PANEL DISCUSSION

Next-Generation PERT Concepts: Ensuring Sustainability While Improving Care Pathways

Moderator Kenneth Rosenfield, MD, MHCDS, leads an expert conversation on sustaining PERT programs, preventing burnout, reducing therapeutic bias, integrating AI, and improving patient-centered PE care.

With Vivian L. Bishay, MD; Patrick Muck, MD, and Sameh Sayfo, MD, MBA, FSCAI, FACC

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Dr. Rosenfield: Although there's still room for growth and improvement, pulmonary embolism (PE) response teams (PERTs) have already begun to revolutionize care for PE patients and practitioners where they've been instituted. The next summit to strive for in their evolution is to focus on ensuring their sustainability.

After the initial phases of development and implementation have concluded, how can teams ensure a lively and energetic approach continues?

Dr. Bishay: Teams sustain momentum by providing opportunities for ongoing education, including regular multidisciplinary journal clubs and morbidity and mortality conferences. Incorporating trainees into the consult process is another way to engage many voices and enliven the PERT. At Mount Sinai, our senior integrated interventional radiology (IR) residents rotate through PERT participation, evaluating acute PE patients and presenting them to the PERT in conjunction with our attendings. Standardizing consult activation reduces the overall number of PERT contacts that don't require

our care, helping the team focus on high- and intermediate-high–risk PE or particularly complex cases. We also make efforts to regularly recognize the team's efforts, highlighting team members with successful patient outcomes, particularly in complex scenarios that lean on multiple specialties. Finally, we host an annual hospital-wide PERT meeting to review year-on-year outcomes metrics, reinforcing the group's mission and continued efforts to improve.

Dr. Muck: PERTs have undoubtedly revolutionized care for PE patients. PERTs are exciting in the beginning when you see the coordinated care and new innovative therapies being brought to this very ill patient population. The best way to maintain this excitement is with regular, consistent communication. Quarterly quality assurance meetings are helpful to facilitate communication and foster accountability. These meetings inevitably bring out collaboration among the various specialties involved in the PERT. Specific case discussion as well as treatment algorithm development are ideal ways to bring the team together and keep the PERT momentum.

Dr. Sayfo: After the initial phases of development and implementation, sustaining a lively and energetic PERT requires a truly multidisciplinary structure supported by engaged champions from every involved specialty—including interventional cardiology, IR, vascular surgery, emergency medicine, internal medicine, cardiothoracic surgery, and pharmacy. Appointing dedicated representatives from each department ensures consistent communication, ongoing education, and continuous reinforcement of protocols, with regularly scheduled meetings to address questions, clarify algorithms, and maintain system-wide alignment. Quarterly program-wide meetings further strengthen sustainability by providing a forum to review updated algorithms, institutional data, outcomes, and mortality metrics, allowing teams to identify opportunities for improvement and implement system-level changes. Maintaining a structured database—or participating in a national registry such as The PERT Consortium's PERC initiative—is equally essential, as it enables granular analysis of outcomes and supports data-driven quality improvement. Finally, celebrating successes and highlighting the program's impact helps sustain enthusiasm, reinforces the value of the PERT across the institution, and fosters long-term engagement among all team members.

Dr. Rosenfield: Are there any ways to ensure teams don't experience damaging drop-offs if key members are absent, on leave, or depart entirely? How can teams prepare for these events proactively?

Dr. Sayfo: Long-term program durability relies on avoiding dependence on any single individual. Many strategies to avoid this come to mind, including:

- **Dual leadership model:** Appoint codirectors from different disciplines to ensure continuity and balanced decision-making.
- **Distributed leadership:** Assign meaningful leadership tasks (protocol updates, education, quality review) to multiple PERT members.
- **Cross-training:** Ensure that other members can seamlessly step into key roles when needed.
- **Succession planning:** Identify rising leaders early and provide them with mentorship and exposure to administrative responsibilities.

Dr. Bishay: The best chance for a PERT team to experience success is to have a core handful of clinicians who are invested early on. In time, they draw in other individuals interested in improving PE care to the group, introducing more depth, until finally there are enough committed members to protect against burnout and drop-off. Of course, different institutions will tend to face different problems achieving this steady state. Community hospitals often have too few team leaders, who may get overwhelmed with requests for help. Big institutions may have too many early participants and suffer from dilution of responsibility. One way Mount Sinai IR has protected against burnout was to have all our interventionalists stay up to date with current techniques and technology. Early on, we had two providers perform PE cases rather than silo this knowledge with a few physicians. This has allowed our IR group to have complete comfort with the PE service line with all of our providers rotating onto the PERT while on call.

Dr. Muck: All PERTs are different and reflect the nature of the specialties involved. Our vascular surgery team has been providing the interventional care for this patient population since its inception in 2013. New members to the group are all trained in these PE therapies, and these skills are a prerequisite before joining the group. Fortunately, TriHealth has both a vascular surgery fellowship and residency. Training the next generation is imperative to populate PERTs going forward. Program directors in vascular surgery training programs should consider getting involved with their institutions' PERTs so the next generation of graduates is prepared for this venous thromboembolic workload.

Dr. Rosenfield: How can response teams for emergent conditions such as PE avoid burnout in their team members?

Dr. Sayfo: One of the most common misconceptions about PERTs is that activation inevitably leads to middle-of-the-night or holiday interventions. In reality, the majority of PERT cases fall into low- and intermediate-risk categories and can be safely managed medically until regular daytime hours. Preventing burnout starts with clear, well-understood risk stratification algorithms that reduce unnecessary activations and ensure appropriate triage. Expanding the call pool so the workload is shared across a broader team also helps minimize after-hours burden. Ongoing education for house staff, emergency teams, and hospitalists further improves triage accuracy and reinforces proper activation criteria. Finally, setting realistic expectations—that not every PE requires emergent intervention—helps decrease pressure on the team and supports long-term well-being.

Dr. Muck: Team member burnout as well as a hostile work environment are serious concerns. As the years go by, our PERT has rapidly risk-stratified patients and identified more intermediate-high–risk patients who need interventions. This can stress team members and lead to long hours, with many add-on procedures in the interventional suites. It is vital for PERT members to interact with administrators to ensure there are plenty of team members to handle this seemingly increasing endovascular case volume. The more boots on the ground to absorb this workload, the less chance of burnout.

Dr. Rosenfield: How does your PERT reduce bias toward specific therapies, matching the right care to each individual patient? What are your thoughts on the importance and challenges of doing so?

Dr. Muck: It's very easy to see an elevated right ventricular/left ventricular (RV/LV) ratio on CTA and then schedule an endovascular intervention. However, not all PE patients are created equal, and rapid risk stratification is vital to determine the proper therapy. Each patient's care is individualized according to their clinical presentation and underlying comorbidities. Endovascular therapies have become safer, and many do not require thrombolysis at all. However, there are still risks to every intervention. Arrhythmia, hematoma, intracranial hemorrhage, blood loss, tricuspid valve injury, and pulmonary artery perforation are all potential complications from endovascular procedures. Therefore, the risks and benefits of all therapies need to be individualized.

Dr. Sayfo: Our PERT reduces bias toward any single therapy by grounding all decisions in clear, evidence-based algorithms that support accurate risk stratification and guide clinicians toward the most appropriate treatment pathway for each patient. Continuous education ensures that all team members remain current on evolving data, guidelines, and consensus recommendations from PE-focused societies. Real-time multidisciplinary communication—supported by a shared platform that enables instant, case-based discussion—helps integrate guideline-based recommendations with patient-specific clinical nuances. We also conduct quarterly reviews of all cases, including both successful and challenging ones, and use these insights to refine our protocols and enhance consistency. Despite these efforts, several challenges persist, including variation in experience across specialties, the rapid evolution of PE technologies, a natural inclination to rely on familiar therapies, and limited randomized controlled trial (RCT) data in certain areas. These factors reinforce the need for ongoing collaboration, education, and protocol refinement.

Dr. Bishay: With the rapid expansion of catheter-directed technology over the last decade, it is imperative that providers understand the current state of evidence for acute PE intervention. Although the recent STORM-PE study was a positive RCT for thrombectomy versus anticoagulation alone, we still have a long way to go in understanding outcomes of endovascular interventions, particularly in the long term. Moreover, the majority of studies on endovascular interventions are industry funded. Although they produce valuable data, these must be complemented by studies that are independent of commercial interests. Among the PE trials we are running, our PERT has prioritized enrollment in PE-TRACT, a National Institutes of Health–funded RCT of endovascular intervention versus anticoagulation that is device agnostic (leaving it to the discretion of the operator). Although the study is not powered to compare subgroups, it will provide a wealth of data that we hope can be hypothesis driving. One of the benefits of having a PERT is that it creates a nexus of clinicians drawing on respective departmental resources to engage in active enrollment of patients in a variety of studies. This multidisciplinary arrangement further minimizes bias by encouraging participants to critically engage with their assumptions while engaging in research and in the delivery of PE care.

Dr. Rosenfield: Do you see the role of triage and communications evolving to meet the

unique and changing needs of modern PERTs? What do you see as the future of artificial intelligence (AI)/machine learning (ML) in assisting human diagnosis, communications, and even therapy decisions?

Dr. Bishay: By providing teams with a centralized communications hub that also pulls in pertinent information and helps identify and risk-stratify patients, AI/ML has the potential to play a significant role in helping PERTs deliver more efficient and better care. Like many PERT Consortium member organizations that use hybrid virtual-physical activation and secure image and data sharing systems, at Mount Sinai, we use an AI-driven platform that identifies patients based on their CT pulmonary angiogram and automated RV/LV ratio calculation. Based on the RV/LV ratio, centrality of the thrombus, vital signs, and biomarkers, it flags and risk categorizes patients for PERT consultation. This cuts down on time to identification and assessment of critical acute PE patients and thus shortens time to treatment. We are also working to develop our own large language models, which will be iterated to mine information from image-based data.

Dr. Muck: The future is now at TriHealth in Cincinnati. We have been using Viz.ai since December 2022. Their AI-powered platform that uses a cloud-based system for PE patients (Viz PE) is remarkable. The program uses deep learning algorithms to analyze CTA scans to diagnose PE and determine right heart strain. If there is a PE with an elevated RV/LV ratio, we are notified within 5 minutes of the patient's CTA. We have published our experiences in *Methodist DeBakey Cardiovascular Journal* and presented them at The PERT Consortium annual meeting.[1] Viz.ai's program leads to a quicker diagnosis, quicker communication among PERT members, quicker triage of care, quicker time to anticoagulation, and, ultimately, decreased mortality.

Dr. Sayfo: The role of triage and communication within PERT programs will continue to evolve, particularly as AI and ML become more deeply integrated into clinical care. AI has the potential to support real-time risk stratification by synthesizing imaging findings, biomarkers, and clinical parameters into a unified assessment. It can also provide unbiased decision support by consolidating guideline recommendations and relevant evidence, helping teams navigate complex cases more consistently. AI-powered communication platforms may further streamline workflows by alerting the appropriate team members, summarizing key clinical information, and reducing information overload during acute evaluations. In addition, predictive modeling can help identify patients at risk for deterioration earlier in their course. Although AI will never replace the clinical judgment and experience of the care team, it will increasingly serve as a powerful tool to reduce bias, standardize triage, and improve communication efficiency across the PERT system.

Dr. Rosenfield: How can patient feedback be gathered and incorporated into PERT models to ensure needs are understood, prioritized, and met?

Dr. Sayfo: Patient feedback has historically been underutilized in PE care, often because of assumptions about patients' medical literacy or concerns about overwhelming them with complex information. Yet incorporating the patient voice is essential for a truly patient-centered PERT model. This begins with providing clear, easy-to-understand educational materials (eg, visual guides, videos, infographics) early in the care process. Structured posttreatment surveys can help capture patient expectations, concerns, and insights, while patient focus groups or advisory boards offer deeper opportunities for engagement. Transparent communication is also critical; clinicians should present treatment options based on guidelines and evidence, invite open questions, and ensure patients feel informed and supported. When patient perspectives are intentionally integrated into the workflow, it strengthens trust, enhances shared decision-making, and ultimately leads to better patient satisfaction and outcomes.

Dr. Muck: Patient feedback is best addressed with regular scheduled PERT meetings. Our meetings are quality assurance meetings with a multidisciplinary panel. Our cardiothoracic surgeons and vascular surgeons address the PERT's extracorporeal membrane oxygenation (ECMO) and interventional results. Our intensivists and pulmonologists assess the short- and long-term results of patients treated via the PERT. Our PERT nurse navigators evaluate the patient's feedback and take a comprehensive look at the patient-centered care.

Dr. Rosenfield: What separates a good PERT from a great one?

Dr. Muck: We have a great PERT at TriHealth in Cincinnati, Ohio. Our PERT members work long and hard to provide the best care for this very ill population. The broad range of care, including anticoagulation, endovascular procedures, ECMO, and Trendelenburg procedures, requires a team with a variety of skill sets. A great team requires collaboration, collegiality, and open-mindedness.

Teams are built on constant communication. This is done not only with direct dialogue but also through our Viz.ai application, which allows for rapid HIPAA (Health Insurance Portability and Accountability Act)–compliant texting throughout the patient care continuum.

Dr. Sayfo: A great PERT distinguishes itself through exceptional communication among team members and in interactions with patients, assuring clarity, coordination, and trust at every stage of care. What elevates a PERT from good to great is a steadfast commitment to continual evolution, with protocols that are regularly updated to reflect new evidence, emerging technologies, and consensus recommendations. Great programs also ensure access to advanced technologies and maintain rigorous training and credentialing standards, so operators are fully prepared to deliver high-quality care. They are inclusive, bringing together a broad range of specialties while upholding high expectations for competency and performance. Finally, great PERTs rely on data-driven quality improvement, consistently reviewing outcomes and reporting them transparently to guide ongoing refinement and excellence.

Dr. Rosenfield: What are the biggest gaps in current PERT capabilities, and what are some possible solutions?

Dr. Bishay: The largest gaps in current PERT capabilities are the lack of dedicated funding and inconsistent access to PERT services across institutions and care settings. Sustainable solutions include establishing protected institutional or bundled reimbursement models to support staffing and infrastructure, expanding regional or virtual PERT coverage to smaller and rural hospitals, and using standardized data collection to demonstrate clinical value. The problem is going to be that PERTs are still at a relatively nascent stage of development. This is why organizations like The PERT Consortium—which, for example, is pulling together knowledge and resources for an accrediting body to designate PERT centers of excellence and spearheading the PERC research initiative—are so important.

Dr. Muck: I think the biggest gap is the lack of societal guidelines. The technology is rapidly changing, and the result is safer endovascular interventions. However, the current guidelines still reserve endovascular interventions for patients who fail anticoagulation or need "rescue" therapy. Recent data from Penumbra's STORM-PE trial confirm our belief that endovascular therapies are safe and better for patients than anticoagulation alone.[2] Our various societies need to gather the available data and provide up-to-date guidelines around the appropriateness of endovascular interventions.

Dr. Sayfo: Several significant gaps continue to limit the consistency and effectiveness of current PERT programs. Many institutions still lack standardized training and credentialing pathways, resulting in a "learn-as-you-go" approach that creates wide variability in operator expertise and patient outcomes. The absence of unified guidelines across the multiple specialties involved in PE care further contributes to inconsistent practice patterns, both within and between hospitals. In addition, data collection remains uneven, making benchmarking and quality comparison challenging.

Addressing these gaps requires the development of formal training pathways (eg, proctoring, simulation, case-based competency assessments) as well as the creation of unified, cross-specialty guidelines and consensus statements. Participation in national registries can help standardize data collection, while institutional dashboards can track outcomes, protocol adherence, and program performance in real time. Together, these solutions can strengthen the structure, safety, and reliability of PERT programs nationwide. ■

1. Shapiro J, Reichard A, Muck PE. New diagnostic tools for pulmonary embolism detection. Methodist Debakey Cardiovasc J. 2024;20:5-12. doi: 10.14797/mdcvj.1342
2. Lookstein RA, Konstantinides SV, Weinberg I, et al; STORM-PE Trial Investigators. Randomized controlled trial of mechanical thrombectomy with anticoagulation versus anticoagulation alone for acute intermediate-high risk pulmonary embolism: primary outcomes from the STORM-PE trial. Circulation. Published online November 3, 2025. doi: 10.1161/CIRCULATIONAHA.125.077232

Disclosures
Dr. Rosenfield: Consultant/scientific advisory board for Abbott Vascular, AngioDynamics, Boston Scientific Corporation, Cordis, Johnson & Johnson, Biosense Webster, Medtronic, NAMSA, Philips, and Salus Scientific; consulting with equity or stock options in Akura, Contego Medical, Fastwave, Imperative Care, Innova Vascular, InspireMD, Jupiter, Magneto, Radiaction, SonoVascular, Vantis Vascular, and Viz.ai.
Dr. Bishay: Consultant to Penumbra, Inc., Imperative Care; National Co-Principal Investigator, RAPID-PE registry.
Dr. Muck: Speaker for Viz.ai, Penumbra, Medtronic, Gore & Associates, Ichor Medical Systems, Inc., Biotex, Thrombolex, InspireMD, and Reflow Medical.
Dr. Sayfo: None.