

Institution: University of Edinburgh		
Unit of Assessment: 1		
Title of case study: J: Save a Life for Scotland: Improving bystander cardiopulmonary resuscitation rates and increasing survival in Scotland after out-of-hospital cardiac arrest		
Period when the underpinning research was undertaken: 2009 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Gareth Clegg	Senior Clinical Lecturer	2006 – present
Nynke Halbesma	Senior Research Fellow	2012 – present
Holly Branigan	Personal Chair in Psychology of Language and Cognition	1999 – present
Period when the claimed impact occurred: 2015 – 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact Underpinning Research: Action research conducted by the University of Edinburgh (UoE) Resuscitation Research Group (RRG) highlighted how the 'Chain of Survival' following out-of-hospital cardiac arrest (OHCA) could be optimised through specialist training of paramedics to create Resuscitation Rapid Response Units ('3RU') and community training in cardiopulmonary resuscitation (CPR). Significance and Reach of Impact: This research formed the basis of Scotland's OHCA strategy in 2015, which has also been adopted in Wales (2018) and by the Global Resuscitation Alliance (2018). In 2015, the UoE RRG also formed the "Save a Life for Scotland" partnership to achieve the goals of the national strategy. By 2019, 520,000 people in Scotland had received face-to-face familiarisation with CPR. This increased national bystander CPR rates by a third from 48.6% in 2015/16 to 64% in 2018/19. In Scotland in 2018/19, 10.2% of people survived 30 days after an OHCA, compared with 7.1% in 2015/16, reflecting the survival of 181 additional individuals since the implementation of the OHCA strategy. UoE's award-winning 3RU model has been adopted as a national programme by the Scottish Ambulance Service and had been rolled out to 13 additional locations in Scotland by December 2019. The Sandpiper Wildcat project in rural North-East Scotland has trained 500 volunteers and reduced time to first resuscitation by a valuable 5 minutes, reducing regional inequalities in access to care. This model has informed the international programme of the European Resuscitation Academy, which has been delivered in 10 European countries, and has been embedded in the National Strategy for OHCA in Switzerland.		
2. Underpinning research The Challenge: Low survival after out-of-hospital cardiac arrests Out-of-hospital cardiac arrest (OHCA) is a serious health concern in Scotland, with approximately 3,200 patients each year having resuscitation attempted after a cardiac arrest in the community. The survival rate to hospital discharge has historically been low: 6% in 2011–15 in Scotland compared with 25% in the best-performing settings around the world. The 'Chain of Survival' is an internationally recognised metaphor for the sequential series of events that must occur to maximise chances of survival after OHCA. Clegg and his RRG at UoE have investigated sub-optimal links in the Chain of Survival in Scotland and identified practical solutions to optimise it, demonstrating how this knowledge can be implemented in real-life community settings across the country and internationally. Specialist training of paramedics improves outcomes after OHCA: Development of the award-winning triple-responding model '3RU'		

Since 2009, UoE researchers have established a programme of research, initially within the City of Edinburgh, to optimise the whole Chain of Survival in Scotland. A prospective cohort study analysed defibrillator traces from ambulance resuscitation events, followed by targeted resuscitation classes and feedback to ambulance crews after resuscitation attempts. Mean time to hands-on-chest improved significantly following feedback and targeted resuscitation training. There was a significant reduction in the median time-to-shock interval from 20.25 to 13.65 seconds [3.1]. Subsequently, the UoE team showed that when specially trained paramedics with advanced resuscitation skills attended all possible OHCA calls, the rates of return of spontaneous circulation improved to 22.5%, compared with the national average of 16% [3.2].

These findings led to the development of the '3RU' (Resuscitation Rapid Response Unit) programme to establish second-tier paramedic teams in Scotland with specialist resuscitation skills. This 3RU model involves an extra trained pair of hands attending any OHCA alongside existing paramedic crews (= "triple-responding") and the deployment of specialist equipment, such as mechanical CPR devices. In addition, the 3RU team achieved an international first by using body cameras for continuous audit and improvement of resuscitation performance [3.3]. In recognition of this work, the team won the [British Medical Journal Emergency Team of the Year award](#) in 2014.

Linguistic analysis showing how emergency call systems can be improved

The RRG group also worked with researchers in Psychology at UoE and call handlers in the Scottish Ambulance Service to perform linguistic analyses of emergency calls. The collaborators sought ways to reduce the time from collapse to commencement of telephone-guided bystander CPR. The team piloted the use of emergency call transcription to enable analysis, and mapped dialogues to the commonly used Medical Priority Dispatch System [3.4]. They showed that transcription of OHCA emergency calls and analysis of caller–call-handler interaction is feasible, and identified the stages in the Medical Priority Dispatch System that introduced the longest delays to bystander CPR or required the most interactions between caller and call-handler.

Epidemiological data-tracking of OHCA to tackle inequalities

The UoE group set up the first epidemiological registry of OHCA in Scotland to deliver accurate national and regional measures of OHCA outcomes through complex data-linkage. This has, for example, revealed an excess of OHCA in more deprived communities, from which the patients also have a lower likelihood of survival to 30 days. Collaborative work with the Social Marketing Unit at Stirling University on bystander CPR showed that approximately half the Scottish population surveyed had not been trained in CPR. Of those not trained, only 23% felt confident administering CPR, compared with 72% of those who had received some training [3.5]. People in the poorest social quintiles and elderly people were less likely to be CPR trained and less confident to administer CPR. This highlighted the need to provide community training in CPR to improve outcomes, and identified the groups where the training would have the greatest impact.

3. References to the research

[3.1] [Lyon RM, Clarke S, Milligan D, Clegg GR](#). Resuscitation Feedback and Targeted Education Improves Quality of Pre-Hospital Resuscitation in Scotland. *Resuscitation*. 2012;83: 70–75. [doi: 10.1016/j.resuscitation.2011.07.016](#)

[3.2] [Clarke S, Lyon RM, Short S, Crookston C, Clegg GR](#). A Specialist, Second-Tier Response to out-of-Hospital Cardiac Arrest: Setting up TOPCAT2. *Emergency Medicine Journal*. 2014;31: 405-407 [doi: 10.1136/emmermed-2012-202232](#)

[3.3] [Lyon RM, Crawford A, Crookston C, Short S, Clegg GR](#). The combined use of mechanical CPR and a carry sheet to maintain quality resuscitation in out-of-hospital cardiac arrest patients during extrication and transport. *Resuscitation*. 2015;93: 102-106 [doi: 10.1016/j.resuscitation.2015.05.030](#)

[3.4] [Clegg GR, Lyon RM, James S, Branigan HP, Bard EG, Egan GJ](#). Dispatch-Assisted CPR: Where Are the Hold-Ups during Calls to Emergency Dispatchers? A Preliminary Analysis of

Caller–dispatcher Interactions during out-of-Hospital Cardiac Arrest Using a Novel Call Transcription Technique. *Resuscitation*. 2014;85:49–52. [doi:10.1016/j.resuscitation.2013.08.018](https://doi.org/10.1016/j.resuscitation.2013.08.018)

[3.5] Dobbie, F, MacKintosh AM, Clegg G, Stirzaker R, Bauld L. Attitudes towards Bystander Cardiopulmonary Resuscitation: Results from a Cross-Sectional General Population Survey. *PloS One*. 2018;13:e0193391 [doi: 10.1371/journal.pone.0193391](https://doi.org/10.1371/journal.pone.0193391)

4. Details of the impact

Pathway to Impact: Translation of research to a national strategy for OHCA in Scotland

In 2015, following the British Medical Journal's recognition of the excellence and importance of the 3RU research, Clegg was invited by Scotland's then Minister for Public Health, Michael Matheson MSP, to develop a national strategy for OHCA to translate the UoE research into national practice and consequently improved health outcomes [5.1]. The same year, UoE's RRG formed the multi-agency 'Save a Life for Scotland' partnership ([SALFS](#)), which uniquely brings together the key partner organisations, including Emergency Services, third sector organisations and Scottish Government, under a single umbrella with a streamlined agenda to drive national change to increase bystander CPR rates and improve OHCA survival.

The SALFS has been instrumental in driving practice and culture change thus improving health outcomes in Scotland. The Scottish Government Policy Manager for OHCA confirmed: *"SALFS is a key platform for achieving the aims of Scotland's OHCA Strategy. [...] SALFS is a unique model; it is a collaborative partnership which builds on a strong foundation of research and evidence developing and testing new approaches to learning CPR. The Scottish Government fully supports this impact statement."* [5.2].

Impact on policy

The key novel components of the Scottish OHCA strategy are based on UoE's research-led initiatives to train paramedics, namely the 3RU programme, and SALFS to improve bystander CPR. For example, the strategy highlights that *"Scotland's 3RU programme, which began in Edinburgh, is internationally recognised as a leading example of such a model."* [Box 3, p.9, 5.1]. The Minister of Public Health in 2015 confirmed: *"it's so important that members of the public know how to do CPR and are confident enough to try it. The Scottish Government fully backs Save a Life for Scotland. Training an extra 500,000 people in this life-saving skill [a key pledge within the strategy] could save thousands of lives over the next few years."* [5.3].

The Scottish strategy has been noted across the UK and internationally. In October 2018, the Welsh Cabinet Secretary for Health and Social Services announced the establishment of a new OHCA partnership, *"similar to the one in Scotland"*, called Save a Life Cymru [5.4a]. Key resources listed refer to SALFS [5.4b]. The Global Resuscitation Alliance's 2018 report (*"Acting on the Call"*), also highlighted the Scottish OHCA strategy as a key best-practice example [p.73; 5.4c].

Impact on emergency responding practice in Scotland

Edinburgh's 3RU model of triple-responding has been rolled out across the whole of Scotland as part of the new clinical response model by the Scottish Ambulance service [5.5a] based on UoE research data showing improved patient outcomes. By 2019, the new model had reached 14 regions covering all major population centres in Scotland [5.5b]. The Scottish Ambulance 2019 report states: *"Over the pilot period we have seen an almost 100% increase in patients receiving a multi-resource/ clinician response in our highest priority response category, providing a greater chance of survival"* [p.6; 5.5a].

In addition, in January 2017, the SALFS partnership established the "Sandpiper-Wildcat project" in rural Grampian (North-East Scotland) in order to train local volunteers to respond to OHCA calls and deliver CPR in areas that were identified to be under-served by the current emergency infrastructure, and where response times can be fatally slow. By April 2020, the project had deployed 500 cardiac responder volunteers using a novel training programme, who carry Wi-Fi-enabled monitor-defibrillators to allow audit of resuscitation performance. Results from the first 12 months of the project showed that in the 182 occasions in which a Sandpiper-Wildcat volunteer

attended an OHCA, the volunteer arrived to start resuscitation a median of 5 minutes earlier than the Scottish Ambulance Service. With the probability of survival dropping by approximately 10% for every minute the patient is untreated, this shortened response time contributed to “*delivering demonstrably high quality basic life support*” in rural Grampian [p.3; 5.6].

Impact on international practice

UoE’s 3RU research has informed the European Resuscitation Academy’s international programme. The co-founder of the Academy confirmed: “*The European Resuscitation Academy is using the data from RRG in our HP-CPR [high-performance CPR] presentation [...]. This [...] helped to increase the awareness regarding number of resources that need to be sent to an OHCA case to perform HP-CPR.*” [5.7]. The programme has been delivered to senior emergency service leaders in 10 European countries, including to the Minister of Interior in Luxembourg. Switzerland has embedded this best practice in its National Strategy for OHCA [5.7].

UoE’s work on dispatcher-assisted CPR [3.4] has informed a programme of improvement by the International Academies of Emergency Dispatch, resulting in the adoption of a new, streamlined approach to the handling and screening of OHCA calls to allow CPR to be administered more quickly and effectively. This has increased the proportion of people receiving CPR in the community “*not only in Scotland, but in each of the 50 countries where our protocol is a part of the Chain of Survival.*” The President of the International Academies of Emergency Dispatch states that UoE’s unique research contributions “*have given us a better understanding of how we can reduce delays and deliver life-saving dispatch life support instructions quicker to the caller when that caller witnesses an out of hospital cardiac arrest. The objective is more lives being saved, and because of the RRG, that objective is being achieved*” [5.8].

Impact on public engagement and community training in CPR

It is recognised that increasing the rate of bystander CPR is directly related to improving survival after OHCA. The SALFS partnership has enabled the translation of UoE research into public engagement by facilitating hundreds of events over the past 4 years.

CPR training in schools

International consensus suggests that an effective way to improve bystander CPR rates is to deliver training in schools. The UoE team used the findings of an omnibus poll commissioned by the RRG and subsequent collaborative research with the Institute for Social Marketing [3.5] to develop bespoke tools to facilitate CPR training in Scottish schools with the support of Education Scotland. This has directly facilitated CPR training events in over 100 schools across Scotland [5.9a]. All 32 local authorities in Scotland have committed to teach CPR to every secondary school pupil; by March 2019, records held by the UoE team reported 87% of secondary schools in Scotland have had some form of CPR awareness activity within the last 5 years. In Italy, the President of ‘Pavia Nel Cuore’ stated that “*Learning what has been done in Scotland thank [sic] to that campaign was very inspiring for our association and helped us to greatly improve our project “ScuolaSalvaVita”*”, which trains 10,000 students in CPR every year [5.9b].

CPR familiarisation in the community leads to increased rates of bystander CPR and improved survival

By 2019, the SALFS partnership had carried out face-to-face CPR familiarisation with almost 520,000 individuals (**Table 1**) [Fig. 4; 5.10]. Since the implementation of the Scottish OHCA strategy, there has been a relative increase in OHCA where bystander CPR was administered, from 48.6% in 2015/16 to 64% in 2018/19 (**Table 1**). This increase in bystander CPR has translated to improved outcomes: the percentage of patients with ‘Return of Spontaneous Circulation’ (or ‘survival to hospital’) increased from 19.8% in 2015/16 to 30.3% in 2018/19 [5.10].

Table 1: Number of survivors per million of population of Scotland, percentage of OHCA where bystander CPR was performed and number of SALFS contacts to equip the public with CPR skills by year since strategy implementation [5.10].

Year	Survivors per million	% OHCA with bystander CPR	Cumulative SALFS face-to-face contacts to equip with CPR skills
2015/16	41.7	48.6	60,000
2016/17	52.9	49.9	160,000
2017/18	53.3	55.5	350,000
2018/19	58.5	64.0	519,861

Impact on health and welfare

Since 2015, UoE research, through the national OHCA strategy and SALFS activities, has helped to increase survival rates after OHCA in Scotland by approximately 45%. In 2015/16, 7.1% of patients survived to leave hospital after OHCA; in 2018/19, this figure had increased to 1 in 10 (10.2%) [p.13; 5.10]. This equates to 16.8 more survivors per million between 2015/16 and 2018/19, while the incidence of OHCA remained stable (585 per million in 2015/16 and 573 per million in 2018/19) (Table 1; Fig 1). The changes to the Chain of Survival laid out in the OHCA strategy, informed by UoE research, specifically led to an additional 181 lives being saved between 2015 and 2019 (Fig 1).

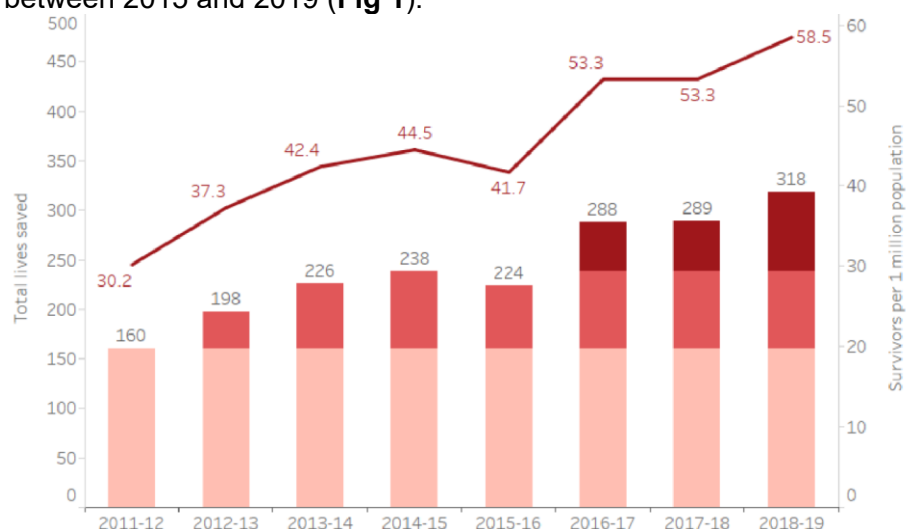


Figure 1. Number of 30-day survivors per million of the Scottish population (red, top line) and absolute number of lives saved (columns) by year. Lower sections (pink) of the column show the baseline number of survivors in 2012, middle sections (red) represent additional lives saved after the start of UoE's initial improvement work and the top sections (dark red) show the impact of lives saved since the OHCA strategy launch in March 2015 (reproduced from p. 17, [5.10]).

5. Sources to corroborate the impact

[5.1] Out-of-Hospital Cardiac Arrest, A strategy for Scotland, Scottish Government, Health and Social Care, 2015, ISBN: 9781785442407

[5.2] Testimonial from OHCA Policy Manager, Scottish Government, December 2020

[5.3] Scottish Government News 'Save a Life for Scotland, October 2015

[5.4] Examples of the uptake of the Scottish OHCA model by other organisations:

a. Save a Life Cymru (2018): [Welsh Government announcement](#)

b. Save a Life Cymru (2018): [Key resources](#) listing Save a Life for Scotland

c. Improving Survival from Out-of-Hospital Cardiac Arrest: Acting on the Call, Global Resuscitation Alliance (2018)

[5.5] Scottish 3RU expansion: a. Scottish Ambulance Service Annual Report and Accounts, March 2019 b. 3RU' expansion, December 2019

[5.6] The Sandpiper Trust: Sandpiper Wildcat Annual Report 2018

[5.7] Email from Co-Founder of The European Resuscitation Academy, March 2020

[5.8] Testimonial from President of the International Academies of Emergency Dispatch, July 2020

[5.9] CPR training in schools: a. Education Scotland National Improvement Hub: Save a Life for Scotland resources b. Testimonial letter from President of Pavia Nel Cuore, Italy; August 2020

[5.10] Scottish Out-Of-Hospital Cardiac Arrest Data Linkage Project: 2018/19 results