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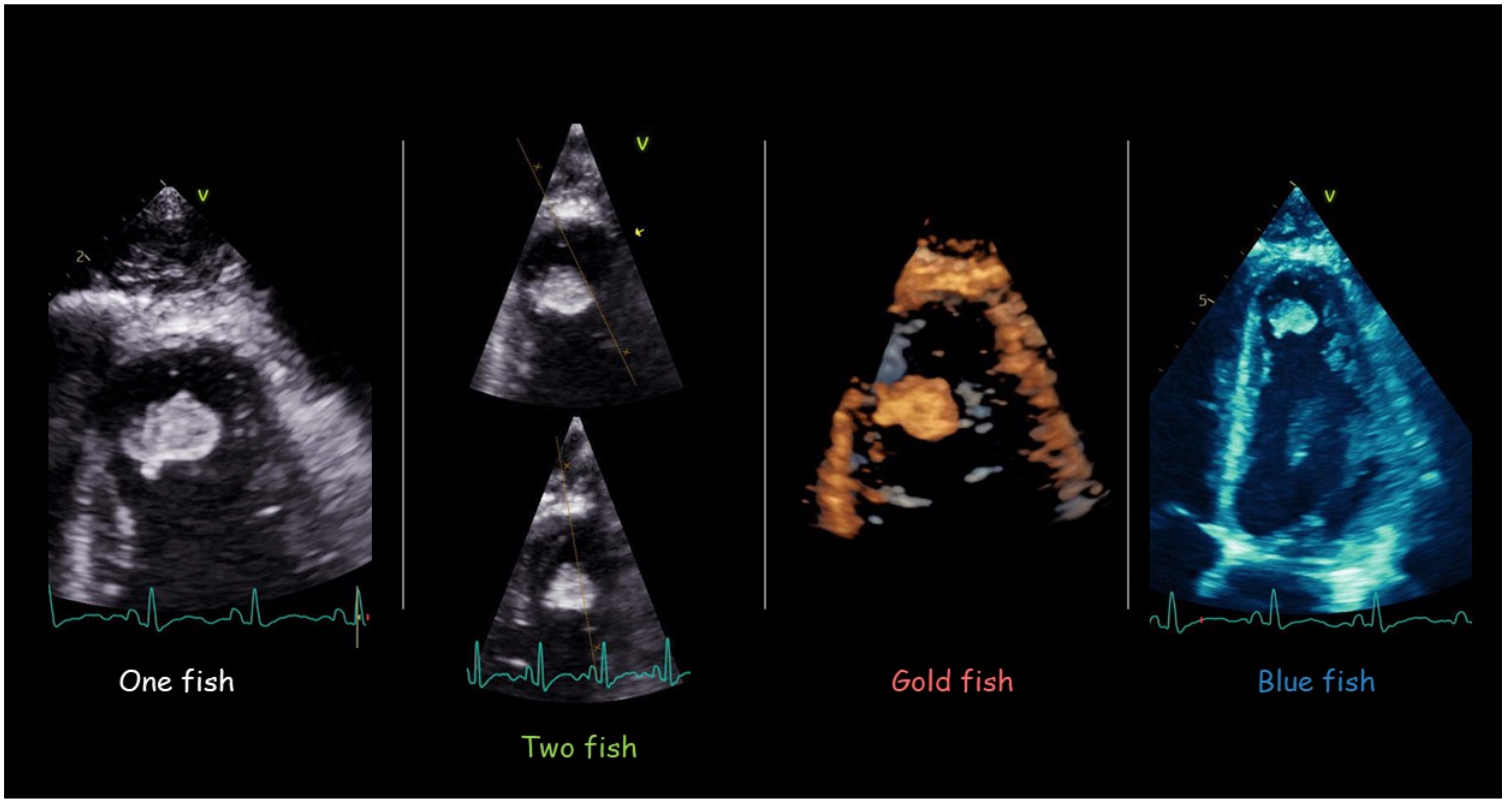

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VOLUME 13 ISSUE 3 **MARCH 2024**

2024 EDUCATION CALENDAR

CONTENT AVAILABLE NOW

Registered Physician in Vascular Interpretation (RPVI) Online Review Course

An overview of all vascular imaging modalities for board review, introductory learning, or as a review for experienced imaging readers

MAY 2024

25th Annual ASCeXAM Review Course Virtual

Content Available May 6, 2024.

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35th Annual Scientific Sessions

June 14-16, 2024
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SAVE THE DATE

4th Annual Advanced Imaging Techniques for Sonographers

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OCTOBER 2024

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Disney's Grand Floridian Resort & Spa
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SAVE THE DATE

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October 26-27, 2024
Virtual Experience

Jointly provided by ASE and the ASE Foundation

Discounted rates for ASE members. *To learn more and register, visit us at **ASEcho.org/Education**.*

*This text also appears in the March JASE. **OnlineJASE.com***

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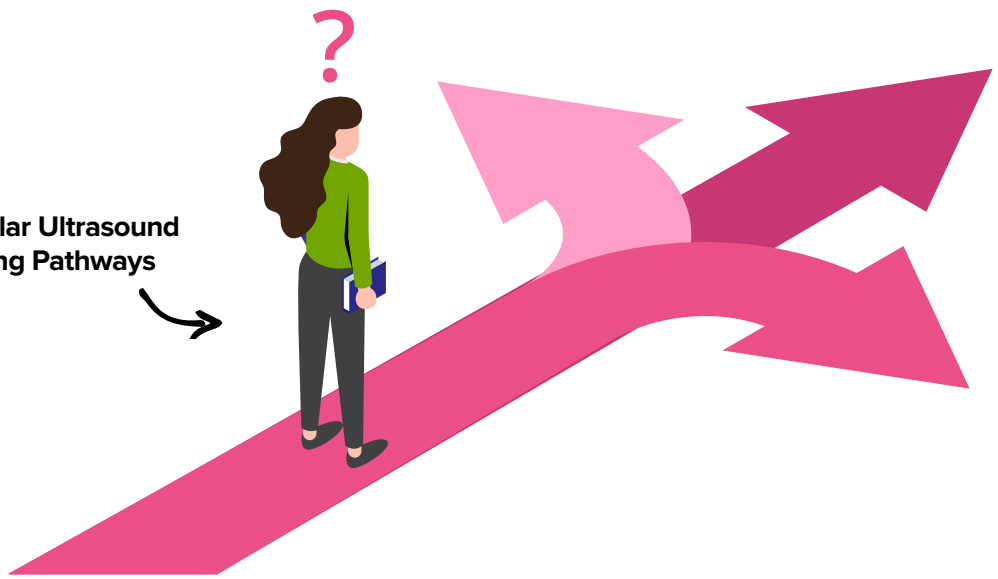

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Cover art: "One Fish, Two Fish, Gold Fish, Blue Fish" Cara Bergeron, BS, RDCS, RVT, FASE and Andy Le, RDCS, DeBakey Heart & Vascular Center, Houston Methodist Hospital, Houston, Texas

EDITORS' NOTE

ASE is very grateful to our members who contribute to *Echo* magazine and values their willingness to share personal insights and experiences with the ASE community, even if they may not be in total alignment with ASE's viewpoint.

INTERNATIONAL CONGENITAL HEART DEFECTS AWARENESS – BE AN ASE ADVOCATE!

Contributed by ***Benjamin W. Eidem, MD, FASE****, Director of Pediatric and Congenital Echocardiography, Mayo Clinic and Professor of Pediatrics and Medicine at Mayo Clinic College of Medicine, Departments of Pediatrics and Cardiology, Rochester, MN*

This past month, the International Congenital Heart Defects Awareness Day was celebrated on February 14th. This day is meant to recognize and highlight children and adults living with congenital heart disease, celebrate their journey, and hopes to increase public awareness of these heart conditions. I wanted to take this opportunity to address the ways ASE has been providing education and awareness in this important population over the past year. Congenital heart disease (CHD) is the most common birth defect worldwide in children, affecting 8-10 newborns per 1,000 live births. This equates to over 40,000 children born with CHD in the United States each year, and over 1.35 million children globally. CHD is also the leading category of birth defects resulting in mortality in both infants and adults. In developed countries, the diagnosis of CHD is often made prior to birth or early in the neonatal period; however, some infants may miss this early diagnosis only to present with significant sequelae later in childhood or adulthood. Early screening and diagnosis are critical to prevent these significant sequelae. There is no cure for CHD, but those appropriately diagnosed and treated can live normal productive lives in adulthood. In fact, over 2.4 million Americans are alive today with a congenital heart defect, and the number of adults with CHD is now greater than the number of children currently living with a congenital heart defect.

> “Congenital heart disease (CHD) is the most common birth defect worldwide in children, affecting 8-10 newborns per 1,000 live births.”

Over this past year, ASE has participated in several distinct areas to increase awareness and address the need for improved education and treatment in both children and adults with CHD. The first area that I would like to highlight was at the 8th World Congress of Pediatric Cardiology & Cardiac Surgery in late August 2023 in Washington, D.C. This meeting brought together almost 1,000 faculty as well as over 5,700 attendees from 115

different countries and is the largest meeting dedicated to the care of patients with CHD. One of the highlights of this conference was the "Call to Action" addressing the global burden of pediatric and congenital heart diseases. This document was developed collaboratively by parents, families, as well as clinical and policy experts to highlight the global inequalities in CHD care. This document calls upon governments, organizations, funders, professional societies, research and teaching institutions, civil society, and the private sector to take several key actions to improve the recognition, access, and investment in health services to address childhood onset heart disease. ASE was one of many societies, organizations, and healthcare institutions to endorse this document at the World Congress. ASE also participated as a Society at the World Congress for the first time, co-sponsoring a congenital echo session as well as having a well-attended booth throughout the conference (special thanks to Dallas Lyons for providing a wonderful interaction with numerous conference attendees). In total, over 80 ASE members served as invited faculty during this Congress, many of whom participated in key areas of program leadership!

In addition to the World Congress, ASE's live and virtual courses have continued to be a wonderful means of disseminating knowledge regarding the diagnosis and treatment of CHD. In particular, the Pediatric & Congenital Heart Disease track at the annual Scientific Sessions as well as the virtual Echo in Pediatric and Congenital Heart Disease course have done a remarkable job in this arena.

ASE has also provided extensive print resources to improve the education and care of patients with CHD. This past month, the *Journal of the American Society of Echocardiography* (JASE) published a focus issue highlighting CHD including two pediatric-related guidelines and standards documents.1,2 An additional guidelines & standards document specifically addressing adult congenital heart disease is in progress, with hopes of publication in JASE later this year. This month, Cardiovascular Imaging Case Reports (CASE) is publishing a comprehensive special monthly issue highlighting a spectacular variety of adult congenital heart disease cases. In addition, Echo magazine continues to address and highlight many key areas of CHD education and training in each of its monthly editions.

Finally, as I have highlighted in my previous Presidential Messages, it is a primary focus of my year as President of our Society to address the education and training of our adult sonographers in the area of CHD imaging. There are several initiatives, including both educational resources and hands-on training, that are in progress to address this significant need.

> "Over this past year, ASE has participated in several distinct areas to increase awareness and address the need for improved education and treatment in both children and adults with CHD. "

In summary, I feel that it is important for all of us to be ambassadors of awareness and education for all types of cardiovascular disease, including those with CHD. There are many similar advocacy days each year that highlight various cardiovascular diseases nationally and globally that also deserve our robust attention and participation. It is my sincere hope that all our members will be an ASE advocate in these vital activities to bring societal awareness to the care of all our patients with cardiovascular disease.

This text also appears in the March JASE.
OnlineJASE.com

Benjamin W. Eidem,
MD, FASE
ASE President

Using an Advanced Cardiac Sonographer to Coordinate Research:

One Health System's Experience

*Contributed by **Alexandra Gardner, BAS, ACS, RDCS (AE, PE), FASE**, **Tamela Fonseca, PhD, RN, CCRC, NE-BC**, and **Rebecca Lazensky, PhD, MPH**, Sarasota Memorial Research Institute, Sarasota Memorial Health Care System*



In 2022, SMRI made the strategic decision to add a research coordinator/ sonographer position to its clinical research team

BACKGROUND

SARASOTA MEMORIAL Health Care System (SMHCS) is a full-service public health system which receives over one million patient visits each year and provides CMS five-star rated care to patients in Sarasota, Venice, North Port, and other growing communities in Southwest Florida. It is the only hospital accredited in Florida by the Intersocietal Accreditation Commission (IAC) to provide adult and pediatric echocardiography as well as vascular ultrasound, and transesophageal echocardiography. The hospital employs four advanced cardiac sonographers (ACS) that all use the registry in different capacities. One such role is within the Sarasota Memorial Research Institute (SMRI).

The Sarasota Memorial Research Institute at SMHCS offers patients the latest treatment options with a highly qualified staff who provide the knowledge, expertise, and infrastructure essential to evaluate and manage drug, device, registry, and biospecimen clinical trials. SMRI currently has over 100 ongoing clinical trials and research studies with many requiring advanced sonography services.

In 2022, SMRI made the strategic decision to add a research coordinator/sonographer position to its clinical research team and **Alexandra Gardner, BAS, ACS, RDCS (AE, PE), FASE**, was selected for this role. As an advanced sonographer, Gardner performs stress and adult echocardiograms, and transesophageal tests, and as a research coordinator she consents, screens, and enrolls patients in SMRI's ongoing research studies and clinical trials. Before this role was created, a sonographer from SHMCS's Cardiac Diagnostic Services would need to be cross trained on a specific research protocol in order to collect the required patient data for the echocardiogram, as well as adjust the protocol to meet study requirements. The addition of this role eases the workload of the non-research technologists who previously needed to be trained in SMRI's many ongoing research protocols and available to perform echocardiograms on both research and non-research patients.

As an advanced sonographer, Gardner performs stress and adult echocardiograms, and transesophageal tests, and as a research coordinator she consents, screens, and enrolls patients in SMRI's ongoing research studies and clinical trials.

STREAMLINED PATIENT CARE

Since the role was created, the research coordinator/sonographer accompanies patients during the research-related echoes and during their follow-up procedures. There is no longer a need to identify an additional technician who is trained in the research protocol within the larger healthcare system as the Research Institute's dedicated sonographer can perform the echocardiogram and is knowledgeable of the research protocol. This removes pressure off the Cardiovascular Diagnostic Services department, allows the Research Institute to

Alexandra Gardner, BAS, ACS, RDCS (AE, PE), FASE
Research Coordinator/Sonographer
Sarasota Memorial Research Institute,
Sarasota Memorial Health Care System

provide comprehensive care, and provides the patient with a single point of contact who travels with them to the study-related appointments. This caliber of service allows SMRI to provide a positive and efficient experience with any patients experiencing little to no wait times and personalized care experience.

In addition, patients receive a single point of contact which gives them the opportunity to build rapport immediately by connecting the research coordinator/sonographer and patient during the initial visit. During the visit, the patient can get their questions answered in real-time. The research coordinator/sonographer can explain the time investment needed and ensure time is prioritized.

Having an advanced sonographer in this role of research coordinator/ sonographer has expanded the personalized care offered at SMRI for research patients, enhanced the quality of care provided, and streamlined services.

ENHANCED QUALITY ASSURANCE

As an ACS, Gardner has brought unique innovation to this role. The higher level of knowledge in 3D, strain, and pathology has helped advance the Institute by closing the gap between the coordinators and physicians. She can review patient cardiac data provided by the physicians and help determine patient eligibility, finding some of the less obvious exclusionary factors seen in echocardiograms. This helps to reduce time, money, and resources. Her advanced skills have also reduced the number of repeated exams. She has the ability to take the time needed to complete all required aspects of the exam and has more experience to obtain the required images on these often difficult to image patients.

The research coordinator/sonographer supports an internal review process where there is continuous oversight of the research protocols, echocardiograms, and patient data to ensure they are collected in accordance with national standards and study protocols. Having a research coordinator who is also a sonographer allows for the collection of additional exams if there are conflicting scans and permits reconciliation of echocardiograms when existing records do not match. This facilitates the enrollment of patients who may not have met the eligibility criteria and avoids collecting repeat scans when possible.

CONCLUSION

Having an advanced sonographer in this role of research coordinator/sonographer has expanded the personalized care offered at SMRI for research patients, enhanced the quality of care provided, and streamlined services. Having a single, highly qualified individual with a sonography training and background in this role who can perform the specialized 3D scans required for SMRI's research studies increases the level of oversight of the images, provides improved consistency, and internal expertise. Since the position was created, patients and the healthcare system have both benefited from improved efficiencies, decreased wait times to participate and enroll in trials, and the personalized expertise the dual role provides. The research coordinator/sonographer provides a high standard of care in an innovative environment which allows more patients to receive new care opportunities.

Vascular Ultrasound Training Pathways

*Contributed by **Alexander Vakili, MD**, Emory University Hospital Midtown, Atlanta, GA*

INTRODUCTION

THE IMPORTANCE OF identifying patients with or at risk for atherosclerotic disease cannot be underestimated. Many times, the focus falls on atherosclerosis involving the coronary arteries, but when diagnosed in a timely manner, patients with peripheral arterial disease (PAD) can receive appropriate risk factor modification and therapeutic management to prevent catastrophic complications such as amputation, myocardial infarction, or stroke. The utility of duplex ultrasound in the vascular lab is paramount as the primary means of screening for PAD. The following article outlines the pathways towards formal vascular ultrasound training.

The utility of duplex ultrasound in the vascular lab is paramount as the primary means of screening for PAD.

COCATS

The Core Cardiovascular Training Statement (COCATS) 4 underwent an update in 2015 to incorporate a specific focus on the non-invasive management of peripheral vascular diseases, establishing a standardized Level I-III certification structure.

Fellows enrolled in accredited cardiovascular training programs are expected to attain Level I certification in vascular medicine. This typically requires two months of exposure to vascular medicine, emphasizing history taking, physical examination skills, and an introduction to vascular ultrasound and physiologic testing. Level I trainees should possess the ability to discern the strengths and weaknesses of various testing modalities and recognize situations warranting referral to a

vascular specialist. Level II trainees should deepen their understanding of vascular medicine, with a focus on non-invasive laboratory procedures. Proficiency in performing and interpreting vascular diagnostic studies is a key expectation, culminating in eligibility for the Physicians' Vascular Interpretation Examination (RPVI).[1]

Unlike Levels I-II, completion of Level III training extends beyond the standard 24-month cardiovascular fellowship, necessitating an additional year of experience. In 2021, the ACC/AHA/SVM/ACP published an advanced training statement on vascular medicine that expands upon the COCATS 4 update with an emphasis on advanced fellowship training in vascular medicine. The committee has highlighted the importance of building upon the existing clinical foundation, applying acquired skills to a wide range of vascular diseases, emphasizing the creation of complex treatment and management plans to fill the critical gap in vascular medicine specialists. Level III training allows for the ability to direct a vascular laboratory, train others, and conduct advanced research in vascular medicine. Successful completion of this year fulfills the prerequisites for taking the American Board of Vascular Medicine (ABVM) examination.[2]

REGISTERED PHYSICIAN IN VASCULAR INTERPRETATION (RPVI)

The Alliance for Physician Certification & Advancement (APCA) partnered with the American Registry for Diagnostic Medical Sonography (ARDMS) to oversee the RPVI examination. Requirements to sit for the examination include documentation of at least 500 vascular studies interpreted in a clinical diagnostic setting over a minimum of one month within the preceding 36 months of application submission. Out of the 500 studies, a maximum of 100 can originate from didactic or simulated cases, and no more than 50% of the cases should be derived from a single type of examination.

Three distinct pathways exist for fulfilling the RPVI interpretation experience requirement.

1. Clinicians in an accredited residency or fellowship, in addition to the minimum study requirements, must also engage in didactic instruction and mentored training in the interpretation of vascular laboratory studies. This clinician must provide a letter signed by a program director, vascular lab director, or RPVI certified affiliate.
2. For clinicians in non-accredited programs, a minimum of 48 weeks of dedicated vascular clinical training is required, involving at least 30 hours of didactics as well as at least 40 hours of observed participation in the vascular laboratory setting. Didactic instruction may include *AMA PRA Category 1*™ CME relevant to the vascular laboratory. A letter of completion must be signed before submitting the RPVI application.
3. Practicing clinicians need vascular interpretation experience while employed in a supervised clinical diagnostic setting such as hospitals, clinics, or private practices. They must complete

40 hours of *AMA PRA Category 1*™ CME related to the vascular laboratory within the preceding three years prior to the application. A letter from the medical director of the vascular lab or another qualified physician is once again necessary.[3]

OUR INSTITUTIONAL EXPERIENCE

At Emory University, for our clinical fellows we have established one- and three-month vascular medicine rotations, concentrating on the three pillars of COCATS requirements to help them achieve Level I-II respectively. We are also in year three of our formal one-year vascular medicine training fellowship where our trainees achieve COCATS III as referenced above. These rotations include mentored ultrasound interpretation of noninvasive diagnostic modalities (duplex ultrasound, vascular physiologic testing, computed tomographic and magnetic resonance angiography), outpatient exposure in a vascular medicine clinic as well as inpatient consults, and practical scanning sessions with our vascular lab technologists. To best prepare our fellows, lectures are provided by our vascular medicine specialists focusing on the fundamental skills needed to interpret the studies done in our laboratory, which includes physiologic, carotid, visceral, and lower extremity arterial and venous studies. Also, a monthly vascular medicine conference, which is open to all trainees and faculty, is held to review various topics as well as recent publications. The participating fellow is tasked with pre-reading all vascular studies, managing outpatient vascular patients, and engaging in hands-on scanning as time permits. Upon completion of these rotations, we anticipate our fellows will possess the requisite knowledge for clinical care of vascular diseases and the ultrasound interpretation skills necessary for the RPVI certification (3- and 12-month fellows).

ASE RPVI COURSE

An excellent resource for clinicians looking to prepare for the RPVI examination is the new virtual ASE RPVI Review Course. This course features lectures led by internationally renowned faculty in the fields of vascular medicine and ultrasound interpretation, as well as practice exam questions. There are a broad range of topics covered including vascular ultrasound physics, image acquisition, and patient cases to help prepare clinicians to succeed on the RPVI examination and become thriving vascular ultrasound readers.[4]

To best prepare our fellows, lectures are provided by our vascular medicine specialists focusing on the fundamental skills needed to interpret the studies done in our laboratory.

CONCLUSION

The field of cardiovascular medicine covers a wide range of pathologies, including disorders affecting the peripheral vasculature. The interpretation of vascular ultrasound has become increasingly integral to this field, enhancing overall patient care significantly. In response to the critical need for vascular medicine specialists and formal COCATS and RPVI requirements, programs like ours have established rotations and advanced fellowship opportunities that will enhance our fellow's competence and grow the field of vascular medicine.

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The Pediatric Experience in the

ASE Leadership Academy

*Contributed by **Jimmy Lu, MD, FASE**, University of Michigan Congenital Heart Center, Ann Arbor, MI; **Daniel Forsha, MD, MCS, FASE,** Children's Mercy Kansas City, Kansas City, MO; **Melissa Wasserman, RDCS, RCCS, FASE**, Children's Hospital of Philadelphia, Philadelphia, PA; **Shiraz Maskatia, MD, FASE**, Lucile Packard Children's Hospital Stanford, Palo Alto, CA; and **Vera Rigolin, MD, FASE**, Northwestern Medicine, Chicago, IL*



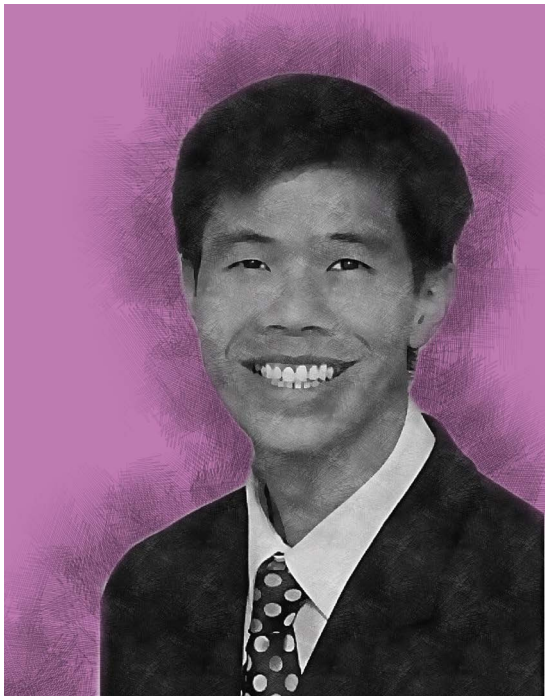


The ASE Leadership Academy (LA) was created in 2018 by Dr. Neil Weissman to cultivate and educate the future leaders of the Society.

THE ASE LEADERSHIP ACADEMY (LA) was created in 2018 by Neil Weissman to cultivate and educate the future leaders of the Society. There have been two cohorts who have completed the two-year experience, a third cohort underway, and a fourth cohort being recruited beginning in June 2024. We asked four pediatric members of the first three cohorts (cardiologists and sonographers) about their experience in the LA and followed that with a summary of the program from the current program director, Vera Rigolin.

Jimmy Lu (Cohort 1, Pediatric Cardiologist)

More than anything, the relationships are what I will treasure from the Leadership Academy. There were people I knew *of*, but didn't really know until I actually spent time with them during the first cohort. I got to see up close how much ASE leaders like Neil Weissman and Madhav Swaminathan genuinely care and invest in mentorship. I got to meet many ASE staff and see how committed they are to working behind the scenes and making everything possible. Most importantly, I treasure the relationships with other members of my cohort, celebrating their successes in new appointments, roles in ASE and around the country. I got to spend time with the late



▲ Jimmy Lu, MD, FASE

> *"More than anything, the relationships are what I will treasure from the Leadership Academy."*

Greg Tatum, moments I will treasure. The Leadership Academy did open doors for my career, such as committees, writing guidelines, and invaluable training, but the connections and relationships are gifts that are beyond measure.

Dan Forsha (Cohort 2, Pediatric Cardiologist)
Being chosen for the 2nd cohort of the ASE Leadership Academy was a wonderful honor and has opened the path to many opportunities at the ASE and beyond. I must reflect Jimmy's thoughts on the key importance of the relationships formed during the 2-year academy. These cohorts are made up of a melting pot of physicians and sonographers that included strong representation from pediatrics, anesthesiology, and other specialties. In some cardiology societies, the pediatric/congenital group can feel isolated, but this Leadership Academy created friendships across specialties that will benefit each of us, as well as ASE, for years to come.

And, amid the COVID-19 pandemic, the creation of a new circle of colleagues and friends (albeit a virtual one) was truly special. Since completing the Leadership Academy, doors have opened to multiple areas of leadership within ASE, and I feel prepared to take on these roles after having completed the Academy's curriculum. We need to credit Leadership Academy founder Neil Weissman and current program director Vera Rigolin for their vision and execution of the Leadership Academy. This is an excellent experience that any future leaders should strongly consider.

Melissa Wasserman (Cohort 2, Pediatric Sonographer)
I was incredibly excited and am still so very honored to have been accepted into the 2nd cohort of the ASE Leadership Academy! The classes are so diverse, bridging people from all parts of the echo

> *"Since completing the Leadership Academy, doors have opened to multiple areas of leadership within ASE."*

▼ Daniel Forsha, MD, MCS, FASE

▲ **Melissa Wasserman, RDCS, RCCS, FASE**

> *"The classes are so diverse, bridging people from all parts of the echo world together. There is as much to learn from each other as there is included in the curriculum."*

world together. There is as much to learn from each other as there is included in the curriculum. Being a part of the Leadership Academy taught me that there is very little difference between sonographer and physician leadership, or whether your background is in adult or congenital echo. We all face many of the same challenges: struggling with imposter syndrome, navigating conflict within your team, or wanting to improve on communicating effectively. Not only did we learn together, but since graduating, we have navigated leadership opportunities within ASE together. I am so grateful for all I learned that I use every day as a leader at my home institution, for my continued growth in this awesome organization, and for my Leadership Academy classmates who I am lucky to now call friends.

Shiraz Maskatia (Cohort 3, Pediatric Cardiologist)
As I reviewed the syllabus for the ASE Leadership Academy, I was struck by the breadth of topics being covered. These included: Communication, Conflict Management, Effective Teams, Influence and Persuasion, Effective Management, and even Financial Acumen. This felt much more like a mini-MBA than an ASE related activity! Sure enough, with Wharton Business School faculty Kathy Pearson teaching the leadership training portion, and with many of the guest faculty coming from the business world, this turned out to be a relevant comparison. That said, with guest faculty from ASE at every session, the content was always relevant to our own experiences. Who better than ASE Treasurer Cynthia Taub to guide a small group discussion on budgeting for an echo lab? My time in the Leadership Academy is passing very quickly, and I envy those who will start in cohort 4. That said, I am excited to partner with my colleagues in the 3rd cohort of the Leadership Academy in the years to come!

▲ **Shiraz Maskatia, MD, FASE**

> *"As I reviewed the syllabus for the ASE Leadership Academy, I was struck by the breadth of topics being covered."*

▲ **Vera Rigolin, MD, FASE**

> *"The ASE Leadership Academy strives for a diverse group of participants that is representative of ASE's membership."*

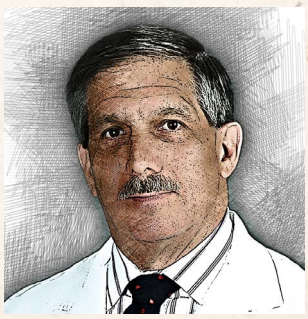
Vera Rigolin (LA Program Director, Cardiologist)
Since its inception, the ASE LA has blossomed into a highly coveted program. Members from the past two LA classes are now active members of ASE committees, task forces, and the Board of Directors. Members of the ongoing LA cohort 3 are sure to follow suit. In addition to providing mentoring opportunities and helping build professional relationships amongst physician and sonographer members, the LA program meets monthly to teach important skills necessary to be a leader at ASE and at their institutions. This year, the leadership training portion of the LA curriculum has been led by Kathy Pearson, PhD. Dr. Pearson is a renowned strategist, systems thinking expert, and an authority in decision making. Dr. Pearson has designed a highly educational program for the LA monthly meetings consisting of expert speakers in topics such as strategic thinking, conflict management, influence and persuasion, financial acumen, and many others. Later this year, recruitment will begin for LA cohort 4. The ideal candidate is a Fellow of the American Society of Echocardiography (FASE), or one who will achieve FASE by completion of the program, who has shown a commitment to cardiovascular ultrasound and ASE, and who will benefit from the Leadership Academy in such a way that their professional growth will include an increasing contribution to ASE over the next 15-20 years. Candidates must be at least two years post training. The LA strives for a diverse group of participants that is representative of ASE's membership. This includes members from ASE's councils (sonography, perioperative, vascular, pediatric/congenital heart disease, interventional echo, and critical care), as well as specialty interest groups. International members are also encouraged to apply. *Members employed full or part-time by industry are not eligible for enrollment.*

ASE LEADERSHIP ACADEMY

Applications for Cohort 4 will open June 1st. Start planning now by reviewing the Leadership Academy webpage.

DROLL DOPPLER *Details*

Many decades ago, when I was learning to become a cardiologist, cardiac hemodynamics were evaluated in the cardiac cath lab. At that time, the cath lab was primarily where diagnoses were made. Indeed – where I worked – patients and staff heading to the cath lab were directed by posted signs directing them to the "Cardiac Diagnostic Laboratory." Some of my older colleagues thought that the small cardiac ultrasound lab located down the hall should be known as the "Cardiac Nondiagnostic Laboratory!"



Contributed by **Alan S. Pearlman, MD, FASE**, ASE Past President, and Editor-in-Chief, Emeritus, *Journal of the American Society of Echocardiography* (JASE)

Invasive hemodynamic assessment still has an important role in some patients, but ventricular size and function, valvular function, and intracardiac pressures are most often evaluated in the Echo Laboratory. That cardiac function can be studied in detail using noninvasive methods is due in part to the use of Doppler ultrasound, which is a critical part of the comprehensive cardiovascular ultrasound exam. I am certain that most readers of *Echo* magazine know about the technology and its current applications, but I would not be surprised if they are not familiar with a few related details. Let's dive right in.

Some of my older colleagues thought that the small cardiac ultrasound lab located down the hall should be known as the "Cardiac Nondiagnostic Laboratory!"

Who was Doppler?

I have seen Doppler's name listed in published articles as "Johann Christian Doppler," "Christian Johann Doppler," "Christian Johann Andreas Doppler," "Christian Andreas Doppler," and just plain "Christian Doppler." In his book "The Search for Christian Doppler," author Alec Eden unravels this confusing situation.[1] Doppler's

father, Johann Evangelist Doppler, was a master stonemason in Salzburg, Austria. Johann Evangelist Doppler and his wife had two sons and two daughters. Their first son was named Johann Evangelist Doppler II. Their second son (and third child) was born in Salzburg in November, 1803. It seems possible that the surname "Johann" was erroneously attributed to Johann II's younger brother. In any event, Eden was able to find Doppler's birth and baptismal records in the Church of St. Andra in Salzburg. Those documents make it clear that the Doppler of the "Doppler effect," Johann Evangelist Doppler's second son, was christened "Christian Andreas Doppler." Doppler himself apparently never used his second name; his famous article "Uber das farbige Licht der Dopplesterne und einiger anderer Gestirne des Himmels", *[additional discussion below]* lists the author as "Christian Doppler."[2]

What about "Doppler Ultrasound"?

Old people who still watch News and Weather programs on television will be familiar with the Doppler technology used by the National Weather Service to map weather systems and to predict whether next Tuesday will be dry or a "soaker." This technology detects a shift in the phase of a pulsed RADAR signal that occurs when it encounters raindrops or dust or other particulate matter in the atmosphere. It takes advantage of what has been termed the "Doppler effect," which is the change in phase of a waveform when the source of that waveform is moving in relation to the observer. This phenomenon was hypothesized by Austrian physicist Christian Doppler, who at the time was employed at the Prague Polytechnic Institute as professor of mathematics and practical geometry. In 1842, Doppler gave a lecture to the Royal Bohemian Society of Sciences in which he postulated that the observed frequency of a wave depends on the relative speed of the source of the wave and the observer. He illustrated this by noting the frequency (color) of observed light emanating from stars. His paper, entitled "Uber das farbige Licht der Doppelsterne und einiger anderer Gestirne des Himmels,"[2] discussed relevant details. For readers (like me) who do not speak German, the title translates as "On the colored light of the binary stars and some other stars of the heavens." Please note that the word "Doppelsterne" refers to "twin stars;" in German, Doppel means "double" and does not refer to the name of the author of the paper! Doppler hypothesized that light from double stars changed color depending on whether the stars were moving toward or away from an observer on Earth. Apparently, some scientists have suggested that the color of a star is determined by its temperature (cooler ones are red, while hot ones are blue) rather than by its motion. Nevertheless, Doppler's hypothesis is the basis for the well-known phenomenon of "redshift and blueshift." These terms do NOT refer to the tendency of states to become more conservative or more liberal between political elections; instead, they describe the Doppler effect that allows astronomers to study how the universe is evolving! In the early part of the 19th century, astronomer Edwin Hubble described the redshift phenomenon and observed that the universe is expanding, since nearly all galaxies therein are moving away from ours.[3]

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It should be apparent to readers that in 1842, neither Doppler nor anyone else had experience with, let alone imagined, "ultrasound." Hence, the term "Doppler ultrasound" could be viewed as a misnomer. The principle that Doppler proposed, which described a relation between frequency shifts and velocity, applied to visible light rather than to sound. Demonstration of the acoustic Doppler effect has been attributed to a Dutch chemist and meteorologist named Christophorus Henricus Diedericus Buys Ballot; his friends called him "Buys Ballot." In 1845, he tested Doppler's theory by arranging for a group of musicians to play a calibrated note while riding in an open car on a train on the Utrecht-Amster-

dam line. Anyone who has listened to the pitch of an ambulance siren will not be surprised to learn that observers on the platform of a station heard the pitch of the calibrated note become higher as the train approached the station, and lower as the train passed by and moved away from the station. This supported the "acoustic Doppler effect" upon which Doppler ultrasound is based.[4]

The Color of Color Doppler

While spectral Doppler results are easy to understand when expressed in terms of velocity, the ability to "map" Doppler frequency shifts onto echocardiographic images represented an important advance. Being able to view the distribution and nature of blood flow (organized or disorganized) in relation to recognizable anatomic features (such as heart valves or vessels) made the output of color Doppler systems much more intuitive.

But how about the choice of color maps? Those who have read carefully will note that Doppler's initial observations suggested that light reflected by objects moving away from an observer would have a longer wavelength than the incident waveform. This means that objects (such as blood cells) moving *away* from the ultrasound transducer ought to be depicted in red hues, while blood moving *toward* the transducer ought to be mapped as blue colors. This has been described by the acronym RABT (Red Away, Blue Toward). In fact, the first color M-mode recordings used the RABT color scheme (see Figure 19 in J Am Soc Echocardiogr 2022;35:1210). But that is not how current echocardiographic systems display color Doppler images. Instead, current echocardiographic instruments typically display flow toward the transducer in red shades, while flow away from the transducer is assigned blue shades. The acronym BART (Blue Away, Red Toward) describes this color scheme.

Why this difference? Broadly speaking, allocating colors to indicate Doppler shift frequencies is an arbitrary decision; one could choose to show flow away from the transducer in green, and flow toward the transducer in purple or yellow or any other color. As I recall, the first real-time 2D color Doppler instruments were developed in the mid-1980s by the Aloka Company; Toshiba released a real-time color flow scanner a year later. The Japanese investigators who first applied this approach to the cardiovascular system thought that blood flowing toward an observer ought to be "warm" while blood flowing away from the observer ought to be "cool" – hence they depicted "flow toward" in red shades, and "flow away" in blue shades. My friend Jeff Stevenson, MD (who in the late 1970s was the first clinician to employ an experimental digital multi-gate Doppler instrument developed at the University of Washington by Swiss engineer Marco Brandestini PhD) told me a humorous story about the "color scale" situation. While lecturing at a meeting in Japan, he noted that the color scale showing "flow away" in red shades was consistent with Christian Doppler's initial observations. He mentioned that since motion of the stars was decreed by God (I'm paraphrasing his words), using red shades to indicate flow receding from – and blue colors for flow approaching – the observer, would be consistent with God's will. Graciously, one of his hosts replied "Yes, but our God has been around longer than yours!"

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PEDOF

Students of grammar (apparently an endangered species) will recognize that words written in ALL CAPITALS represent either a rant on a social media platform, or an acronym. Most readers will recognize the former, but some may not recall that an acronym

is a word formed by a series of letters from a group of words. A familiar acronym is SCUBA, which is shorthand for "Self-Contained Underwater Breathing Apparatus." A simpler acronym is MS. Cardiologists and cardiac sonographers will recognize that "MS" stands for "mitral stenosis," but anesthesiologists might think that MS was shorthand for "morphine sulfate," a graduate student might think "Masters of Science," a psychiatrist might think of "mental status," a computer scientist would instantly recognize "Microsoft," and devoted follower of television programs would appreciate the reference to Marge Simpson. My point is that an acronym can be helpful for saving space in an article where the term for which it is shorthand is used repeatedly. The downside is that unless the acronym is defined clearly and unambiguously, it can be confusing.

OK, so where does PEDOF come from? A well-known echocardiography expert once noted that the term PEDOF should not be included in an echo report "because you shouldn't use the name of the person who invented the instrument" and recommended that instead, the term "non-imaging CW Doppler" should be used. Not everybody has taken that advice, however. So, let's first consider what PEDOF does **not** mean. It is **not** the name of the inventor. It is **not** spelled PEDOFF or PIEDOFF or PEIDOFF or PIEDHOFF. And it is **not** spelled PEED OFF, although that's how I feel when I see it repeatedly misspelled!

Given the discussion above, it should not be surprising that the term PEDOF is an acronym. Dr. Liv Hatle, whose name should be familiar to anyone who has ever used Doppler, confirmed to me some years ago that PEDOF is an acronym derived from the term "**P**ulsed **E**cho **DO**ppler **F**lowmeter" by the Norwegian engineers who developed it. Please make routine use of the PEDOF probe when investigating high velocity lesions – the small footprint facilitates minor adjustments in angulation, and as Doppler aficionados know, accurate measurement of velocity is all about "having the right angle." And … please … spell it correctly

Dr. Liv Hatle, whose name should be familiar to anyone who has ever used Doppler, confirmed to me some years ago that PEDOF is an acronym derived from the term "Pulsed Echo DOppler Flowmeter" by the Norwegian engineers who developed it.

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To advance cardiovascular ultrasound and improve lives through excellence in education, research, innovation, advocacy, and service to the profession and the public.