%	7.50%	9.70%

Table 10 shows the Number of worked OHCA incidents, the proportion which were linked to patient records, bystander CPR, PAD usage, ROSC, and 30-day survival annually from 2011-12 to 2021-22

Shockable	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
All Incidents	724	782	781	808	784	806	813	840	762	656	723
30 Day Survivors	120	143	147	142	141	174	166	210	196	153	189
30 Day Survival Percentage	16.60%	18.30%	18.80%	17.60%	18.00%	21.60%	20.40%	25.00%	25.70%	23.30%	26.10%
Incidents matched to a patient record	620	678	684	667	685	705	736	771	711	622	682
ROSC	171	208	224	211	250	261	306	387	359	303	357
ROSC Percentage	27.60%	30.70%	32.70%	31.60%	36.50%	37.00%	41.60%	50.20%	50.50%	48.70%	52.30%
Incidents matched to a patient record	620	678	684	667	685	705	736	771	711	622	682
Bystander CPR	304	359	373	380	405	410	473	525	478	427	460
Bystander CPR Percentage	49.00%	52.9%	54.5%	57.0%	59.1%	58.2%	64.3%	68.1%	67.2%	68.6%	67.4%
PAD Usage	43	45	44	47	59	29	43	57	73	50	73
PAD Usage Percentage	6.90%	6.60%	6.40%	7.00%	8.60%	4.10%	5.80%	7.40%	10.30%	8.00%	10.70%

Table 11 shows the Number of worked OHCA incidents with a shockable initial rhythm, the proportion which were linked to patient records, bystander CPR, PAD usage, ROSC, and 30-day survival annually from 2011-12 to 2021-22

Non-Shockable	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
All Incidents	1,846	2,199	2,142	2,443	2,348	2,583	2,505	2,020	2,155	2,335	2,415
30 Day Survivors	68	84	77	111	97	115	119	129	113	72	114
30 Day Survival Percentage	3.70%	3.80%	3.60%	4.50%	4.10%	4.50%	4.80%	6.40%	5.20%	3.10%	4.70%
Incidents matched to a patient record	1,680	2,010	1,957	2,243	2,160	2,421	2,342	1,926	2,070	2,274	2,353
ROSC	190	255	232	350	324	378	430	482	499	435	482
ROSC Percentage	11.30%	12.70%	11.90%	15.60%	15.00%	15.60%	18.40%	25.00%	24.10%	19.10%	20.50%
Incidents matched to a patient record	1,680	2,010	1,957	2,243	2,160	2,421	2,342	1,926	2,070	2,274	2,353
Bystander CPR	579	761	715	895	977	1,134	1,213	1,167	1,234	1,459	1,547
Bystander CPR Percentage	34.50%	37.90%	36.50%	39.90%	45.20%	46.80%	51.80%	60.60%	59.60%	64.20%	65.70%
PAD Usage	27	22	10	27	27	76	80	101	134	135	168
PAD Usage Percentage	1.60%	1.10%	0.50%	1.20%	1.30%	3.10%	3.40%	5.20%	6.50%	5.90%	7.10%

Table 12 shows the Number of worked OHCA incidents with a non-shockable initial rhythm, the proportion which were linked to patient records, bystander CPR, PAD usage, ROSC, and 30-day survival annually from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	26.30%	25.60%	26.50%	26.10%	26.70%	27.20%	25.90%	26.70%	26.80%	27.00%	26.70%
SIMD - 2	24.40%	24.10%	22.30%	23.90%	24.20%	23.30%	23.20%	24.20%	24.30%	23.90%	24.00%
SIMD - 3	19.40%	19.60%	20.80%	20.10%	18.80%	20.20%	21.30%	18.20%	19.50%	19.90%	20.80%
SIMD - 4	17.00%	16.50%	16.80%	17.00%	16.90%	16.70%	16.90%	17.40%	16.40%	16.60%	15.50%
SIMD - 5	12.90%	14.30%	13.60%	13.00%	13.40%	12.70%	12.70%	13.50%	13.00%	12.60%	12.90%
Missing	54	69	77	49	42	35	29	32	28	26	56

Table 13 shows the Number of worked OHCA incidents by SIMD quintile from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	63.7	63	63.3	62.9	63.4	61	61.7	61.2	60.6	60.2	60.4
SIMD - 2	66.2	66.5	65.1	66.8	65	65.6	65.9	64.4	64.7	63.3	63.7
SIMD - 3	67.3	68.3	68.2	67.4	68.6	66.9	68.2	67.6	66	65.5	65.9
SIMD - 4	69.5	69.5	67.7	69.9	69.6	69.3	68.3	68.7	68.1	67.7	67.5
SIMD - 5	70	70.7	68.5	72.4	71.6	71	70.2	69.8	70	70	68.3

Table 14 shows the mean age of worked OHCA incidents by SIMD quintile from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	7.80%	7.50%	7.50%	6.60%	6.90%	7.80%	7.60%	11.00%	8.90%	6.50%	10.00%
SIMD - 2	6.20%	7.70%	8.20%	8.40%	7.00%	8.20%	7.70%	12.20%	11.60%	7.50%	10.30%
SIMD - 3	8.80%	7.00%	7.30%	9.90%	6.70%	8.60%	9.00%	11.70%	11.00%	6.10%	10.20%
SIMD - 4	6.40%	8.50%	6.40%	6.30%	9.60%	9.80%	9.70%	10.30%	9.70%	7.90%	9.20%
SIMD - 5	6.60%	7.90%	8.60%	7.20%	9.20%	8.90%	8.60%	14.40%	12.70%	11.20%	8.30%

Table 15 shows the percentage of worked OHCA which were alive at 30-days by SIMD quintile from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	36.90%	38.70%	38.00%	43.50%	47.10%	48.40%	54.20%	62.60%	63.20%	63.20%	63.00%
SIMD - 2	40.00%	38.00%	36.60%	40.90%	47.10%	50.10%	53.20%	62.40%	58.00%	65.20%	63.80%
SIMD - 3	35.60%	43.70%	44.70%	48.00%	50.00%	50.20%	53.40%	60.50%	60.60%	66.10%	67.50%
SIMD - 4	37.40%	46.60%	43.10%	43.20%	50.60%	49.70%	55.30%	63.90%	61.70%	66.00%	70.20%
SIMD - 5	42.40%	43.70%	41.80%	42.50%	49.00%	46.90%	58.00%	64.30%	65.60%	65.20%	67.70%

Table 16 shows the percentage of worked OHCA which had ROSC by SIMD quintile from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	3.20%	2.20%	1.30%	1.60%	2.20%	2.70%	2.40%	3.60%	4.00%	3.90%	5.20%
SIMD - 2	3.60%	1.40%	1.00%	2.90%	2.00%	3.20%	3.80%	4.20%	4.60%	4.30%	7.80%
SIMD - 3	2.30%	2.80%	3.10%	2.80%	3.80%	5.00%	3.90%	5.80%	10.90%	9.50%	10.50%
SIMD - 4	2.70%	2.00%	2.90%	3.10%	3.40%	2.80%	5.90%	9.50%	11.90%	9.90%	8.60%
SIMD - 5	2.70%	4.60%	1.90%	2.40%	3.90%	2.80%	4.60%	7.80%	9.80%	6.00%	7.50%

Table 17 shows the percentage of worked OHCA which received bystander CPR by SIMD quintile from 2011-12 to 2021-22

SIMD Quintile	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
SIMD - 1	15.80%	16.20%	17.20%	20.20%	18.80%	18.80%	22.50%	31.20%	31.30%	25.20%	29.30%
SIMD - 2	14.90%	17.70%	18.00%	18.10%	20.10%	19.90%	22.80%	31.90%	31.10%	25.30%	27.80%
SIMD - 3	17.30%	16.80%	18.40%	19.80%	19.70%	20.50%	25.00%	30.50%	27.30%	24.50%	28.10%
SIMD - 4	14.30%	17.20%	15.10%	17.60%	21.30%	20.40%	23.20%	31.60%	29.40%	22.70%	26.60%
SIMD - 5	17.80%	19.90%	17.00%	20.60%	22.70%	24.40%	26.20%	37.30%	36.90%	31.50%	24.30%

Table 18 shows the percentage of worked OHCA where a PAD was deployed before the arrival of SAS by SIMD quintile from 2011-12 to 2021-22

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