Welsh Ambulance Services University NHS Trust

Today's research, tomorrow's care

The impact of Welsh Ambulance Research on patient outcomes, staff wellbeing and healthcare delivery

Ymddiriedolaeth Brifysgol GIG
Gwasanaethau Ambiwlans Cymru
Welsh Ambulance Services
University NHS Trust

Impact of WAST research
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By Professor Nigel Rees QAM
Assistant Director of Research and Innovation
Amb_Research.Development@wales.nhs.uk

Foreword

The Welsh Ambulance Services University NHS Trust (WAST) has a longstanding reputation of developing and delivering high quality Research Development and Innovation (RD&I).

In recognition of the role in Education and RD&I, WAST was awarded University Trust Status in 2024, which has raised the profile of RD&I across the organisation. Rapid progress has been made in the breadth and scale of RD&I, providing opportunities to tackle complex challenges faced by WAST, across healthcare in Wales and beyond.

Patients and staff deserve treatments which work, in a high-performing healthcare system. This report shares the work WAST has taken part in and led over the past two decades. We look forward to continuing our research in the years to come.

Professor Nigel Rees QAM
Assistant Director of Research and Innovation

Our research questions and their impact

- Defining impact across our portfolio
- Should we use mechanical chest compressions routinely in out-of-hospital cardiac arrest? **PARAMEDIC-1**
- How effective is adrenaline in out-of-hospital cardiac arrest? **PARAMEDIC-2**
- Should we use injections into the bone for patients whose heart has stopped beating? **PARAMEDIC-3**
- Could a simple patch help patients with suspected stroke? **RIGHT-2**
- Could local anaesthetic improve pain relief for patients with suspected hip fracture? **RAPID**
- Could drones help improve cardiac arrest response in rural areas?
- Publications

Defining impact across our portfolio

- This report shows just a few of the studies WAST has supported
- We have a portfolio of research studies covering the three strands of our emergency work: hear and treat (telephone triage), see and treat (where patients are cared for at the scene of the 999 call), and see and convey (where patients are taken to hospital). These do not directly align with acuity, for example, many cardiac arrest patients are cared for under see and treat and have resuscitation discontinued at scene.
- The portfolio includes observational studies, where care is not impacted, but we gain new insights from routinely-collected data, or from research tools such as surveys, focus groups, and simulations
- Finally, we have interventional studies, where a new treatment, medicine, or pathway is compared to existing care, to see whether it has positive impact (see right)

Defining how research creates impact

UK Research and Innovation (a public body sponsored by the Department for Science, Innovation and Technology) defines various research impacts, from academic (changing our understanding) through to instrumental (changing policy, practice and behaviour). Translation to practice can vary in timescale from rapid for withdrawing ineffective treatments such as routine mechanical chest compressions, through to long-term such as introducing new medicines to practice, which needs governance, planning, and training, even after studies demonstrate benefit. See these icons throughout this report:

Patient impact

We look at a range of outcomes, not just survival, but also quality of life, through surveying our patients after they enter a study

Practice impact

Policies and strategies may be impacted by research; ineffective treatments and devices may be withdrawn; pathways may change

Financial impact

Research helps us use limited funding effectively, by considering people's quality of life – do we improve survival to good health, or simply prolong death?

Academic impact

WAST regularly contributes to research which expands our understanding of how to provide excellent care. We measure this impact in various ways, such as by how often studies are cited by other researchers

The PARAMEDIC-1 study

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Should we use mechanical chest compressions routinely in out-of-hospital cardiac arrest?

Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial

WAST were one of four ambulance services who took part in this important study. 4471 patients whose hearts had stopped beating were treated with either mechanical chest compressor devices or the usual method of ambulance staff delivering chest compressions manually. Researchers followed these patients up for up to 12 months.

"On the basis of ours and other recent randomised trials, widespread adoption of mechanical CPR devices for routine use does not improve survival"
Perkins et al, 2015

Patient impact

There was no evidence of improved survival to 30-days with the use of mechanical chest compressions (6% of patients survived) compared to manual chest compression (7% survived).

Practice impact

Guidelines around the world were informed by this study:
"The task force continues to suggest against routinely using mechanical CPR devices while acknowledging their utility in specific situations" *International Liaison Committee on Resuscitation*
"HTW advises that routine adoption of mechanical chest compression devices across the ambulance service is not currently supported by available evidence" *Health Technology Wales*

Financial impact

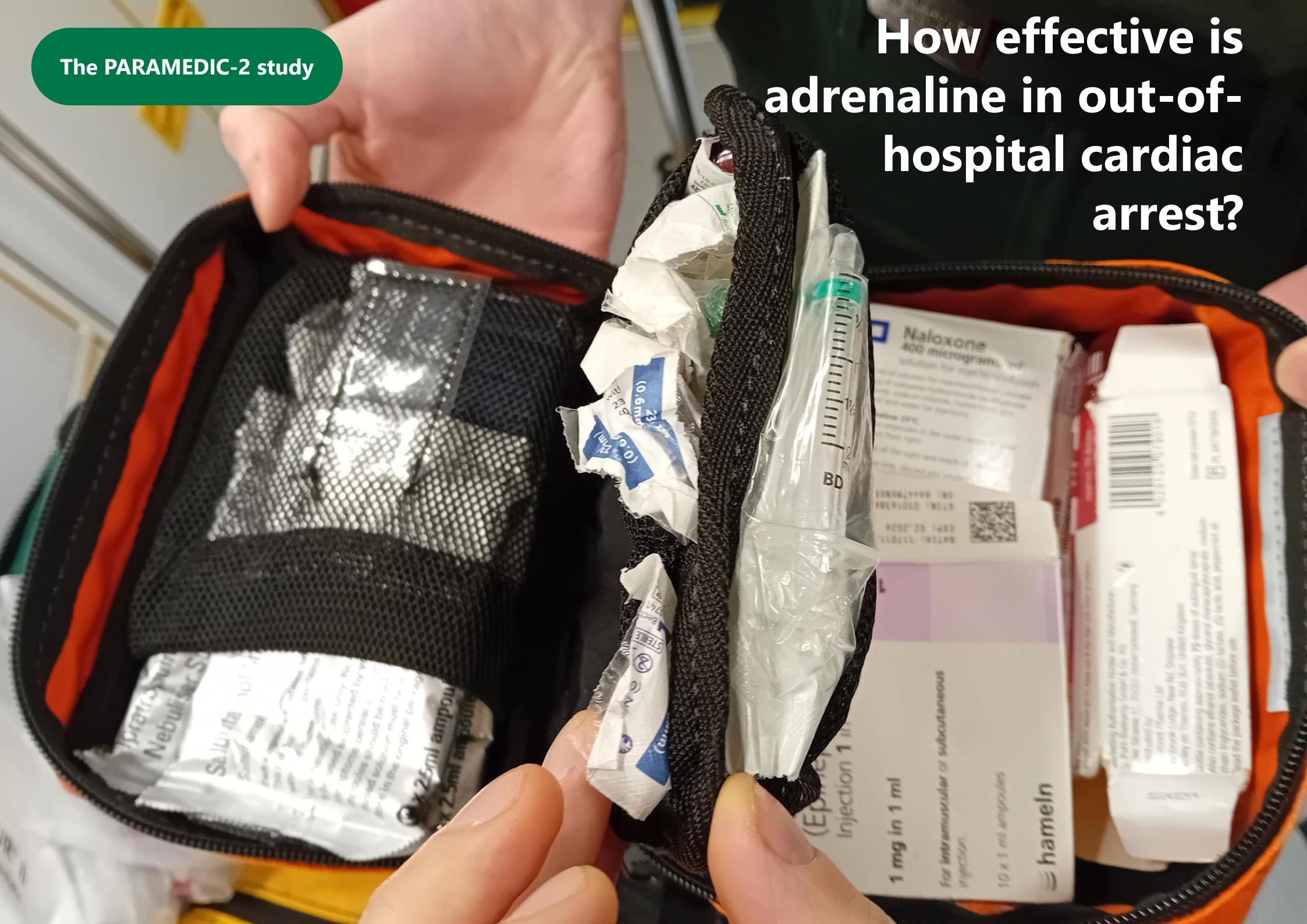
"Our study demonstrates that the use of the mechanical chest compression device LUCAS-2 represents poor value for money when compared to standard manual chest compression in out-of-hospital cardiac arrest."
Marti et al, 2017

Academic impact

The PARAMEDIC-1 study is highly-regarded around the world, being cited 392 times in academic papers. It was published in the Lancet, which, with an impact factor of 88.5, ranks 1st among 332 general medicine journals.

The PARAMEDIC-2 study

How effective is adrenaline in out-of-hospital cardiac arrest?



How effective is adrenaline in out-of-hospital cardiac arrest?

A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest (PARAMEDIC-2)

WAST were one of five ambulance services who took part in this important study. 8014 patients whose hearts had stopped beating were treated with either adrenaline (in some regions known as epinephrine) or placebo, in addition to all other usual treatments.

"The number of patients who would need to be treated with epinephrine to prevent one death after cardiac arrest was 112, as compared with early recognition of cardiac arrest (number needed to treat, 11), CPR performed by a bystander (number needed to treat, 15), and early defibrillation (number needed to treat, 5)" Perkins et al, 2018

Patient impact

"In adults with out-of-hospital cardiac arrest, the use of epinephrine resulted in a significantly higher rate of 30-day survival than the use of placebo, but there was no significant between-group difference in the rate of a favorable neurologic outcome because more survivors had severe neurologic impairment in the epinephrine group." Perkins et al, 2018

Practice impact

Clinicians and policy-makers alike were clear after this study that the impact of adrenaline administration was much smaller than other interventions such as early bystander recognition of cardiac arrest, early CPR, and early defibrillation. Simultaneously, the study showed that the small improvements seen with adrenaline administration were highly time-dependent; this led the study team to design the PARAMEDIC-3 trial, which WAST also supported (see next page).

Financial impact

"Adrenaline was not cost-effective when only directly related costs and consequences are considered. However, incorporating the indirect economic effects associated with transplanted organs substantially alters cost-effectiveness, suggesting decision-makers should consider the complexity of direct and indirect economic impacts of adrenaline." Achana et al, 2020

Academic impact

The PARAMEDIC-2 study is a landmark piece of research cited by over 600 other papers. Its conceptual impact has helped reshape our understanding of how to improve cardiac arrest outcomes – away from advanced care and towards early intervention from our communities (such as by drone delivery of defibrillators, explored later in this report)

Should we use injections into the bone for patients whose heart has stopped beating?

The PARAMEDIC-3 study

Should we use injections into the bone for patients whose heart has stopped beating?

Pre-hospitAl RAndomised trial of MEDICation route in out-of-hospital cardiac arrest (PARAMEDIC-3)

WAST joined forces with 10 other ambulance services in this important study. 6082 patients whose hearts had stopped beating were treated with either an injection into the bone (intraosseous) or the usual method of ambulance staff injecting into the vein (intravenous). Researchers followed these patients up for up to 6 months.

"Among adults with out-of-hospital cardiac arrest requiring drug therapy, the use of an intraosseous-first vascular access strategy did not result in higher 30-day survival than an intravenous-first strategy."
Couper et al, 2025

Patient impact

There was no evidence of improved survival to 30-days with the use of the intraosseous-first strategy (4.5% of patients survived) compared to intravenous-first (5.1% survived). Neither was there evidence of improved survival to discharge with a good neurological outcome (2.7% intraosseous versus 2.8% intravenous)

Practice impact

Guidelines already recommended that intravenous-first strategy should be adopted, but in practice, ambulance services were seeing increasing rates of intraosseous use before this study.

"We suggest IV access, as compared to IO access, as the first attempt for vascular access during adult cardiac arrest (weak recommendation, low certainty evidence)."
International Liaison Committee on Resuscitation, draft Consensus on Science with Treatment Recommendations

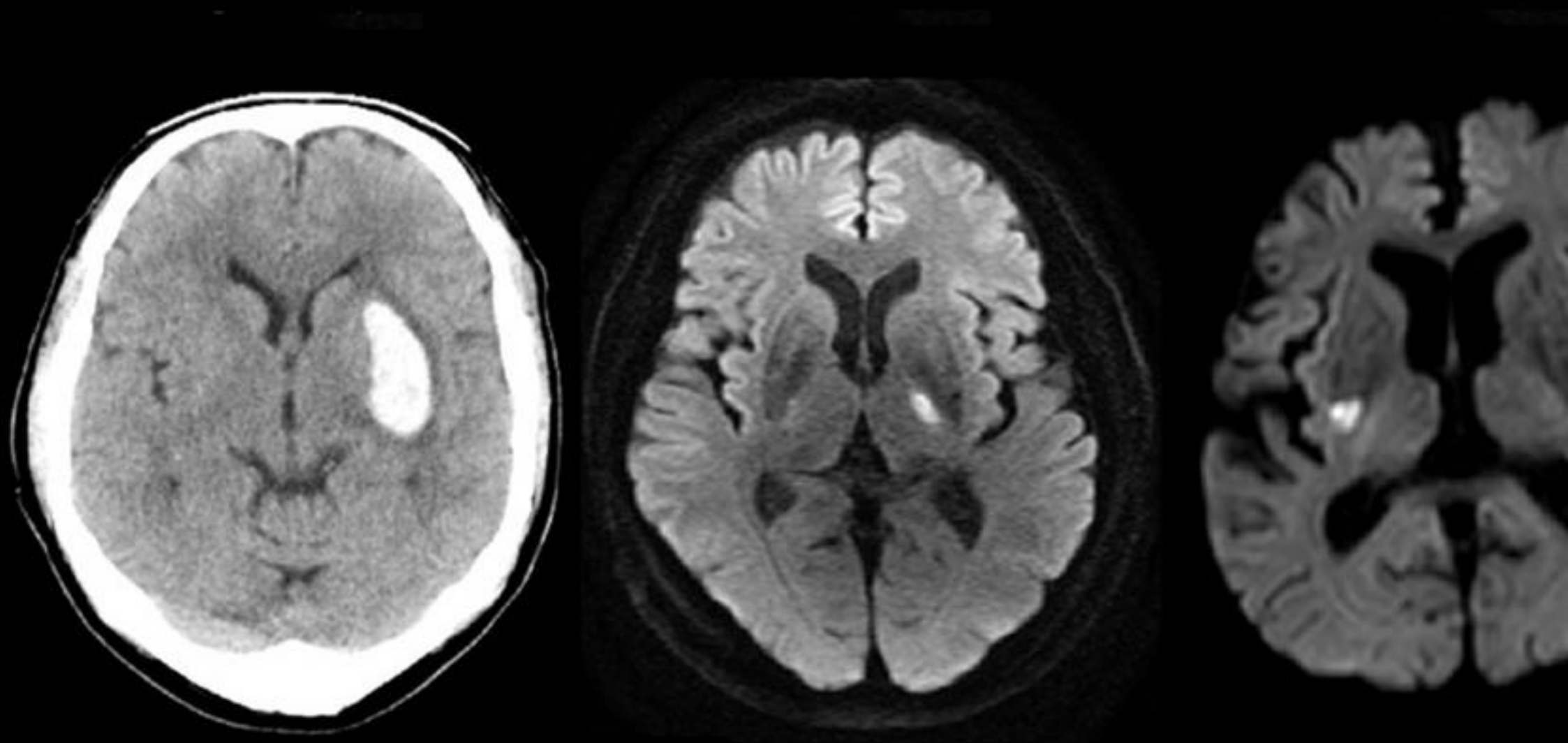
Financial impact

Cost-effectiveness modelling is in progress. Intraosseous devices are many times more expensive than the usual treatment of cannulation, but costs are also borne downstream through differing admission patterns, so full health economic analysis also uses long-term patient outcomes

Academic impact

The PARAMEDIC-3 study, although very recently published, has already been cited 47 times in academic papers. It was published in the New England Journal of Medicine, which is internationally esteemed with a Journal Impact Factor of 78.5, as well as a programme to grant free access to low-income countries.

Welsh Ambulance Services University NHS Trust



The RIGHT-2 study

Could a simple patch help patients with suspected stroke?

Could a simple patch help patients with suspected stroke?

Prehospital transdermal glyceryl trinitrate in patients with ultra-acute presumed stroke (RIGHT-2): an ambulance-based, randomised, sham-controlled, blinded, phase 3 trial

This highly collaborative study involved paramedics applying either a GTN patch or a similar sham patch to patients with signs of suspected stroke, replaced for up to 3 days in hospital. It involved eight ambulance services, including WAST, conveying to 54 stroke hospitals.

"Prehospital treatment with transdermal GTN does not seem to improve functional outcome in patients with presumed stroke. It is feasible for UK paramedics to obtain consent and treat patients with stroke in the ultra-acute prehospital setting."
The RIGHT-2 investigators, 2019

Financial impact

Stroke is an important research topic for the healthcare sector, due to both the impact it has on patients, but also the economy, with the Stroke Association estimating annual costs of stroke at £26 billion. Research spending for stroke is limited, with just £48 per patient, compared with £241 per cancer patient and £118 per dementia patient

Patient impact

There was no evidence of improved survival to 30-days with the use of the intraosseous-first strategy (4.5% of patients survived) compared to intravenous-first (5.1% survived). Neither was there evidence of improved survival to discharge with a good neurological outcome (2.7% intraosseous versus 2.8% intravenous)

Practice impact

This study demonstrated to the research community that ambulance clinicians could recruit to stroke studies in the critical early stages of illness, and that a transdermal patch is a feasible method of medication delivery for prehospital clinicians.

Academic impact

This well-received study showed that ambulance clinicians can recruit to interventional studies even when stroke patients are acutely unwell. Following on from it, other researchers have begun investigations into topics pertinent to stroke care, including:

- Prehospital video triage (PHOTONIC)
- Thrombectomy bypass (SPEEDY)
- Saliva lateral flow test for stroke (GHOST)
- Blood lateral flow test for large vessel occlusion (PRONTO, which WAST has joined)

Could local anaesthetic improve pain relief for patients with suspected hip fracture?

The RAPID study

Could local anaesthetic improve pain relief for patients with suspected hip fracture?

Rapid Analgesia for Prehospital hip Disruption (RAPID): findings from a randomised feasibility study

This feasibility study was delivered with Welsh Ambulance Service as the sole ambulance service treating patients with suspected hip fracture, comparing usual care to fascia iliaca compartment block. This used a local anaesthetic, administered at the scene by specially-trained paramedics to provide pain relief.

Patient impact

We sent quality of life questionnaires to patients in both arms of the study. Patient satisfaction was similar: experimental mean 3.4 (n = 20) versus 3.5 (n = 13) for usual care. Some patients were interviewed about their experiences in the study.

Practice impact

Usual paramedic pain relief for this patient group can include paracetamol, Entonox gas, and opioids. The new method, local anaesthetic injected into the fascia iliaca has been used in hospital settings successfully and with fewer side effects than opioids. It has been tested twice in small prehospital studies, but with the use of morphine at the same time. This feasibility study compared local anaesthetic alone to usual pain relief.

> "They explained everything – the situation and the reason, did I want to try this and all this. I was glad to see them come in. It was perfect. I could not wish for better."
> [RAPID study patient interview]
> Jones et al, 2019

Financial impact

As a feasibility study, this did not provide cost-effectiveness data, but tested whether the patient outcome measures and costs could be measured in a definitive study (currently underway). Costs of an intervention like this include not just the direct costs of anaesthetic and paramedic training, but also downstream costs or savings through length of admission, for example.

Academic impact

This feasibility study was designed to show whether a full trial would be likely to succeed. The feasibility study RAPID has led directly to the RAPID-2 definitive study being funded. Led by the same research team, and again involving Welsh Ambulance Service staff, this study aims to answer whether local anaesthetic for suspected hip fracture is beneficial for our patients. This study is ongoing.

Could drones help improve cardiac arrest response in rural areas?

DRONES

Could drones help improve cardiac arrest response in rural areas?

The use of drone-delivered Automated External Defibrillators in the emergency response for out-of-hospital cardiac arrest. A simulation study

Welsh Ambulance Service worked with academic and industry partners to simulate the delivery by drone of a defibrillator to a bystander performing CPR on a manikin. The study combined audio-recording of the simulated 999 call, video observation, and post-simulation interviews to allow detailed understanding of the entire timeline of events.

"Drone start-up procedures were quick but there were delays once the drone arrived on scene.."
Smith et al, 2025

Patient impact

This simulation study explored how drones could be delivered to a simulated cardiac arrest. The clinical benefits of early defibrillation are well-established, exceeding by many times some of the so-called advanced care interventions provided by ambulance staff (see PARAMEDIC studies elsewhere in this report).

Financial impact

Defibrillation cost-effectiveness does depend on timeliness of delivery as well as siting of the units. Drone-delivered defibrillation may offer an opportunity to overcome some disparities in the location of static public access defibrillators, which are disproportionately located in more affluent areas.

Academic impact

This study's conceptual impact shows the importance of considering all aspects of the timeline to defibrillator use – including the time before dispatch and after arrival of the drone – not simply the flight time. WAST are now involved in a bid for research funding to model optimal locations for defibrillator drone sites, as well as a study into public acceptability of drones flying over land for health purposes.

Publications

The academic impact of research WAST has taken part in can be measured objectively in a variety of ways. Here, we list a non-exhaustive set of publications based on WAST research alongside the journal impact factor (measures the overall prestige of the journal which published our work) and the number of citations for that specific paper. For both scores, the higher the better. We also present instrumental impact throughout this report – such as changes in practice.

Study	Selected publications	Journal impact factor	Citations
PARAMEDIC-1	Gavin D Perkins, Ranjit Lall, Tom Quinn, Charles D Deakin, Matthew W Cooke, Jessica Horton, Sarah E Lamb, Anne-Marie Slowther, Malcolm Woollard, Andy Carson, Mike Smyth, Richard Whitfield, Amanda Williams, Helen Pocock, John J M Black, John Wright, Kyee Han, Simon Gates **Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial**, *The Lancet*, Volume 385, Issue 9972, 2015, Pages 947-955	88.5	397
	Marti J, Hulme C, Ferreira Z, Nikolova S, Lall R, Kaye C, Smyth M, Kelly C, Quinn T, Gates S, Deakin CD, Perkins GD. **The cost-effectiveness of a mechanical compression device in out-of-hospital cardiac arrest**. *Resuscitation*. 2017 Aug;117:1-7. doi: 10.1016/j.resuscitation.2017.04.036. Epub 2017 May 2. PMID: 28476479	4.6	25
	Ji C, Lall R, Quinn T, Kaye C, Haywood K, Horton J, Gordon V, Deakin CD, Pocock H, Carson A, Smyth M, Rees N, Han K, Byers S, Brace-McDonnell S, Gates S, Perkins GD; **PARAMEDIC trial Collaborators. Post-admission outcomes of participants in the PARAMEDIC trial: A cluster randomised trial of mechanical or manual chest compressions**. *Resuscitation*. 2017 Sep;118:82-88. doi: 10.1016/j.resuscitation.2017.06.026. Epub 2017 Jul 5. PMID: 28689046.	4.6	22
PARAMEDIC-2	Perkins GD, Ji C, Deakin CD, Quinn T, Nolan JP, Scomparin C, Regan S, Long J, Slowther A, Pocock H, Black JJM, Moore F, Fothergill RT, Rees N, O'Shea L, Docherty M, Gunson I, Han K, Charlton K, Finn J, Petrou S, Stallard N, Gates S, Lall R; PARAMEDIC2 Collaborators. **A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest**. *New England Journal of Medicine*. 2018 Aug 23;379(8):711-721. doi: 10.1056/NEJMoa1806842. Epub 2018 Jul 18. PMID: 30021076.	78.5	630
	Achana F, Petrou S, Madan J, Khan K, Ji C, Hossain A, Lall R, Slowther AM, Deakin CD, Quinn T, Nolan JP, Pocock H, Rees N, Smyth M, Gates S, Gardiner D, Perkins GD; PARAMEDIC2 Collaborators. **Cost-effectiveness of adrenaline for out-of-hospital cardiac arrest**. *Critical Care*. 2020 Sep 27;24(1):579. doi: 10.1186/s13054-020-03271-0. PMID: 32981529; PMCID: PMC7520962.	9.3	36
	England E, Deakin CD, Nolan JP, Lall R, Quinn T, Gates S, Miller J, O'Shea L, Pocock H, Rees N, Scomparin C, Perkins GD. **Patient safety incidents and medication errors during a clinical trial: experience from a pre-hospital randomized controlled trial of emergency medication administration**. *European Journal of Clinical Pharmacology*. 2020 Oct;76(10):1355-1362. doi: 10.1007/s00228-020-02887-z. Epub 2020 Jun 14. PMID: 32535646.	2.7	11
	Perkins GD, Kenna C, Ji C, Deakin CD, Nolan JP, Quinn T, Scomparin C, Fothergill R, Gunson I, Pocock H, Rees N, O'Shea L, Finn J, Gates S, Lall R. **The influence of time to adrenaline administration in the Paramedic 2 randomised controlled trial.** *Intensive Care Medicine*. 2020 Mar;46(3):426-436. doi: 10.1007/s00134-019-05836-2. Epub 2020 Jan 7. PMID: 31912202; PMCID: PMC7067734.	26.1	77

Publications

Study	Selected publications	Journal impact factor	Citations
PARAMEDIC-3	Couper K, Ji C, Deakin CD, Fothergill RT, Nolan JP, Long JB, Mason JM, Michelet F, Norman C, Nwankwo H, Quinn T, Slowther AM, Smyth MA, Starr KR, Walker A, Wood S, Bell S, Bradley G, Brown M, Brown S, Burrow E, Charlton K, Claxton Dip A, Dra'gon V, Evans C, Falloon J, Foster T, Kearney J, Lang N, Limmer M, Mellett-Smith A, Miller J, Mills C, Osborne R, Rees N, Spaight RES, Squires GL, Tibbetts B, Waddington M, Whitley GA, Wiles JV, Williams J, Wiltshire S, Wright A, Lall R, Perkins GD; PARAMEDIC-3 Collaborators. **A Randomized Trial of Drug Route in Out-of-Hospital Cardiac Arrest**. *New England Journal of Medicine*. 2025 Jan 23;392(4):336-348. doi: 10.1056/NEJMoa2407780. Epub 2024 Oct 31. PMID: 39480216; PMCID: PMC7616768.	78.5	48
	Hooper A, Nolan JP, Rees N, Walker A, Perkins GD, Couper K. **Drug routes in out-of-hospital cardiac arrest: A summary of current evidence**. *Resuscitation*. 2022 Dec;181:70-78. doi: 10.1016/j.resuscitation.2022.10.015. Epub 2022 Oct 26. PMID: 36309248.	4.6	32
	Couper K, Ji C, Lall R, Deakin CD, Fothergill R, Long J, Mason J, Michelet F, Nolan JP, Nwankwo H, Quinn T, Slowther AM, Smyth MA, Walker A, Chowdhury L, Norman C, Sprauve L, Starr K, Wood S, Bell S, Bradley G, Brown M, Brown S, Charlton K, Coppola A, Evans C, Evans C, Foster T, Jackson M, Kearney J, Lang N, Mellett-Smith A, Osborne R, Pocock H, Rees N, Spaight R, Tibbetts B, Whitley GA, Wiles J, Williams J, Wright A, Perkins GD. **Route of drug administration in out-of-hospital cardiac arrest: A protocol for a randomised controlled trial (PARAMEDIC-3)**. *Resuscitation Plus*. 2023 Dec 30;17:100544. doi: 10.1016/j.resplu.2023.100544. PMID: 38260121; PMCID: PMC10801302.	2.4	7
RIGHT-2	RIGHT-2 Investigators. **Prehospital transdermal glyceryl trinitrate in patients with ultra-acute presumed stroke (RIGHT-2): an ambulance-based, randomised, sham-controlled, blinded, phase 3 trial**. *Lancet*. 2019 Mar 9;393(10175):1009-1020. doi: 10.1016/S0140-6736(19)30194-1. Epub 2019 Feb 6. PMID: 30738649; PMCID: PMC6497986.	88.5	92
RAPID	Jones JK, Evans BA, Fegan G, Ford S, Guy K, Jones S, Keen L, Khanom A, Longo M, Pallister I, Rees N, Russell IT, Seagrove AC, Watkins A, Snooks HA. **Rapid Analgesia for Prehospital hip Disruption (RAPID): findings from a randomised feasibility study.** *Pilot and Feasibility Studies* 2019 Jun 12;5:77. doi: 10.1186/s40814-019-0454-1. PMID: 31210961; PMCID: PMC6560881.	1.6	18
DRONES	Smith CM, Powell C, Bernstein CJ, Howe H, Holt M, O'Sullivan M, Couper K, Rees N. **The use of drone-delivered Automated External Defibrillators in the emergency response for out-of-hospital cardiac arrest. A simulation study.** *Resuscitation Plus*. 2025 Jul 25;25:101045. doi: 10.1016/j.resplu.2025.101045. PMID: 40821007; PMCID: PMC12355114.	2.4	-

Thank you for supporting Welsh Ambulance Service research

For any questions and/or support, please contact the Research Team:

Amb_Research.Development**@wales.nhs.uk**

https://ambulance.nhs.wales/about-us/research-and-development/

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Today's research, tomorrow's care