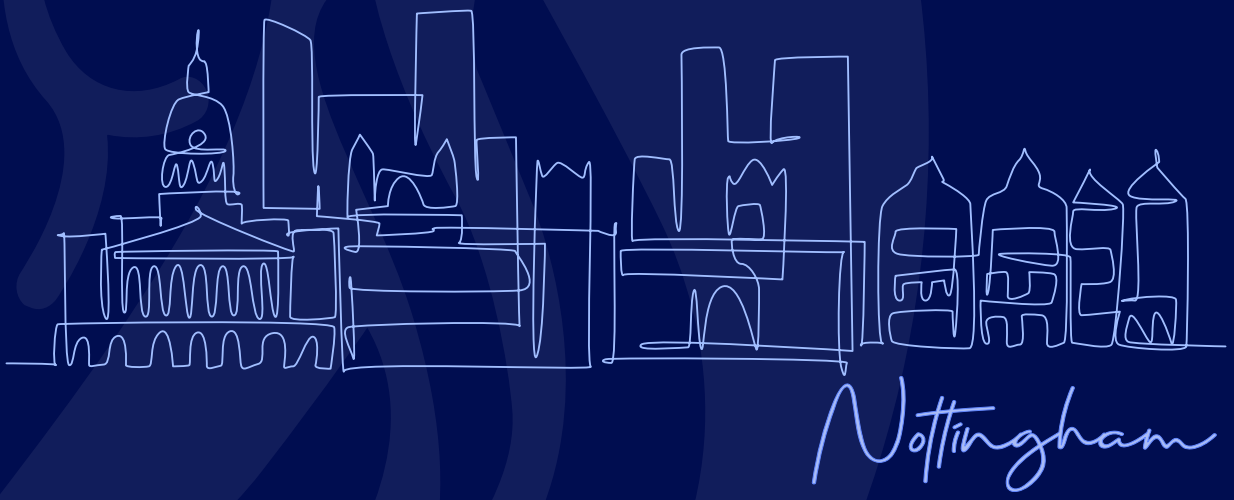
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2026 ABSTRACTS



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Mike Adamek

BIOGRAPHY

Mike is a healthcare practitioner with nearly 2 decades of experience across a range of clinical roles, primarily within critical care. His interest in cardiac care developed whilst working in PICU, where exposure to ECMO inspired him to pursue a career in Perfusion. He qualified as a Perfusionist in 2018 and has since worked in senior perfusion roles, gaining extensive experience in cardiopulmonary bypass and extracorporeal support.Mike is currently Deputy Perfusionist at Spire Southampton Hospital. He has a particular interest in introducing innovative technologies, driving improvements in clinical standards, and service quality.

ABSTRACT

From Business Case to Bedside: A 12-month review of the procurement, implementation and clinical use of the “Mr Frosty” at Spire Southampton.

In 2025, Spire Southampton Hospital procured the "Mr Frosty" heater-cooler system as part of a wider initiative to modernise its perfusion equipment, replace an ageing and increasingly unreliable water-based heater-cooler fleet, and enhance clinical practice and safety.

Spire Southampton was the first centre in the UK to transition from a water-based to a glycol-based heater-cooler system. The introduction of this technology has delivered significant operational benefits; improving efficiency whilst eliminating the risk of heater-cooler-associated mycobacterial contamination.

This presentation provides a retrospective review of the journey from initial business case development through procurement, implementation, and staff training to established clinical use during the first 12 months following adoption. All stages of the project were examined to identify key successes, challenges, and lessons learned. The presentation aims to provide perfusionists with a practical, user-based evaluation of the “Mr Frosty” system, together with guidance for departments considering the procurement and implementation of this technology within their own clinical practice.



Peter O'Sullivan

BIOGRAPHY

Peter is a newly graduated perfusionist from Kerry, working in Beacon hospital Dublin. He has a background in neuro and cardiac physiology and completed this research as part of his MSc with the University of Bristol.

ABSTRACT

Haemolysis In Cardiopulmonary Bypass: A Prospective Oxygenator Comparison

Background: Haemolysis is a well-established complication of cardiopulmonary bypass (CPB), primarily arising from mechanical shear stress imposed on erythrocytes by circuit components. Despite widespread clinical use of multiple oxygenator models, comparative data on device-specific haemolysis in adult cardiac surgery remains limited.

Aim: This study aimed to compare levels of haemolysis caused between two oxygenator models, the Terumo Capiox FX25 and the Sorin Inspire 8F, during adult CPB for a range of cardiac surgeries.

Methods: A prospective observational study was conducted at Beacon Hospital Dublin. Haemolysis was quantified using Roche Cobas haemolysis index (H-index). Two oxygenator groups were established (n = 52 patients; 26 per oxygenator) and a third exploratory group was reported on using the Maquet Quadrox (n = 7). The primary outcome was defined as the change in H-index from pre-bypass to 60 minutes on bypass (ΔH). Normality was tested using the Shapiro-Wilk test. Differences between oxygenators were analysed using Mann-Whitney U test. Analysis of covariance (ANCOVA) was performed on log-transformed ΔH to adjust for baseline H-index, and a Spearman correlation examined the relationship between pressure drop and ΔH.

Results: The Inspire 8F was associated with a statistically significant greater haemolysis than the Capiox FX25 (median ΔH 22.5 [IQR 21] vs 16.5 [IQR 14.5], W = 219.5, p = 0.031). This difference persisted after adjustment for baseline H-index with ANCOVA. No correlation was observed between pressure drop across the oxygenator and ΔH.

Conclusion: The Sorin Inspire 8F was associated with greater ΔH than the Terumo Capiox FX25. Although these findings do not warrant routine practice change, these findings suggest that oxygenator selection warrants consideration in high-risk cases and haemolytically vulnerable patients.



Joseph Hughes

BIOGRAPHY

Joseph Hughes is the ECMO lead for the Perfusion Department at Harefield Hospital in north London. He first trained and qualified at University Hospitals Birmingham, before moving to Harefield Hospital where his interests have developed to include ECMO, mechanical circulatory support and the emerging field of pre-hospital ECMO.

ABSTRACT

A shocking 5 years? Service and departmental developments during the first 5 years of a Cardiogenic Shock ECMO and eCPR service.

As a hospital already providing a busy out of hours primary PCI service alongside cardiothoracic transplantation, ECMO has always been a core part of the service for the Perfusion Department at Harefield Hospital. In 2021 the formal introduction of a service to provide ECMO for cardiogenic shock and eCPR presented multiple departmental and service level challenges. This oral presentation aims to summarise the developments made in the Perfusion, Surgical and Critical Care departments over the last 5 years in order to meet the challenges presented by this expanding area of ECMO.





Dominic Summers

BIOGRAPHY

Dominic is a Consultant Transplant Surgeon at Addenbrooke's Hospital and an Affiliated Assistant Professor at the University of Cambridge. His main clinical interests are kidney and pancreas transplantation, along with vascular access surgery (creating access for patients to receive dialysis). Dominic's research interests includes epidemiological studies evaluating risk in transplantation and patient outcomes, clinical trials, and development of new types of organ donation pathways. He is the transplant lead in the East of England Renal Network and the Chief investigator of the UK pilot study of Uncontrolled Donation after Circulatory Death.

ABSTRACT

Organ Donation Following Sudden Out Of Hospital Cardiac Arrest

Introduction: There are only 1300 deceased organ donors a year in the UK, despite popular support for donation. France and Spain have successfully managed allow some patients who have out-of-hospital cardiac arrests and don't survive, to become organ donors. There are 34 000 out-of-hospital cardiac arrests in UK per year – this study aimed to see if this type of organ donation and kidney transplantation was feasible in the UK.

Methods/case presentation: This was a single centre feasibility study based at Addenbrooke's Hospital in Cambridge. Patients were aged 60 years with a witnessed out-of-hospital cardiac arrest and start of cardio-pulmonary resuscitation (CPR) <15 mins following arrest. Patients were transported in cardiac arrest to the emergency department of Addenbrooke's. If they were not able to be resuscitated successfully, CPR ceased and, following verbal agreement with family, patients were placed on normothermic regional perfusion via a groin incision, with occlusion of the descending thoracic aorta using an endoclamp device. Kidneys were recovered after formal consent and characterisation were complete and transplanted into pre-consented recipients.

Results/outcome: The study is currently ongoing, but to date we have transported 8 patients to the emergency department with the intention of offering organ donation, and cannulated 4 for the purposes of normothermic regional perfusion. We have successfully transplanted 2 kidneys in patients on the transplant waiting

list.

Discussion: Kidney transplantation following uncontrolled donation after circulatory death is possible in the UK and shows potential for increasing the number of kidneys for transplantation. We are now developing a new combined ECMO-Cardiopulmonary resuscitation (eCPR) -first, with organ donation offered if eCRP is unsuccessful.





Mya Rai

BIOGRAPHY

Mya Rai is a Clinical Perfusionist at Basildon Hospital with a BSc in Physiology from University College London and an MSc in Perfusion Science from the University of Bristol. She has a particular interest in clinical research and evidence-based practice.

ABSTRACT

The 3/8-inch Venous Line: Conserving Blood, but Not Preserving It?

Background: Haemodilution from the cardiopulmonary bypass (CPB) prime is a modifiab factor associated with patient outcomes, and circuit tubing contributes substantially to prime volume. Narrowing the venous line from 1/2-inch to 3/8-inch lowers venous line volume by approximately 44% but raises flow velocity, wall shear stress and hydraulic resistance, potentially requiring vacuum-assisted venous drainage (VAVD). Increased mechanical stress and VAVD have been implicated in red blood cell (RBC) injury, so a strategy intended to limit haemodilution may damage the cells it is designed to conserve.

Aim: To determine whether reducing venous calibre from 1/2-inch to 3/8-inch increases haemolysis during simulated CPB, whether VAVD magnitude does so independently, and whether the two interact.

Methods: A closed-loop benchtop CPB circuit was run with porcine erythrocytes at a haematocrit of 30%. Venous calibre (3/8-inch versus 1/2-inch) was crossed with four VAVDlevels (0, 20, 40 and 60 mmHg), giving eight two-hour runs at 5 L/min. Blood was sampled at five time points and plasma free haemoglobin (PfHb) measured, giving 40 observations, analysed by linear mixed-effects regression with a random intercept for run.

Results: No difference in ΔPfHb was detected between the 3/8-inch and 1/2-inch lines ($p = 0.715$), across VAVD levels ($p = 0.708$), or for the calibre × VAVD interaction ($p = 0.398$). Circulation time was the only predictor for which an association was detected ($\beta = 0.036$ per minute on the $\ln(\Delta PfHb + 1)$ scale, 95% CI 0.029 to 0.043; $p < 0.001$).

Conclusion: Reducing venous calibre and applying moderate VAVD produced no statistically detectable increase in overt haemolysis under the conditions tested. However, the unreplicated experimental design limits the reliability of these findings, and sublytic RBC injury cannot be excluded. The safety of the narrower line therefore remains unestablished in the model and requires further investigation.





Saeed Taiyari, MSc, CCP

BIOGRAPHY

Saeed Taiyari, MSc, CCP, is a Senior Clinical Perfusion Scientist at Great Ormond Street Hospital NHS Foundation Trust in London. His clinical interests include cardiopulmonary bypass, extracorporeal support, haemolysis reduction, blood conservation and perfusion management of complex high-risk patients. He has a particular interest in developing practical perfusion strategies to improve patient safety and clinical outcomes.

ABSTRACT

Modified Cardiopulmonary Bypass Strategy for Severe G6PD Deficiency During Coronary Artery Bypass Grafting: A Practical Perfusion Technique

Background: Severe glucose-6-phosphate dehydrogenase (G6PD) deficiency presents unique challenges during cardiopulmonary bypass (CPB) because of increased susceptibility to oxidative injury and haemolysis. Published guidance regarding optimal perfusion management remains limited, particularly in patients with a history of severe haemolytic complications and renal dysfunction.

Technique: A 63-year-old male with severe G6PD deficiency, a previous dialysis-requiring haemolytic crisis, chronic renal impairment and residual hemiparesis following a cerebrovascular accident underwent urgent three-vessel coronary artery bypass grafting. A modified CPB strategy was developed to minimise oxidative stress and mechanical haemolysis. Key components included controlled oxygenation (PaO_2 approximately 10 kPa), alpha-stat management, tepid blood cardioplegia, minimisation of cardiotomy suction and blood-air interface exposure, albumin-enriched priming, continuous haemofiltration, and avoidance of oxidant medications, including methylene blue. Oxygen delivery and haematocrit were maintained to support end-organ perfusion and reduce renal hypoxic stress.

Results: CPB duration was 112 min, with an aortic cross-clamp time of 76 min. No clinically significant intravascular haemolysis or haemoglobinuria occurred. Plasma free haemoglobin, bilirubin and lactate dehydrogenase elevations were modest and transient. A single postoperative haemodialysis session was required, after which renal function improved without ongoing renal replacement therapy. The patient was discharged on postoperative day seven without evidence of delayed haemolysis.

Conclusion: A carefully modified CPB strategy focused on reducing oxidative stress, preventing haemolysis and protecting renal function may facilitate successful cardiac surgery in selected patients with severe G6PD deficiency. This report provides a practical perfusion approach for managing patients at exceptionally high risk of peri-operative haemolytic complications.



BIOGRAPHY

Kirsty Dempster is a Partner at Cambridge Perfusion with more than 30 years' experience in clinical perfusion. After training at Bristol Royal Infirmary, she joined Royal Papworth Hospital in 1994 and has worked across cardiac surgery, organ retrieval, liver transplantation, VAD programmes and ECMO services. Kirsty became a line manager in 2006, combining a full clinical role with operational leadership and responsibility for quality management systems, including ISO 9001. Since becoming a Partner in 2016, she has balanced business leadership with continued clinical practice, maintaining a strong commitment to excellence in patient care and service delivery.

ABSTRACT

ECMO to LVAD in heparin-induced thrombocytopenia: a perfusion approach to bivalirudin on cardiopulmonary bypass

Background: Patients bridged from ECMO to a durable left ventricular assist device (LVAD) are among the sickest entering mechanical circulatory support. Heparin-induced thrombocytopenia (HIT) complicates surgery further. Bivalirudin has no reversal agent and is cleared by proteolysis, so any stagnant blood in the bypass circuit can clot.

Case: A 50-year-old woman had a late-presenting anterior STEMI, then a refractory in-hospital PEA arrest. She was rescued with extracorporeal CPR and converted to central VA-ECMO with an LV vent. Her course was complicated by bleeding, acute kidney injury and HIT. With no LV recovery, an RV stress test on ECMO supported implantation of a HeartMate 3 as a bridge to transplant. At operation on day 28 she had a thin, aneurysmal LV, a re-do chest and thrombus on the pulmonary vein vent, and required heparin-free bypass.

Perfusion management: Guidelines and the CHOOSE-ON and EVOLUTION-ON trials supported bivalirudin: 50 mg in the prime, a 1.0 mg/kg bolus and a 2.5 mg/kg/hr infusion, split between the venous line and the central line. ACT was checked every 10–15 minutes. To avoid stasis we used two cell savers for all shed blood and vents, no pump suckers, a low reservoir level, crystalloid cardioplegia, no haemofiltration and temperature of 34°C or above. Bypass time was 169 minutes and cross-clamp time 60 minutes.

Outcome: The chest was closed on day 30 and she was extubated on day 33. Renal function recovered and she was discharged home on day 56 on warfarin. Both cell savers developed clot, suggesting that a higher ACD-A rate was needed.

Conclusion: Bivalirudin on bypass can be safe and effective in HIT, but needs a team protocol, attention to stasis, anticipation of bleeding and early transfusion planning.



Matthew Donald

BIOGRAPHY

Matthew Donald is a recently qualified Clinical Perfusionist at the Golden Jubilee National Hospital in Glasgow, Scotland. Before pursuing a career in perfusion, Matthew worked as a Biomedical Scientist specialising in Haematology and Blood Transfusion. Matthew's background in transfusion science inspired his MSc dissertation, investigating the association between intraoperative red blood cell transfusion and prolonged ICU stay following cardiac surgery. Matthew's professional interests include patient blood management, blood conservation and improving outcomes following cardiac surgery.

ABSTRACT

Association Between Intraoperative Red Blood Cell Transfusion and Prolonged ICU Length of Stay Following Routine Cardiac Surgery: A UK Single-Centre Retrospective Study.

Background: Red blood cell (RBC) transfusion is frequently used during cardiac surgery to maintain oxygen delivery and manage blood loss. However, increasing transfusion exposure has been associated with adverse postoperative outcomes, including prolonged intensive care unit (ICU) length of stay (LOS). This study investigated the association between intraoperative RBC transfusion and prolonged ICU LOS following routine adult cardiac surgery.

Methods: A retrospective single-centre observational study was conducted using prospectively collected audit data from 1,632 adults undergoing routine cardiac surgery at the Golden Jubilee National Hospital between May 2024 and April 2026. Patients were grouped according to intraoperative RBC transfusion exposure: 0 units, 1-2 units, or greater than/equal to 3 units. The primary outcome was prolonged ICU LOS, defined as greater than/equal to 72 hours. Binary logistic regression was used to estimate unadjusted and adjusted odds ratios for prolonged ICU LOS across transfusion groups.

Results: Of 1,632 patients, 1,431 received no intraoperative RBC transfusion, 167 received 1-2 units, and 34 received greater than/equal to3 units. Prolonged ICU LOS occurred in 10.6%, 24.6%, and 50.0% of patients, respectively ($p<0.001$). In unadjusted analysis, the odds of prolonged ICU LOS were higher in patients receiving 1-2 units (OR 2.76, 95% CI 1.85-4.05) and greater than/equal to3 units (OR 8.48, 95% CI 4.21-17.1) compared with no transfusion. After adjustment for clinically relevant patient and operative factors, RBC transfusion group remained independently associated with prolonged ICU LOS overall ($p=0.026$). The adjusted odds ratio was 1.51 (95% CI 0.93-2.41) for 1-2 units and 2.92 (95% CI 1.20-6.87) for greater than/equal to 3 units.

Conclusion: Increasing intraoperative RBC transfusion exposure was associated with progressively higher odds of prolonged ICU LOS, with the strongest evidence observed in patients receiving greater than/equal to 3 units. Causation cannot be established because of the retrospective design and residual confounding. These findings support careful transfusion decision-making and further evaluation of patient blood management strategies to reduce unnecessary transfusion exposure.



Michael Van Driel

BIOGRAPHY

In his role as Vice President of International Business Development and a mechanical engineer with over thirty-five years of experience in perfusion technology development, market introduction and business development in Europe, Middle East, Africa, Canada and Australia/New Zealand, Mike is three years into a new startup company called Lifemotion Medical Technology. As a part of the executive leadership team, Mike is also the General Manager of the manufacturing facility being built in Mirandola, Italy for new and exciting ECLS/ECMO technology and the global market. Mike is a long-time advocate of perfusion technology, continuous Training and Education, and the profession of perfusion as a whole, having a fierce loyalty to the field while holding a strong commitment to bringing innovation into everyday use, as well as a commitment to continued supply and product availability.

ABSTRACT

Lifemotion System For Long Term Support

Lifemotion founded 2013 originally in Germany as a Sino Italian technology venture was able to bring a modular, reliable, transportable long term support system that is extremely user friendly and easy to adopt to routine clinical use – Safe, Simple, Smart. This presentation sponsored by Lifemotion Srl in Mirandola, Italy will feature an update on the new technical and clinical characteristics of the Lifemotion system for long term support. Clinical data and experience locally from the UK as well as abroad will be shared, providing a one year snapshot into launch post CE MDR, perspectives from different clinics, and opportunities for expanding access to different countries while continuously focusing on product feature-set improvement.





Ryan Sapiandante

BIOGRAPHY

Ryan Sapiandante is a Clinical Perfusionist with over 18 years of experience in cardiac perfusion across the Philippines, Saudi Arabia, and the United Kingdom. For the past eight years, he has worked at the University Hospitals Bristol ad Weston NHS Foundation Trust, support both and adult and paediatric cardiac surgical services. His clinical expertise encompasses cardiopulmonary bypass (CPB) and extracorporeal support with particular interests in paediatric perfusion, quality improvement and clinical research aimed in advancing evidence-based practice and improving patient outcomes.

ABSTRACT

Paediatric Cardiopulmonary Bypass Priming Practices

Background: Cardiopulmonary bypass (CPB) involves the administration of crystalloid and colloid solutions to facilitate extracorporeal circulation. In paediatric patients, fluid selection is particularly critical due to smaller circulating volumes and an increased risk to haemodilution. Despite its clinical significance there is no standardised approach to CPB priming and contemporary UK and Ireland data remains limited.

Aim: To evaluate contemporary paediatric priming practices across UK and Ireland, examine crystalloid and colloid selection and identify variations in practice and key factors influencing clinical decision-making.

Methods: A cross-sectional national survey was distributed electronically across paediatric cardiac centres in the UK and Ireland between November 2024 and January 2025. The questionnaire included seven questions exploring priming composition, decision-making and monitoring practices, incorporating both multiple-response and free-text items. Responses were anonymised and analysed using descriptive statistics and thematic analysis.

Results: Ten centres participated in the survey. Plasmalyte-148 was the predominant crystalloid, reported by eight centres while one centre used Ringer's solution. In contrast, the use of colloids varied considerably between centres. Packed red blood cells were used universally, however the use of Gelofusine, fresh frozen plasma and human albumin solution were used inconsistently with no single preferred strategy identified. Priming decisions were mainly guided by institutional protocols, clinician experience, and technical considerations such as prime volume, with limited reporting of physiological parameters that influence decision-making. All centres monitored metabolic parameters including glucose and lactate, however only two measured albumin.

Conclusion: Paediatric CPB priming practices remain variable across the UK and Ireland. While crystalloid selection is relatively consistent, colloid strategies remain heterogeneous and largely protocol-driven. Decision-making is primarily influence by protocol, clinical experience and technical considerations, with limited reporting of physiological parameters. These findings highlight ongoing variation in practices and support the need for future collaboration and research between centres to improve patient care.



Ben Fryer

BIOGRAPHY

Ben is a recently qualified Clinical Perfusion Scientist at the Royal Brompton Hospital in London. Prior to pursuing a career in perfusion, Ben spent ten years working as a nurse in specialities including intensive care, ECMO and both adult and paediatric organ donation. His special interests include oxygenator development, membrane thrombosis and teaching Advanced Life Support. Away from the clinical environment, Ben enjoys walking his two dogs and learning new languages.

ABSTRACT

Neurological outcomes measured at follow-up clinic after the institution of Extracorporeal Membrane Oxygenation in the setting of cardiopulmonary resuscitation (ECPR) in paediatric patients: a single-centre retrospective observational cohort study.

Background and Aims: Children undergoing veno-arterial extracorporeal membrane oxygenation for in-hospital cardiac arrest (ECPR) are at risk of poor neurological outcomes over time. This study investigated relationships between clinical parameters in the six hours prior to ECPR cannulation and neurological outcome as assessed at follow-up clinic after discharge.

Methods: A single-centre retrospective observational cohort data analysis was undertaken of Paediatric Cerebral Performance Category (PCPC) scores, measured at follow-up clinic appointments over time, from children who survived to hospital discharge after being cannulated for ECPR (n=22). These were measured by neurodevelopmental physiotherapists. Variables assessed were worst pH and worst PaCO2 prior to ECPR, in addition to cannulation site and duration of ECMO run. Groups were statistically analysed by favourable (n=19) and unfavourable (n=3) outcomes in addition to analysis by individual PCPC score. ECMO duration was assessed against distribution across PCPC score groups and an analysis undertaken to examine ordered trends in pattern.

Results: A weak, negative correlation was identified with an association between lower pH values and worse PCPC scores plus finding that hypercapnia may be associated with slightly improved neurological recovery, however these findings did not reach statistical significance. A descriptive gradient was established, showing worse neurological outcomes occurred more frequently in patients cannulated in the right carotid or femoral vessels than in the aorta but this did not reach statistical significance. When assessed against duration, there was a statistically significant ordered trend towards longer ECMO runs and worsening PCPC scores (p=0.002).

Conclusions: This small study demonstrated that as ECMO run duration increased in this cohort of paediatric ECPR patients PCPC scores deteriorated, representing worse neurological injury as assessed at longitudinal follow-up clinic appointments. There may be associations between acidaemia, hypercapnia and cannulation site in terms of neurological function, but this study was underpowered to demonstrate this.





Leigh-Anne Brooks

BIOGRAPHY

Leigh-Anne qualified in Perfusion Science in September 2026 and work at the Freeman Hospital in Newcastle, which provides adult, congenital and paediatric perfusion services. She spent over eight years in Newcastle's Cardiothoracic ITU, progressing to Sister before starting my career in Perfusion Science. This experience provided her with extensive critical care knowledge and skills in managing complex clinical situations. Leigh-Anne has a particular interest in simulation-based learning and education, exploring how structured in-house training can improve performance, enhance staff confidence and ultimately improve patient safety and outcomes.

ABSTRACT

Enhancing Emergency Protocol Training: Evaluating the Impact of Video-Based Learning on Clinical Performance and Staff Confidence

Background: Cardiopulmonary bypass (CPB) emergencies are rare but potentially catastrophic events requiring rapid recognition and action from perfusionists. Written protocols remain central to perfusion training however, video-based learning is increasingly popular in healthcare education offering potential to improve procedural recall and performance in emergencies.

Aim: To evaluate the effectiveness of video-enhanced training on perfusionists' performance, confidence and preparedness when managing CPB emergencies, whilst also exploring its potential for wider implementation.

Methods: A multicentre survey of current CPB emergency training practices, across perfusion centres in Great Britain and Ireland, and a single-centre study assessing video-based education. A prospective, simulation-based, experimental study was conducted with 12 perfusionists. Participants undertook a baseline simulation, were randomised by performance then allocated to a control or intervention group. The control group repeated the simulation without additional training, whereas the intervention group viewed a boot-pump rupture simulation video three times. Participants were re-assessed and paired outcomes analysed using Wilcoxon signed-rank.

Results: The survey received 140 responses (28.8%) from perfusionists. Training provision varied with 22.1% reporting informal or ad hoc training and 7.9% no formal training. Hands-on (53%) and visual (27%) learning was preferred, although 69.7% reported their preferred style was not supported. 73.6% of respondents considered video-based training effective, although only 32.1% had experienced it previously. The simulation study (n=12), revealed video training reduced completion time by 32%, procedural errors by 81.1%, whilst protocol adherence was increased by 40%. Small, non-significant control-group improvements were also present.

Conclusion: Predominantly reliant on in-house learning and mentorship providing essential hands-on, the multicentre survey identified anomalies in perfusion training and a need for more a structured, practical, standardised education. The simulation study evidenced video-based emergency training resulting in faster completion times, fewer errors and critical omissions, improved protocol adherence and reduced facilitator prompting compared to without it.