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The Academy Newsletter

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Message from the AACP President

Dear Fellow Members,

As I sit down to write this letter, I find myself reflecting on how much ground we have covered since gathering together in St. Petersburg this past February. The work of a presidential year has a way of sneaking up on you — each month feels manageable in isolation, and then you pause and look at the whole of it and realize the scope of what this community has accomplished together. Committees have met, speakers have committed, legislative hearings have been attended, and collaborative conversations that once lived only on wish lists are now on the calendar. I am genuinely proud of what the Academy and its members have set in motion, and I am grateful for the opportunity to share some of it with you here. There is much to cover — scope of practice, licensure advocacy, our upcoming meeting in Salt Lake City, the role of artificial intelligence in our field, and the kind of behind-the-scenes organizational work that rarely makes headlines but quietly defines where a profession is headed. So let's get into it.

Coming Together: The ABCP Liaison Panel

One of the most consequential developments in our organizational landscape right now is the formalization of the ABCP Liaison Panel — a collaborative body that brings together representatives from the American Board of Cardiovascular Perfusion (ABCP), the American Academy of Cardiovascular Perfusion (AACP), the American Society of ExtraCorporeal Technology (AmSECT), the Accreditation Committee – Perfusion Education (AC-PE), the Perfusion Program Directors Council (PPDC), and the Canadian Society of Clinical Perfusion (CSCP). This is not simply a meeting of organizational presidents exchanging updates. It is — or is becoming — something with real teeth: a standing, ongoing working body with shared business, shared accountability, and a shared commitment to the long-term health of this profession.

The panel convened in February 2026 at our Annual Meeting in St. Petersburg, and the conversation was as substantive as any I have participated in at the organizational level. A second meeting was held on May 4th with focus on the panel's formal purpose, meeting cadence, the right composition of representation, and near-term action items. Minutes from that session are being finalized, and I will share them through the usual channels once complete.

The February meeting surfaced a recurring and urgent theme: the question of Normothermic Regional Perfusion and who owns it. NRP is expanding rapidly as a modality in deceased donor organ procurement. Perfusionists are the trained professionals most logically suited to perform it — it is extracorporeal circulation, full stop. And yet, without deliberate, organized advocacy, we risk watching it migrate into other hands the way ECMO has, in some institutions, drifted away from CCP oversight. The panel recognized this plainly. The conversation turned not just to what the right answer is, but to what it will take to defend it.

Among the action items that emerged: each participating organization was asked to return to its governing body and secure approval to work together as a formal Liaison Committee meeting on a quarterly basis — not just for annual updates, but for ongoing, collaborative work. The Liaison Panel has also identified engagement with the Organ Procurement and Transplantation Network (OPTN) as a specific priority. OPTN is a standard-setting body with direct influence over how organ procurement procedures are defined, credentialed, and governed. Perfusionists need a seat at that table, and the Liaison Panel is positioned to help us earn it.

There was also candid discussion about the economics of advocacy. Licensure work is expensive. Lobbying is expensive. And the profession's fragmentation — between organizations, between states, between clinical settings — has historically made it difficult to build the kind of financial and political mass that moves legislative bodies. Several panel members raised the idea of a shared, pooled mechanism for funding professional lobbying efforts, with the most successful licensure states being those organized around active state perfusion societies. We will continue to develop that conversation.

One specific observation from the meeting has stayed with me. Ed Delaney put it plainly: the biggest lobbyist wins. Nurses win their scope battles because there are hundreds of thousands of them, organized, funded, and present in every state legislature. We are not nurses in terms of numbers — but we can be disciplined, coordinated, and strategic in ways that compensate for our size. The Liaison Panel, if we build it correctly, is how we do that.

Scope of Practice and the Work of Licensure

On May 8th, members of our advocacy community joined together — remotely, and on barely sixteen hours' notice — to oppose a proposed executive action that would have eliminated Nevada's existing perfusion licensure as a cost-saving measure. Let me say that again: a state that had already done the work of establishing licensure was at risk of losing it with the stroke of a pen. The response from our community was immediate. Perfusionists, organizational representatives, and advocates across the country logged on, made their voices heard, and ensured that our opposition and the reasoning behind it became part of the official public record. I am proud of everyone who showed up on that call with almost no lead time. It is exactly the kind of rapid, organized response that demonstrates what this profession is capable of when we are paying attention — and it is a sobering reminder that licensure, once won, is not permanent. It must be defended.

That reality shapes how we need to think about the broader licensure landscape. There are currently somewhere between sixteen and eighteen states with active perfusion licensure, and the long-term goal is a national framework strong enough to support reciprocity — so that a credentialed, licensed perfusionist can move across state lines without encountering a regulatory void that creates risk for the practitioner, the program, and most importantly, the patient. Getting there requires sustained, state-by-state effort. It also requires that states which have already achieved licensure remain vigilant, because as Nevada illustrated, the work does not end at the finish line.

The ABCP has laid important groundwork. Letters of support for perfusion licensure have been drafted, endorsed by multiple organizations, and distributed to licensure boards, organ procurement organizations, and donor service areas across the country. Those tools are available to anyone who needs them. AmSECT's Government Relations arm has also been active in this space, and the Liaison Panel discussions have reinforced the value of aligning our collective efforts rather than each organization pulling in its own direction.

I would be remiss not to name my own state in this conversation. Washington has outstanding health systems, a strong clinical community, and perfusionists who are as capable as any in the country. It does not have a perfusion licensure statute. That needs to change, and I intend to be part of changing it. If you are based in Washington, have connections to the state legislature, or simply have an interest in contributing to that effort, please reach out. This is not work any one person accomplishes alone — and frankly, that is exactly the point.

Salt Lake City 2027: A Program Taking Shape

Planning for the 48th Annual Seminar at the Hilton Salt Lake City Center — February 3 through 6, 2027 — is well underway, and the Program Committee has been doing genuinely excellent work. We are targeting program finalization in June, and what is coming together reflects both the breadth of our clinical landscape and the particular urgency of this moment in the profession.

The meeting opens Wednesday evening with Pro/Con Debates — a format our members have consistently told us they value for the intellectual energy it generates and the honest disagreement it models. We have structured debates on hypobaric versus traditional oxygenation approaches and on the question of perfusionist-led versus expanded-operator management of ECMO, VAD, and NRP. The second of those debates is not abstract — it is a proxy for the scope-of-practice conversation we have been having all year.

Thursday features an Emerging Technologies and Novel Interventions panel in the morning, covering physiologic perfusion systems, rapidly deployable ECMO catheters, catheter-based gas exchange tech-

nology, and microvascular perfusion monitoring beyond conventional DO2 thresholds. The afternoon splits into concurrent tracks — a Congenital and Pediatric Perfusion session in the main ballroom and an Administrative and Leadership track in the Canyon Room covering team dynamics, psychological safety in multidisciplinary environments, and practical leadership frameworks for the clinical setting. Industry sponsor programming runs concurrently.

Friday morning opens with a dedicated Special Scientific Panel on AI in Perfusion and Data Registries. The afternoon brings a Transplant and Organ Preservation panel covering NRP from fresh angles, ex vivo organ technologies, preservation strategies, novel kidney procurement approaches, and the current state and outlook of xenoheart transplantation — a session that will land directly alongside the advocacy work the Liaison Panel is undertaking with OPTN. Friday closes with the Memorial Session and the Charles C. Reed Memorial Lecture, which this year takes on the relationship between artificial intelligence and expert development in our field — more on that below.

Saturday closes the scientific program with a Hot Topics and Circuit Science session, covering percutaneous hepatic perfusion, inflammatory response reduction, hyperthermic extracorporeal tumor therapy, and generational differences in perfusion education and communication.

Running throughout Thursday and Friday are five concurrent Fireside Chat sessions per block — intimate, facilitated discussions that have become one of the most valued parts of any AACP meeting. Saturday features a smaller number of concurrent chats, intentionally scaled to keep the rooms full and the conversations rich. Topics span the full breadth of what our community is thinking about: ECMO staffing models, wellness and burnout, onboarding practices, the state of licensure, transplant developments, veterinary perfusion, global health, and more. The Fireside Chat Committee has also proposed integrating a Perfusion Journal Club element into each block, with moderators selecting two or three recently published articles for group discussion — a welcome addition that takes advantage of the fact that, as Academy members, we all have legitimate access to the literature.

If you have interest in presenting, facilitating, or submitting a case report for consideration, please connect with your committee representatives. This program is still being built, and it is better for the involvement of more voices.

Artificial Intelligence: Opportunity, Caution, and Our Responsibility

Artificial intelligence deserves thoughtful, unhurried engagement from our profession — not the reflexive enthusiasm of early adopters, and not the defensive skepticism of those who see in it only threat. The truth, as usual, is somewhere more interesting than either of those positions.

The concern I find most worth sitting with is not that AI will make perfusionists obsolete. It is that AI, by automating the routine and eliminating friction from early-career learning, may quietly erode the formative experiences through which genuine expertise is built. The difficult cases, the uncertain moments, the cycles of error and correction: these are not inefficiencies to be optimized away. They are how clinical judgment develops — and that is a conversation our profession needs to be having deliberately, not reactively. Our Reed Memorial Lecture this year speaks directly to this theme, and I am looking forward to the discussion it will generate.

At the February Liaison Panel meeting, the group engaged the AI question from several angles — including whether AI should have a role in certification or recertification processes, how evolving decision-support technology influences competency assessment, and whether the profession is yet ready to produce a formal position paper on AI in perfusion. The consensus was that the conversation is essential and that the time for a position statement is approaching, even if we are not fully there yet.

At the Salt Lake City meeting, we have dedicated programming to AI throughout the schedule — including automated data acquisition for ECMO pathways and national database development, augmented reality in simulation training, the OR black box and clinical decision support, and the broader question of what it means to build and maintain expertise when powerful tools are increasingly available to do the work of early learning for us. I hope those sessions generate the kind of frank, informed dialogue that can actually shape how our institutions, our credentialing bodies, and our professional societies engage with the vendors and developers who are already at the door.

On Collaboration — Human and Otherwise

Running a professional society like the AACP has always required a particular kind of balance. None of us does this full-time. The Academy runs on the energy of members who also carry demanding clinical and administrative responsibilities. For me, that means navigating the Academy's needs alongside my role as Chief Perfusionist and Director of Perfusion Services at the Pulse Heart Institute within MultiCare Health System — a program performing over five hundred open-heart cases annually, continuously evolving its clinical capabilities, and navigating the same workforce and technology pressures that every cardiac surgery program in the country is facing.

I will be transparent about something that has genuinely changed how I manage that balance: the use of AI-assisted tools in the day-to-day work of this presidency. The volume of correspondence, documentation, committee coordination, and strategic communication required to run this organization is substantial, and AI tools — used carefully and with judgment — have allowed me to keep pace in ways that would otherwise have been difficult. Speaker outreach, legislative research, program development, committee briefing materials, and organizational communications are all areas where having a capable AI collaborator has made a meaningful difference in what I am able to accomplish with the hours available to me.

I raise this not as a promotion for any particular technology, but because the experience is directly relevant to the conversation our field is having about AI more broadly. What I have found is that human judgment — about what matters, what is appropriate, and what reflects the values of this organization — remains the part no tool can replace. The AI helps me work faster and communicate more thoroughly. It does not tell me what to say or why it matters. That part is still ours, and I believe it always will be.

The theme that runs through everything in this letter — the Liaison Panel, the licensure work, the seminar program, the AI conversation — is collaboration. Between organizations. Between perfusionists and surgeons and intensivists and organ procurement teams. Between state societies and national bodies. Between experienced clinicians and the students they are training. Between professional judgment and the tools professionals choose to use. We are a small profession doing genuinely consequential work, and we are always more effective when we pursue it together than when we pursue it in pieces.

Thank you for your trust, your engagement, and the extraordinary work you do for your patients every day. I look forward to seeing many of you in Salt Lake City.

Warm regards,

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NIRS on CPB: Application and Techniques

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About the Author

I earned my Bachelor of Science in Health and Kinesiology with an emphasis in Biomedical Engineering from the University of Utah in 2024. During my undergraduate studies, I worked at the Weiss Biomechanics Lab studying angiogenesis and cyclic fatigue of tendons. From 2022-2023, I worked as a Non-Invasive Cardiology Technician where I performed routine and emergent ECG procedures and prepared time- sensitive data for physician review in direct support of diagnostic and therapeutic decisions across multiple units.

Abstract

Near-Infrared Spectroscopy (NIRS) is a noninvasive cerebral oximetry technology used during cardiopulmonary bypass (CPB) to monitor regional cerebral oxygen saturation (Jobsis, 1977). Despite its clinical utility, NIRS prevalence during adult CPB was estimated at only 25% as of 2009 (Murkin, 2009), and all existing management algorithms have been developed by and for anesthesiologists — omitting the perfusionist's role and available interventions entirely (Denault et al., 2007; Bochmann et al., 2021). This study surveyed U.S. board-certified perfusionists to determine current NIRS prevalence, characterize the clinical parameter ranges applied when responding to cerebral desaturation, and establish an empirically grounded intervention priority sequence. Preliminary results from 33 complete responses indicate that NIRS is now used in 63.19% of all CPB cases. Perfusionists consistently shift mean arterial pressure (MAP), PaCO2, PaO2, hematocrit (HCT), and cardiac index (CI) upward when correcting desaturation, with CI and MAP ranked as the top intervention priorities — a sequence absent from all published algorithms. Nearly one-third of institutions report no standardization, and physician skepticism represents the leading barrier to broader adoption. These findings provide the empirical foundation for developing the first perfusion-specific NIRS algorithm for use during CPB.

Overview

Physiological Parameters

Six variables are central to cerebral saturation management during CPB. Cannula malposition — arterial or venous — produces characteristic unilateral or bilateral NIRS drops that are detectable before other hemodynamic changes occur (Gottlieb et al., 2006; Sakamoto et al., 2004). Arterial blood pressure is governed by the Hagen-Poiseuille relationship; increasing pump flow or vascular resistance raises cerebral perfusion pressure (Shamsi et al., 2024). HCT improves both oxygen-carrying capacity and blood viscosity, each independently benefiting cerebral oxygen delivery (Cinar et al., 1999; Ranucci et al., 2010). PaCO2 above 40 mmHg induces cerebral vasodilation and increased cerebral blood flow, while subnormal values cause vasoconstriction and reduced perfusion (Yoon et al., 2012). Increases in PaO2 raise hemoglobin saturation per the oxyhemoglobin dissociation curve and contribute an additional dissolved oxygen component (Patel et al., 2025). CI is arguably the most critical determinant of cerebral saturation, as it directly governs the rate of oxygen delivery; however, pump flow is constrained by a curvilinear hemolysis risk at high output rates (Anai et al., 1996; Gao et al., 2023). CMRO2 is most efficiently reduced through patient cooling, with even mild degrees of hypothermia producing clinically meaningful reductions in cerebral oxygen consumption (Ziganshin & Elefteriades, 2013).

Organizational Standards

AmSECT first recommended cerebral oximetry in its 2013 standards and guidelines (Baker et al., 2013). Pediatric and congenital standards and guidelines were separated in 2019 and now cite continuous cerebral oxygen saturation monitoring as a standard during pediatric CPB (AmSECT, 2019; AmSECT, 2025), while in the adult patient, continuous cerebral oxygen saturation monitoring remain as a guideline (AmSECT, 2023). ELSO guidelines for venoarterial ECMO (2021) speci-

fy that cerebral saturation should remain above 50%, with an ideal minimum of 60%, and define a maximum acceptable interhemispheric difference of 20% (Lorusso et al., 2021). No equivalent CPB-specific saturation thresholds appear in current AmSECT adult guidance.

Evolution of NIRS Algorithms

NIRS management algorithms have been published continuously from 2007 through 2023. The original Denault, Deschamps, & Murkin (2007) algorithm addressed bilateral and unilateral cerebral desaturation through sequential checks of head position, MAP, SaO2, PaCO2, hemoglobin, and CMRO2. Subsequent iterations by Zogogiannis et al. (2011), Trafidlo et al. (2015), Yoshitani et al. (2019), and Bochmann et al. (2021) refined absolute thresholds and introduced distinct unilateral pathways, yet none included CI as a corrective variable. The most recent algorithm (Tomic Mahecic et al., 2023) reduced management to two steps: titrate norepinephrine, then increase FiO2. All published algorithms share a critical structural limitation — they were designed by and for anesthesiologists and therefore do not reflect the operational sequence or the interventions available to the perfusionist during bypass.

Preliminary Results

Demographics and NIRS Prevalence

A total of 155 responses were recorded; 76 respondents completed the demographics instrument and 33 completed the full survey. The majority of respondents (84.2%) were board-certified perfusionists with more than two years of experience, and 46.1% practiced at academic medical centers. The median annual case volume was 120 total CPB cases, with a median adult volume of 110 and a pediatric median of zero. Preliminary results indicate that NIRS was used in 63.19% of all CPB cases — more than double the 25% adult prevalence reported by Murkin (2009). Usage was highest in aortic surgery (84.59%), emergency cases (73.54%), and redo procedures (68.48%), while isolated CABG (49.51%) and valve-only procedures (55.96%) demonstrated lower rates. Protocol requirement was the most commonly cited deciding factor (62.2%), followed by redo or complex case type and physician request (43.2% each).

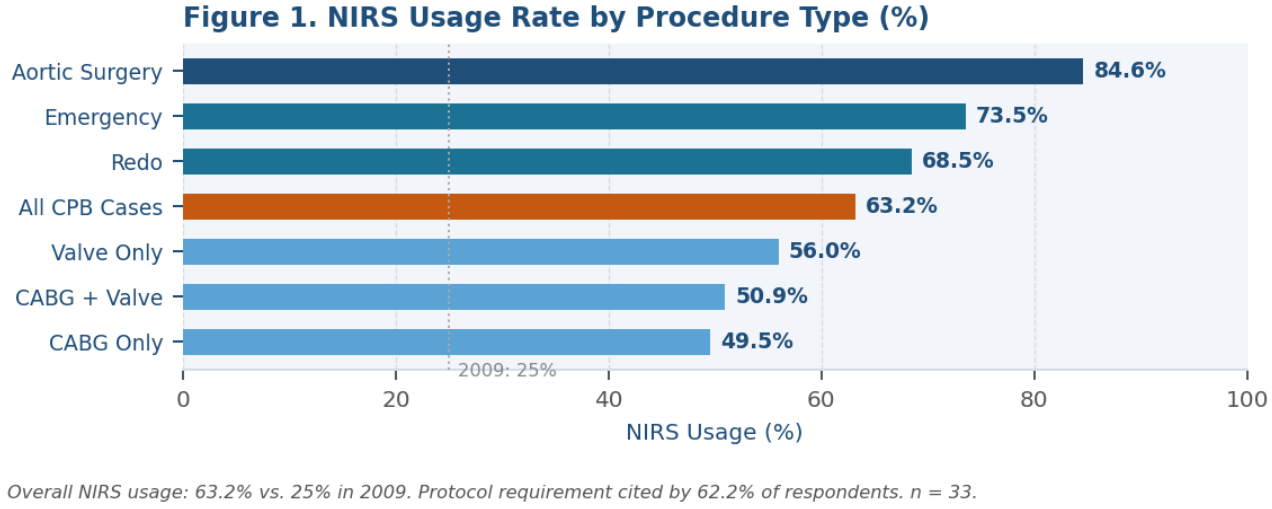


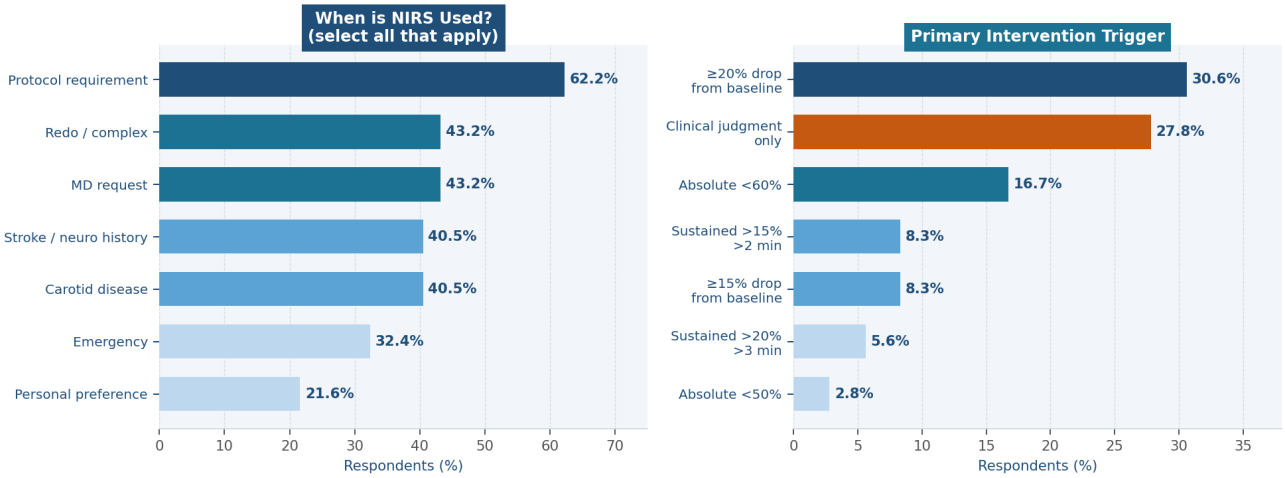
Figure 1. NIRS usage rate by procedure type (%). The amber bar indicates the overall 63.2% prevalence — more than double the 25% reported in 2009. n = 33.

Decision Factors and Intervention Thresholds

The most common intervention trigger was a relative drop of 20% or greater from baseline (30.6%), consistent with the threshold established by Denault et al. (2007) and carried through most subsequent iterations. However, 27.8% of respondents relied solely on clinical judgment, and 16.7% applied an absolute threshold of 60% — consistent with ELSO ECMO guidance (Lorusso et al., 2021) — suggesting that ECMO-

derived standards have partially migrated into CPB practice in the absence of CPB-specific recommendations (Buel & Searles, 2019).

Figure 2. NIRS Decision Factors and Primary Intervention Triggers



Notable: 27.8% rely on clinical judgment alone — nearly equal to the 30.6% using the evidence-based 20% threshold. Wide variation reinforces need for a standardized protocol.

Figure 2. NIRS decision factors (left) and primary intervention triggers (right). Clinical judgment alone was cited by 27.8% of respondents — nearly equal to the evidence-based 20% threshold (30.6%). n = 33.

Clinical Parameter Ranges

Across all five parameters, respondents reported consistent upward shifts in target values when correcting for cerebral desaturation. The MAP corrective lower limit increased from 52.81 to 57.34 mmHg, consistent with the 2012 SCA survey in which 13 of 24 anesthesiologist respondents increased blood pressure to a maximum of 80 mmHg (Searles, 2012). PaCO2 shifted from a normal range of 36.25–45.25 mmHg to a corrective range of 40.47–47.66 mmHg, reflecting deliberate permissive hypercapnia (Yoon et al., 2012). PaO2 demonstrated the widest spread (181.25–310 to 212.66–322.50 mmHg) with large standard deviations, consistent with mixed willingness to modify this parameter observed by Buel & Searles (2019). HCT showed the smallest corrective shift (20.06–35.88% to 22.72–36.53%), indicating conservative transfusion practice (Ranucci et al., 2010). CI shifted from 1.88–2.59 to 2.13–2.72 L/min/m^2, approaching but not reaching the higher values reported by anesthesiologist respondents in the 2012 SCA survey (Searles, 2012), likely reflecting hemolysis risk awareness at elevated pump flow rates (Anai et al., 1996; Gao et al., 2023).

Figure 3. Accepted Clinical Parameter Ranges on Bypass: Normal vs. Corrected

Parameter	Normal Low	Normal High	Corrected Low	Corrected High	Low Shift	n
MAP (mmHg)	52.8	76.6	57.3	75.9	+4.5	9–10
$PaCO_2$ (mmHg)	36.3	45.3	40.5	47.7	+4.2	6–9
PaO_2 (mmHg)	181	310	213	323	+32	8–10
HCT (%)	20.1	35.9	22.7	36.5	+2.6	10–12
CI (L/min/m^2)	1.88	2.59	2.13	2.72	+0.25	7–11

All five parameters showed a consistent upward shift when correcting cerebral desaturation. PaO_2 showed the widest spread (SD 59–137 mmHg). n = 6–12 unique responses per limit.

Figure 3. Accepted clinical parameter ranges on bypass: normal versus corrected values for MAP, PaCO2, PaO2, HCT, and CI. Corrected low and high values (teal) and low shift (green) are highlighted. n = 6–12 unique responses per limit.

Intervention Priority and Timing

CI modification and MAP augmentation were ranked first or second by 43.2% and 29.7% of respondents, respectively. PaCO2 adjustment ranked third, PaO2 modification fourth, transfusion or HCT augmentation fifth, and cannula position verification last, with 47.2% ranking it sixth. This empirically derived sequence differs substantially from all published algorithms, which place head and cannula position first and omit CI as a corrective variable entirely (Denault et al., 2007; Bochmann et al., 2021; Yoshitani et al., 2019). Regarding response timing, 45.2% of respondents waited three or more minutes before intervening. Only 35.5% notified anesthesia immediately upon a NIRS drop; the majority (51.6%) communicated only after their own corrective measures had failed — demonstrating that perfusionists function as the primary responders to desaturation events during CPB.

Institutional Practices and Barriers

No standardization was the most commonly reported protocol status (30.3%), and only 12.1% of institutions had a written protocol with defined thresholds. The leading barrier to broader NIRS adoption was physician skepticism and resistance, identified as a major or moderate barrier by 39.4% of respondents, exceeding both equipment cost and disposable cost at 30.3% each. Staff education and training was widely regarded as not a barrier (66.7%). Additionally, 39.4% of institutions did not prioritize NIRS quality monitoring, yet 75.7% of respondents believed NIRS probably or clearly improves patient outcomes, with no respondents reporting no benefit.

Discussion

The 63.19% overall NIRS prevalence represents a substantial increase from the 25% reported by Murkin (2009) and reflects meaningful growth in adoption driven primarily by institutional policy rather than individual clinical judgment. The higher utilization rates in aortic, emergency, and redo cases are consistent with the elevated neurological risk associated with these procedure types. The corrective parameter shifts observed across all five variables are physiologically coherent and align closely with findings from the 2012 SCA anesthesiologist survey (Searles, 2012), suggesting convergence of practice intuition across professions over time. The conservative HCT corrective shift and the divergence in CI upper limits from anesthesiologist counterparts likely reflect perfusionist-specific awareness of transfusion-associated risks (Ranucci et al., 2010) and the hemolysis constraints inherent to pump-based flow delivery (Anai et al., 1996; Gao et al., 2023).

The intervention priority data represent the study's most clinically significant finding. The empirically derived sequence — CI and MAP first, gas parameter management second, transfusion reserved, and cannula verification applied contextually — reflects the operational reality of CPB and contradicts the structure of all existing NIRS algorithms (Denault et al., 2007; Trafidlo et al., 2015; Yoshitani et al., 2019; Bochmann et al., 2021). This discrepancy is not a failure of prior algorithm development; it is a structural consequence of algorithms designed by and for a different clinical provider. The 27.8% of perfusionists relying on clinical judgment alone as their primary intervention trigger, combined with the absence of standardization in nearly one-third of institutions, demonstrates an urgent need for a unified, profession-specific operational framework.

The team communication data further reinforce this conclusion. Perfusionists are independently managing cerebral desaturation events during bypass and escalating to anesthesia only after their own interventions have failed. Existing anesthesia-derived algorithms are not designed for this operational context. A perfusionist-specific algorithm grounded in empirical survey data would address both the clinical gap and the physician skepticism identified as the primary barrier to broader adoption — providing an evidence base developed from within the perfusion profession itself.

Conclusions

This study documents a substantial increase in NIRS utilization during CPB since 2009, characterizes the clinical parameter ranges applied by perfusionists when responding to cerebral desaturation, and identifies an empirically supported intervention priority sequence that differs fundamentally from all existing NIRS algorithms. These findings provide the foundation for developing a perfusion-specific NIRS flow diagram that reflects the actual scope and operational sequence of the perfusionist during CPB — a tool that is currently absent from the field and supported by the preliminary data as both clinically necessary and institutionally overdue.

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Ann Guercio, *CCP, LP, FAACP*
Deborah L Adams, *CCP, LP, FAACP*

Special thanks to ***Terry Crane*** *CCP Emeritus and Senior Fellow AACP for the historical pictures.*

In Memory of Raymond Jean McInnis, Jr.

March 27, 1947- April 19, 2026

It is with sadness that we inform the perfusion community of the passing of Ray McInnis, long time Program Director at the Texas Heart Institute School of Perfusion Technology.

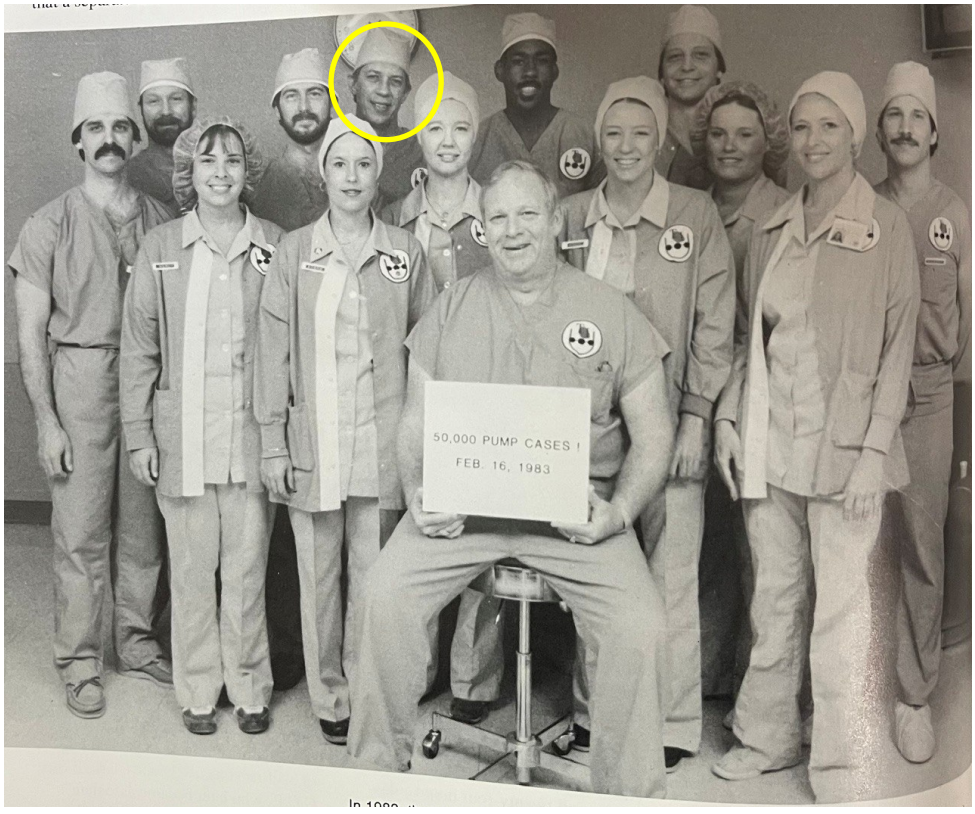
Raymond Jean McInnis was born in Beaumont, Texas, obtained his BS in Education from Lamar University in 1974 and a Master of Education from the University of Houston in 1980. Ray trained in perfusion technology at the Texas Heart Institute in 1976, became a staff instructor at THI and rose to the position of Program Director in 1985.

For those of us who worked with and for Ray, his even temper, dry sense of humor and calm demeanor will always be remembered. He listened thoughtfully and sincerely, often providing helpful and impartial feedback. I remember interviewing with Ray as a perfusion student applicant; he was a natural conversationalist who engaged and calmed me immediately during what is most often a stressful scenario. His door was always open to students and instructors alike. It is befitting that he received the Outstanding Teacher of the Year award from The University of Texas Health Science Center at Houston, School of Allied Health Sciences in 1982.

I never heard Ray raise his voice or demean a colleague. He was a gentleman who treated all of us with respect and fairness. He collaborated with physicians, academics and manufacturers alike with ease and grace, a true gentle giant. He enjoyed a good story, witty joke and a good cocktail. A patron of the arts, Ray supported local theater groups, nurtured a love of theater in young thespians and was active in promoting productions along with his partner, Michael.

Many perfusionists in the profession today benefitted from Ray's mentorship, support and stewardship of perfusion education and certification. He contributed much to elevating a fledgling profession into a respected healthcare discipline. We will miss him.

Ray's Perfusion School Class Picture



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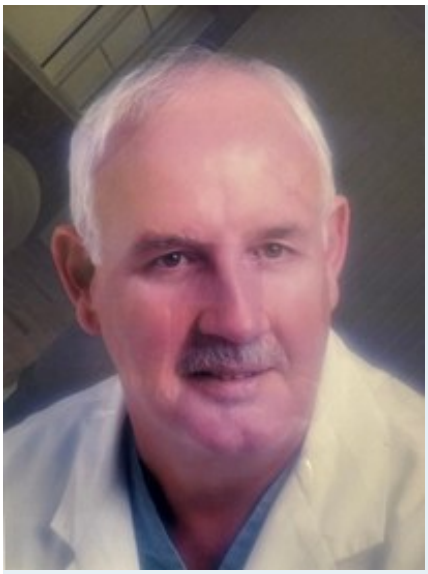
Featured speaker:
Dr. Timothy Maul, CCP, FPP, PhD

Dr. Maul is a perfusionist and senior research assistant at Nemours Children's Health Florida. He holds faculty positions at the University of Central Florida College of Medicine and the University of Pittsburgh Department of Bioengineering, has served as a key member of the ELSO simulation team, and is Chair of the ELSO Innovation and Technology Committee.

danaher



Jim MacDonald. CPC (Ret) CCP (Emeritus)

Former Chief, Clinical Perfusion Services, LHSC

Past President & Senior Fellow AACP

Past President CCCP

Senior Fellow, AmSECT

Ilderton, Ontario, CANADA

Reflection In One's Rear View Mirror

There would be, little to no reason, to look back into our prior extracorporeal history, unless we might find out, "that something", that "tidbit" of our past history that would relate to our present day clinical interface reality. Within the subtle reminder, "there will always be a before your time", I welcome the reader, to another of my "right index fingers" (), bumble submission entitled, "Reflection In One's Rear View Mirror", representative of my historical "peek back" into, your and my, much earlier extracorporeal circulation (ECC) history - a history having been directly experienced, by myself, over these last several decades ( ). Within each of our singular experiences, there would be our personal, as well as, our shared extracorporeal journeys. As is also true, within that very reality, we would also remember the many individuals who had pioneered, the well had trodden extracorporeal path which, many of us, were to follow - a path that would lead us to, this YOUR every day, clinical reality experience ()! That realized, I would like to share a personalized quotation from my personal past, having been told myself, by my mentoring Paediatric Cardiac Surgeon, the late, Dr. Alex Gillis, former Chief of Cardiac Surgery, the Isaak Walton Killam (IWK) Health Centre, Halifax, Nova Scotia, who had said, "Jim, the early years of one's career, are shaped by the many"! Within that poignant reminder, the collective "WE" would owe, so much, to so many! With ourselves being mere mortals, and each of us having a singular expiration date (), we would also be wise, to reflect on the reflective words of Geoffrey Chaucer, the English poet, who had written, "time nor tides wait for no man"! Within that proverb, perhaps this "peek back into our historical past", be best written now than never to have been written, at all ()! Yourself, as the reader, might be the best determinant of this reality ()!

In a previous American Academy Of Cardiovascular Perfusion (AACP) Newsletter, I had introduced my "Fickle Finger Of Fate" (FFOF) scenario which recalled an earlier 1980s membrane oxygenator incident. This incident NOT being representative of a negative reflection of the said membrane oxygenator but rather, human error, involving two "very experienced" Cardiovascular Perfusionists (CP) i.e, yours truly, having been, one of the two (). Within this very admission, I do take some refuge within the reality, that very few of us can proceed, certainly within our specialized extracorporeal reality, without having had experienced, the occasional mishap, near miss incident or, dare I say, perfusion related accident (). I was involved in our department's first introduction of our Quality Assurance (QA) Program into our practice. I had always taught our students a very brief definition of what QA, really is, that

being, “doing the right thing right, the first time”! “Personal who care will do this”(1). We might take, some understandable refuge in our understanding, that failures aren’t just failures, if we might “learn” from them! We might take some comfort within the submission that mistakes are what makes us humans! Dr. Walton Lillehei, the American, Father OF Open Heart Surgery, has once stated, “experience, is a great teacher - good judgement comes from experience and experience comes from bad judgment”. Likewise, Oscar Wild, had defined the word experience, as “simply the name we would give our mistakes” - both of these quotes, although thought provoking, might deserve our specific rethinking of the word, experience, especially as it would, might and could, reference our daily clinical interface experiences (👍)?

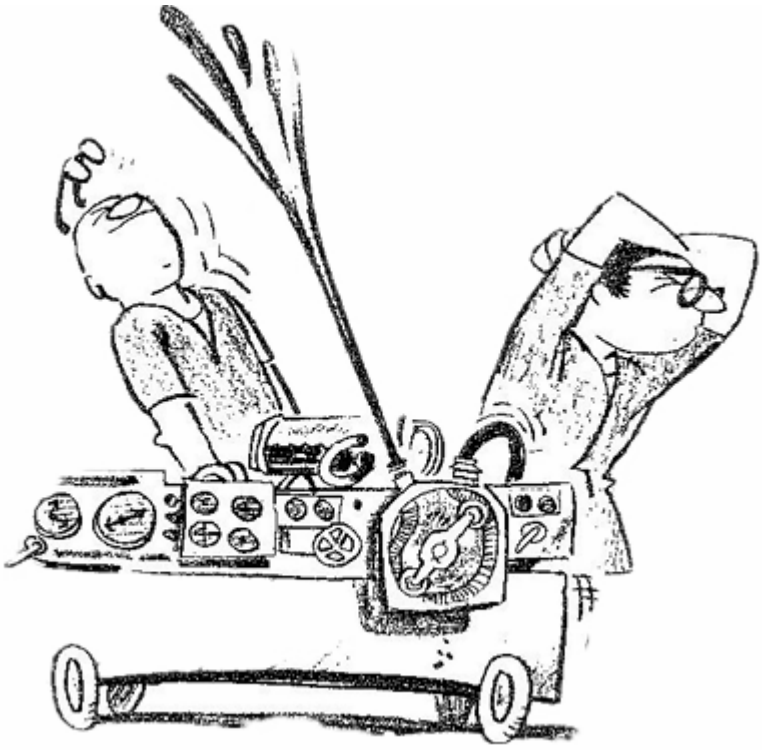
Speaking of experience, I would like to continue to explore the reality of our much earlier era generational membrane oxygenator, “historical clinical interface”, reality. Within that, I offer you, a secondary quote, specific to the word “history” as explained by David Burnett, National Geography, “history has a way of receding, our recollections become secondhand, then third hand and eventually, just mere words, in a history book”! That very quote would continue to address your present reality, as it had mine, during my previous several decades of both personal and shared, extracorporeal experiences and reality (🤝)!

Within that realization, I would like to explore my personal clinical experiences given my much earlier clinical utilization of one of the original generational membrane oxygenators having been clinically used, by this author, within the clinical reality, of our Infant and Paediatric, cardiac patient population, within the aforementioned, IWK, Health Center, Halifax, Nova Scotia, in 1972. It has been noted, there would be, little to no reason, to venture back into YOUR or MY, much earlier extracorporeal history, unless we might find out what I would refer to as, those extracorporeal “tidbits” or, to use the metaphorical phrase, those “golden nuggets”, of our previous clinical experience that had served to, initially reshape, our modern day membrane oxygenator clinical interface reality! These earlier era extracorporeal nuggets, would also bear witness to another very important historical daily reality, that being, every single CPB component that YOU would utilize, within your daily conduct of CPB, would have a unique and interwoven, “before your time, history” (👍)! Within that subtle reminder, and the fact that the Cardiovascular Perfusionist (CP) of today, had not been exposed to their personal use of a Bubble Oxygenator, or “Bubbler”, let us take “a reflective look back by way of my rear view mirror”, into a much earlier era of our inherited extracorporeal membrane complexity that is, while my recollections remain, “first hand and, hopefully, not just mere words within a history book” (😳)! I had always thought that ones memory are the cerebral pictures we had never taken! Luckily, I still retain a somewhat healthy extracorporeal memory - rekindled, by way of my many contemporaneous notes and personal clinical photos - **(I now ask myself, “where was my iPhone, when I really needed it, back then (😳)”? The photos shown, within, would hopefully, provide the reader a visual peak back into those, possible historical gaps, having been clinically experienced, by myself and others, all those many decades ago (😳)?

If you would allow, prior to the introduction into my membrane recollections, I thought it interesting to inform you about this, perhaps little known indispensable tidbit, having found its, more than purposeful place, within our much earlier era CPB reality. Out of necessity we were to learn to utilized this, “simple but very important improvised technique”, during our initial generational use of, the Hard Shell Bubble Oxygenator, i.e, (Bubblers) of the early, 1970s, era (😉), prior to our membrane oxygenator use, so, with that mentioned, here goes.

BONE WAX, TIDBITS AND HARD SHELL OXYGENATORS: in the Fall AACP Newsletter, I had made reference to the Galen OptiFlo Bubble Oxygenator, so named after the Greek Physician, Claudius Galen. This hard shell Bubble Oxygenator was to, ironically, provide the Heart Lung Pump Tech, of the early 1970s, an unavoidable but impromptu use, of surgical bone wax (😱). With the reader’s per-

mission, perhaps a side bar is warranted: prior to my entering our fledgling profession in 1968, I had worked, as an Operating Room Technician (ORT). As such, I was afforded, the opportunity, to not only have scrubbed for such surgery, but when "extra retractor hands" might be required, I would be asked to scrub in and to assist in both Thoracic as well as Cardiovascular Surgery **quite the surgical apprenticeship with Perfusion about to become my reality (👍)! In the day, surgical bone wax was to have found its fundamental use, by the attending Cardiac Surgeons, to insure "hemostasis" along both edges of the patients sternal borders, being applied immediately, post sternotomy. Of historical note, in assuring "a straight median skin incision", the surgeons would press a heavy black cotton suture, onto the patient skin, between the proximal sternal notch and the distal xiphoid process, thereby, insuring the initial skin incision was not only "vertical" in its required surgical alignment but was, always, "straight". Post skin incision, the "Gigli wire", illustrated here, would be used to "manually" perform the median sternotomy dissection, with the Cardiac Surgeon using a rather forceful, up and down straight motion, as the Gigli wire bore through the bony sternum. While, in present day, you certainly would not see the Gigli wire used, you might still see this "cotton suture technique" performed within the operating room of today and if so it, no doubt, being a "surgical remnant of a technique" having been acquired from a previous, much earlier era, Cardiothoracic Surgeon (😉)? It is certainly correct to say, most surgeon of today, would carry forewords several particular surgical technique (tidbit) they had been exposed to during their surgical training days. Actually, are we not ourselves, a reflection of such Perfusion related training tidbits (👍)! Finally, in the early 1970s, the Gigli wire would be replaced by the newer pneumatically driven, reciprocity sternal bone saw that you would be mostly familiar with, having been introduced by the Sarns Corporation. Even the gigli wire has a history. Cardiac Surgeon of that era, had borrowed the adjunctive use of the Gigli wire, bone saw, from its previous intended use in both Neurosurgery (craniotomies) and Orthopaedic (amputations) surgery (😉). This much earlier history would provide, yours truly, as well as other, "Pump Techs", of that era **(the terminology, Cardiovascular Perfusionists, would not surface until later years and, yes, there would be another story there) the unintended but sometimes, "secondary use of the said sternal bone wax", being, strategically placed, in a ball shape, upon the lap of the attending Pump Tech (😂). Why might that be: we were to quickly learn to both "adopt and to adapt a technique" in our urgent/emergent use of said sternal bone wax, specifically, "to PLUG OXYGENATOR BLOOD LEAKS" having originating from the new commercially available, hard shell, Galen OptiFlo Bubble Oxygenator (😅)! In absolute clinical fairness, this emergent bone wax legacy, necessitated secondary to these much earlier inherent manufacturing defects would be, on occasion, also shared with other "hard shell bubblers" of that era (😂)!! These reoccurring blood leaks had also been a reality given our initial clinical use of the, much earlier, "Pump Oxygenator" during my apprenticeship training days. These "bubbler" leaks, therefore were, representative of a kind of "deja vu" having been experienced, as is cited by Gary Grist, within his publication, "A Face Full Of Blood, (1,2) albeit, again, within my initial apprenticing OJT extracorporeal career and, obviously, beyond (😳). The below, rather reminiscent extracorporeal cartoon, is representative of a, "bygone, era"! Nevertheless it does, conjure up for myself, vivid reminders of those occasional, less than appreciative, CPB, related incidents (😳)!! Within this very reality, one might see why, such tidbits of history, are worth our revisiting (👍)! It would not be until later years, given the explosive growth of both open heart surgery and its accompanying increase in CPB applications, that associated mishaps, near misses and perfusion related accidents would gain, not only professional recognition but, in-depth clinical analysis and open discussion, at both national and regional Perfusionist related meeting. (3)!!



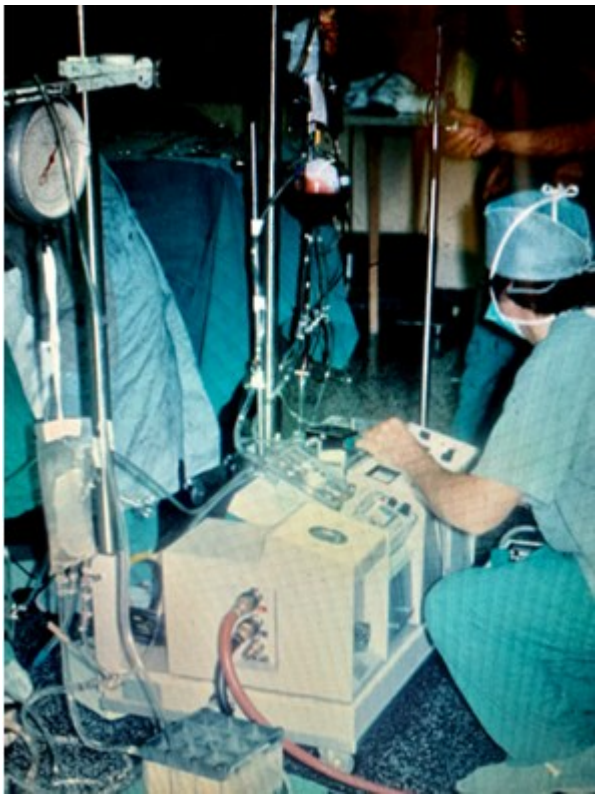
"The pump oxygenator depicted in the above cartoon, specifically, the Kay Cross Rotating Disc Pump Oxygenator, showing a caricature of the "pump oxygenator, I had trained on, in 1968" - a special thank you to, Ron Stetzer, "OOPS Cartoon", September 14, 2018.

These much earlier blood leak incidents would lessen, over time, given the introduction of the initial heat sealed, soft shell polyvinyl disposable bubble oxygenators (👍)! That being realized, none the less, other inherent historical clinical interface realities, i.e, poor oxygenation, would and did also occurr and, as such, would required "urgent attempts" at several, improvised remedies - but, that's another story (😅)! I would, once again, refer the reader to, yet another historical reference, having been written by my Perfusionist colleague, Kelly Hedlund (3). So, with these "specific tidbit" of historical indispensable necessities, having been brought to your immediate attention (😊), let us proceed, towards our clinical utilization of, a much earlier era generational, extracorporeal membrane pump lung oxygenator interface reality, that is, "while my recollections remain, first hand" (😊)!

OUR, FIRST GENERATIONAL, MEMBRANE OXYGENATOR INTERFACE (circa 1972): my original introduction into this initial era of, our earliest membrane oxygenator intervention, began in 1972, within the IWK, Hospital, Halifax, Nova Scotia. We had introduced the new, Lande-Edwards, Flat Plate, Silicone Membrane Lung Oxygenator, within the Children's, IWK, specifically for Cardiopulmonary Bypass (CPB) utilization, within both our Infant and our Paediatric patient population. This was, in historical retrospect, the pursuit of "a significant extracorporeal event" given our initial use of both the membrane oxygenator and its, incorporated, "closed extracorporeal circuit" **(with Bubble oxygenators being, much less complicated, open reservoir systems)! As a future, add on accountability, it would only be within a few years, that this specific membrane technology would become, yet another, completely new and ever evolving clinical interface reality, that of membrane oxygenator support, OUTSIDE the operating room (OR), given the introductory use of Extracorporeal Membrane Oxygenation (ECMO), thereafter, forever changing and challenging, to this very day, our ever expanding cardiac patient care horizon, i.e, respiratory support in infants, adults, etc . (4-9)

The 1.0 and the 3.0 square meter Lande-Edwards Silicone Membrane Lung Oxygenator

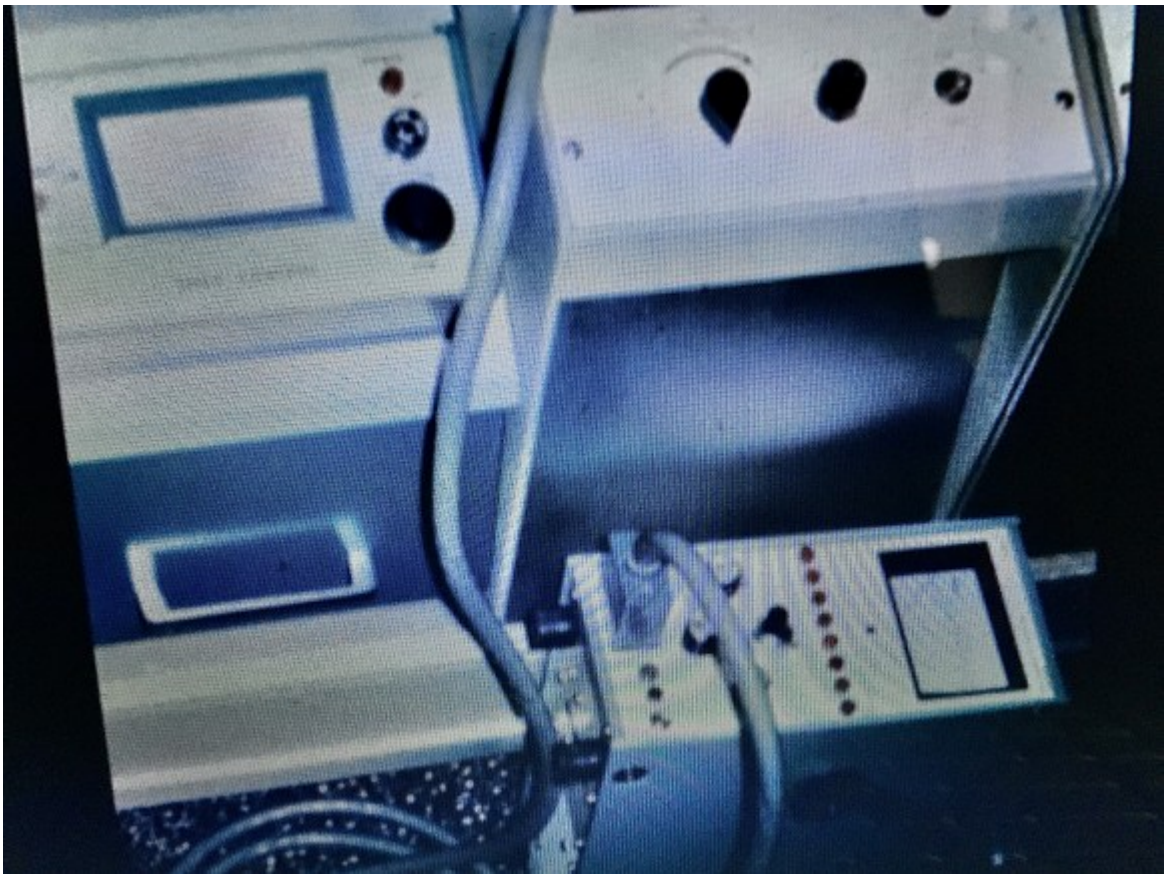
The Lande-Edwards Silicone Membrane Lung Oxygenator was the, FIRST of its kind, "disposable flat plate, gravity feed, commercially available, sandwiched type, siliconized non porous, **(TRUE) membrane oxygenator" initially introduced, in 1968. The solid silicone sheets, membrane oxygenators, were commercially available, in three distinct sizes, with each membrane sheet being separated by a "sodium chloride powder". This powder was to prevent, the siliconized membrane material, from sticking together. It was therefore, "ESSENTIAL", this residual powder be "WASHED OUT" prior to each CPB use! This resulted in an elaborate and time consuming "three phase priming technique" necessary, to rid the membrane sheets of any residual salt solution, particularly, prior to the introduction, of the third and final, "physiological fresh, Citrate Phosphate Dextrose (CPD) whole blood prime", specifically for our Infant, open heart patients. As was referred to, this was our initial introduction in regards the use of a "closed circuit extracorporeal and membrane oxygenator" with its, associated complexity, inclusive of an external hanging arterial blood reservoir bag, a disposable Travenol mini-prime heat exchanger and a neonatal weighing scale, being personally absconded (😉), from the Grace Maternity Hospital, situated just across the street from the IWK, as shown in the below, operative photograph, with the NEW Sarns "modular separate pump configuration", heart-lung machine (HLM).



The 1.0 square meter, Lande-Edwards Membrane Oxygenator Lung, used for Infants less than 8 Kilos, show positioned on the OR floor with the, improvised, infant weighing scale, shown in the upper left, used to "measure precise blood volume changes between the CPB and the recipient patient - the IWK Hospital, Halifax, NS, *(circa 1972).*

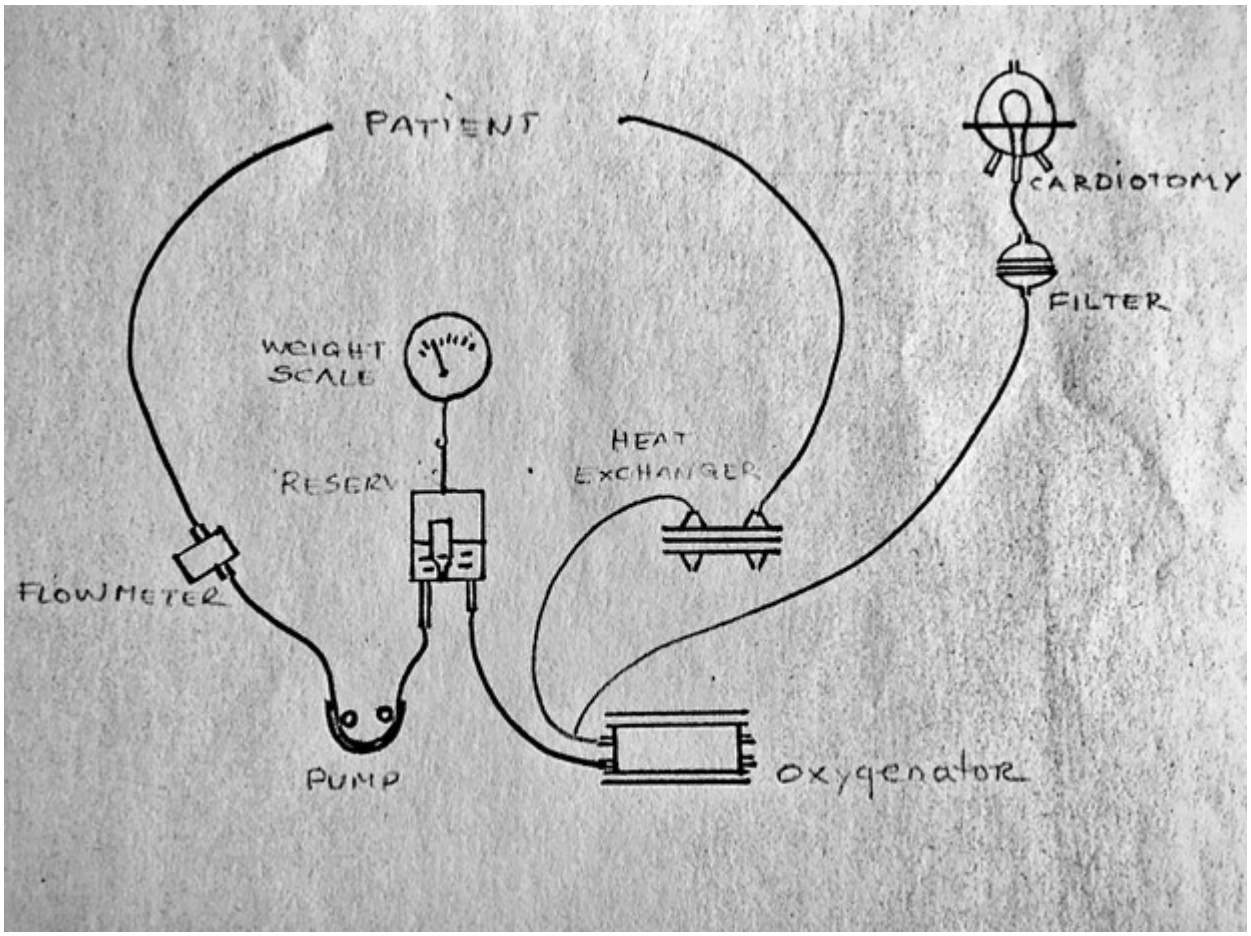
The 1.0 square meter Lande-Edwards membrane was used, initially within the IWK, for selected infants undergoing more complex congenital heart defects, in the day! The 2.0 and 3.0 square meter, surface area, membrane could also be used, either separately or “in parallel” **(also new to us) in order to accommodate larger children and/or whenever a more complicated congenital heart defects was to be surgical corrected! Given this parallel case scenario, the 2.0 Lande-Edwards membrane lung could be occasionally, set up with each each membrane bundle being primed, independently, thereby providing increased blood contact surface area and, improved oxygen transfer, while temporarily and/or, selectively, occluding pump blood flow to the other, should it be required (👍)? This specific clinical scenario, in and of itself, would certainly, only add, to the complexity of the ECC setup! Of clinical interest, we had continue in our use of the more convenient disposable 2 Liter Flow (2LF) soft shell, Baxter Travenol Bubble Oxygenator, as we were using, for patients with less complex forms of congenital heart disease! That said, the Lande-Edwards, as well as futurist generations of related membrane oxygenator technologies, would find its routine utilization, within all Infant and Paediatric open heart cases, to this very day, within the IWK Health Center, Halifax, NS (👍👏)!

The measurement of CPB blood flows was preciously maintained, given our use of the Statham electromagnetic blood flow meter, which allowed for accurate measurement of the CPB blood flow which, was thought mandatory, especial in the infant patients, about to undergo complex corrective congenital, open heart surgery.



The smaller American Optical Polystan and Infant Precision Blood Flow Roller Pump, with the precision, Statham Electromagnetic Blood Flow Meter

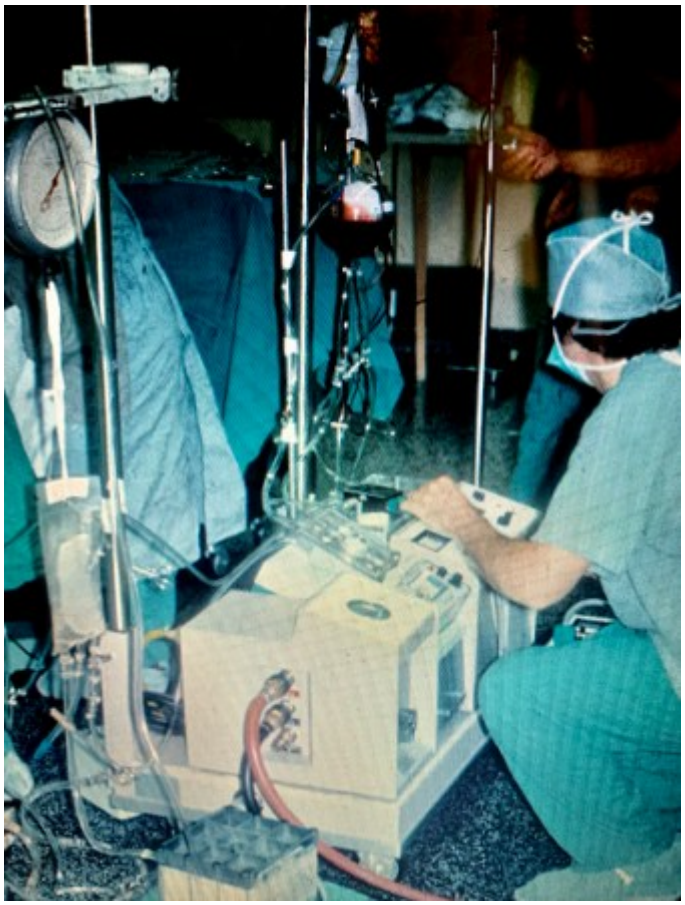
THE ANATOMY, PHYSIOLOGY AND CLINICAL INTERFACE OF THIS "SPECIFIC CLOSED ECC": the Lande -Edwards solid membrane oxygenator would be placed, on a foot stool, 12 inches off the OR floor, to insure both proper positional height from the operating table and also, to insure, proper blood distribution, throughout the many flat membrane silicone sheet bundles - **(of historical interest, microporous membranes were, only to be realized, in later years). Venous blood, returned to the HLM by gravity venous line return, into the disposable Travenol mini-prime heat exchanger, which insured any potential venous return air, would be caught up in the heat exchanger. The venous return blood was next, gravity feed, into the Lande-Edwards membrane where oxygenation occurred and arterial blood would then, be introduced, into the airless, collapsible arterial blood reservoir, hung from a weight scale, one foot, above the oxygenator arterial outlet. This height was to insure the membrane sheets were adequately distended with blood as well as to prevent an undesirable condition called "blood streaming" which could interfere with the functional oxygen transfer rate capacity. Exiting the hanging arterial reservoir, arterial blood was next pumped, by way of a "low flow paediatric Polystan arterial roller pump", from the arterial reservoir and into the Statham electromagnetic blood flow meter, where precise infant extracorporeal blood flow were continuously monitored and the arterial return blood, returned to the patient, by way of the arterial return line, into the patients systemic circulation. We had adapted, direct ascending aortic root cannulation in the day and, as a result, direct femoral artery cannulation had, unless otherwise required, been intentionally, abandoned!



The initial schematic drawing, circa 1971

FIRST PHASE PRIME: consisted of one litre of 5% Dextrose in water containing 10,000 units of heparin was initially introduced, into this closed ECC, by way of the Bentley Hard Shell cardiotomy reservoir with its distal incorporated, cardiotomy filter, next into the Lande-Edward membrane oxygenator. This initial, one litre crystalloid prime was then, manually fed into the closed ECC, with the main arterial pump being "rapidity increased and then, rapidly decreased" with the membrane bundle being shaken, "rather vigorously" in an up and down thumbing motion" also, from side to side", to insure the closed ECC, was both bubble free and, as importantly, to insure the sodium chloride solution was "throughly washed" from off the many silicone membrane sheets and, also as importantly, that any resulting entrapped ambient air bubbles were removed, into the waste container, as the SECOND phase prime was being, slowly introduced, via the Bentley cardiotomy reservoir. Within the passage of time, this 3 phased priming technique and, its constant maneuvering was to become, more simplified, given our every developing and constantly, improving phased priming technique ( )!!

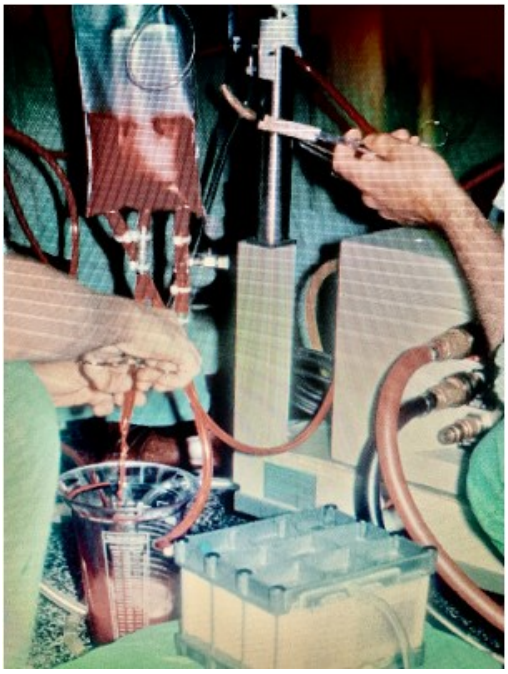
SECOND PHASE PRIME: consisted of one litre of 5% Dextrose in water with 25 grams of salt free albumin. The albumin was added to physiologically coat the entire ECC! This second prime, after 15 minutes of "continued deliberate shaking" of the membrane bundle, while constantly de-airing and recirculation, would next be replaced by the third phase and final prime or what was referred to as "our physiological whole blood prime".



The Lande-Edwards Membrane shown, with its "second phase prime" being circulated, while awaiting "the third physiological whole blood prime" being shown, held within the isolated cardiotomy reservoir.

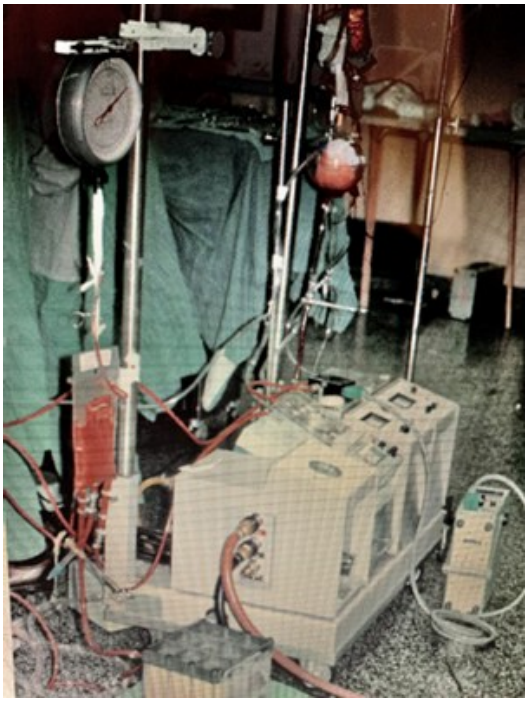
THIRD PHASE, "PHYSIOLOGICAL, WHOLE BLOOD" PRIME: consisted of fresh Citrate Phosphate Dextrose (CPD) reconstituted whole blood to which had been added 10 mls of 25% mannitol and 15 mg of magnesium sulphate (MgSO4) used as neuro protection. This physiological blood prime was "VERY carefully but SLOWLY introduced", by way of the isolated Cardiotomy reservoir, while gently draining the second prime rinse out of the extracorporeal circuit, thus our allowing the whole blood

prime, with a final hematocrit (HCT) of 25% and with an osmolarity of approximately 380 mOsmol/L, to enter the final pre- bypass ECC - in the day, this final third phase whole blood prime technique, had demanded “a tidbit of both required and acquired”, Pump Tech, extracorporeal skill (😊)!!



The second phase prime is shown, being slowly removed and replaced, by the third phase CPD whole blood prime - this technique ensuring, “a physiological third phase physiological prime”, with a resulting pre-bypass HCT of 25%!

This complex, laborious and time consuming three phase priming sequence, from the first to the third physiological whole blood phase prime, could take up to approximately, 45 minutes or more, in preparation for CPB, to satisfactorily completion! One might now understand the complexity of priming this, initial introduction into the clinical use of this earlier generational, Lande-Edwards membrane lung oxygenator, as is shown in the below, clinical interface photo.



The CPB circuit, showing the “third phase, whole blood prime” in situ, after the required, initial two stage wash/rinse out procedure.

Within each of our professional career, we would have, a beginning and an ending (😳)! On August, 15, 1978, some 48 years ago, the late, Dr. Alex Gillis, the Paediatric open heart surgeon was to, patch close, with Dacron, a secundum atrial septal defect (ASD) on a 7 year old boy - who's name, I can still remember to this very day (👍)! This was, in fact, to be my last Paediatric CPB pump case, within my Perfusion career (😳). On that resolute day, I had utilized the Harvey H-1000 Hard Shell Paediatric bubble oxygenator, while being assisted by my friend and colleague, Ralf Ricketts! Just one month later, I was to leave for my new position, within University Hospital, London, Ontario. Ironically, I was not to return, to this "specific IWK Cardiac OR," until 2013, while ironically, observing the closure of an ASD, on a Neonate, with my Perfusionist friend and colleague, Mark Henderson, CPC, that being, some 35 years after my leaving Halifax, Nova Scotia. Ironically, serendipity, would play its role! it was on that very day, I was to "reconnect with Dr. Alex Gillis", the retired Paediatric Cardiac Surgeon, with whom I had shared, my last CPB pump run, in 1978! We were, on several very special occasions, to also meet (👍)! That said, these much earlier era open heart days, with my having been OJT (apprenticeship trained), I would remember ALL the clinicians with whom I had both, initially trained and then, had worked with, within the IWK: Dr. Alex Gillis-Cardiac Surgeon, Dr. David Murphy-Cardiac Surgeon, Dr. Steward Wenning- Anesthesiologist, Dr. Doug Roy-Cardiologist as well as, Heart Pump Technician, Alan Smith, Richard Leadon, Clarence Power, Ralf Ricketts and Paul Pike - names that remain, "etched, within my extracorporeal memory bank, forever"! Extracorporeal time, nor tides, wait for no man as shown in the below photo, taken within the Halifax, IWK Health Center of today, with its, modern day CPB technology! As mentioned, "memories are the photos we had never taken"! Luckily, I am most fortunate to have retained, much of our extracorporeal past, to the present day, given my many photo's and my memories, having been preserved, over these past, several decades, as I had, initially apprenticed, as an OJT "Pump Tech" into a "Cardiovascular Perfusionist".

The Infant Paediatric Sorin Heart Lung machine with its modular base design, during clinical use with the Sorin Infant FX05 Hollow Fibre Oxygenator, IWK Hospital, Halifax, January 2022 (👍).

Should the reader so wish, a thorough and personal review, of these and other of my historical CPB, Halifax "Pump Tech reality and OJT apprenticeship training and events", can be explored within my book entitled,""Our Shared Extracorporeal Circulatory History - A Personal Remembrance", Halifax, Nova Scotia, Canada (10).

Revisiting our CPB historical past with Perfusionists friend - myself holding the Lande-Edward 1.0 square meter membrane (note, animal unit) and the Baxter Travenol Membrane Oxygenator (TMO), with my Senior Perfusionist colleague, Pierre Lavalle, holding the Galen OptiFlow Bubble Oxygenator with colleagues, Mary-France and Julie Ouellette, holding earlier generational Bubble Oxygenators, etc, The Fleurimont CUS) Cardiac Hospital, Sherbrooke, Quebec April, 16, 2015.

As I had cited within a previous AACP Newsletter, the philosopher, Henry David Thoreau, had said, "how vain it is to sit down to write when you have not stood up to live"(⏳)! I believe the reader, of this specific extracorporeal history, would appreciate his, rather, salient point! Within this very realization, we would understand, the extracorporeal era that YOU would now "pump in" would also provide, the reader of future years, your historical perspective given your specific, but acquired, clinical inheritance! It is my personal hope, we would continue to, "sit down and to write" our historical past - a repository of experiences, albeit within, an accurate and documented clinical scenario given our shared, but related, extracorporeal experience? In this "refection in one's rear view mirror", representative of a peak back into our rich extracorporeal past, it may be prudent to, once again, remember the sage words of my mentoring Cardiac Surgeon, the late Dr. Alex Gillis, having said, "Jim, the early years of one's career, are shaped by the many"! As is also true, both your initial and your ongoing clinical interface years, would also be shaped "by the many"! These thoughtful sentiment would, still remain alive, within each of our singular experiences (👍)! If I might, lastly mention, the greatest professional gift, any one Perfusionist might have available, would be the opportunity to involve oneself within the low hanging fruit of organizational collegial support, given its associated acquired friendships and ones ability to perhaps, one day, to "sit down and to write" within both your singular as well as your and my, shared personal historical journeys! Within that reminder, of our "being shaped by the many", I think it rather timely these specific historical "tidbits" of your and my past extracorporeal related past experiences, be now written, and, in particular, while my memory remains "first hand and hopefully, not just mere words, within, another history book"(⏳ 👏 😉)!

We are, ALL of US, "THE SHARED HANDS, in the care of our Cardiac patients".
With kindest regards, your extracorporeal colleague,
Jim MacDonald CPC (Retd) CCP (Emeritus)

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Hannah Calcote, BS and **Ashley Fellows**, RN, BSN, CEN

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The Renin–Angiotensin–Aldosterone System and Vasoplegia During Cardiopulmonary Bypass

You are on cardiopulmonary bypass (CPB) and your flows are appropriate, the heart is ejecting well and your cardiac output is great. However, your patient's mean arterial pressure (MAP) continues to trend downward. The use of vasopressors is increasing in frequency during the case to maintain an adequate blood pressure. Phenylephrine, norepinephrine and possibly even vasopressin may be added to treat the arterial pressure, and the results are modest at best.

Let's take a glimpse into this familiar picture of maintaining MAP on bypass. Initiating bypass is a stressful moment, not only for the perfusionist but for the patient's physiology. Contact activation, cytokine release and nitric oxide production are only some of the relevant vasodilatory factors that occur with the initiation of CPB and have a direct effect on the patient's MAP. Under normal conditions, the renin-angiotensin-aldosterone system (RAAS) serves as a critical defense against hypotension. When the blood pressure drops, this hormonal cascade will activate to ultimately restore vascular tone. However, on cardiopulmonary bypass, this critical system may be disrupted. In other words, the RAAS cascade exists to prevent the scenario we are trying to correct on bypass.

Revisiting RAAS Physiology

The RAAS cascade is initiated in response to a drop in arterial blood pressure, decreased renal perfusion and sodium depletion (Gravlee et al., 2015). This results in the proteolytic enzyme, renin, being released from the juxtaglomerular cells located in the afferent arterioles of the kidneys. Thus, activating the cascade that ultimately generates angiotensin II, a potent endogenous vasoconstrictor. Renin is the rate-limiting step of the cascade and is responsible for cleaving angiotensinogen from the liver into angiotensin I. Angiotensin I is altered into angiotensin II via the angiotensin-converting enzyme (ACE), which is found in highest concentrations on the endothelial surface of the pulmonary vasculature. Conversion of angiotensin I to angiotensin II is nearly complete during a single pass through the lungs (Gravlee et al., 2015). Once produced, angiotensin II increases systemic vascular resistance through potent vasoconstriction. This active hormone also works to stimulate aldosterone secretion, promoting the reabsorption of sodium and water to support circulating volume. These effects together act to restore arterial pressures.

About the Authors

Hannah is a current Rush University student graduating in May 2027. She earned her Bachelor of Science in Microbiology and has built a strong clinical foundation through roles in transplant services and critical care environments. She is passionate about lifelong learning, teamwork, and contributing meaningfully to patient-centered care as she continues her professional journey.

Ashley is a current Rush University student graduating in May 2027. She is a former registered nurse with training in the emergency department and Neuro ICU. She is incredibly grateful for the perfusion community—the mentors, educators, and clinicians who continually offer guidance, encouragement, and support.

Implications During Cardiopulmonary Bypass

Cardiopulmonary bypass fundamentally alters this tightly regulated system on multiple levels. First, the renal system is exposed to non-pulsatile flows and hemodilution from circuit prime volume. Since renal arterioles are highly sensitive to pulsatility and stretch, these changes are interpreted as hypovolemia. As a result, renin release increases, initiating activation of the RAAS cascade. Renin is in abundance and is the activator of the RAAS cascade, so why is the pressure still low? Despite high renin levels, a very crucial element of the RAAS cascade is out of play: the lungs. During CPB the lungs are bypassed from circulation. This matters because the production of angiotensin II relies on ACE, which resides mostly in the pulmonary vasculature. Reduced exposure of circulating angiotensin I to pulmonary endothelial ACE limits the production of angiotensin II, allowing vasodilatory and nitric oxide-mediated pathways to persist. This leaves the body in a paradoxical state: renin levels are elevated, yet angiotensin II is low. Without angiotensin II, SVR decreases, vascular tone becomes very difficult to maintain and a state known as vasoplegia may develop.

Vasoplegia

Gravlee et al. (2015) define vasoplegia as the state of pathologic vasodilation resulting in low systemic vascular resistance (SVR) and hypotension despite normal or high cardiac output. Post-cardiopulmonary bypass vasoplegia is thought to be a result of inflammatory activation and cytokine release, excessive nitric oxide production and disruption of RAAS (Gravlee et al., 2015). Within hours of separation from bypass, this sequence of events causes significant postoperative hemodynamic instability. So, while the heart continues to work properly, our vessels remain wide open, resulting in distributive shock.

This situation can create diagnostic confusion, as the problem is not inadequate forward flow or circulating volume, but rather the pressure generated against a profoundly reduced SVR. Increasing doses of catecholamines may produce modest improvements, suggesting that not only is vasodilation an issue, but also impaired vascular smooth muscle responsiveness.

Angiotensin II as Targeted Therapy for Post-CPB Vasoplegia

An article by Zarbock et al. (2026) is a comprehensive clinical review examining vasoplegia after CPB, with the narrative synthesis focused on the pathophysiology, clinical evidence and mechanisms of RAAS in cardiac surgery. A particular focus of this study was the

emerging role of angiotensin II therapy. The authors suggest that angiotensin II may serve as a targeted therapy capable of restoring vascular tone when vasopressors are insufficient (Zarbock et al., 2026). From a perfusion perspective, this review recognizes vasoplegia as a hormonally mediated process rather than a catecholamine-responsive condition (Zarbock et al., 2026). It is imperative that perfusionists recognize vasoplegia early during and after CPB. This identification then needs to be communicated so the team can collaborate and integrate angiotensin II into vasopressor therapy for refractory vasoplegia.

Large cardiac surgery-specific trials are still needed, but the data available does suggest a promising outlook for angiotensin II as a targeted therapy. For perfusionists, this reinforces the importance of understanding alterations during CPB. Although the patients' heart may look great, the underlying story of their vessels can be completely different. In order to maintain adequate perfusion, collaborative strategies might be the future for managing post-CPB vasoplegia.

Conclusion

Post cardiopulmonary bypass vasoplegia has been framed as an inflammatory phenomenon. This is expected due to contact activation, cytokine release and nitric oxide-mediated vasodilation brought on by CPB. Alongside inflammation, CPB also disrupts a fundamental hormonal system that is responsible for maintaining vascular tone. Zarbock et al. (2026) reviewed how CPB alters RAAS, leading to elevated renin, relative angiotensin II deficiency and impaired vascular tone. Understanding how RAAS is altered on bypass allows us to interpret hemodynamics through a different lens and encourages consideration of hormonal pathways as targeted therapy. By recognizing RAAS dysfunction early, prevention or treatment of vasoplegic shock can be a collaborative approach by using angiotensin II with vasopressor therapy to restore vascular tone.

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48th Annual Seminar of
The American Academy of Cardiovascular Perfusion
Hilton Salt Lake City Center
255 South West Temple, Salt Lake City, UT 84101
February 3-6th, 2027

Tentative Program Outline

Wednesday, February 3rd, 2027

1:00 pm – 5:00 pm	REGISTRATION
2:30 pm – 5:00 pm	**Manufacturers' Breakout Rooms**
5:00 pm – 5:30 pm	Opening Business Meeting *Fellow, Member, Senior, and Honorary Members*
5:30 pm – 7:00 pm	**Pro/Con Debates** *Hypobaric (Physiologic) Perfusion vs. Traditional Oxygenation* *ECMO / VAD / NRP — CCP-Led vs. Non-Perfusionist Operators*

Thursday, February 4th, 2027

7:00 am – 10:00 am	REGISTRATION
7:00 am – 7:45 am	Historical Video Presentation and Breakfast
7:45 am – 9:30 am	**Special Scientific Panel Session I — Emerging Technologies & Novel Interventions** Opening Remarks & Session Introduction Physiologic (Hypobaric) Perfusion & Hybrid Venous Reservoir Expanding Intravascular Catheters for Rapid ECMO Deployment Intravascular / Catheter-Based Gas Exchange Measuring Microvascular Perfusion on CPB — Beyond DO2i Circuit Design & Reduction of Systemic Inflammatory Response Panel Q&A
9:30 am – 11:30 am	**Fireside Chats**
11:30 am – 12:30 pm	Lunch and Historical Presentation
12:30 pm – 2:30 pm	**Special Scientific Panel Session II — MCS, ECMO & Anticoagulation** *Session Introduction* *Advances in Anticoagulation for ECMO* *New ECMO Platforms & the LAVA Technique* *Updates on Heart Failure & Mechanical Circulatory Support* *Impella: Prophylaxis, Escalation & De-escalation Strategies* *AI in ECMO Pathways — Automated Data Acquisition* *Panel Q&A*

2:30 pm – 3:00 pm Historical Presentation and Break

3:00 pm – 5:00 pm **Concurrent Dual-Track Session**

ROOM A — Main Ballroom
Congenital & Pediatric Perfusion

Congenital & Pediatric Session — Welcome

Pediatric Interesting Cases — Complex Congenital, ECMO & Hybrid

Bloodless Surgery & Modified Ultrafiltration in Small Patients

PD Perform Registry — Pediatric Outcomes & Automation Roadmap

(Re)Building a Congenital Heart Program

Panel Q&A

Room B — Canyon Room
Administrative & Leadership

Administrative & Leadership Session — Welcome

Teaming in Cardiac Surgery — Year 1 Findings

Psychological Safety in Multidisciplinary Teams

Reality-Based Leadership: Ditch the Dra-ma

New Hire Onboarding — Corporate Model vs. Preceptor-Led Immersion

Perfusionist Wellness & Avoiding Burnout

Panel Q&A

5:30 pm – 8:30 pm **Sponsor's Hands-On Workshop & Reception**

Friday, February 5th, 2027

7:00 am – 10:00 am REGISTRATION
7:00 am – 7:45 am Historical Video Presentation and Breakfast with Sponsors/Exhibitors

7:45 am – 9:30 am **Special Scientific Panel Session III** — *AI in Perfusion & Data Registries*
Session Introduction
AI, Education & the Expert Development Pipeline
AI in Perfusion — Automated Data Acquisition to Improve Operator Performance
Perfusion Data Registries — Adult Perform & Pediatric PD Perform
ECMO Data Registries & National Database Development
Panel Q&A

9:30 am – 11:30 am **Fireside Chats**

11:30 am – 1:00 pm Historical Video Presentation and Lunch

1:00 pm – 2:55 pm	**Special Scientific Panel Session IV — Transplant, Procurement & Organ Preservation** *Session Introduction* *NRP (Normothermic Regional Perfusion) — Fresh Perspectives* *Ex-Vivo Technologies for Organ Procurement* *Organ Preservation — Sherpa Packs & Temperature-Controlled Coolers* *The Re-Up Study — Del Nido-Based DCD Heart Preservation* *Xenoheart Transplantation — Current State & Clinical Trials* *Transmedics OCS — Warm Beating-Heart Ex-Vivo Transport* *Panel Q&A*
2:55 pm – 3:15 pm	Historical Video Presentation and Break
3:15 pm – 5:00 pm	**Memorial Session** *Introduction* *Charles C. Reed Memorial Lecture* *Thomas G. Wharton Memorial Lecture* *Robert Grimmett, President, AACP*
6:30 pm	**Induction Dinner** *All Attendees and Guests (pre-registration required)*

Saturday, February 6th, 2027

7:00 am – 10:00 am	REGISTRATION
7:00 am – 7:45 am	Historical Video Presentation and Breakfast
7:45 am – 10:00 am	**Scientific Paper Session**
10:00 am –12:00 pm	**Fireside Chats**
12:00 pm	Closing Business Meeting *Fellow, Senior, and Honorary Members Only*

Live Webcast of the AACP Conference

The AACP will be offering a Live Webcast of the 2027 Annual Seminar in Salt Lake City, Utah.

Virtual attendees will be able to stream all of the General Sessions, as well as have two virtual Fireside Chats each day, exclusively for virtual attendees, ensuring qualification for Category I CEUs.

Virtual attendees will have the opportunity to again ask questions of the moderators.

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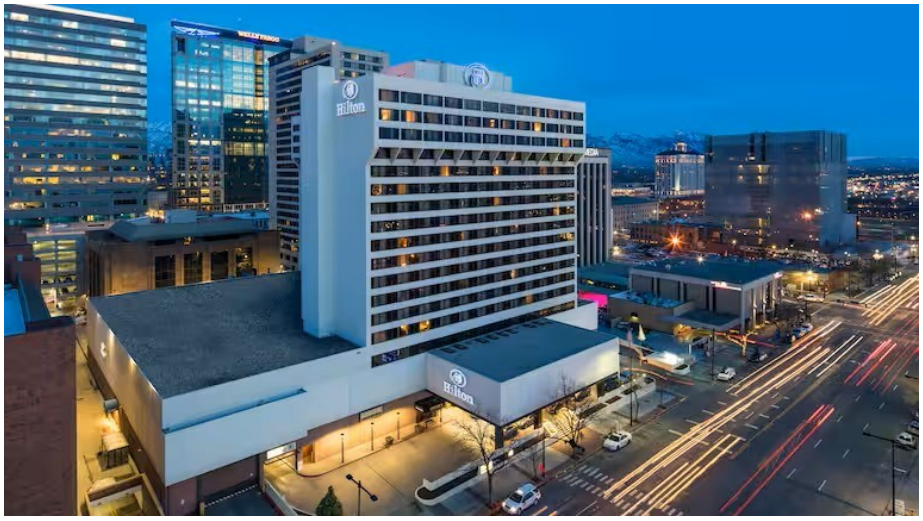
Important Academy Dates

The ACADEMY ANNUAL MEETING DEADLINES

ABSTRACT DEADLINE	**October 15, 2026**
MEMBERSHIP DEADLINE	**December 2, 2026**
PRE-REGISTRATION	**January 9, 2027**
HOTEL REGISTRATION	**January 9, 2027**
2026 ANNUAL MEETING	**February 3-6, 2027**

2027 Annual Meeting

Salt Lake City, Utah
February 3-6, 2027



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