

PANEL DISCUSSION

Training the Next Generation in Cardiogenic Shock Care

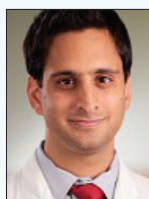
The essential competencies, multidisciplinary training and collaboration, and specialized expertise needed to prepare the next generation for the rapidly evolving field of CS care.

With Adnan Khalif, MD, FACC, FSCAI; Ajar Kochar, MD, MHS, FSCAI, FACC; and Balim Senman, MD



Adnan Khalif, MD, FACC, FSCAI

Interventional and Critical Care Cardiology
Director, Cardiac Intensive Care Unit
Associate Program Director,
Interventional Cardiology Fellowship
Cardiovascular Institute
Allegheny Health Network
Pittsburgh, Pennsylvania
adnan.khalif@ahn.org
@AdnanKhalifMD



Ajar Kochar, MD, MHS, FSCAI, FACC

Program Director, Interventional
Cardiology Fellowship
Brigham and Women's Hospital
Harvard Medical School
Boston, Massachusetts



Balim Senman, MD

Interventional and Critical Care
Cardiologist
Director of Shock Programs
Richmond VA Medical Center
Director of Cardiovascular Critical
Care Regional Networks
VCU Health
Richmond, Virginia
balim.senman@soccc.org

Walk us through your own journey in cardiogenic shock (CS) training. How did you build your expertise over time, and in what specific areas would you have benefited from more targeted instruction or additional experience?

Dr. Khalif: My journey into CS training started early in my fellowship as a covering fellow in the cardiac intensive care unit (CICU). I followed a nontraditional training pathway, encompassing cardiovascular medicine, interventional cardiology (IC), and, subsequently, dedicated critical care medicine (CCM) training. This unique trajectory allowed me to develop a multifaceted perspective on CS management.

For instance, my cardiology background honed my skills in early bedside evaluation and recognition of patients presenting with CS. This was complemented by my critical care training, which provided expertise in troubleshooting mechanical circulatory support (MCS) devices at the bedside. Finally, my IC experience equipped me with the practical skills for emergent MCS cannulation and initiation across various platforms, such as Impella CP (J&J MedTech Heart Recovery) or venoarterial extracorporeal membrane oxygenation (VA-ECMO).

Dr. Senman: After I completed my general cardiology fellowship, I sequentially pursued additional training in CCM and IC. Together, these fellowships have allowed me to cultivate distinct but complementary cognitive and procedural skills that are particularly useful in managing patients with CS. Although general cardiology was certainly foundational, the additional training forced me to approach CS in unique ways and has allowed me to tackle CS clinical care and research in a more holistic

way. The CCM training equipped me to care for some of the sickest cardiac patients in the hospital, but, more importantly, it has taught me how to do so as part of a diverse, multidisciplinary team. I've learned to work with brilliant colleagues who may have different perspectives and often come with very different tools but who are all essential teammates in a patient's CS care. I collaborate closely with cardiothoracic surgeons, heart failure (HF) cardiologists, perfusionists, respiratory therapists, anesthesiologists, emergency medicine physicians, pharmacists, emergency medical services providers, and many others. I continue to learn from each of them, and these partnerships have shaped my understanding of shock physiology, organ dysfunction, hemodynamics, pharmacologic and mechanical support, heart-lung interactions, and critical illness.

On the other hand, IC training helped me better understand the humbling hemodynamic consequences of acute myocardial ischemia and the immediate physiologic impact of coronary revascularization. It provided invaluable experience with invasive hemodynamic assessment and the exploitation of temporary MCS (tMCS) in the cardiac catheterization lab. I was also exposed to structural heart cases, where I often saw dramatic hemodynamic perturbations associated with critical valvular disease and the sudden benefit that can result from successful intervention. I have also learned how to deal with complications and how to get myself out of trouble, an important element of CS care.

Together, these complementary experiences have helped me cultivate a more comprehensive, multidisciplinary perspective on CS. I've gotten to see diverse patient presentations, numerous management strategies, and both common and unusual outcomes. Exposure and experience are so important for CS training, and I am grateful to have had that as a result of my unique training pathway.

Dr. Kochar: The foundation of my training was excellent clinical exposure. I was fortunate to train at a program with a very high volume of HF-related CS, transplantation, and durable left ventricular assist device (LVAD) care. I learned from exceptionally thoughtful advanced HF cardiologists and cared for critically ill patients across the continuum. During my research years, I also deliberately spent time with our cardiothoracic surgeons, including coscrubbing on VA-ECMO cannulations, as well as with the cardiac anesthesiologists who staffed our cardiothoracic ICU and our ECMO perfusionists. That exposure gave me a much better understanding of cannulation, extracorporeal support, and the multidisciplinary nature of shock care. In retrospect, I could have

been even more intentional about seeking out those experiences. There is an enormous amount for cardiologists to learn from our surgical, anesthesia, critical care, perfusion, and nursing colleagues.

My shock journey progressed further during interventional fellowship. I developed a foundation in complex coronary intervention, but I was also fortunate to acquire core peripheral skills. Those skills have been extraordinarily valuable when managing the complications of large-bore MCS: hemorrhage, arterial dissection, thrombosis, acute limb ischemia (ALI), and access site failure. Placing a device is only one part of the procedure; a shock interventionalist must be able to recognize and manage the complications created by that device.

I seriously considered pursuing a dedicated critical care year after interventional fellowship. In retrospect, the ideal sequence might have been critical care before intervention, because after 1 or 2 interventional years, it is valuable to enter your first job with those procedural skills as fresh as possible. The challenge was that I did not fully recognize my interest in the intersection of intervention and critical care until later in training. Ideally, trainees would identify that interest earlier, because it will allow them to design a much more intentional and efficient pathway.

There are also several additional procedural areas that I would have liked to pursue more deeply. In retrospect, I would ideally have completed a dedicated chronic total occlusion or advanced coronary year. Shock is fascinating, but it is, by definition, unpredictable. You cannot build an interventional practice around scheduled shock cases. Coupling shock expertise with an advanced coronary skill set—or alternatively with a dedicated peripheral practice—provides both complementary expertise and a sustainable foundation of elective cases. Transseptal access is another valuable skill for an interventional shock physician. Historically, that has included TandemHeart (LivaNova) placement, but it is increasingly relevant for left atrial VA-ECMO configurations and, in selected cases, atrial septostomy for left-sided decompression during VA-ECMO. Additionally, transcaval access may also become more relevant as alternative access strategies evolve.

Ultimately, most of my later education came through caring for difficult patients, reviewing cases with multidisciplinary colleagues, helping develop shock systems, and participating in clinical research.

What does the contemporary training landscape for shock look like, and why is there no standardized training pathway?

Dr. Senman: The training experience in CS varies considerably depending on a physician's specialty. Although

many disciplines (including cardiology, cardiac surgery, anesthesiology, emergency medicine, and critical care) treat patients with CS, each invariably approaches the disease from a different clinical perspective. Consequently, the knowledge, skills, and experiences gained during training can differ substantially depending upon where and from whom one is learning.

One reason that there is no single training pathway for CS is that its care spans numerous specialties and clinical environments. There are, in fact, numerous stops in the journey of the patient with CS. Their first hospital contact may be in the emergency department, they may undergo emergent revascularization in the cath lab, surgical pathology may take them to the operating room (OR), and additional care may be rendered in the CICU, cardiothoracic surgical ICU (CSICU), or other postoperative recovery units. Because no single specialty owns CS, and because the condition can be so phenotypically heterogeneous, designing a training pathway that encompasses every aspect of its management can be challenging.

Rather than creating a universal fellowship pathway, I believe that the field would benefit most from standardized protocols and pathways aimed at enhancing timely recognition, efficient triage, and evidence-informed management of CS. These could then be adopted across institutions. In many ways, this parallels the evolution of sepsis care. There is no dedicated training pathway for septic shock, yet the Surviving Sepsis Campaign has established evidence-based protocols that provide a common framework for early recognition and management, regardless of which specialty sees the patient. A similar multidisciplinary, protocol-driven approach to CS could improve consistency of care while allowing individual physicians to contribute their unique expertise.

Dr. Kochar: The honest answer is that cardiovascular training is already becoming longer and increasingly subspecialized, and it is difficult to create an additional standardized pathway devoted specifically to shock. The current landscape is fragmented across IC, advanced HF, critical care cardiology, cardiac surgery, and ECMO programs. Each pathway provides an essential component, but no single pathway reliably provides the entire skill set.

Several different models have emerged. Dr. Navin Kapur and others helped spearhead a combined IC–advanced HF pathway. Several of my friends and colleagues have pursued IC followed by critical care training, which is also a very elegant combination. Both pathways are highly reasonable.

However, once someone pursues IC, I believe intervention should remain their primary technical skill set. As IC itself becomes increasingly subspecialized, there can be real value in a second interventional year devoted to advanced

coronary, peripheral, structural, or other complementary skills. That is valuable clinically and also helps create a sustainable practice, as shock volume is unpredictable.

At a minimum, meaningful shock training should occur at centers with high volumes across the spectrum of temporary support—intra-aortic balloon pump, percutaneous ventricular assist devices, and VA-ECMO—and with experience using different access strategies, including femoral and axillary access and, at selected centers, transcaval and transseptal approaches. The center should also manage both myocardial infarction– and HF-related shock and have advanced HF, cardiac surgery, perfusion, and critical care expertise.

The lack of standardization reflects several realities: (1) the interdisciplinary nature of shock, (2) the variation in institutional resources and case mix, (3) the rapidly changing evidence and technology; and (4) the increasing length of cardiovascular training. We also have not fully agreed on what defines a “shock specialist.” Is it the person who implants the device, manages the ICU course, determines candidacy for advanced therapies, or builds the regional system?

Dr. Khalif: The absence of a standardized training pathway for CS can be attributed to several critical factors. CS is not a day job. Consequently, exposure to shock patients and their complex management is heterogeneous across various cardiovascular subspecialties.

Furthermore, the evolving nature of CS, in addition to the limited evidence to guide our decision-making, means there is no single optimal training pathway to cultivate expertise. This landscape necessitates a more adaptive and individualized approach to skill development.

What is the field getting right when it comes to shock training and education, and in what ways does the current approach need to evolve to better prepare physicians who want to specialize in shock?

Dr. Khalif: I believe the collaborative, team-based approach has been one of the biggest advances in CS training and management. The ability to reach out to similar institutions and colleagues and attend national meetings dedicated to the management of these patients provides an excellent opportunity to hone skill sets and improve decision-making.

Dr. Senman: There is now far greater emphasis on the recognition and early management of CS than ever before, and training programs are doing an increasingly better job of exposing trainees to these fundamental concepts. However, one important gap remains: mean-

ingful collaboration and communication between the different specialties that care for these patients.

Despite the multidisciplinary nature of CS, care often remains siloed. In some cases, emergency medicine, cardiology, cardiac surgery, critical care, anesthesiology, and HF may be tasked with managing different phases of the illness with very little cross-talk. Greater discourse between these specialties would improve not only patient care but also trainee education. Providing opportunities for trainees to learn alongside colleagues from other disciplines through multidisciplinary rounds, shock team activations, joint conferences, and simulation would foster a more comprehensive understanding of CS and better prepare the next generation of physicians to lead collaborative, team-based care.

Dr. Kochar: Compared with when I was training, there are many more dedicated educational resources. The Society for Coronary Angiography and Interventions (SCAI) Shock meeting conference has been around for some time and provides a focused, practical educational experience. The Houston Shock Symposium has similarly grown into a major meeting with didactic, case-based, hands-on education. The Extracorporeal Life Support Organization (ELSO) does excellent educational work around ECMO and extracorporeal support. Critical care cardiology has also expanded dramatically, with organizations and programs such as the Society of Critical Care Cardiology (SoCCC), the University of Minnesota Critical Care Cardiology Education Summit, the New York University (NYU) Langone Critical Care Cardiology Symposium, and other regional and national initiatives. There are also highly practical case-based conferences and forums such as the Critical Care Cardiology Enthusiasts Shock Talks.

I have found case-based discussions to be particularly valuable. That includes local quality-improvement reviews conducted by institutional shock teams as well as regional and national case conferences. These discussions teach the aspects of shock care that are difficult to learn from a textbook: troubleshooting a device that is not providing the anticipated support, managing hemolysis or limb ischemia, interpreting discordant hemodynamics, deciding whether to escalate or reconfigure support, and recognizing when the original therapeutic strategy is no longer achieving its goal.

The science is also progressing. We have learned important lessons from several dedicated cardiogenic shock registries, randomized trials, and prospective efforts such as the OASIS-AMICS study should help illuminate best practices for patients treated with microaxial flow pumps.

At many institutions, shock education remains embedded within general cardiology, IC, HF, or critical care training, with the onus on interested fellows to assemble the additional experiences themselves. Programs ideally would identify these trainees early, provide cross-disciplinary mentorship, and create individualized plans to address the gaps in their primary fellowship. Professional societies are increasingly developing these mentorship pathways, but there remains an opportunity to make them more visible, coordinated, and accessible.

We also need to recognize the risk of burnout. Combining intervention and critical care can mean a great deal of call and sustained exposure to high-acuity, emotionally demanding work. Institutions should be protective of physicians pursuing this pathway. That means ensuring sufficient elective interventional volume—particularly early in someone's career—avoiding excessive clustering of interventional, shock, and ICU call, and providing a sustainable clinical structure rather than simply relying on an individual's enthusiasm.

If you could design the ideal pathway to shock expertise, what elements might it include?

Dr. Senman: In my opinion, the ideal training pathway for developing expertise in CS would provide exposure to the entire continuum of shock care, while allowing trainees to view the disease through the lens of the multiple specialties involved in its management. CS is not owned by any single discipline, and meaningful expertise requires an understanding of the unique perspectives, priorities, and decision-making processes of each.

This begins in the emergency department, where many patients with shock first present and where the earliest diagnostic and therapeutic decisions are made. Training should then extend to the CICU, where the majority of ongoing medical management, hemodynamic optimization, and multidisciplinary care occur. Equally important are rotations in the cardiac catheterization laboratory, OR, and CSICU, where trainees may gain additional experience with the dynamic physiology of shock, advanced coronary and structural interventions, tMCS, ECMO, and the management of postcardiotomy shock. These environments should provide additional exposure to the rapid, minute-to-minute physiologic changes that occur and the complex decisions required to stabilize critically ill patients.

Beyond physician training, expertise in shock care also requires immersion in the multidisciplinary teams that are integral to patient outcomes. Spending dedicated time with ECMO specialists and perfusionists, palliative care teams, physical and occupational therapists, and HF coordinators and participating in formal

shock team activations provides critical insight into the longitudinal care of these patients. These experiences teach both the technical management of CS as well as the nuanced considerations surrounding patient selection, recovery, rehabilitation, goals-of-care discussions, and long-term quality of life, to name a few.

Dr. Khalif: My ideal pathway would be as follows: (1) exposure to various MCS platforms, understanding the management from escalation to de-escalation; (2) mastery of advanced hemodynamic assessments using invasive (pulmonary artery catheter) and non-invasive (echo, physical exam) methods; and (3) early exposure to multidisciplinary shock teams to accelerate the learning curve in collaborative decision-making.

Dr. Kochar: I would define shock expertise through competencies rather than insist on one rigid sequence of fellowships. The pathway might begin in IC, advanced HF, or critical care cardiology, but the trainee would need to address the gaps created by their primary discipline.

For an interventionalist, the technical foundation begins with exceptionally strong coronary skills. Shock is not the setting in which someone should still be learning fundamental coronary decision-making or procedural bailout techniques. Core peripheral skills are also critical: large-bore access and closure, up-and-over access, and the ability to manage dissection, perforation, hemorrhage, thrombosis, and ALI. Ideally, a dedicated shock interventionalist would also have exposure to axillary access, transseptal access, and, where available, transcaval access.

Transseptal skills are relevant for TandemHeart, left atrial VA-ECMO configurations, and atrial septostomy for LV decompression. Depending on the local practice, additional training in complex coronary intervention, peripheral intervention, structural intervention, or pulmonary embolism (PE) intervention may provide a valuable complementary practice.

From the noninterventional standpoint, the trainee needs genuine critical care competence, not simply cardiac hemodynamics. That includes mechanical ventilation, refractory hypoxemia, acute kidney injury and renal replacement therapy, sepsis, hemorrhage, coagulation disorders, neurologic injury and prognostication, nutrition, sedation, and multiorgan failure.

HF CS is increasingly the dominant form of CS in many centers. Therefore, the trainee also needs a deep understanding of how advanced HF physicians evaluate candidacy for durable LVAD and transplantation. It is not sufficient simply to stabilize the circulation; one must understand where the patient can realistically go from there.

As the shock population ages, training should also consider incorporating geriatric cardiology and palliative care. Frailty, cognition, preillness function, caregiver support, and patient-defined goals all affect whether a technically feasible therapy is likely to produce an outcome the patient would value. Ideally, care includes longitudinal responsibility for shock patients.

How has the skill set and knowledge base required for CS care evolved over the course of your career? What competencies are most important for clinicians in current practice?

Dr. Senman: The field of CS is evolving rapidly. Even over the course of my 8 years of postgraduate training, I have witnessed significant advances in both pharmacologic therapies and MCS, with many more innovations on the horizon. Although the technologies we use will continue to change, the principles that guide their use should remain constant.

The most important foundation for anyone caring for patients with CS is a thorough understanding of cardiovascular physiology and hemodynamics, the mechanisms of action of vasoactive medications, and the hemodynamic effects of mechanical support therapies. A strong grasp of these fundamentals will enable clinicians to critically evaluate new technologies, adapt to evolving treatment strategies, and provide thoughtful, evidence-based care throughout their careers.

Dr. Kochar: The field has evolved from a relatively narrow focus on hypotension, revascularization, and device placement toward a much more sophisticated understanding of shock phenotypes, trajectories, and systems of care. One obvious area of development is temporary MCS technology. Many of us are excited about newer platforms that may provide meaningful support through smaller arteriotomies, including Impella ECP and the emerging Elevate (Magenta Medical) and Supira (Supira Medical) systems. Smaller access profiles could potentially reduce some of the bleeding, vascular, and limb complications that remain a major limitation of current support strategies.

Alternative access is also becoming more common, particularly for patients with severe iliofemoral disease. Contemporary shock interventionalists increasingly need to understand femoral, axillary, transseptal, and selected transcaval strategies, as well as the different complications created by each approach.

The growth of percutaneous treatment for acute PE and PE-related shock has been another major change since my fellowship. I will acknowledge that I am deeply biased as an interventional cardiologist, but I believe

many severely ill PE patients benefit from going to the cath lab early because it preserves the widest range of options. We may be able to rapidly debulk proximal clot with mechanical thrombectomy; initiate VA-ECMO in refractory shock or arrest to provide both hemodynamic and oxygenation support; or, in selected cases, provide isolated right ventricular (RV) support. This does not mean that every high-risk PE should undergo intervention, and the optimal strategy remains patient- and center-specific. In fact, the 2026 multisociety PE guideline reflects the field's broader shift toward multidisciplinary PE response team evaluation.¹

Valvular shock is another rapidly developing area. I did not train in structural intervention, but the structural field has exploded, and we increasingly encounter patients presenting with shock related to severe aortic stenosis, acute mitral regurgitation, prosthetic valve dysfunction, or other valvular emergencies.

Dr. Khalif: The most impactful skill set in my day-to-day practice remains expertise in MCS. I am frequently asked to help guide decision-making in escalation to various support strategies, troubleshoot alarms at the bedside, and mitigate complications. Weaning strategies to allow for safe de-escalation from MCS are also important. VA-ECMO management is a core competency of contemporary cardiovascular medicine in my opinion, given its increasing use in CS patients.

What exposure to CS care is typically included in a standard interventional fellowship today?

Dr. Kochar: I think this depends substantially on the interventional fellowship and its case mix.

Dr. Senman: IC fellowship offers a distinct perspective on CS. Fellows develop an intimate understanding of coronary physiology and acute hemodynamic deterioration by caring for patients presenting with acute myocardial infarction complicated by shock, acute decompensated HF requiring invasive therapies, and hemodynamic compromise during high-risk coronary or structural interventions. The cardiac catheterization laboratory provides a unique environment in which trainees can directly observe the immediate physiologic consequences of ischemia, reperfusion, valvular intervention, and procedural complications. In addition, fellows gain substantial experience with invasive hemodynamic monitoring and the placement of tMCS devices, integrating physiologic principles with procedural decision-making in real time.

Dr. Khalif: Typically, an interventional fellow will gain competency in safe vascular access to allow for place-

ment of MCS and understand hemodynamic phenotypes to guide decision-making in the cath lab and CICU.

Ideally, increasing exposure to multidisciplinary team decision-making should be included in contemporary IC training as well.

For physicians who don't pursue specialized training, what should they be able to recognize and manage independently, and when should they involve a dedicated shock team or specialized center?

Dr. Khalif: CS does not discriminate. It presents to the majority of hospitals regardless of geography. Physicians should familiarize themselves with the ability to recognize a patient who shows signs of hypoperfusion and/or end-organ dysfunction. Understanding risk stratification tools such as SCAI SHOCK staging helps identify patients who may need to be escalated to tertiary and quaternary centers capable of managing higher-risk patients. I always tell my fellows in training to ask themselves, "What is the trajectory of the patient's primary illness, and are they potential candidates for early escalation to advanced HF therapies?" If yes, you should consider evaluation at a dedicated shock center.

Dr. Senman: For anyone caring for patients with CS, the single most important, and potentially lifesaving, intervention is early recognition. Clinicians must maintain a high index of suspicion when treating at-risk patients, recognize the early signs of hemodynamic deterioration, and identify shock before irreversible end-organ injury develops. Early diagnosis is consistently associated with better outcomes and creates the opportunity for timely intervention.

Equally important is recognizing that CS is a team sport. Once shock is suspected, early activation of the appropriate subspecialists or a dedicated shock team (when available) facilitates rapid multidisciplinary decision-making, aligns treatment strategies, and expedites the initiation of advanced therapies when needed. Early recognition followed by early collaboration remains the cornerstone of high-quality CS care.

Dr. Kochar: I personally believe most interventional cardiologists or even cardiologists can recognize overt SCAI SHOCK stage C, D, or E. The greater challenge is identifying SCAI SHOCK stage B or earlier stage C, when the patient may not yet be profoundly hypotensive but has begun to develop clinically important hemodynamic compromise or hypoperfusion. I think there is a major opportunity here for earlier recognition and rapid stabilization/treatment. Thus, there should be a particularly high index of suspi-

cion in patients at elevated risk, such as those with a large anterior myocardial infarction, significant RV infarction, known severe ventricular dysfunction, or decompensated HF. Physicians should recognize that blood pressure alone is an inadequate screen for shock. They should assess mental status, extremity perfusion, urine output, renal and hepatic function, acid-base status, and lactate. Serial lactate measurement can be especially helpful because lactate trajectory is generally more informative than a single admission value. Interventional cardiologists should also have a low threshold to perform right heart catheterization to help clarify both diagnosis and guide management plans (including MCS strategies).

A dedicated shock team or specialized center should be involved early for an unfavorable trajectory: increasing lactate, escalating vasoactive requirements, worsening renal or hepatic function, significant RV or biventricular failure, recurrent arrhythmia or cardiac arrest, mechanical complication, refractory hypoxemia, or potential need for temporary MCS, ECMO, durable LVAD, or transplantation.

The purpose of early shock team involvement is not necessarily to place a device. It is to create a shared physiologic assessment, determine whether the patient needs transfer, and preserve options before severe multiorgan failure or neurologic injury makes those options no longer feasible.

As CS care becomes increasingly specialized, do you see it evolving into a more distinct career path? What infrastructure would be needed to support such a pathway?

Dr. Senman: Although I do not believe CS will or should evolve into a distinct career pathway, I do believe that its management is fundamentally a team sport. The future of shock care should focus on the broader implementation of multidisciplinary CS teams that extend across institutions that care for these critically ill patients.

To achieve this, we first need a better understanding of what constitutes an effective shock team, including its optimal composition, workflow, and activation processes. Equally important is understanding the institutional infrastructure required to support these teams in a sustainable manner, including appropriate staffing, compensation models, and strategies to mitigate provider burnout. Building this evidence base will be essential to expanding access to high-quality, team-based CS care.

Dr. Khalif: I don't particularly see CS management becoming its own career pathway. Despite increasing use of MCS and recognition of these shock patients, CS is not a ubiquitous diagnosis and remains in the minority of shock patients we see in the general population. Although CS remains the predominant shock phenotype

within CICUs, I believe dedicated training pathways for critical care cardiologists would be sufficient to facilitate expertise in the management of these patients, in addition to maintaining expertise in the more common CICU admissions such as acute myocardial infarction, acute decompensated HF, and valvular heart disease.

Dr. Kochar: It is very reasonable to have cardiologists who are particularly passionate about and expert in shock. However, I personally would not anchor the career solely around CS, instead broadening it to cardiac critical illness. That encompasses CS but also postarrest care, temporary MCS, ECMO, acute PE, valvular emergencies, severe respiratory failure in cardiac patients, and other forms of critical cardiovascular disease.

For interventionalists, I would again emphasize that shock cases cannot be planned. A sustainable interventional practice thus requires another core skill set. For me, I enjoy complex coronary work. For others, it might be peripheral or structural. The complementary area should produce both additional expertise relevant to shock and a sufficient base of elective procedural work.

The institution must invest not only in the individual physician but also in the broader shock program. That includes infrastructure for multidisciplinary shock calls, clearly defined activation criteria, around-the-clock access to appropriate specialists, regional transfer pathways, and the ability to rapidly mobilize cath lab, operating room, perfusion, and ICU resources. Ideally, the shock team would remain engaged throughout the hospitalization. There should also be regular shock-focused quality improvement meetings to develop better institutional practices.

Finally, the professional model must be sustainable. Combining interventional, ICU, and shock responsibilities can create enormous call and emotional burdens. Protected time, appropriate clinical credit, balanced call structures, adequate elective procedural volume, and access to multidisciplinary support are essential if institutions want these physicians to build durable careers rather than burn out.

What training opportunities, programs, or resources exist for physicians who want to pursue more specialized expertise in CS? How can physicians get involved with the broader shock community?

Dr. Khalif: There are multiple national and regional meetings throughout the year that help facilitate improving our knowledge in the management of CS, such as the SCAI Shock meeting, Houston Shock Symposium, NYU Langone Critical Care Cardiology

Symposium, and University of Minnesota Critical Care Cardiology Education Summit. Attending one of these meetings helps provide physicians with a forum to get involved in the shock community.

Dr. Senman: CS is now a widely recognized focus within cardiovascular medicine, and educational opportunities extend well beyond formal fellowship training. National conferences regularly feature dedicated sessions on shock, and professional societies, including the SoCCC SCAI, American College of Cardiology, and American Heart Association (AHA), offer a wealth of educational resources through webinars, podcasts, case conferences, guidelines, and online learning materials that can be accessed live or on demand.

Engaging with these organizations through membership, educational programming, and collaborative initiatives is an excellent way to stay current with rapidly evolving evidence, learn from leaders in the field, and build a professional network within the CS community. Continuous learning and active participation are essential for keeping pace with advances in shock care throughout one's career.

Dr. Kochar: There are many ways to become involved, even though there is not yet a single standardized training pathway. Clinically, I would seek training or visiting experiences at centers with substantial volume across myocardial infarction CS, HF CS, temporary MCS, VA-ECMO, transplant, and durable LVAD care. Trainees should deliberately identify the gaps in their primary fellowship and seek mentorship from other disciplines—HF, IC, cardiac surgery, cardiac anesthesia, critical care, perfusion, imaging, vascular surgery, neurology, geriatrics, and palliative care.

Educationally, meetings such as SCAI SHOCK and the Houston Shock Symposium provide focused shock education and opportunities to present cases. ELSO offers extensive ECMO education. The critical care cardiology community has developed excellent conferences and educational programs, including those organized through the SoCCC, the Minnesota Critical

Care Cardiology community, NYU, and other academic groups. Case-based programs such as Shock Talks are particularly useful because they expose participants to troubleshooting and real-world decision-making.

I would also make a concerted effort to add to the evidence base. If feasible, physicians and institutions should join one of the major shock or cardiac critical care research collaborations, such as the Cardiogenic Shock Working Group, Critical Care Cardiology Trials Network, or AHA Cardiogenic Shock Registry. These collaborations provide opportunities to contribute data, participate in quality improvement, develop research proposals, and learn how other centers approach similar problems.

At the institutional level, joining or creating a multidisciplinary shock conference is one of the best educational opportunities available. Regular review of shock cases—particularly complications, unexpected deterioration, unsuccessful support strategies, and difficult decisions about candidacy or futility—can be more instructive than reviewing only technical successes.

Finally, trainees and early career physicians should attend meetings, present cases, volunteer for projects, and actively seek out mentors and collaborators. I am admittedly biased, but the shock community includes remarkably committed and generous people. Many established investigators and clinicians devote substantial time to mentoring, supporting, and sponsoring younger colleagues. ■

1. Writing Committee Members; Creager MA, Barnes GD, Giri J, et al. 2026 AHA/ACC/ACCP/ACEP/CHEST/SCAI/SHM/SIR/SVM/SVN guideline for the evaluation and management of acute pulmonary embolism in adults: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2026;153:e977–e1051. Published correction appears in *Circulation*. 2026;154:e24. Published correction appears in *Circulation*. 2026;154:e24. doi: 10.1161/CIR.0000000000001415

Disclosures

Dr. Khalif: Speaker's bureau for Inari Medical, Abbott.

Dr. Kochar: Receives grant funding from the American Heart Association; site PI for OASIS-AMICS (J&J Med Tech), ELEVATE III (Magenta), and LIVEBETTER (PCORI); speaker for Getinge.

Dr. Senman: Speaker fees/honoraria from AOP Health and Getinge.