

Cultivating a Culture of Safety in Perfusion Practice

Patient safety is the heartbeat of perfusion and perfusionist aim. As perfusionists, we can keep you alive without a heart or even lungs — but what truly keeps you safe is our *conscience, compassion, and care*. Each time the heart is stopped and replaced by the steady flow of the heart-lung machine, we make a silent promise to protect that life with all our knowledge, experience and integrity. In perfusion, the margin for error is virtually nonexistent; one oversight can place a patient's life in immediate danger or even death and ripple through the lives of their loved ones.

Every patient's survival rests on the perfusionist's skill, awareness, experience, knowledge, and conscience. Behind every flow reading is a human being who has entrusted us completely. True patient safety extends beyond checklists — it lives in teamwork, humility, experience, knowledge, and clear communication. In the operating room, safety is not achieved by one person but through mutual respect and collaboration among surgeons, anesthesiologists, nurses, perfusionists, and other team members. This shared vigilance transforms a high-risk procedure into a life-saving act of trust.

Recognizing a Near Miss

Before beginning my training in the United States as a master degree student, I worked as a clinical perfusionist in Iran for seven years. During that time, one moment left a lasting impression on how I view patient safety. It was a routine small adult congenital cardiac surgery, and my master's degree student had helped set up the heart-lung machine. A few minutes before incision, I stepped out briefly. When I reentered the room, the patient's blood pressure had dropped suddenly. We decided to initiate cardiopulmonary bypass immediately, but as we reached full flow, I noticed something alarming — the blood entering the oxygenator remained dark and failed to turn bright red as it should.

In Iran, where resources are limited, we did not have in-line blood gas monitoring. That meant the only indicators were visual observation and perfusion parameters. Acting quickly, I asked the anesthesiologist to resume mechanical ventilation to preserve oxygen delivery while I inspected the circuit. Within seconds, I discovered the issue: the gas supply line had been mistakenly connected to the exhaust port of the Terumo FX15 oxygenator. Once the connection was corrected, the blood instantly regained its bright red color, and the patient's condition stabilized.

The patient's life was never endangered for long, but the experience stayed with me. It reminded me that patient safety depends not only on technology, but on human attentiveness and clear communication — especially in teaching environments, where learning and responsibility intersect.

Human Factors and System Vulnerabilities

Although the potential harm was addressed promptly, the underlying vulnerabilities were multifactorial. The trainee's cognitive overload during simultaneous equipment setup, inadequate redundancy in the setup verification process, overall workload and center case load, and environmental distractions all contributed. In this case, the setup took place inside the operating room, with the patient already on the bed and the surgical team preparing for incision, and the patient also had unstable hemodynamics during induction—a setting that naturally increased pressure and divided attention. This may have been a key factor in the loss of concentration that led to the misconnection.

Safety Mitigators and Process Improvements

Several practical steps can strengthen patient safety in perfusion practice:

Two-person verification:

Always double-check circuit connections—especially gas, blood, and monitoring lines—with another team member before bypass, rather than relying solely on a checklist completed by the same individual.

Human factors and simulation training:

Practice handling distractions and emergencies in a controlled environment to build confidence and focus under pressure.

Structured communication:

Pre-bypass verbal checklists between the perfusionist, surgeon, and anesthesiologist promote shared understanding and reduce ambiguity.

Post-case debriefing:

Reviewing near misses encourages learning and system improvement rather than blame, turning moments of error into opportunities for growth. Having weekly journal clubs to review accident reports, relevant literature, and our own experiences further reinforces this learning culture.

Optimized timing and environment:

Whenever possible, perform circuit setup with adequate time and without rushing, ideally before the patient enters the operating room. This reduces stress and prevents mistakes caused by noise, time pressure, or environmental distraction, and highlights the importance of having a clean, dedicated room where the pump can be set up in advance.

Active supervision during training:

Students should never perform setup unattended.

Equipment compatibility awareness:

Check for mismatches between gas outlets and oxygen tubing sizes. While modern systems are now better standardized, verifying fit and flow before use remains essential.

Advanced monitoring technologies:

Tools such as in-line blood gas analyzers allow early recognition of inadequate gas exchange, while cerebral oximetry enables prompt detection of perfusion or oxygenation issues, offering an additional layer of safety during bypass.

Building a Culture of Patient Safety

Patient safety is not confined to critical moments; it's embedded in daily habits: consistent documentation, continuous reading, honest debriefing, and the humility to learn from near misses. In perfusion, technology is indispensable but never infallible. Alarm fatigue, automation bias, and routine familiarity can trick even experienced clinicians into a false sense of security. The most impactful safety devices, therefore, remain human insight, team communication, and staff vigilance.

Mentorship plays a vital role in shaping this safety culture. Observing my preceptor's composure during that near miss reinforced how leadership during uncertainty sets the tone for the team's response. A calm, analytical attitude prevents escalation, while immediate debriefing transforms an incident into a learning opportunity. Incorporating structured post-case reviews, documentation, and weekly journal clubs enables both reflection and system improvement—a cornerstone of high-reliability organizations.

Personal Reflection and Commitment

That experience in Iran continues to shape who I am today as a perfusion student in the United States. It taught me that patient safety is not driven by fear of mistakes, but by respect for life and the responsibility we carry with every procedure. Every perfusionist should also be aware of how to scientifically report accidents and write articles about

them; we should not leave any experience behind us, considering it merely a personal lesson, but instead share our accident experiences with colleagues to gain feedback and resolutions.

Perfusionists are the publicly unknown guardians of the heart. We stand quietly behind the surgical field, yet the patient's survival often rests in our hands. Each bypass feels like a silent promise between science and compassion—a moment when knowledge merges with conscience. My goal is to help foster a culture where communication and humility define success, where teamwork outweighs ego, and where patient safety remains the essence of our profession.

Because in the end, **as perfusionists, we can keep you alive without a heart or even lungs — but what truly keeps you safe is our conscience, compassion, and care.**