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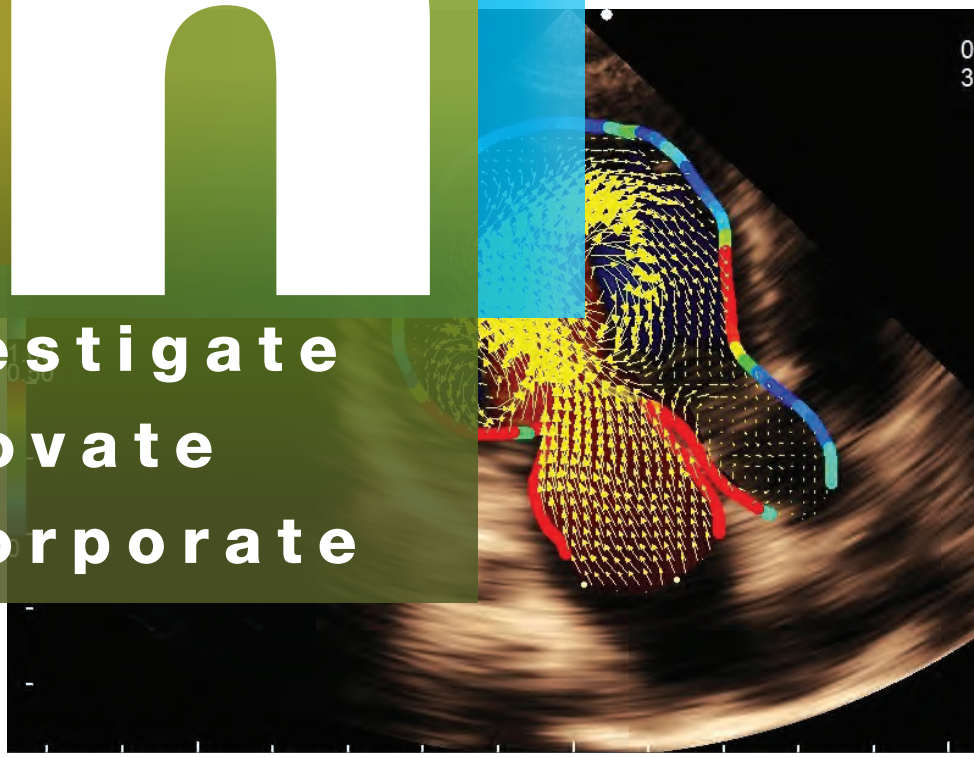

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VOLUME 5, ISSUE 1 | OCTOBER 2016

YOUR ASE WORLD.
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ABOUT ASE

The American Society of Echocardiography (ASE) is a professional organization of physicians, cardiac sonographers, nurses, and scientists involved in echocardiography, the use of ultrasound to image the heart and cardiovascular system. The Society was founded in 1975 and is the largest international organization for cardiovascular ultrasound imaging.

ASE'S MISSION

ASE is committed to excellence in cardiovascular ultrasound and its application to patient care through education, advocacy, research, innovation, and service to our members and the public.

COMMENT & CONTRIBUTE

Like what you read? Have an idea for a future article? We want to hear from you!

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ASE MEMBERS:

This issue is packed with information on initiatives that were pursued to assist ASE in reaching its new three-year strategic goals. From the Echovation competition (page 36) to the Benchmarking Survey (page 34), Point of Care Training (Page 10), and Governance changes (page 22), the ASE leadership has been working hard to evolve and grow to help our members and the field be more efficient, timely, and impactful. We are on a track for unprecedented growth; our membership has broadened and expanded, reaching nearly 17,000 members with 17% outside the United States. This success has been met with a renewed interest in making sure ASE does not lose what is and has been at its core from the beginning—a community of experts that support one another. The Executive Committee members are examples of this organizational strength; they each have been touched by mentors from ASE and, in turn, are now working to mentor others to achieve new heights. At the Scientific Sessions this year, members of the Membership Committee, Scientific Sessions Program Committee, Councils, and the Board of Directors all volunteered to mentor over 200 new trainees, helping connect them with an expert and giving advice on navigating their careers.

What impact will these activities make on the field? We hope it will create a ripple effect where their outreach will encourage others to do the same, establishing a lasting example of the power of associations and a fulfillment of the very basic human need to feel like we belong.

Join me in celebrating the power of new ideas and being rooted in our traditions!

Robin Wiegerink, CEO

Aldo Prado, MD, FASE
Chief of Echocardiography Department,
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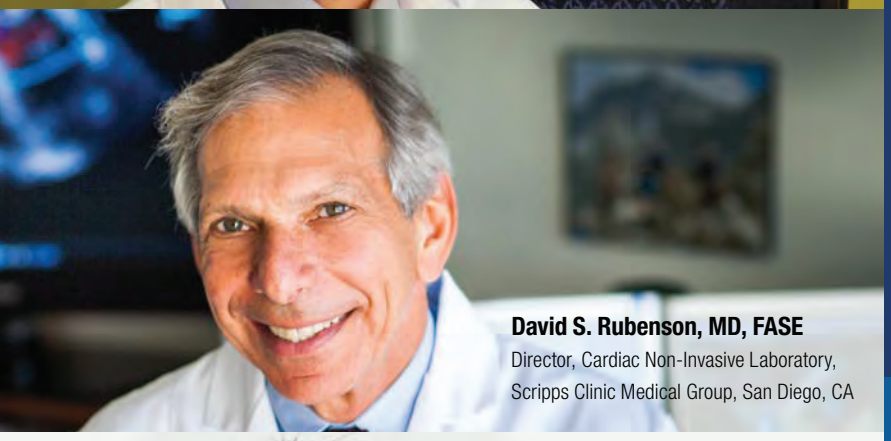

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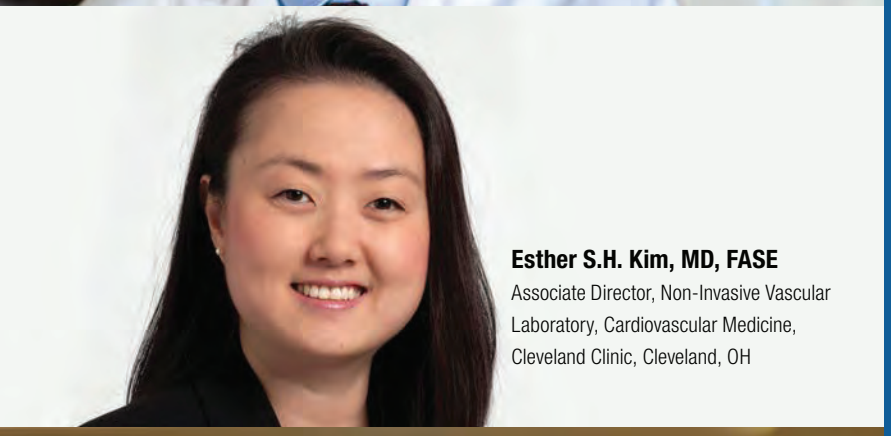

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EDITOR'S NOTE

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.

[Focus] ON LEADERSHIP

Mentors play a key role in the professional development of all ASE members. What is your experience with a mentor, and how do you think ASE can help nurture the next generation of cardiovascular ultrasound enthusiasts?

ASE's 2016-2017 Executive Committee Responds

ALLAN L. KLEIN, MD, FACC, FASE
President
Cleveland Clinic

Mentoring of our echo fellows and early career cardiologists is essential to the future of the ASE. On a recent trip back from Montreal, I had the opportunity to reminisce about my own mentoring experiences along the way in becoming your new ASE president. I have been very fortunate in my career to have had great mentors during my medical residency, cardiology training, and echo fellowship (Drs. Liv Hatle, Jamil Tajik, and James Seward, Mayo Clinic) and as a staff cardiologist (Drs. William Stewart and James Thomas, Cleveland Clinic). These sage people have guided me and helped me become a better physician, cardiologist, echocardiographer, and leader. It wasn't all easy. I remember before my first oral American Heart Association abstract presentation, I had tough love mentorship and learned at 11 p.m. that I had to redo my script for all my slides (before the era of PowerPoint) and had to be ready for an 8 a.m. presentation the next morning. I aced it!!

The vision of our Society is to enhance the mentorship opportunities at the annual Scientific Sessions. At the last meeting in Seattle, board and executive members were linked with some of the new abstract presenters and the top 25 investigators. We networked with them and gave them good advice. Going forward, we would like to further encourage mentorship from our executive committee, board, and councils. The networking possibilities at the Scientific Sessions including the Fellow & Early Career Networking Reception are very important. In addition, ASE's new governance structure has proposed a leadership academy to offer training and mentorship to our young leaders in the organization. I realize that I am very thankful for all the mentorship opportunities in my career, and now it is time to give back to our future rising stars.

VERA H. RIGOLIN, MD, FACC, FASE
President-Elect
Northwestern University Feinberg School of Medicine

Mentors play a critical role in all of our lives, both professionally and personally. I have been privileged with several mentors throughout my career who have nurtured my professional growth, guided me in the right direction, and opened doors that I did not even know existed. These mentors have come in many forms, including attending physicians, researchers, nurses, sonographers, peers, and other colleagues.

My growth in the field of echocardiography has been due, in large part, to the support and mentorship by outstanding leaders in the echo world that I met though ASE. ASE provides a forum for all echo enthusiasts to come together to meet one another, share ideas, and contribute to the growth and quality of the field of echo. Attracting the next generation of cardiovascular enthusiasts is critical to the survival of our field and that of ASE. Young people will be encouraged to participate if ample opportunities for personal and professional growth are provided. Examples include, a forum to present research and new ideas, allowing participation in the Society's activities, creating mentorship programs such as the one recently instituted for young sonographers who are first time presenters, and networking events that allow young people to interact directly with the leaders in the field.

ASE is the glue that brings echo enthusiasts together. By providing opportunities for involvement, support, and mentorship for young people, the field of cardiovascular medicine will continue to thrive well into the future.

JONATHAN R. LINDNER, MD, FACC, FASE
Vice President
Oregon Health & Science University

There is a quote about mentoring that I believe is uttered too infrequently: "Mentoring is a brain to pick, an ear to listen, and a push in the right direction." These words underscore the key attributes of a successful mentor. Professional mentorship should not be viewed only as apprenticeship or the grooming of a replacement. Instead, it is the offering of your own experiences and knowledge to those who seek it. Most importantly, it is the giving of your own time. For those in a position of knowledge and wisdom (these are not synonymous), it is critical to listen to the needs, concerns, and desires of those seeking mentorship. For those who are seeking mentorship, it is perfectly acceptable (and perhaps desirable) not to want to take the identical path that your mentor has taken. In my own experience, I had a mentor who gave me a "push in the right direction" at the right time; to leave the comfortable and successful research path that I was on, and to seek foreign knowledge, which opened a door to a completely new ultrasound-based field of study. Among the ranks of the ASE, there is a rich resource of experienced clinicians, researchers, and leaders in imaging. The most important step to receiving mentorship is the first one: to reach out to them. You will be surprised how giving our seasoned members are in terms of their time and their ability to listen.

BENJAMIN W. EIDEM, MD, FACC, FASE

Treasurer

Mayo Clinic College of Medicine

For me, mentors at ASE have been present in so many aspects of my ASE experience. From helping me to write abstracts for the Scientific Sessions, to finding roles for service within the Pediatric & Congenital Heart Disease Council and ASE committees, to encouraging me to pursue leadership roles within the Board of Directors and Executive Committee. I have had so many wonderful colleagues, teachers, and role models from sonographers, physicians, and staff at ASE. Each mentor has fostered a sense of dedication to various areas within ASE that has helped me to shape my overall vision of our Society.

One of the distinct advantages of being an ASE member is that there are so many potential areas of member participation and so many sonographer and physician members who are willing to help our next generation of imagers achieve success at ASE. It simply takes the desire to make a difference in our Society from our younger members which then opens the door to many educational, clinical, research, and administrative roles that are available to broaden their scope of ASE and their commitment to our Society.

After 17 years of ASE involvement, I am so excited to see the next generation of our members continue to move into these important roles at ASE, and I look forward to helping them along this journey!

DEBORAH A. AGLER, ACS, RDCS, FASE

Secretary

Cleveland Clinic

Over the span of my career, I've had the great fortune of having tremendous mentors. Dr. Ernesto Salcedo was the first to lead me down the pathway to echocardiography.

My ASE exposure started in San Francisco at the 1998 Scientific Sessions. I was encouraged by sonographer council member and my director at the time, Annitta Flinn, to submit an abstract. I was coached by Drs. Richard Grimm, Brian Griffin, William Stewart, and past and current ASE Presidents Jim Thomas and Allan Klein on effective presentations. I receive continued encouragement for professional growth from these and others at the Cleveland Clinic, where I have worked since the late 1970s. Through my ASE membership, I've been shown the way from ASE Cardiovascular Sonographer Teacher and Lifetime Achievement Award recipients David Adams, Peg Knoll, Marti McCulloch, and Alan Waggoner. David and Allan encouraged and co-authored my first publication for JASE.

So many others who want to have an active role at ASE are not as fortunate to have support from on-site mentors. This past year, the inaugural initiative of assigning mentors for the Scientific Sessions was launched for upcoming sonographers and physicians. In the future, guidance could be given towards the posters, oral presentations, and recommendations for images for the membership image calendar.

I've been on a magnificent journey with the ASE, and I would like to see opportunities given to others. The future for the Society depends on mentorship of the next generation.

SUSAN D. PHILLIP, RCS, FASE
Council Representative
Johns Hopkins University

In my mind there are two types of mentors. One type helps you gain expertise in your field. For me, these mentors were senior sonographers and echocardiographers who taught me echo, particularly the nuances and tips that helped me develop into an expert sonographer. My daily interaction with these folks helped me form good echo imaging habits and grow technically. The other type of mentor is a career mentor. This individual (or individuals) helps you grow as a leader in echocardiography, particularly up the ranks of ASE.

While I had plenty of technical mentorship, it was more difficult to gain career mentorship. I always had a vision where I wanted my career to lead, but lacked guidance on how to achieve it. It wasn't until later in my career that I found a mentor who had the professional and academic experience to help guide and develop my career. I owe my success to my career mentors, some of whom were not in my hospital.

The future of ASE is dependent upon mentoring. The success of the Society, five or 10 years from now, will be determined by how well those with experience guide and train those new to the field. There are several ways ASE can foster mentors and mentees. Experienced members should identify those with potential and passion, explore how they would like to contribute to the Society, steer them to a committee they would enjoy, and help them network.

The new members should identify someone they admire, and talk to them about mentoring. ASE may consider events to match mentors to mentees, as not all sonographers may have the means and opportunity to gain mentors. My journey in ASE has been very fulfilling. ASE is a wonderful organization that truly engenders growth in upcoming sonographers. Being a part of ASE for over 20 years and part of its leadership team over the last few years has only strengthened my views about ASE. I would encourage all those who have not taken an active role in ASE to seek mentors and contribute to the growth and excellence of ASE.

SUSAN E. WIEGERS, MD, FACC, FASE
Immediate Past President
Lewis Katz School of Medicine at Temple University

Figure out what you need and (politely) ask for it. My biggest lesson in being a mentee came when I was a junior faculty member. My mentor was very friendly to me, reviewed my abstracts and manuscripts immediately, and was very helpful with suggestions for research projects. But I began to fume that I was never invited to dinner with Grand Rounds speakers, and faculty more junior to me were being put forward for national talks when I was not. I began to suspect that I was being treated differently because I was a woman, and it took me months to bring it up to him. But in a private meeting in his office I said, "I notice I am never invited to dinner or to give a talk. I am wondering why." I actually had practiced saying it calmly and unemotionally, even though I was pretty concerned by this point. My mentor looked shocked and said, "But Susan, you have such small children. I thought you didn't want to go out to dinner!" It was my turn to be shocked. I thought he was discriminating against me and he thought that he was doing me a favor by not asking me to be away from my kids. We agreed on four dinners and two talks a year. The rest is history. After several talks, I got invitations on my own, and while being judicious in my choices was still able to meet the requirements for promotion. So here is the take home message: Review your institution's criteria for promotion. Review your CV. Figure out what you need. Then ask for it. Politely always works better.

Point of Care Comes of Age — Two Voices Discuss Its Impact

The Cardiologist

Contributed by Vera H. Rigolin, MD, FACC, FASE, FAHA, Northwestern University Feinberg School of Medicine, Northwestern Memorial Hospital, Chicago, Illinois

Over the past two decades, ultrasound equipment has become more compact, higher quality, and less expensive. The wider availability and feasibility of echo equipment has allowed for the expansion of cardiovascular ultrasound outside the traditional echo lab domain. Unlike the comprehensive echo exam performed and interpreted by the echo lab staff, Point of Care Ultrasound (POCUS) is a goal-directed, focused exam that answers brief and important clinical questions. The most common applications of this technology are in the evaluation of emergency medical conditions and in the resuscitation of acutely ill or injured patients. It can also be applied to any emergency medical condition in any setting with limitations of time, personnel, or patient condition. Unlike in the traditional echo lab, where the echo exam is performed by a sonographer and then later interpreted by a cardiologist, the POCUS exam is performed, interpreted, and integrated into clinical practice in an immediate and rapid manner by a trained healthcare provider. Common clinical scenarios where the focused exam is most useful have been previously published.[1-4] An example of a typical patient who benefits from a POCUS exam:

> Ms X has a history of breast cancer that has been treated with radiation and chemotherapy. She presents with progressive shortness of breath and dizziness. On physical exam, she is hypotensive, tachycardic, and tachypneic. The emergency room physician performs an urgent POCUS exam that reveals a massive pericardial effusion (Figure 1). The patient quickly undergoes urgent pericardiocentesis resulting in immediate resolution of her symptoms.

Non-cardiology healthcare providers such as emergency room and critical care physicians have already embraced POCUS into routine clinical practice and have created guidelines for training.[2,4,5] The portability, reduced cost, and immense amount of information attainable using this technology makes POCUS attractive to a wider number of non-traditional users of echocardiographic technology. The challenge is to allow for growth and expansion of this technology in the appropriate fashion.

Guidelines and standards for training cardiology fellows to become proficient in echocardiography in the traditional setting also exist.[6] As POCUS becomes integrated into daily clinical practice for the cardiologist, such guidelines will need to be modified. Other potential users of POCUS include anesthesiologists, medical students, physician assistants, nurse practitioners, primary care physicians, and hospitalists, among others. Guidelines for training and continuing education for such users are less well established.

With so many potential users, initiating a POCUS program can be a daunting task. There is wide variability in the level of expertise within different departments in an individual institution and globally between different institutions around the country. Thus, each POCUS program should to be tailored according to the specific users of POCUS technology and their level of expertise. The goals and objectives within each group of users will differ depending on the particular clinical scenarios within that practice and typical questions that need answers. Therefore, the first step in creating a new POCUS program is for each group of users to define its

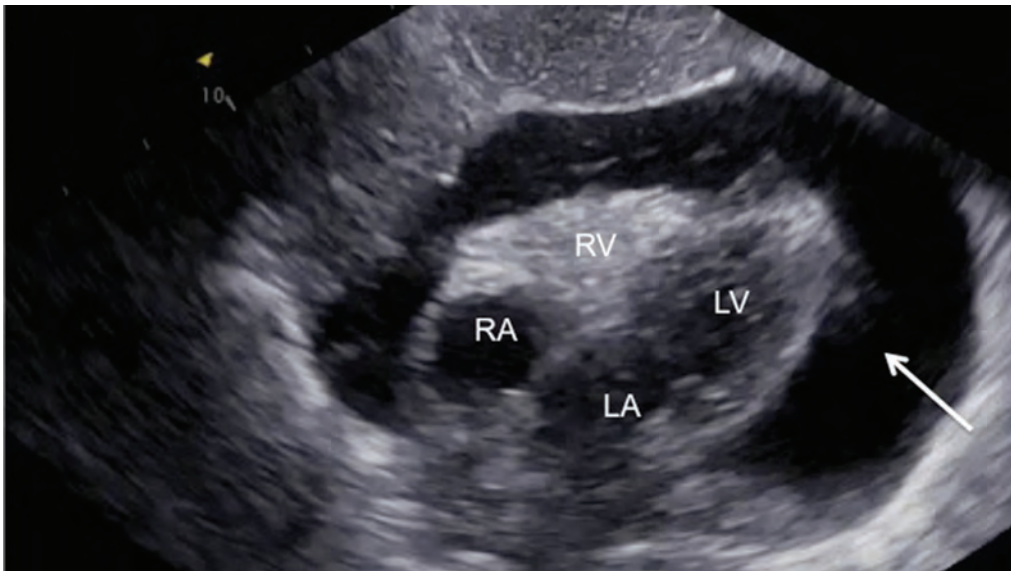

Figure 1: Subcostal view of a patient with a large pericardial effusion (arrow). RA=right atrium, RV=right ventricle, LA=left atrium, LV=left ventricle.

own scope of practice and then design the educational and quality assurance programs accordingly. Irrespective, all users of POCUS should work together to share learning and expertise with the common goal of assuring high quality care for all patients. Key factors in developing a robust POCUS program include:

- Education and training appropriate to the scope of practice for each user
- Report generation/documentation for all ultrasound studies used in clinical decision making
- Appropriate storage and archival system for ultrasound images that is available to all healthcare providers within the healthcare system
- Continuing medical education appropriate for each user group
- On-going quality assurance program within each user group

In addition to the use of POCUS for direct patient care, this technology is an ideal teaching tool. Many medical schools have already incorporated POCUS into the curricula.[7,8] The use of simulators to assist in the learning of ultrasound image acquisition and interpretation has also increased dramatically, which greatly facilitates training without significant burden on patients. Small devices can now fit into a clinician's pocket, allowing for bedside teaching for healthcare trainees as well as for patients. In this scenario, the POCUS exam is being used to train the student in cardiovascular physiology and physical examination. Although several medical school and residency training programs have embraced POCUS as a teaching tool, there is extensive variability in the quality, methodology, and available resources from institution to institution. Well-designed curriculum with clear goals and objectives are needed to standardize the use of echo as a teaching tool.

As the clinical applications of POCUS and the number of users expand, education, appropriateness, and quality must remain in the forefront. Cardiologists and other healthcare providers are encouraged to partner together to develop educational programs, appropriate use guidelines, and quality assurance initiatives within their institutions. Hospital administrators are encouraged to assure proper credentialing and well-maintained ultrasound equipment. Information technology departments are encouraged to ensure adequate image storage and report generation capabilities for all POCUS images used in clinical decision making. The success of the POCUS program in every institution will therefore depend upon the collaborative efforts among a large, diverse group of individuals.

Vera H. Rigolin, MD, FACC, FASE, FAHA, is Professor of Medicine at the Northwestern University Feinberg School of Medicine, Medical Director of the Echocardiography Laboratory at Northwestern Memorial Hospital, Chicago, Illinois, and President-Elect of the American Society of Echocardiography

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Contributed by Sasha K. Shillcutt, MD, MS, FASE, University of Nebraska Medical Center, Omaha, Nebraska

For the past several decades, anesthesiologists have found themselves as the stewards of perioperative ultrasound. From regional nerve blocks and vascular procedures to advanced transesophageal echocardiography imaging for cardiothoracic procedures, ultrasound is used daily by anesthesiologists to guide procedures, influence medical and surgical management, and optimize patients during the perioperative period.[1-4] In the last five years, Point of Care Ultrasound (POCUS), defined as ultrasound performed at the bedside in real-time by the physician, has become increasingly used in operating rooms, preoperative holding areas, post-anesthesia care units, and critical care wards to evaluate surgical patients.[5-9] As POCUS expands into the acute care realm, questions surrounding training, competency, credentialing, quality, image storage, and reporting all rise to the surface.[10] We know that POCUS, performed in real-time by experts, may influence medical and surgical decision making, but who should perform it, what defines a POCUS exam, and who should teach it?

Several medical schools and training programs have begun to introduce ultrasound into their core curricula, while the Accreditation Council of Graduate Medical Education has specified defined competencies for ultrasound in some specialties such as emergency medicine. Other medical specialties, for example, critical care medicine, have included ultrasound application in their board exam content. While the implementation of ultrasound grows daily, the ability to educate, define, and provide quality metrics to the practice of POCUS has been outpaced by its introduction into clinical practice. In a recent publication by Dr. Feroze Mahmood and colleagues solicited by the Society of Cardiovascular Anesthesiologists, there was a call to action to define and implement perioperative ultrasound training, including POCUS, for all future anesthesiology trainees.[11] While the training of future physicians is crucial, what about physicians currently in practice? Physicians on the front lines in acute care arenas may find themselves with little training in POCUS in institutions where its practice may be considered standard of care. What education is available to those physicians, and how do they gain competency in this important skill set?

Both cardiologists and anesthesiologists, with training in advanced echocardiography concepts, may be best poised to partner with different specialties and lead POCUS education. Many of the most passionate and experienced educators in the field of echocardiography exist in the subspecialties of cardiology and anesthesiology.

While we often pride ourselves as having mastered the most "advanced" concepts, the future success of POCUS depends on reliable, competent, accurate interpretation of basic yet critical point of care images.

> One could argue that perhaps the most important area where quality should exist is in POCUS, where one image may save a life or guide a life-saving procedure.

Making the diagnosis of pericardial tamponade, pneumothorax, or severe hypovolemia in real-time by the bedside physician has significant implications, and those images and imagers mandate quality, respect, and provision by our Society.

As someone who has had the privilege of creating a POCUS curriculum and courses at my own institution, I have found my role as teacher and collaborator as most rewarding. My colleagues using POCUS have helped me see the value of their expertise in this critical skill set. This concept that basic life-saving images, interpreted accurately and reliably, demand exceptional teaching, quality, and esteem just as much as advanced imaging practices may change the way we as advanced-trained echocardiologists approach POCUS. Perhaps it is time to expand our goals as educators and embrace quality education in POCUS with our colleagues who find themselves using this modality.

Sasha K. Shillcutt, MD, MS, FASE, is Associate Professor, and Vice Chair of Strategy and Clinical Transformation, Director, Clinical and Translational Research, and Director, Perioperative Echocardiography at the University of Nebraska Medical Center, Omaha, Nebraska. She is a member of ASE's Council on Perioperative Echocardiography steering committee.

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FROM SGR TO MACRA TO MIPS: WHAT YOU SHOULD KNOW

Contributed by: Geoffrey A. Rose, MD, FACC, FASE, Chief of Cardiology, Sanger Heart & Vascular Institute, Charlotte, North Carolina

When President Obama signed the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) into law, the 12-year battle to repeal the Sustainable Growth Rate (SGR) formula—the method that determined Medicare's payment for physician services—came to a close. Once fully implemented, MACRA has been projected to be the most consequential driver of how healthcare is organized, delivered, and reimbursed since the development of DRGs. The aim of this article is to explain why indeed this may be so and to provide a primer on key elements of this legislation.

FROM SGR REPEAL TO MACRA

First, what was SGR and why did most in the medical community want it repealed? To begin, note that since Medicare's inception in 1965, determining a workable method for paying physicians for their services has proved problematic. Original payment methods reimbursed physicians at rates equaling their local 'usual and customary charges.'[1] This provided no guardrails to curb spending, and predictably, spending increased. Subsequent attempts to rein in spending yielded little success. Ultimately in the Balanced Budget Act (BBA) of 1997, increases in physician and other provider reimbursement became linked to the overall U.S. per capita GDP growth. The logic: an overall increase in the Medicare spending on provider reimbursement would be ***sustainable*** so long as it matched the overall growth of the economy at large. At the time, the U.S. economy was expanding rapidly, and for the next few years provider payments increased.

But the logic of the BBA was flawed. By 2002 the U.S. economy had cooled, yet provider payments continued to increase. This led to an historic 4.8% reduction in the Medicare physician fee schedule and resulted in public outcry. For the next 12 years—until MACRA was signed—the medical community found itself, at the end of each fiscal year, lobbying Congress to postpone the payment reductions stipulated by SGR. Each year Congress acceded. Yet the stakes grew, as each of these reprieves merely stalled but did not reset the mandated reductions in provider payments. This created greater degrees of financial jeopardy with each passing year. At the time MACRA was signed, providers were facing a 21% across-the-board decrease in reimbursement.

By offering relief from the yearly face-off with Congress, MACRA was initially greeted with broad support. In MACRA, (1) legacy SGR-mandated provider payment reductions were repealed for good; (2) a yearly 0.5% increase in the physician fee schedule was to be enacted for the four years (2016-2019); then (3) payment was to be held constant for six years thereafter (2020-2025). This so called 'doc fix' legislation was hailed as offering both clarity and stability for provider payments for the next decade – or so it seemed.

THE QUALITY AGENDA

Although most of the concern regarding provider reimbursement has centered on base rates for payment, it is important to point out that since passage of the Patient Protection and Affordable Care Act of 2010 (aka 'Obamacare'), a number of payment modifiers have been introduced to secondarily adjust provider reimbursement based upon quality measures. Today, the Physician Quality Reporting System (PQRS), Meaningful Use of the Electronic Health Record (EHR), and the Physician Value-Based Payment Modifier (VM) programs combine to put 6% of physician reimbursement at-risk; this will increase to 9% in 2017. These programs represent initial legislative attempts to focus attention on the quality of services delivered instead of solely on their volume.

In parallel, Medicare also began developing alternative models aimed at reducing overall cost of care while maintaining the quality. These models are different than traditional fee-for-service arrangements, and Accountable Care Organizations (ACOs) serve as the primary vehicle through which this may be accomplished. In ACOs, providers and facilities work together to coordinate care. So long as specific quality measures are attained, if the ACO provides total cost of care below a predetermined value, the ACO shares in those savings (one-sided risk arrangement). In addition to this 'upside' risk, the ACO may elect also to assume liability for a percentage of costs in excess of benchmarks (two-sided or 'downside' risk arrangement). The percentage of overall shared saving available to the ACO is higher in this downside risk arrangement.

MACRA takes these two approaches to increase quality (i.e., fee-for-service care with quality modifiers vs. ACO care reorganization) and codifies them into two distinct payment tracks: the Merit-Based Incentive Payment System (MIPS) and qualifying Alternative Payment Models (APMs).

APMs

The APM model applies to those providers who are organized into qualifying ACOs that assume downside risk. MACRA then provides for additional financial opportunity. Should the qualifying ACO achieve a certain threshold value for revenue derived from APMs, its providers will receive a 5% bonus on all of their Medicare charges (assessed yearly through 2024). ACO providers are also liberated from reporting on individual quality measures. (See MIPS below.)

While this model may seem attractive, three distinct issues with APMs must be recognized. First, the criteria for qualifying for APM payment are quite stringent. It is expected that fewer than 10% of all Medicare providers will be eligible for APM track payment in 2019, the year that MACRA goes into effect. Second, the 5% APM bonus payment will sunset in after 2024.[2] Third, keep in mind that the ACO may need to deliver up-front financial returns before qualifying for APM bonus payment. APMs are not a business models that can be entered into without considerable expertise in actuarial analysis, operational execution, and financial management.

MIPS

If a provider is not in an ACO, or is in an ACO that does not meet the revenue threshold for APM qualification, the provider will be assigned to MIPS evaluation. It is expected this will encompass 90% of all providers in 2019. Every MIPS provider will be evaluated on performance in four domains: quality, resource use, clinical practice improvement, and advancing care information. Scorecards will be produced and publicly available (https://www.medicare.gov/physiciancompare). Not only are rules complicated as to how performance in each domain will be assessed, but also the burden for reporting in all of these domains is not trivial.

Based on individual performance relative peers, providers will receive ±4% adjustment on all their Medicare payments beginning in 2019, increasing to ±9% in 2022 and beyond.

The MIPS program is essentially self-funded. Those whose performance is deemed to be below the mean will incur financial penalties. These dollars in turn will fund bonuses for those considered to be performing above the mean. While there is additional funding for exceptionally high performers, at its core MIPS is a zero-sum game. The specific rules by which resource use will be allocated and how quality will be assessed are still being developed. Nevertheless, at the time of this writing, MIPS evaluation of physician performance is slated to begin January 1, 2017. It is the performance in 2017 that will dictate the individual 2019 payment modifier for each MIPS provider.

Given the multiple performance dimensions of MIPS, the associated reporting burden, and concern that the achievement thresholds for penalty avoidance will move ever upwards, present consensus is that the APM tract is the safer harbor. However, as pointed out, participation in an APM requires complete reorganization of the infrastructure for care delivery. This is no small undertaking.

LOOKING AHEAD

MACRA is ambitious in its scope and aggressive in its timeline for implementation. So, it is important to highlight that MACRA made its way through the perpetually gridlocked U.S. Congress with tremendous bipartisan support, a phenomenon particularly noteworthy in today's political climate. Passing 392-37 in the Republican-controlled U.S. House, 92-8 in the Republican-controlled U.S. Senate, and then signed into law by a Democratic President, the key elements of this legislation are unlikely to change.

There is justifiable concern over the hydraulics of exactly how to measure, monitor, and award payment for the value of healthcare services rather than their volume. However, movement to some type of value-based payment system is arguably not an imperative but instead an inevitability. Medicare beneficiaries number roughly 54M today, and that number will climb to 82M by 2030. Meanwhile, there were 3.1 tax-paying workers for each Medicare beneficiary in 2015, and that ratio will decrease to 2.3:1 by 2030.[3] The actuarial implications are staggering: ever more beneficiaries needing care and ever fewer taxpayers to support this cost. Even with the projected cost-saving provisions of ACA and MACRA, the Medicare trust fund is projected to be insolvent in 2030. Our present model of care delivery is simply no longer scalable.

Unless we wish to face the prospect of rationing healthcare for lack of resources, we must find new ways to provide healthcare that is of high quality yet delivered at lower aggregate cost. While MACRA does not provide us with this blueprint, it certainly does provide us with the incentive to develop one.

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Two New CPT™ Add-On Codes for Echocardiography

Contributed by: Michael Main, MD, FACC, Saint Luke's Mid America Heart Institute, Kansas City, Missouri and Denise Garris, The Korris Group, Washington, D.C.

Over the past two years, the American Society of Echocardiography (ASE) has submitted two Code Change Proposals (CCP) to the American Medical Association (AMA) Current Procedural Terminology™ (CPT) Panel. CPT™ codes describe medical services and procedures—new codes are necessary when novel technologies enter clinical practice. New CPT™ codes describing 1) echocardiographic myocardial strain imaging and 2) myocardial contrast perfusion echocardiography were ultimately approved by the CPT™ panel published by the AMA. Both of these new codes are "Category III" or "tracking" codes—this code type is used to describe "emerging technologies." While the Centers for Medicare and Medicaid Services (CMS) does not provide coverage for Category III codes, there is an opportunity for Category III codes to ultimately be reclassified as Category I codes (reimbursed by CMS) if 1) the Category III code demonstrates significant utilization in clinical practice and 2) additional peer-reviewed literature is published which demonstrates the utility of the new service.

ECHOCARDIOGRAPHY MYOCARDIAL STRAIN IMAGING

In February 2014, at ASE's request, the AMA CPT™ Panel established a Category III add-on code for "myocardial strain imaging (quantitative assessment of myocardial mechanics using image-based analysis of local myocardial dynamics)." This code was published on July 1, 2015, and became active for reporting purposes on January 1, 2016. Report CPT™ code 0399T when you perform myocardial strain imaging. CPT™ code 0399T may be used in conjunction with base CPT™ codes 93303, 93304, 93306, 93307, 93308, 93312, 93314, 93315, 93317, 93350, 93351, and 93355. This add-on code may only be reported once per imaging session. ASE has discussed this new service with both private payers and Medicare Administrative Contractors (MAC). ASE is seeking limited coverage for myocardial strain imaging when it is performed to aid in detection of cardiotoxicity in patients who are receiving potentially cardiotoxic chemotherapy or radiation therapy. ASE has developed a strain code payer "toolkit" which is available at ASEcho.org/Advocacy.

MYOCARDIAL CONTRAST PERFUSION ECHOCARDIOGRAPHY

In October 2015, at ASE's request, the AMA CPT™ Panel established a Category III add-on code for "myocardial contrast perfusion echocardiography, at rest or with stress, for assessment of myocardial ischemia or viability." This code was published on January 1, 2016, and became active for reporting purposes on July 1, 2016. Report code 0439T when you perform myocardial contrast perfusion echocardiography. This code may be reported in conjunction with base CPT™ codes 93306, 93307, 93308, 93350, or 93351. This add-on code may only be reported once per imaging session. ASE will work with private payers and Medicare Administrative Contractors in 2016 to seek reimbursement for this service.

WHAT YOU CAN DO

Ensure that your echo lab staff and business department are familiar with these new CPT™ add-on codes, and submit these codes when you perform myocardial strain imaging or myocardial perfusion echocardiography. This will allow national utilization tracking, which is a critical first step towards establishing reimbursement for these services.

ASE members have access to a coding consultant, who is an expert that can help with these codes and any coding and reimbursement questions you may have. More information is available at: **ASEcho.org/Advocacy/Coding-and-Reimbursement**.

Michael Main, MD, FACC, FASE, is the medical director of the Cardiovascular Ultrasound Imaging Laboratory at Saint Luke's Mid America Heart Institute in Kansas City, Missouri. He serves as chair of the ASE Advocacy Committee. Denise Garris, principal with The Korris Group, is ASE's RUC consultant.

ASE: The Hub for Your Professional Success

Contributed by Natalya Read, ASE Director of Membership

ASE strives to provide the latest tools and information to assist your professional success. Our commitment to you rests on four principles: providing superior service to our members; giving timely news and information; being a reliable and vocal advocate for cardiovascular ultrasound; and offering outstanding educational opportunities. Allowing ASE to serve as the hub for all of your professional development needs frees your time to focus on providing the very best care to your patients.

- **30+ hours of free CME is included with membership, enough to meet most credentialing requirements**
- **ASE will transfer your CME, MOC, and CEU credits to ABIM, ABP, ARDMS, and CCI so you don't have to keep track of your credits**
- **Members receive free access to live webinars where the lead author explains and answers your questions about new guidelines**
- **The *Journal of the American Society of Echocardiography* (JASE) provides access to cutting-edge research and is included free with your membership**
- **Significant discounts on ASE live courses, educational products, DVD's, posters, and co-sponsored events allows multiple opportunities for advanced learning**
- **Networking with other ASE members is easy through the Connect@ASE online community**
- **ASE retains a lobbyist so your voice is represented on Capitol Hill through extensive advocacy efforts**
- **Since 2013, ASE has had a full delegate within the American Medical Associations (AMA) House of Delegates**

ASE recognizes that providing superior service to our members includes advocating on their behalf. ASE represents our members, while advocating to create an environment for excellence in the quality and practice of cardiovascular ultrasound. ASE's role as the voice of echocardiography on Capitol Hill, to federal agencies, and among private payers is unquestionably of great–and ever-increasing–importance. In the past year, while constantly working to protect echocardiography, ASE successfully lobbied against an echocardiography specific site neutrality policy, and the two-year budget deal Congress passed included a significantly modified version of site neutrality that is not echo or cardiac imaging specific.

ASE works diligently to retain the affordability of membership while continuing to fund and offer new initiatives and member benefits to enhance our services to members. We believe you will find that the value of ASE membership continues to expand and improve.

ASE works hard to ensure that membership is priced competitively with similar specialty membership organizations.

ASE will always be THE voice in the cardiovascular ultrasound community for ALL practitioners while continually evolving to provide resources that are vital to continued professional development. Please feel free to contact Natalya Read, ASE's Director of Membership, at nread@asecho.org with any feedback you may have.

WHY PARTNERSHIPS MATTER – ENHANCING HEALTHCARE DELIVERY IN THE PHILIPPINES

Contributed by Andrea M. Van Hoever, ASE Vice President of Research

Change occurs when we build partnerships. This is especially true in healthcare. The ASE Foundation's global health initiatives and humanitarian events program is an example of the positive change that is created through strong partnerships. When personal, professional, and organizational relationships all converge to guide clinical decision-making and improve patient care, change becomes transformational.

The Foundation's most recent event happened this summer in Legazpi City, Albay, Philippines. Located on the island of Luzon, Legazpi City is a port city nestled between the Albay Gulf and the southern foothills of the "beautiful lady," the Mayon Volcano. Luzon, also home to the capital of Manila, is the country's largest and most populous island.

The Philippines is a country of over 102 million people spread over 7,000 islands in the Western Pacific. Cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes are the leading causes of morbidity and mortality. Travel between the islands for medical care is often financially prohibitive. Our coalition of partners for this event hailed from all over the world, but we all arrived in Legazpi City at the end of June with the same goals – to work together and learn from each other's experience while providing education and training in an underserved area of the world.

PARTNERS IN CARE

It all started in Danang, Vietnam, in August 2015. Knowing that the Foundation was bringing a team to Hanoi (ASEFoundation.org/Vietnam), ASE member and U.S. Navy cardiologist CDR Steve Romero connected David Adams (himself a former Navy corpsman) with CDR Dylan Wessman, a cardiologist participating in the 2015 Pacific Partnership. The Pacific Partnership is a multilateral, disaster-relief preparedness mission conducted in cooperation with the U.S. Navy, regional governments, and humanitarian and non-government organizations. After the Foundation event concluded in Hanoi, David and I met with the Navy's internal medicine team while they were working at Danang General Hospital. It was there that the idea for our 2016 collaboration began.

Once the Pacific Partnership's deployment schedule for the summer of 2016 was confirmed, ASE reached out to its International Alliance Partners in the Pacific. ASE member Dr. Edwin Tucay at the Philippine Society of Echocardiography (PSE) connected us with Dr. Thad Ciocson with the Philippine Heart Association Bicol Chapter (PHA), and a multi-day program of education, hands-on training, and patient assessment for structural heart disease was developed to coincide with the U.S. Navy's 2016 Pacific Partnership stop in Legazpi City. Our event was held at the Bicol Regional Training and Teaching Hospital (BRTTH).

ASE Foundation

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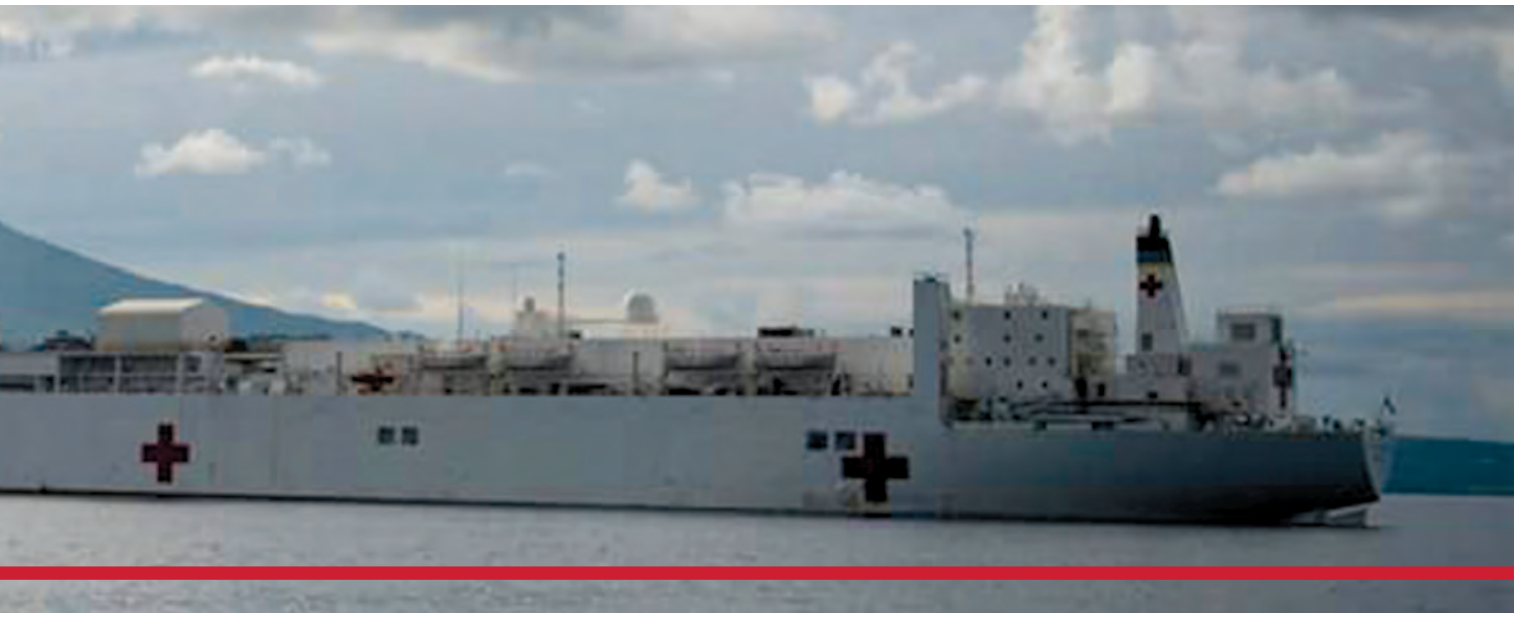
PHILIPPINE HEART ASSOCIATION, INC. • PHILIPPINE COLLEGE OF CARDIOLOGY •

PACIFIC PARTNERSHIP



ADVANCING CLINICAL SKILLS

The BRTTH is a tertiary government hospital located in the heart of Legazpi City. It is the largest public healthcare facility in the Bicol region. The Heart Center echo lab currently has only one imaging machine, but the government has just broken ground on a new building that will serve as a regional cardiology center when it is complete.

Our team members rotated between two locations at the BRTTH. In a large conference room in the Outpatient Department building, we presented two days of didactic lectures to 50 clinicians from the BRTTH and other area hospitals. The lectures covered current updates in cardiovascular ultrasound, combined with hands-on training of echo techniques to identify congenital and rheumatic heart disease (RHD). Simultaneously, in the Heart Center echo lab, our sonographers and physicians were scanning patients. Particularly interesting cases were then sent over to the conference room as real-world, hands-on training subjects.

Most of the patients our team scanned had RHD, some had congenital heart disease as well. All of the patients left the BRTTH with a paper copy of their echo report and are being followed by a cardiologist to coordinate any needed treatment. A teenager with a ruptured aortic sinus of Valsalva aneurysm was sent to Manila for surgery. Multiple patients with severe valvular problems from RHD were being evaluated for surgery. Two patients with patent ductus arteriosus will have catheter-based closure procedures.

CDR David Krause works with local clinicians to optimize scanning techniques.

David Adams, with assistance from Eberhard Kurz (Hitachi-Aloka) and Dr. Gregg Pressman, walks local students through what they should look for in their images.

Patients queue in the Heart Center echo lab for their exams.

Dr. Aurora Muriel Gamponia lectures on congenital heart disease.

Dr. Jose "Donny" Magno and Gerald Shishido assess a patient.

LOOKING FORWARD

Our partnership with the PSE, PHA, and BRTTH was essential to the success of this event, and we cannot thank them enough for their guidance on what would be most appropriate educationally for the local clinicians, and for their genuine and sincere welcome to the Philippines. We came away from this event with what we hope is a replicable model for future collaborations with ASE's International Alliance Partners, as well as the U.S. Navy. As in all things, we are stronger together, and the Foundation will continue to seek partners who can help expand our educational efforts, enable population health research, and further clinical outreach in underserved areas of the world.

ABOUT THE USNS MERCY AND THE PACIFIC PARTNERSHIP

The U.S. Navy hospital ship USNS Mercy (T-AH 19) is one of the largest floating hospitals in the world. A converted San Clemente-class supertanker, the Mercy holds 12 fully-equipped operating rooms, a 1,000- bed hospital facility, full blood and pathology suites, a radiology department, dental suite, ophthalmology capability, and four intensive care units including an isolation unit.

The Pacific Partnership is an annual humanitarian aid and disaster response-preparation program in the Indo-Asia-Pacific region. This year a multinational team of over 900 military and civilian specialists are aboard the Mercy as she visits Timor-Leste, the Philippines, Vietnam, Malaysia, and Indonesia on a four-month deployment.

TEAM LEGAZPI PARTICIPANTS

TEAM LEADERS

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CDR Miguel S. Gutierrez, MD
LCDR Dean Kang, PharmD, MHA
CAPT Tony Han, MD
LCDR Margrette M. Moore, MD
CAPT Keshav Nayak, MD
CAPT Peter F. Roberts, MD
CDR Steven C. Romero, MD, FASE
CDR Dylan E. Wessman, MD

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ASEFoundation.org/Philippines

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A Look Back and Forward – ASE's Governance

Contributed by: Neil J. Weissman, MD, FACC, FASE, Medstar Health Research Institute, Washington, D.C.

During ASE's 41-year history, several Governance Task Forces have been appointed by the organization to review its governance structures and make recommendations for improvement. In 1996, Dr. Richard Popp chaired a Governance Task Force to look at the Council structure. Dr. Harry Rakowski chaired a Governance Task Force in 2009 to review how ASE develops and recruits for leadership positions and to make recommendations for how the nominations process and relationships might be improved. These types of efforts continue today.

> "As the composition and audience for our membership has evolved, there is the need to again re-evaluate ASE's infrastructure to ensure that our diverse groups of members are being well represented in the Society and in its leadership."

In June 2015, ASE approved a new strategic plan for the Society. One of the four goals was to "create a governance structure that is representative of our membership and supports an efficient and effective organization." While serving as Immediate Past President, I was appointed to chair a new Governance Task Force to recommend a plan for accomplishing this strategic goal. From June 2015 – June 2016 this Task Force, comprised of a diverse section of ASE leaders, worked to formulate a plan. The plan focused on three key areas: structure and effectiveness of the Councils, Boards, and committees. The Task Force met several times throughout the year to have in-depth conversations to focus on each individual area of the goal (ASE and ASEF Board, Council, and Committees).

ASE also conducted a membership survey in spring 2016 that included questions about the current Board structure to assist the Task Force in making recommendations for future changes. Over 791 members responded and gave feedback on ways to improve the ASE's board. They recommended including "more practice diversity," "more specialty representation," and "including a new generation of members." Taking these member comments into consideration, the Governance Task Force made several recommendations at the June 2016 ASE Board of Directors Meeting in Seattle, WA. These included:

- **Decrease the size of the Board to increase its effectiveness and engagement. Have a steady change over the next five years. The Board will be reduced from its current 29 to 20 by 2021, with more frequent involvement of the full Board in overall decision-making.**
- **Develop a leadership training program to foster young leaders and provide them a pathway onto the Board.**
- **Reframe Board nominations towards open seats for any subspecialty or category of member.**
- **Revise Board terms to rotate at two years (a maximum of four years for exceptional service) to allow for more participation and also increase the impact of board members.**

The Governance Task Force also made recommendations to begin building a better infrastructure for the Councils. These included:

- **Renewing the focus and integration of Council activities in ASE's strategic plan.**
- **Having more in-depth new Council Chair orientations.**
- **Creating smaller, more diverse Council Steering Committees.**
- **Opening the ladder to the Steering Committee leadership to all members.**
- **Standardizing the nominations process for all Councils modeled on ASE's.**
- **Setting uniform term limits for all Council Steering Committees.**
- **Reaffirming the Council Chairs' role on the Board of Directors.**

The Board approved all these recommendations during their meeting, and now the Bylaws will be revised to ensure that ASE is operating accordingly to their vision. These changes will also affect the call for nominations for officers and directors that opened in September 2016. The Nominating Committee will be charged to recommend members for open positions that are the best fit (based on a select set of criteria) for ASE's strategic goals. The Board restructuring will be a work in progress over the next few years. We are looking to see progressive change in our overall governance structure that will reflect the needs and wishes of our constituency of members. Ultimately we want a well-balanced and representative leadership. It is key that we reach out now to mentor and encourage our strong candidates, particularly sonographers, to see themselves as future leaders and help move them up the ladder to the presidency.

Yet I think the lesson learned for me as Chair of the Governance Task Force is that the work is not done when the task force makes final decisions – the implementation is key. I hope you will join with me in advocating for more members to run for seats on the Board of Directors and the Council Steering Committees to assist in becoming an even more effective and vital organization for years to come.

Neil J. Weissman, MD, FACC, FASE is the Director of the Cardiovascular Core Laboratories and President, MedStar Health Research Institute, and Professor of Medicine, Georgetown University in Washington, D.C. and an ASE Past President.

Echo and the Structural Heart Team

Interventional echocardiography plays a significant role in managing structural heart disease (SHD). SHD refers to conditions that interrupt the natural flow of blood through the chambers and valves of the heart. This article shares perspectives from two key members of the structural heart care team, a cardiologist, and an anesthesiologist.

ECHOCARDIOGRAPHY IN TRANSCATHETER STRUCTURAL INTERVENTIONS

Contributed by William J. Stewart, MD, FACC, FASE, Cleveland Clinic Lerner College of Medicine, Cleveland, Ohio

Echocardiography is extremely useful prior to, during, and after catheter-based interventions for various valvular and nonvalvular abnormalities. Ultrasound provides amplitude imaging of cardiac structure and Doppler analysis of valve function and flow, providing excellent utility for transcatheter procedures. Used in combination with clinical data, physical examination, invasive hemodynamics, fluoroscopy, and angiography, echo contributes to procedural success.

Prior to the procedure, transesophageal and/or transthoracic echocardiography (TEE or TTE) are used to define candidacy for the procedure. Echo information assists with the decision to perform transcatheter treatment, versus surgery or medical management. The important anatomy is the size of the annulus or the portion of the valve in question where the device will be inserted or applied, and size and shape of the adjacent chambers of the heart. In addition, echocardiographic imaging defines the presence and severity of ventricular dysfunction and dysfunction of other valves as a baseline for future reference.

Intraprocedural imaging can also be done with transthoracic or transesophageal echo. Together with fluoroscopy, echo guides the location and position of device implantation. At the time of deployment, the device is guided by echocardiography into optimum position. For devices which can be repositioned if the initial placement is suboptimal after initial deployment, this too is guided by echo. Echo is used immediately after device deployment to initially and repeatedly look for valve dysfunction. The severity and mechanism of valvular regurgitation helps define procedural success. Additionally, the intraprocedural echo continuously monitors for potential complications, such as pericardial effusion, dysfunction of other valves, aortic dissection, annular rupture, valve migration, ventricular septal perforation, wire entanglement, or new segmental myocardial dysfunction resulting from acute coronary artery obstruction. If the access for the intervention has been trans-septal, echo assesses the size of the atrial septal defect to see if that should be closed to avoid a significant new left-to-right shunt.

Echocardiography after the procedure is again used to determine the success of the procedure and define the recovery phase in comparison with pre-implant imaging. For example, it is useful to define the function of the newly implanted device, such as measuring valve gradients and valve regurgitation. In addition, reassessment of biventricular function provides a new baseline for future follow-up.

Echo does have limitations. In particular, there are shadows in the ultrasound images related to the reflection of the sound waves by solid structures, especially calcification, hardware, and prosthetic material. Although the experienced echocardiographer can usually circumvent these limitations by using multiple transducer positions and imaging planes, there is some uncertainty that persists.

A. The most common structural intervention for which echo is useful is transcatheter aortic valve replacement (TAVR). Most patients for whom TAVR has been used have had aortic stenosis (AS) as the indication, but patients with aortic regurgitation (AR) are increasingly treated by TAVR with the newer devices.

   Pre-op echo is useful especially to discover if AS patients proposed for TAVR will not be candidates because their annulus size is too small or too large, or if there is an anatomic barrier such as a protruding upper septal bulge. To size the valve, pre-procedure 3D echo (Figure 1) and/or computerized tomography are used for measuring the area of the aortic annulus. The outflow tract of the left ventricle (LV) is often elliptical in shape; using a diameter (from 2D echo) to choose TAVR size leads to underestimation of the size and predisposes to paravalvular regurgitation (PVR) after TAVR implantation.

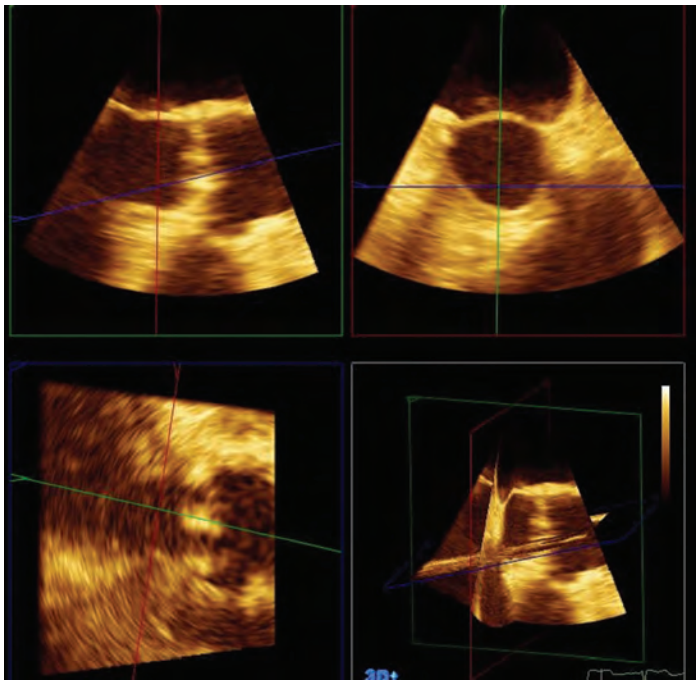

Figure 1: 3D echo in aortic stenosis prior to transcatheter aortic valve replacement (TAVR) – showing offline analysis deriving two long axis cut planes (upper left and lower left) and a short axis cut plane (upper right). The short axis shows the elliptical shape, the area of which provides a better way to measure the aortic annulus size and choose a prosthesis of the optimum size. This is more helpful than using a diameter from a long axis plane and assuming circular symmetry.

In the past, bicuspid valve patients have been excluded from having TAVR but this is changing. TAVR has been used for patients with good and bad LV function, and in the presence of dysfunction of other valves, as long as the primary lesion is the AS or AR. TAVR also can be performed soon after, or just before, other procedures such as coronary interventions in patients with combined disease.

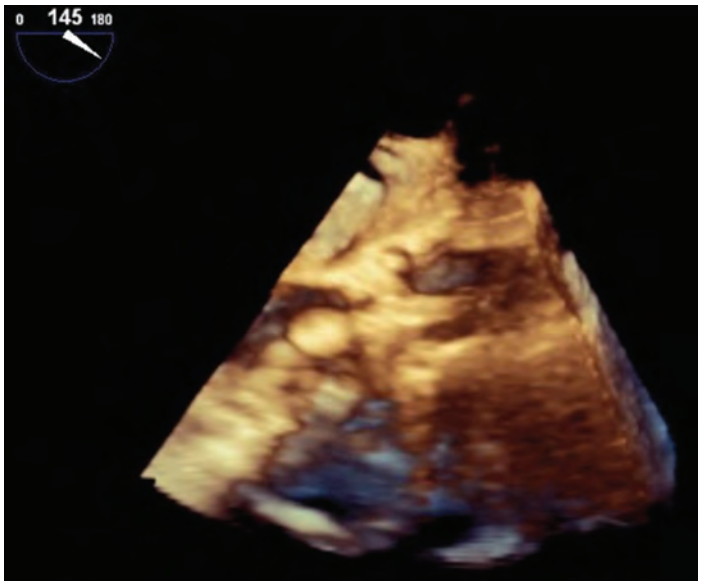

Figure 2: 3D echo during TAVR for aortic stenosis - showing a mid-esophageal long axis TEE view, with the ascending aorta to the right and the LV to the lower left of the figure. This shows the unexpanded prosthesis, allowing the interventionalist to center it within the aortic annulus, straddling the valve, so that the deployment will seat well.

For the balloon expandable valves used for TAVR, echo assists with determining the exact level and angle to deploy the valve (Figure 2), and watching as the valve is expanded to define its stability. Immediately after implantation, echo is useful for assessment of the amount and location of AR, LV function, and other issues like mitral regurgitation (MR). It is important to compare the presence and severity of segmental wall motion abnormalities immediately after implantation with those seen beforehand, as this is the most sensitive way to see if the device has impinged on the coronary ostia. In some situations where PVR is found, repeat balloon dilation ("post dilation") is performed, which sometimes expands the stent of the device sufficiently to reduce the PVR.

Despite all those useful applications, it should be emphasized that, in some situations, TAVR can be done very well without echo. As interventionalists have become more facile in doing the procedure, there is a trend to avoid general anesthesia and therefore omit TEE. Monitoring is then done by fluoroscopy and angiography, with a little help from transthoracic echo. Mostly this works out well. However, the TTE images obtained are usually poor quality because the sedated patient cannot move into the left lateral decubitus position or suspend respiration. The suboptimal images are probably sufficient to diagnose a large pericardial effusion and guide pericardiocentesis, hopefully uncommon, but not usually good enough to accurately locate or grade PVR.

B. Mitral regurgitation (MR) has been successfully repaired with transcatheter methods, most commonly with an edge-to-edge technique using the MitraClip® device. Using femoral vein access with a trans-septal approach, the device fixes the two mitral leaflets together to reduce MR. This procedure veritably cannot be done without TEE guidance. In addition to determining the mechanism and severity of MR to define candidacy for MitraClip, echo helps define the optimal location of transeptal puncture. It guides the trajectory of the catheter to align the delivery system parallel to antegrade mitral flow, and to align the arms of the clip perpendicular to the MV coaptation line. It also guides placement of the clip in the location where the most significant MR jet emerges (Figure 3). After the clip is closed, echo determines the stability of the clip and its success of grasping both leaflets (Figure 4), the degree of improvement in the MR, and the mitral gradient, based on maximum antegrade velocity. If the MR is not sufficiently reduced, the clip can be opened again to place it in a different location. Once a major reduction of leakage has been achieved, the clip is released from the delivery catheter. Sometimes, it is necessary to place a second or even a third clip, again using TEE to guide its delivery to the location where the most significant jet emerges.

C. Transcatheter closure of PVR is another situation where the role of intra-procedural echo is essential, in determining the feasibility of the procedure, guiding its performance, and follow-up afterward. Echo can localize and quantitate the PVR (Figure 5), and define the structure and function of the prosthesis. Another role for echo and fluoroscopy is guiding the atrial septal puncture

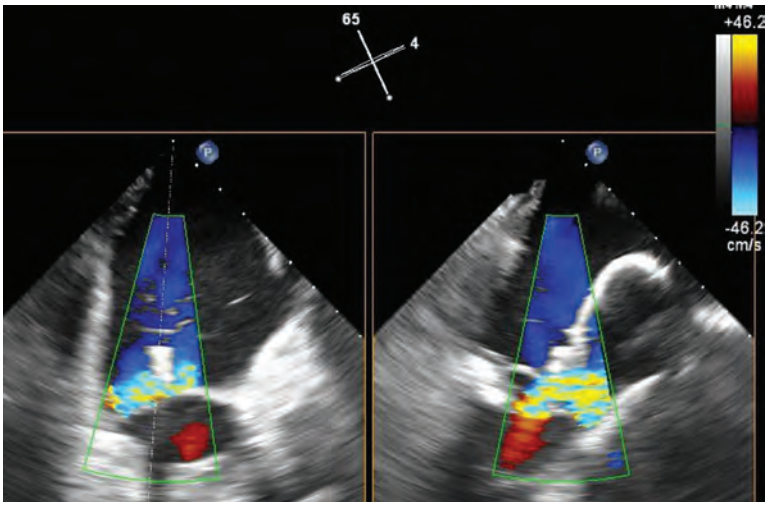

Figure 3: Biplane 2D color Doppler images in MitraClip® repair of MR - showing an intercommissural view (left) illustrating placement of the clip at the site of the largest MR jet, and another long axis view showing the delivery catheter (aligned parallel to antegrade flow), attached to the unopened clip just above the regurgitant valve.

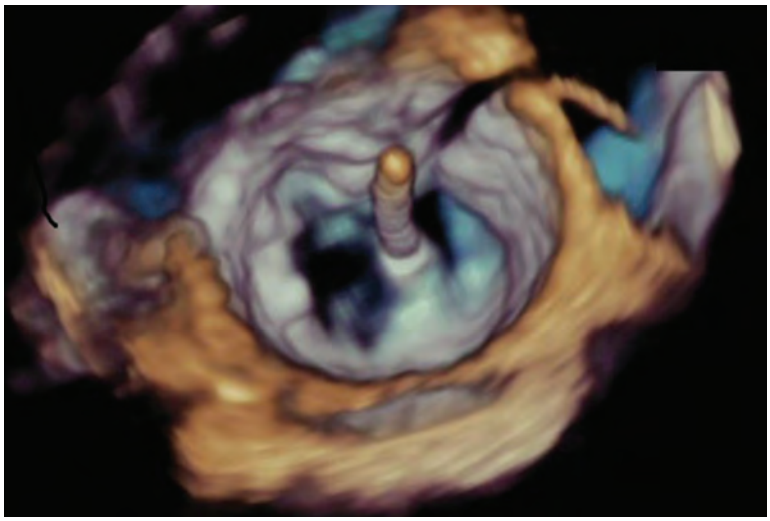

Figure 4: 3D echo (from left atrial perspective) in MR during transcatheter repair using MitralClip®. Note the delivery catheter (in the middle, pointed toward the viewer) still attached to the clip which has grasped both leaflets and created a double mitral orifice, shown in diastole.

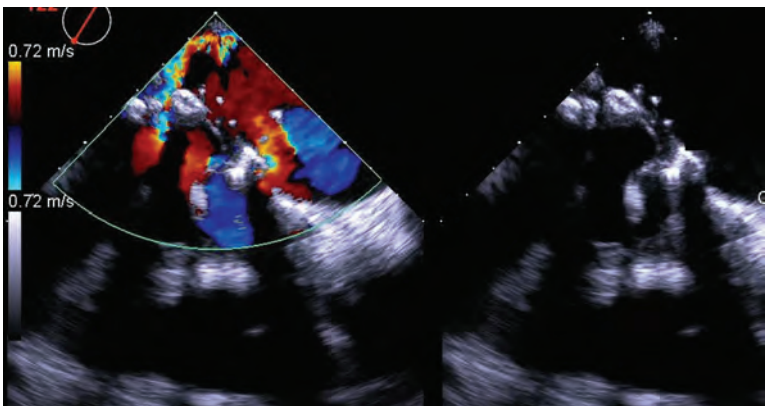

Figure 5: 2D echo images in a patient with two para-prosthetic mitral leaks prior to transcatheter closure of both. These are two mid-esophageal long axis images. On the left color Doppler image, note the MR jet to the left of the posterior part of the sewing ring, and the smaller MR jet to the right of the anterior side of the sewing ring. On the right structural image, there is obvious separation between the sewing ring and the posterior mitral annulus.

or the LV apical puncture. Access to a PVR often requires placement of a veno-arterial rail so the plug device can be pulled in either direction. Sometimes there are numerous areas of dehiscence of the prosthesis. Once a wire is across the hole, it is useful to watch the reduction in PVR during inflation of a balloon inside the hole, to monitor the effects. Especially for patients with mechanical valves, the leaflet (occluder) motion should be observed, looking for reduction in leaflet motion, which can result from the balloon or the plug. After the permanent plug is inserted (Figure 6), echo can assess its stability and reassess the severity of PVR. Often a second plug is needed to achieve the desired amount of improvement.

D. Insertion of a device in the left atrial appendage, such as the Watchman™ device, to prevent formation and embolization of thrombus is another procedure for which echocardiography, mostly transesophageal echo, is useful. Measuring the size of the appendage guides what size and shape occluder will accomplish the clinical goals. Echo guides deployment of the device (Figure 7), assesses for flow around it, and then observes while the interventionalist tugs on the device to assure that it is stable.

E. Valve in valve procedures, where a new prosthetic valve is inserted inside a dysfunctional bioprosthesis, are another group of structural interventions that benefit by use of echo before, during, and afterward. Echo certainly has a central role in diagnosis of the original prosthetic dysfunction, either stenosis or regurgitation. Fluoroscopy is often sufficient intraprocedurally to place the valve optimally; TEE has the advantage of repeated assessments of the amount of AR, compared to angiography which is usually done only once.

F. Closure of septal defects, either ventricular or atrial, is also benefitted by echo guidance. The location and size of the hole are defined by TTE or TEE, including color Doppler and contrast echo. The closure device is then introduced using echo and fluoro guidance. Color Doppler and contrast are again used to test for residual shunting. In some circumstances, especially in ischemic VSD, a second plug is often needed, in which case, echo is indispensable in guiding its placement.

Additional, less common procedures have utility for echo. This includes percutaneous transluminal septal myocardial ablation for hypertrophic cardiomyopathy, balloon valvotomy for mitral or aortic stenosis, transcatheter mitral valve replacement (Figure 8), coil embolization of coronary arteries, and other less common interventional indications.

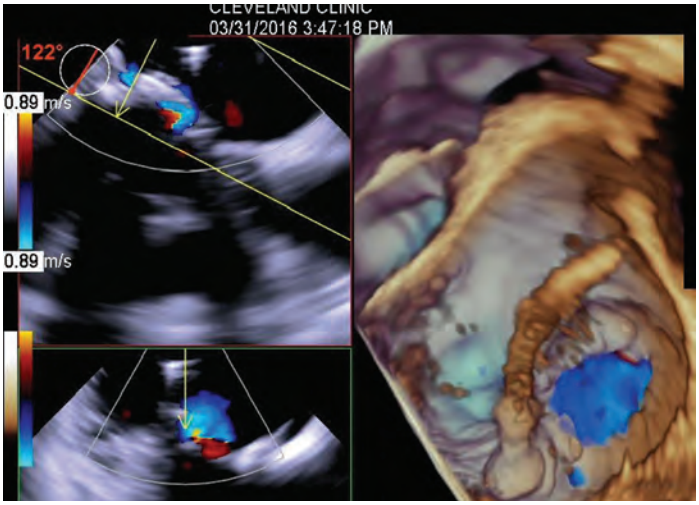

Figure 6: 3D color Doppler image during transcatheter placement of a plug to treat para-prosthetic mitral regurgitation. Note the bioprosthetic valve sewing ring encircling the normal blue intravalvular diastolic flow, with the delivery catheter still attached to a plug which has been inserted into the paravalvular hole, outside the sewing ring. On the left, the two 2D color Doppler cut planes show diastolic flow inside and outside the prosthetic annulus.

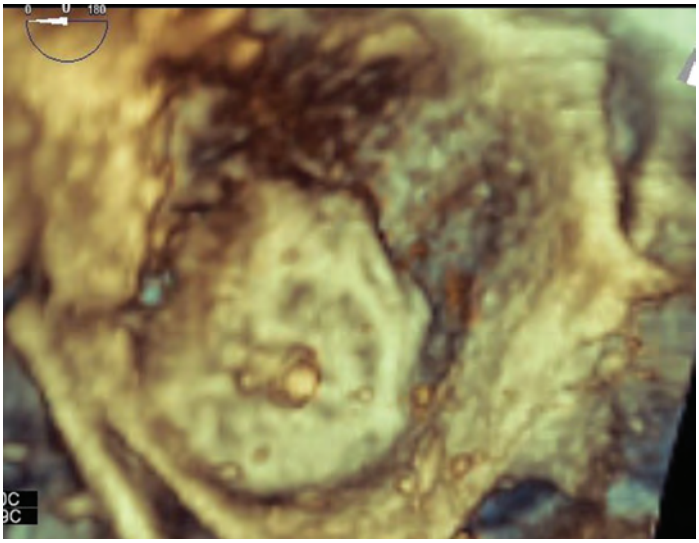

Figure 7: 3D echo image of the newly implanted Watchman™ device in the left atrial appendage in a patient with atrial fibrillation and systemic embolization of thrombus. Note the central delivery catheter still attached.

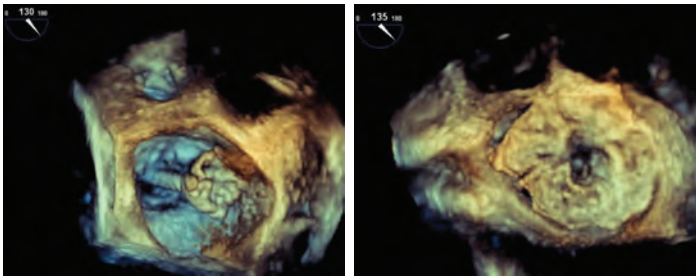

Figure 8: Two 3D echo views from a left atrial perspective in a patient with severe calcific mitral stenosis during implantation of a Tendyne® mitral bioprosthesis introduced via a LV apical approach. Figure 8A: the partially expanded prosthesis is seen well above the mitral valve still attached to the delivery catheter. Figure 8B: The fully expanded prosthesis has been pulled down tight against the left atrial side of the mitral annulus using a cord (not visible) permanently connecting the prosthesis to a button device exterior to the LV apex. The pre-implant mean mitral gradient was 16 mm Hg, which fell to 4 mm Hg after the device was implanted.

Conclusion – For the many structural interventions that have been developed, most are best performed using guidance by transesophageal and/or transthoracic echocardiography. Intraprocedural echo detects and characterizes complications of structural interventions, and helps determine what is needed to salvage the situation. Each of the transcatheter procedures has its own unique questions that can be answered by echo, which have been detailed in this article. Some of the procedures, especially MitraClip and transcatheter closure of PVR, cannot be effectively done without echo.

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THE ANESTHESIOLOGIST-ECHOCARDIOGRAPHER

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The past decade has been marked by tremendous advancements in all forms of cardiovascular care, but especially in catheter-based interventions in structural heart disease (SHD). In a similar fashion, for the past decade echocardiography has also seen the development of incredible advancements in imaging and post-processing technology. This synergy has led to an increasing role of echocardiography in the guidance of SHD, with the rise of a new subspecialty, interventional echocardiography, and with it a new brand of echocardiographers.

The role of the cardiac anesthesiologist/echocardiographer has evolved alongside technological advancements. We are an integral part of the Structural Heart Disease Team, we speak the technical and interventional language, and unambiguously contribute to the intra-procedural decision making. The dynamics of the procedural environment are unique and require constant communication and adaptability. Intra-procedural echocardiographic findings have to be interpreted in the context of the patient's hemodynamics influenced by the presence of anesthesia and by the procedure itself, and decisions have to be made in real time, after careful consideration, and deliberation of all aspects of risks and benefits.

Three main procedures are performed under transesophageal echocardiographic (TEE) guidance in the operating room or the catheterization laboratory: transcatheter aortic valve replacement (TAVR), percutaneous mitral valve (MV) interventions and left atrial appendage (LAA) closure.

TRANSESOPHAGEAL ECHOCARDIOGRAPHY

While the role of TEE in guidance of percutaneous MV and LAA closure interventions is clear, a recent shift towards less invasive anesthetic and monitoring techniques has challenged the necessity of TEE and general anesthesia in TAVR procedures. Irrespective of the imaging modality used in TAVR procedures, the ultimate goal is early detection and mitigation of paravalvular leak (PVL), a well-known complication associated with higher mortality and to promptly recognize and address periprocedural complications in these high acuity patients. Therefore, intra-procedural TEE, with the added value of real-time three-dimensional (3D) imaging techniques, provides an undisputed wealth of continuous, physiologic information both in procedural guidance and in detecting complications. In the following text, we will briefly highlight some of the unique benefits of intra-procedural TEE in patients undergoing TAVR.

Pre-procedural assessment of aortic root anatomy and dimensions are paramount to the successful deployment of the trans-catheter valve. However, the 3D and the complexity of the aortic root anatomy can be adequately appreciated only by using a three-dimensional imaging modality. Two-dimensional (2D) echocardiography has proved unsuitable for the assessment of the aortic annulus dimensions as it consistently underestimates the dimensions, cannot appreciate the eccentricity of the aortic annulus, and is associated with a greater likelihood of PVL when compared with the multidetector computed tomography (MDCT).[1] 3D transthoracic echocardiography lacks the spatial resolution required for accurate assessment of the aortic root. On the other hand, several recent studies have shown that 3D TEE assessment of the aortic annulus using multiplanar reconstruction (Figure 1) or other post-processing software analysis is comparable with MDCT, with differences too small to be clinically significant.[2, 3] Other unique pre-procedural information with impact on the subsequent development of PVL include leaflet morphology and extent and distribution of the calcifications at the level of the leaflets, the aortic root, and anterior mitral annulus. Left ventricular outflow tract morphology with the presence of basal hypertrophy as well as the presence of mid-ventricular hypertrophy is important to assess, as the development of subvalvular dynamic obstruction post-valve deployment has been described.

During procedural guidance, the significant advantage of TEE is continuous monitoring of all aspects of the procedure. In situations of acute hemodynamic changes, TEE can readily diagnose complications associated with balloon valvuloplasty and transvalvular wire and delivery system placement. During deployment, TEE provides continuous information regarding the severity of PVL, position of prosthesis, leaflet mobility, and the degree of expansion and circularity of the deployed valve. Continuous feedback on all these elements is particularly useful during deployment of a new generation of valves that can be recaptured and completely repositioned.

Possibly one of the most significant advantages of intra-procedural TEE is in the assessment of PVL. There is strong evidence that residual moderate or severe PVL is associated with a higher late mortality. More recently, it has been suggested that even mild PVL may be a relevant predictor of late mortality, although this association is still controversial.[4] It is likely that some patients may not tolerate even mild degrees of PVL based on their underlying disease, pure aortic stenosis with a hypertrophied left ventricle and a small, non-compliant ventricular cavity compared with patients with mixed aortic stenosis and regurgitation[5] (Figure 2). As TAVR is adopted for treatment of aortic stenosis in intermediate-risk and possibly low-risk patients in the future, a low threshold for complications and a high threshold for long term effectiveness will be expected. Post-implantation PVL can be

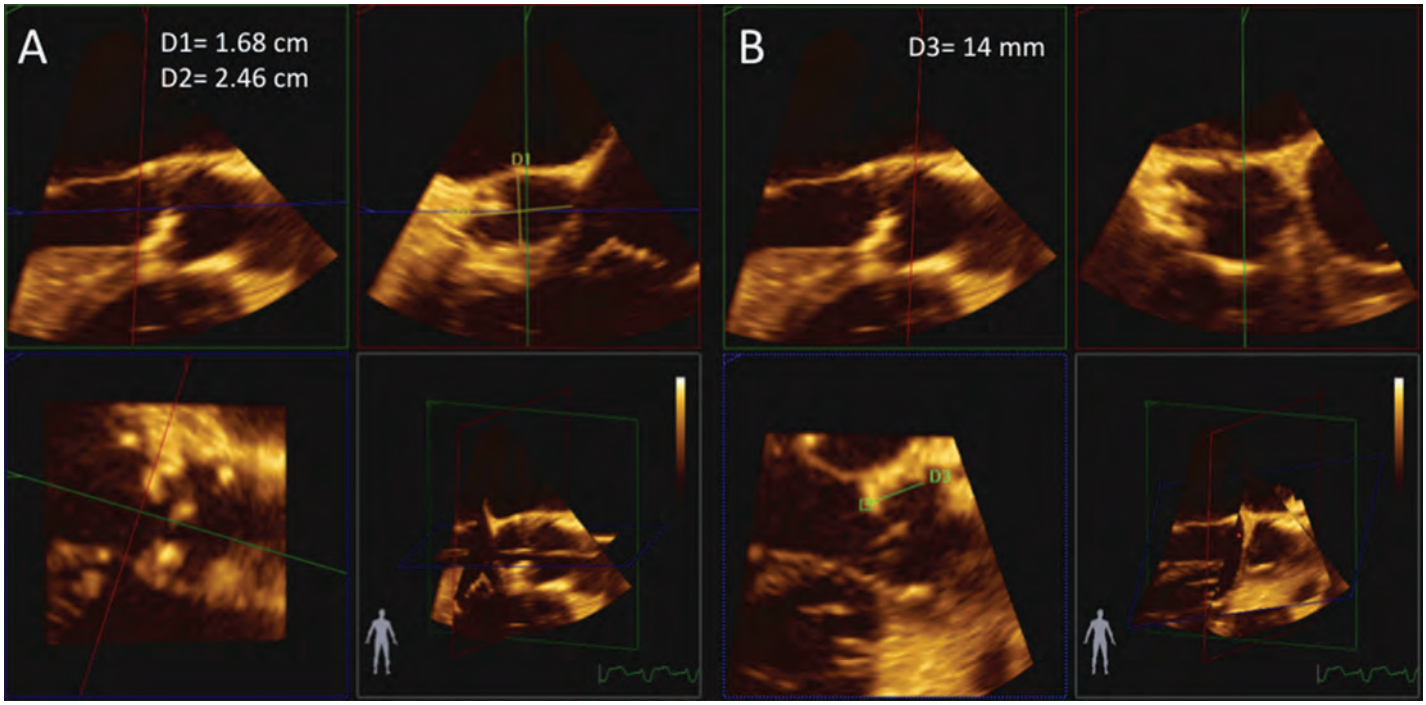

Figure 1 - Postprocessing by multiplanar reconstruction of a 3D dataset of the aortic root. Panel A. Measurements performed in the cross sectional plane at the level of the aortic annulus demonstrate an eccentric annulus, with a maximal (D2) and minimal diameter (D1). Panel B. While measurement of the distance from the aortic annulus to the origin of the right coronary artery can be performed by 2D imaging, the height of the origin of the left coronary artery (D3) can be measured only in the coronal plane by multiplanar reconstruction.

evaluated by cine-angiography, hemodynamic assessment, or echocardiography. However, each technique has its own limitations and pitfalls.[6] There are multiple limitations to evaluating PVL by TEE: acoustic shadowing, multiple, possibly eccentric jets with vena contracta at different levels and outside of the imaging plane, and the need to integrate multiple 2D, 3D, color, and Doppler parameters. Even taking into account all these limitations, TEE offers advantages when compared with other imaging modalities: it can differentiate between intra- and paravalvular regurgitation, provides safe, continuous information on the number, location, extent, and direction of the PVL jets, and can evaluate the result of additional treatment of PVL without the added risk of contrast load.

THE CHOICE OF ANESTHETIC

There are two factors when considering the choice of anesthetic for a TAVR procedure – the value of general anesthesia compared to local anesthesia with mild sedation, and quality of echocardiographic imaging with either technique.[7, 8] While TEE is a desirable and valuable imaging modality, it is usually performed under general anesthesia, which requires additional healthcare resources. In an environment where cost of care is under increasing scrutiny, techniques with lower resource utilization may be more valuable. There has consequently been a recent shift in several institutions, notably in European centers, towards performing TAVR procedures under local anesthesia and conscious sedation, with transthoracic imaging following valve deployment. While high-volume TAVR programs with an extensive accrued experience obtain good results without employing general anesthesia and intra-procedural TEE, sites with lower volumes, less experience, or just starting may benefit from the continuous intra-procedural guidance and post-implantation evaluation offered by TEE. In a recent multi-center registry analysis, intraprocedural TEE was found to offer protective effects against overall and late mortality, reducing the risk of death by 43% and 53%, respectively.[9] However, it is important to consider that as with any imaging modality, intra-procedural TEE is operator dependent. Providing good quality, accurate information requires diligence in performing best quality comprehensive imaging and intimate knowledge of the latest 3D imaging and post-processing technology. Although TEE can be performed under conscious sedation, the patient's discomfort and increased risk of aspiration may make this alternative undesirable. Moreover, modern anesthesia techniques and short acting anesthetic drugs make administration of general anesthesia safe even in the high acuity patient population undergoing TAVR. Some studies have examined the safety and efficacy of TAVR procedures performed under general anesthesia versus local anesthesia and mild sedation.[10, 11] While there is general agreement that there is insignificant difference in outcomes with either technique, an important cost reduction with improved mobility has been noted with the minimally invasive technique. It is reasonable, therefore, to expect that high-volume institutions will increasingly consider techniques that help limit costs while maintaining quality of imaging for TAVR.

SUMMARY

The rapid progress in the interventional management of structural heart disease has seen a parallel evolution of the role of the intra-procedural echocardiographer. The anesthesiologists play an important role in the hemodynamic management of patients during the procedure and are an integral part of the SHD team. They also play a major role in evaluating the success of the procedure with TEE and interpreting the results in the context of the anesthetic and hemodynamics. However, given the higher resource use with general anesthesia and TEE, the feasibility of less expensive, yet equally effective sedation and imaging techniques is being explored. Although TEE has distinct advantages, its benefit must be evaluated in the context of overall quality and cost of care delivered. The perspective of the anesthesiologist, therefore, continues to evolve.

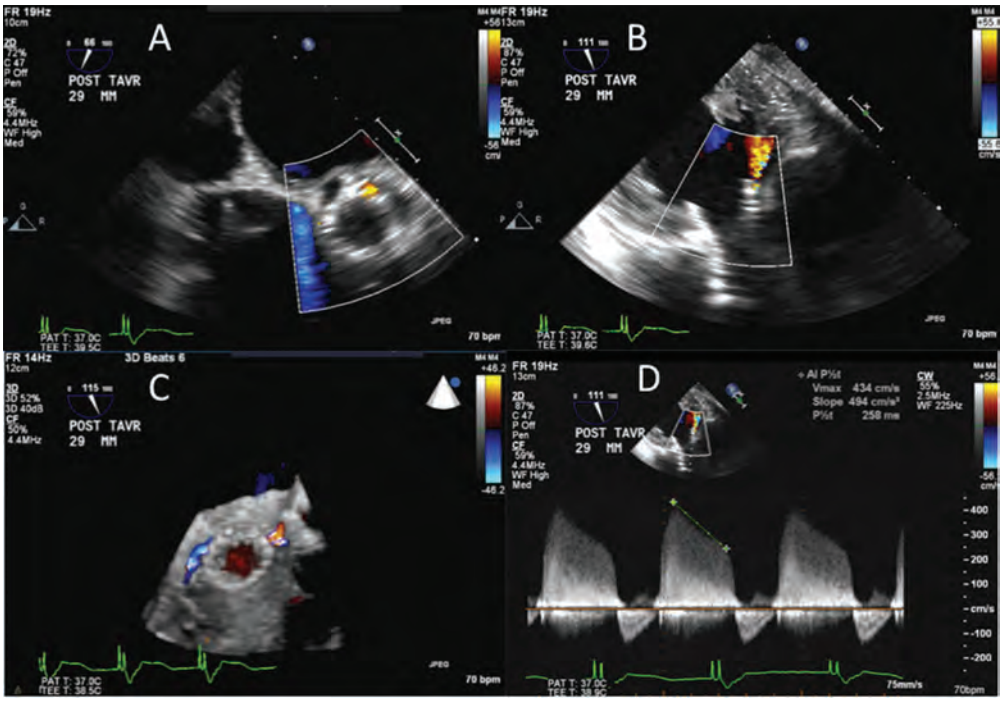

Figure 2: Paravalvular leak (PVL) assessment by 2D, 3D and Doppler measurements. While the PVL is assessed as mild by 2D and 3D measurements (panels A, B and C), Doppler measurement shows a pressure half-time of 258. ms, consistent with a moderate-to-severe PVL.

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A GLANCE TO THE PAST OF ECHOCARDIOGRAPHY –

The People Behind the Names

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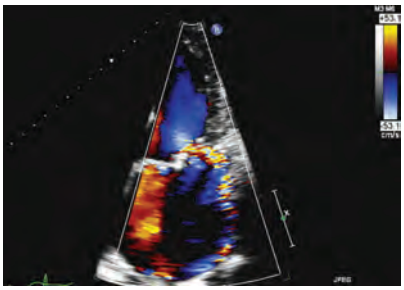
There are many well-known terms in the field of echocardiography that we use in the day-to-day activities in the echo lab. For example, color and spectral Doppler, Simpson's method for estimating ejection fraction, Bernoulli's equation for estimating pressure gradients, Coandă effect for the wall-hugging regurgitant jets, and more. Surprisingly, many students and practitioners of echocardiography do not know the people behind these names and the colorful history behind them. Here is a little glance to the past to learn where these terms come from, and to shed some light on these important pioneers and how they have contributed to our everyday life. To find out who these scientific heroes are, read on, and you will realize why you have to capitalize Doppler, Simpson's, etc. in the echo reports.

Doppler method is a special part of the ultrasound examination that assesses blood flow both in direction and velocity. During the Doppler examination, the ultrasound beams will evaluate the flow of blood as it makes its way though and out of the heart. This information is presented visually on the monitor (as color images or grayscale tracings and also as a series of audible signals). **Christian Andreas Doppler** (29 November 1803 - 17 March 1853), was an Austrian mathematician and physicist. At the age of 38, Doppler presented his most famous brilliant idea to the Royal Bohemian Society and subsequently published his most notable work, "Über das farbige Licht der Doppelsterne und einiger anderer Gestirne des Himmels" (On the colored light of the binary stars and some other stars of the heavens). In this work, Doppler postulated his principle (later coined the Doppler effect) that the observed frequency of a wave depends on the relative speed of the source and the observer, and he tried to use this concept for explaining the color of binary stars. The minutes of the meeting reported on Doppler's lecture: *"Mr. Doppler talked about a wonderful phenomenon of the colored light of the double stars and some other stars in the heavens. He sought the explanation of this striking phenomenon in formulating a new general theory, which included in itself as an integral part the theory of Bradley."*[1]

Doppler was appointed head of the Institute for Experimental Physics at the University of Vienna in 1850. During his time there, Doppler, along with Franz Unger, played an influential role in the development of young Gregor Mendel, known as the founding father of genetics, who was a student at the University of Vienna from 1851 to 1853. Doppler died at age 49 from a pulmonary disease in Venice.

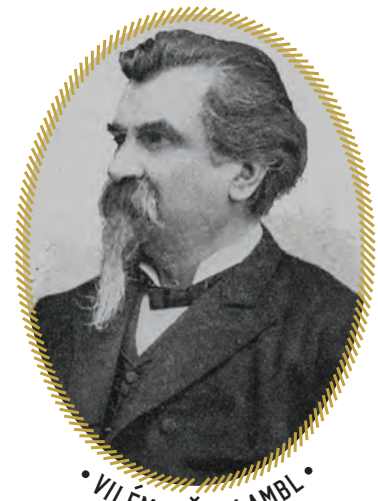
• HENRI MARIE COANDĂ •

It is interesting how a physical phenomenon described 70 years ago has found its clear demonstration and real time visualization on color Doppler flow mapping. **Coandă effect** influences jet size and color encoding, determining (for eccentric jets) smaller color Doppler jet areas, greater variance, and reverse velocity encoding. The phenomenon may alter the interpretation of color Doppler images and needs to be taken into account for an appropriate echocardiography assessment of valvular regurgitation and other abnormal flows.[3] **Henri Marie Coandă** (7 June 1886 - 25 November 1972), was a Romanian inventor, aerodynamics pioneer, and builder of an experimental aircraft, the *Coandă-1910* which was constructed on the principle of air-reactive propulsion described in the mid-1950s as the world's first jet. He invented a great number of devices, designed a "flying saucer," and discovered the Coandă effect of fluid dynamics which is the tendency of a fluid jet to stay attached to a convex surface. The Coandă effect accounts for the separate streams of blood in the fetal right atrium. It also explains why eccentric mitral regurgitation jets are attracted and dispersed along adjacent left atrial wall surfaces (so called "wall-hugging jets" as seen on echocardiographic color Doppler interrogation). This is clinically relevant because the visual area (and thus severity) of these eccentric wall-hugging jets is often underestimated compared to the more readily apparent central jets. In these cases, volumetric methods such as the proximal isovelocity surface area (PISA) method are preferred to quantify the severity of mitral regurgitation. Coandă won many honors and awards: UNESCO Award for Scientific Research, The Medal of French Aeronautics, Order of Merit, Commander ring, and Award and Grand Gold Medal "Vielles Tiges." Bucharest's *Henri Coandă International Airport* is named after him.[4]



• HANS CHIARI •

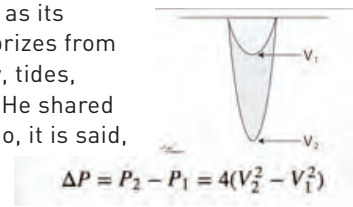
Chiari network is a filamentous structure seen in the right atrium, an embryological remnant of one of the valves of sinus venosus. This embryonic remnant has no known purpose and is not pathological. Although the Chiari network has no clinical significance, it must be distinguished from other pathological masses in the right atrium including thrombus, vegetation, and myxoma. It appears to be a web-like structure with a variable number of thread-like components. **Hans Chiari** (4 September 1851 - 6 May 1916) was an Austrian pathologist. He studied medicine in Vienna, and received his habilitation in pathological anatomy in 1878. Within a few years, Chiari became an associate professor at the University of Prague. In the 1890s he described a condition involving deformities of the cerebellum and brainstem in children with herniation of the spinal cord. The phenomenon was later to become known as the *"Arnold-Chiari malformation,"* named after Chiari and German pathologist Julius Arnold (1835–1915). Another medical term named after Chiari is the *"Budd-Chiari syndrome,"* which was named in conjunction with British physician George Budd (1808–1882). Lastly, Chiari is also famous for describing the *"Chiari network,"* an embryonic remnant found in the right atrium, first published in 1897.[7]



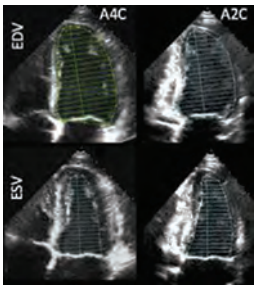
• VILÉM DUŠAN LAMBL •

Lambl's excrescences are filiform fronds that occur at sites of valve closure. They originate as small thrombi on endocardial surfaces (where the valve margins contact) and have the potential to embolize to distant organs. They appear to be wear-and-tear lesions that originate in the endothelium of the contact margins of a valve, commonly the aortic valve.[8] **Vilém Dušan Lambl** (5 December 1824 - 12 February 1895) was a Czech physician from Letina, Kreis Pilsen, Bohemia. He discovered small fibrin deposits on the aortic valve, which later were named Lambl's excrescences. He is also remembered for his description of an intestinal protozoan parasite which causes gastroenteritis; he called the protozoan *Cercomonas Intestinalis*. In 1888, the name was changed to *Lamblia intestinalis*. In 1915 the species was renamed to *Giardia lamblia* in honour of Lambl and French biologist **Alfred Mathieu Giard**. Today the illness caused by the parasite is called either *"lambliasis"* or *"giardiasis."*[9]

Spectral Doppler provides information about the velocity of blood flow over time. Therefore, it permits measurement of maximal and mean velocity. In our day-to-day practice we use the modified Bernoulli equation $4V^2$ to assess the maximal instantaneous gradients. This clinical equation has been derived from the more complex Bernoulli equation by assuming that viscous losses and acceleration effects are negligible and by using an approximation for the constant that relates to the mass density of blood, a conversion factor for measurement units. The physical principle was first described by **Daniel Bernoulli** (8 February 1700 - 17 March 1782), the most distinguished of the second generation of the Bernoulli family of Swiss mathematicians. In 1723–24 he wrote *Exercitationes Quaedam Mathematicae* on differential equations and the physics of flowing water, which won him a position at the influential Academy of Sciences in St. Petersburg, Russia. He lectured there until 1732 on medicine, mechanics, and physics, and he researched the properties of vibrating and rotating bodies and contributed to probability theory. Daniel's reputation was established in 1738 with *Hydrodynamica*, in which he considered the properties of basic importance in fluid flow, particularly pressure, density, and velocity. He put forward what is called "Bernoulli's principle," which states that the pressure in a fluid decreases as its velocity increases. Between 1725 and 1749 Bernoulli won 10 prizes from the Paris Academy of Sciences for work on astronomy, gravity, tides, magnetism, ocean currents, and the behavior of ships at sea. He shared the 1735 prize for work on planetary orbits with his father, who, it is said, threw him out of the house for thus obtaining a prize he felt should be his alone.[2]



The most commonly used 2D measurement for volume measurements is the biplane method of disks (modified **Simpson's Rule**). The principle underlying this method is that the total LV volume is calculated from the summation of a stack of elliptical disks. It is an integral part of left ventricular size and function assessment as recommended by the American Society of Echocardiography.[5] **Thomas Simpson** (20 August 1710 - 14 May 1761), was a British mathematician, inventor, and eponym of Simpson's Rule to approximate definite integrals. He discovered a method for numerical integration, the numerical approximation of definite integrals. At the age of 19, he married a 50-year old widow with two children. He taught himself mathematics and from 1743, he taught mathematics at the Royal Military Academy, Woolwich. Simpson was a fellow of the Royal Society. In 1758, he was elected a foreign member of the Royal Swedish Academy of Sciences. The method commonly called Simpson's Rule was known and used earlier by Bonaventura Cavalieri - a student of Galileo in 1639, and later by James Gregory. The long popularity of Simpson's textbooks invites this association with his name, in that many readers would have learned it from them. Simpson died in Market Bosworth in Leicestershire, England, where a plaque inside the church commemorates him.[6]



The aortic valve has three sinuses which provide space behind the open aortic leaflets, so the coronary artery orifices are not occluded by the aortic valve cusps. **Antonio Maria Valsalva** (17 January 1666 - 2 February 1723), was an Italian anatomist who described **the aortic sinuses of Valsalva** in his writings, published posthumously in 1740. His research focused on the anatomy of the ears, and he coined the term Eustachian tube. Anatomical structures bearing his name are *Valsalva's muscle* - one of the auricular muscles occurring as a band of vertical muscular fibers on the outer surface of the tragus of the auricle, and *taeniae Valsalvae* - a collection of three longitudinal muscular fibers in the large intestine. In 1705, he was appointed professor of anatomy at Bologna. He was later chosen as president of the Academy of the Sciences. Valsalva was an extremely skilled anatomist and pathologist, a fine physician, and an excellent surgeon for a quarter-century in the Bolognese hospitals. As a surgeon he anticipated the importance of nephrectomy, and did work in ophthalmology and rhinology surgery. He is particularly remembered for his handling of aneurysms. He also invented surgical instruments that were of great use. As he lost his health, he lost his sense of smell, but he recognized the prodromal symptoms, in the form of dyslalia, of the disease that would eventually cause his death from stroke at Bologna.[10]

Eustachian valve is called the valve of the inferior vena cava; it lies at the junction of the inferior vena cava and right atrium. **Bartolomeo Eustachi** (1500 or 1514 - 27 August 1574), was an Italian anatomist also known by his Latin name of **Eustachius**. He acquired such an excellent knowledge of Greek, Hebrew, and Arabic that he was able to edit an edition of the Hippocratic glossary of Erotian (1566) and is said to have made his own translations of Avicenna (Ibn Sïnã) from the Arabic. He appears to have studied medicine at the Archiginnsio della Sapenza (Philosophical Institute) in Rome, but it is not known precisely when. He began to practice medicine in his native land about 1540. Eustachius was one of the founders of the science of human anatomy. He was the first to describe *valvula venae cavae inferioris*, which was later changed to eustachian valve - a venous valve that lies at the junction of the inferior vena cava and right atrium. He also is the first who described the anatomy of the inner ear extensively and named the eustachian tube after him. He also described internal and anterior muscles of the malleus and the stapedius, and the complicated figure of the cochlea. He is the first who studied accurately the anatomy of the teeth, and the phenomena of the first and second dentition. Eustachius also discovered the adrenal glands (reported in 1563).[11]

Aliasing occurs with pulsed ultrasound and is most commonly encountered with color Doppler or pulse wave spectral Doppler. With pulsed ultrasound, there is an upper limit of the Doppler shift which can be displayed. **This is known as the Nyquist limit**. **Harry Nyquist**, (7 February 1889 - 4 April 1976), was a Swedish-born American electronic engineer who made important contributions to communication theory. He entered the University of North Dakota in 1912 and received B.S. and M.S. degrees in electrical engineering in 1914 and 1915, respectively. He received a Ph.D. in physics at Yale University in 1917. He worked at AT&T's Department of Development and Research from 1917 to 1934, and continued when it became Bell Telephone Laboratories that year, until his retirement in 1954. Nyquist received the IRE Medal of Honor in 1960 for "fundamental contributions to a quantitative understanding of thermal noise, data transmission, and negative feedback." Nyquist had many contributions in the field of electrical engineering which include: Nyquist limit, Nyquist filter, Nyquist plot, Nyquist rate, Nyquist frequency, and "*Nyquist*" - programming language for sound synthesis. Nyquist lived in Pharr, Texas after his retirement, and died in Harlingen, Texas on April 4, 1976.[12]

Chi-Ming Chow, MDCM, MSc, FRCPC, FASE, and Bandar Al-Amro, MBBS, MD, both share an interest in the history of medicine. Dr. Chow is the director of the Echo lab at St. Michael's Hospital. He is an associate professor in the Department of Medicine, University of Toronto. In his spare time, he likes writing medical apps and photography. Dr. Al-Amro graduated from King Saud University, Riyadh, Saudi Arabia. He just completed his echo fellowship at St. Michael's Hospital and is currently pursuing a multimodality imaging fellowship at the same hospital.

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Benchmarking in an Era of Heightened Awareness

Robin Wiegerink, MNPL, ASE CEO

How do you know if your echo lab is on top of the trends in the industry? The American Society of Echocardiography's (ASE) leadership believes that this kind of information is crucial to put into the hands of our members (you!). If knowledge is "power," then in this era of cost-cutting and economic scrutiny, it is imperative that you know exactly where your lab stands in comparison to the other labs in the country and in your particular region.

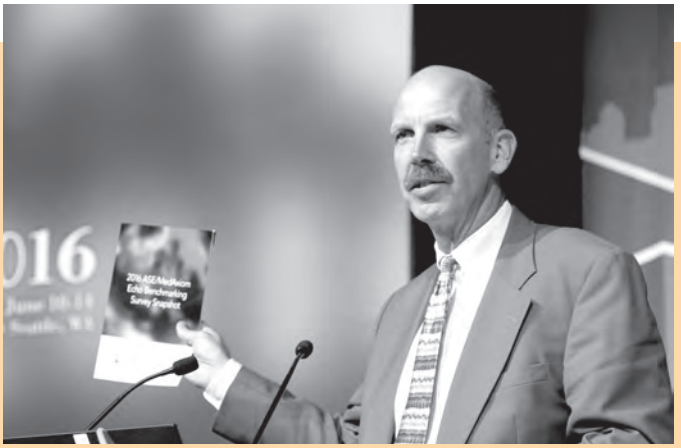
This past spring, ASE worked with MedAxiom to distribute a survey to echocardiography labs spanning across the U.S., encompassing both large and small private practices and hospital systems. By definition, benchmarking is a way of discovering what is the best performance being achieved – whether in a particular company, by a competitor, or by an entirely different industry. This information can then be used to identify gaps in an organization's processes in order to achieve a competitive advantage.

This benchmarking survey is now completed and provides much-needed baseline metrics for the field. It is the only qualitative national survey of echo services to date. By having access to these survey results, we believe ASE members will be able to look at their current processes and identify possible gaps that could be targeted to better compete in the marketplace.

The echo lab survey was robust and included 97 data elements. We were pleased that 301 organizations completed the survey, representing 5,321 echo physicians, 2,930 sonographers, 2,669 echo machines, and 1,068 echo locations. It was well-balanced with relatively equal representation from academic, employed, and independent labs and comprised geographic balance from respondents (approximately one-quarter represented in each U.S. regional area—South, North, West and East). The information collected on the survey was enhanced with the addition of data gleaned from more than two million echoes in MedAxiom's annual database captures. This allowed data to be presented that depicted the trends in echo over the past 10 years (both in-patient and outpatient echoes per practice and per physician have trended downward).

A snaphot summary of 37 key findings from this study was printed and distributed to all 2016 Scientific Sessions attendees. A more expansive version will be released on ASE's member-only area—Connect@ASE—this fall.

The results of the survey show that there is a strong adherence to quality metrics in most echo labs, with 83.7% achieving accreditation. Furthermore, quality, as defined by IAC minimum standards, was reported as being consistently tracked and maintained regardless of size or organizational model. The data also shows that labs are changing to be



Larry Sobal, MBA, Executive Vice President of Business Development for MedAxiom, presented the preliminary results of the echo benchmarking survey at the June 2016 Scientific Sessions.

poised for a value-based future where quality is a requirement for reimbursement. A key quality metric, adherence to using Appropriate Use Criteria (AUC) to triage patient care, was followed with 72% of respondents tracking AUC use by ordering physicians. Another quality metric, patient satisfaction, also has gotten the attention of the labs, with over 66% of the organizations checking for patient satisfaction through their health system standardized satisfaction tool and 34% adding on their own echo labs' internal satisfaction surveys.

Based on the survey results, it also appears organizations are moving to a multidisciplinary approach, focusing on select populations of patients to build "centers" to focus patient care and provide a wide range of specialists working in teams on patients. Over one-third of the organizations responding to the survey have disease management clinics that incorporate an echocardiographic imaging specialist into the care planning. Of those labs adding disease management clinics, structural heart and cardio-oncology services lead the list and hypertrophic cardiomyopathy, congenital, and ventricular assist device clinics also are becoming commonplace.

The findings also depicted systems that have room for improvement. For instance, only 49% of the respondents offered 24/7 sonographer or physician interpretation services, **(Figure 1)** only 27% required readers of abnormal studies to review past abnormal studies for comparison purposes, and only 55% tracked utilization of their equipment in the lab **(Figure 2)**; these measures, if followed, could improve services and patient care. On the flip side, some labs reported going beyond the norm to improve the system; for example, 16.6% of the respondents had their interpreting physicians take the time to field live calls from referring physicians, providing immediate education for appropriate resource use, and 48% of labs report offering same-day interpretation with results to the ordering provider to speed patient care.

“We were pleased that 301 organizations completed the survey, representing 5,321 echo physicians, 2,930 sonographers, 2,669 echo machines, and 1,068 echo locations.”

This survey is broken down into five main sections: Key Demographics, Compelling Findings, Advancements and Future Direction of the Science, Gaps, and Key Findings and Trends. MedAxiom summarized the study saying, “While echo may be the typical and longstanding clinical diagnostic service offering for all cardiovascular organizations today, the art of delivering these services takes on an entirely new look. It is one of rapid access and interpretation, flexible outpatient scheduling, a desire to please the patients, and provide an immediate and accurate clinical service to community-based referring physicians.” ASE will be offering a webinar later this year to focus on learnings from surveyed labs that depicted the highest levels of transformation and to interpret the other data that was not included in the initial snapshot. In the meantime, if you would like to receive a free copy of the benchmarking survey snapshot, contact Lori Smith at lsmith@asecho.org.

FIGURE 1

Does your inpatient Cardiac Imaging (ECHO) Department provide 24/7 Physician interpretation services?

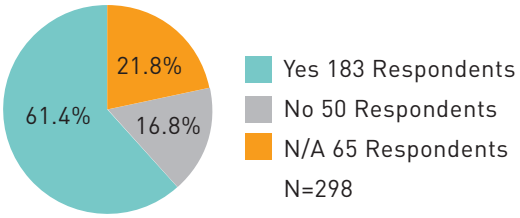
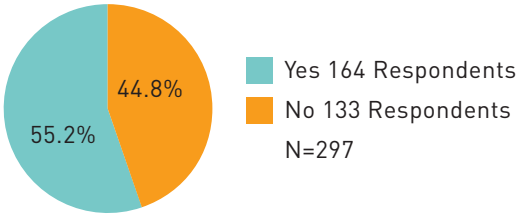


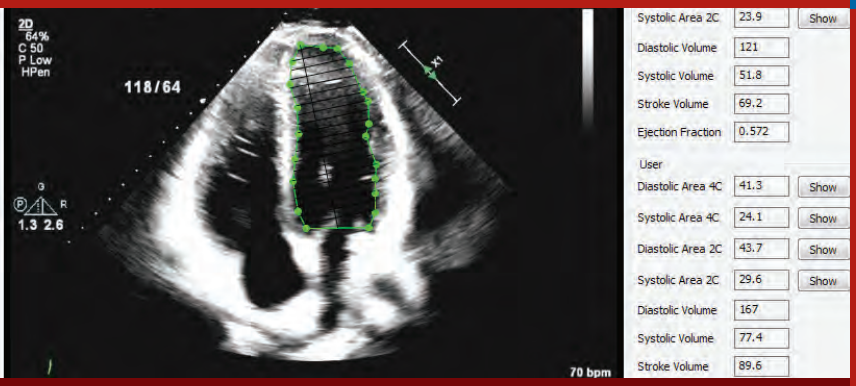
FIGURE 2

Does your inpatient Cardiac Imaging (ECHO) Department track and monitor Echo Equipment Utilization?



Creative Learning; Better Outcomes

This one-of-a-kind tool enhances the skills of sonographers and physicians by teaching consistent measurement and interpretation of cardiac ultrasound images.



“As we move into the era of rewarding value over volume, it becomes increasingly vital that echocardiographic measurements and interpretations must be accurate and reproducible for echocardiography to continue to be cost effective.”

Harvey Feigenbaum, MD, FASE, and Founder of ASE

ASE American Society of Echocardiography

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An Echocardiography Measurement & Interpretation Simulator

Benefits and Features

- Enhances patient care by reducing variability
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- Supports fulfillment of lab accreditation requirements
- Offers a hands-on, real-world training experience without being tied to an imaging devices
- Cloud-based, so users have access anytime and anywhere
- Contains case studies covering multiple areas and new cases are continually added
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ECHOVATION CHALLENGE

A Window into the Future of Cardiovascular Ultrasound

Contributed by
Andie Piddington,
ASE Corporate
Relations Manager

During a phone conversation in 2014, two of ASE's many innovative thinkers, Drs. Steven Lester and Partho Sengupta, were chatting about ideas to enhance ASE's impact on the field of cardiovascular ultrasound and take ASE to the "next level" in coming years. They wondered if ASE could emulate one of the most famous innovation contests in the world, the X Prize, which has helped bring the dream of commercial spaceflight to a near reality, and continues to inspire innovation in multiple fields. Many phone calls, ASE Board meetings, and Innovation Competition Task Force meetings later, the seed of an idea planted that day has blossomed into ASE's Echovation Challenge.

(L to R) Echovation judges Jay Goyal, Larry Sobal, MBA, MHA, CMPE, Larry S. Dean, MD, FACC, MSCAI, Susan E. Wiegers, MD, FASE and Echovation Chair Steven J. Lester, MD, FASE

"When we first started kicking this idea around, we all believed strongly that ASE could play a pivotal role in encouraging collaboration among researchers, industry, and clinicians that could accelerate the evolution of cardiovascular ultrasound, creating better value with impact," commented Dr. Lester, who served as the first Chair of the Innovation Competition Task Force. When ASE developed its new Strategic Plan in 2015, the importance of driving innovation in the field was reaffirmed, and plans for the Echovation Challenge began in earnest.

On June 12, 2016 during ASE's 27th Annual Scientific Sessions in Seattle, after being chosen by a panel of ASE members from over 30 submissions, three teams traveled from across the United States and halfway around the world to share their projects for the inaugural Echovation Challenge 2016. Each team presented their innovation and its potential impact on workflow efficiency to Scientific Sessions attendees and a panel of judges comprised of cardiovascular experts and entrepreneurs, followed by questions and answers that included audience participation.

EchoPlan Team Leader
Mike Singer, PhD

DiA Cardio Team Leader
Hila Goldman-Aslan

TeleHealthRobotics Team Leader
Sarah Doherty

Team EchoPlan emerged as the winner with their submission that combines sophisticated mathematical algorithms with standard 2D and 3D echocardiographic data to improve accuracy in pre-planning for one of the most rapidly growing cardiovascular interventions, Transcatheter Aortic Valve Replacement (TAVR). Team EchoPlan, which hails from California and New York, was awarded the top prize of $3,000 and included Mike Singer, PhD, Mario Garcia, MD, and Ronald Wharton, MD.

"Feedback provided by the judges and audience are invaluable and will help Team EchoPlan develop a more impactful product that benefits patients, physicians, and payers," commented Mike Singer, captain of Team EchoPlan and founder of Stenomics.

Team DiA Cardio took the second place prize of $1,500 for their project which uses fully automated software tools to increase accuracy and speed in the diagnosis of heart disease. Team leader Hila Goldman-Aslan remarked, "Team DiA Cardio was thrilled to be chosen as one of the finalists, and to make the trip from Israel to compete in the finals. There is a lot of innovation happening in Israel, and we were very proud to be able to demonstrate our cutting-edge image processing technology to an American audience of health professionals."

The third place team, TeleHealthRobotics, presented a novel concept to combine telemedicine and robotics for echo guidance of TAVR procedures. Team leader Sarah Doherty noted, "The feedback we got, as well as the subsequent support and opportunities for collaboration we have received, have been tremendous. We greatly appreciated the chance to participate and were honored to receive the prize money of $1,000. It will support our clinical work which aims to demonstrate the feasibility of long-distance, telerobotic ultrasound in the clinic and, to follow, the feasibility of transitioning from TEE to robotic TTE procedure guidance for TAVR in the cath lab."

The other teams or individuals that finished in the top ten overall were:

>> Jennifer Monti, "TEE for modern times"

>> Team Rain City Hearts, "All the better to SEE you with, my dear"

>> Team UTMB / Hitachi Aloka Medical America, "Using LV eFlow to Improve Time and Cost Efficiency in the Echo Lab"

>> Team Architects of Echovation, "Building A+ Reports with Decision Support and QA"

>> Team Go Trojans!, "SmartExam: Answer to Perioperative Provider Prayers"

>> Chad Bousanti, "Echo Invasion"

>> Yue-Hin Loke, MD, "From Holding the Probe to Holding the Heart: A 3D echo protocol to create 3D models of complex congenital heart disease in neonates"

Forward to the Future

With the success of the inaugural competition, ASE's Innovation Competition Task Force is already planning for Echovation Challenge 2017, which will follow a similar structure and timeline. Dr. Sengupta will Chair this year's event, and the Task Force has plans to incorporate mentoring into the process, as well as an even more entertaining live event during the 2017 Scientific Sessions in Baltimore, Maryland. "This first year was a fantastic learning experience for us, and we heard some great ideas from a lot of ASE members on how we can improve both the submission process and the live finals," noted Dr. Sengupta. "Our theme for 2017 will be 'Streamlining Diagnostics for Augmented Medical Decision Making,' which could be any small step in the workflow or in instrumentation, perhaps improvements in hardware or software – whatever accelerates the time to come to a diagnosis, so we can spend more time with patients to personalize a therapy of choice."

To learn more about the Echovation Challenge, please visit our Echovation webpage, **ASEcho.org/Echovation-Challenge**, which includes additional pictures and video of this year's presentations. Echovation Challenge 2017 is slated to launch in September or early October 2016, so keep your eyes open for announcements and submission dates!

education corner

Contributed by Hilary Lamb, MPA, ASE COO

Why is Continuing Medical Education so Important?

The decision to become a healthcare provider requires a large investment of resources, both time and financial. However, the learning doesn't stop once the diplomas have been awarded, the credentials have been earned, and the care begins. Continuing Medical Education (CME) helps practitioners learn and discover ways to improve the patient care they deliver and to effectively manage a career in the ever-changing landscape of the medical industry. The requirements or acceptable level of CME vary across medical disciplines. ASE is widely recognized as the premier source for cardiovascular ultrasound continuing education. In addition to providing CEU credits for local echo societies and echocardiography laboratories, ASE's cardiovascular ultrasound CME regime is unparalleled in the field.

CME provides an avenue for practitioners to:

>> Refine skills to improve overall patient care

>> Stay current with the latest developments within their specialty

>> Address real-world challenges that healthcare professionals face day to day

>> Gain professional growth and a means to advance career status

>> Meet licensing/certification requirements

>> Meet lab accreditation standards

ASE has earned "Accreditation with Commendation" status with the Accreditation Council for Continuing Medical Education (ACCME). This is the highest level of accreditation an organization can earn. The ACCME is committed to ensuring that medical practitioners have access to quality learning opportunities and a solid means to obtain and meet licensing and credentialing requirements. ACCME's accreditation ensures that a CME program meets rigorous high standards of relevance, effectiveness, and independence. ASE works hard to maintain this accreditation while providing members with a variety of avenues to earn CME. Every month ASE offers new CME activities such as on demand webinars, live guideline webinars, DVD's, textbooks, and live courses.

ASE Makes it Easy

Nearly 17,000 members turn to ASE to provide resources that are vital to continued professional development. A large part of professional development is earning CME, MOC, or CEU credits. Your ASE membership currently includes more than 30 free continuing education credits.

Another benefit of being an ASE member is that all credits earned through ASE activities are automatically transferred to the appropriate organizations. Every month ASE transfers the hundreds of credits earned by members to the American Board of Internal Medicine (ABIM), American Board of Pediatrics (ABP), American Registry for Diagnostic Medical Sonography® (ARDMS), and Cardiovascular Credentialing International (CCI). These automatic transfers mean that you have one less piece of documentation to manage when maintaining your certifications and credentials.

More Opportunities for Members

ACCME has formed collaborations with ABIM, ABP, and the American Board of Anesthesiology (ABA). These collaborations aim to simplify the integration of MOC and accredited CME. ASE has reviewed its products and courses and has designated all live courses, seven CME products, and all on demand CME webinars to offer ABIM MOC points. Integration of ABP and ABA MOC will begin in early 2017.

As ACCME continues to add additional collaborations, ASE will manage the process of making sure our members have their credits transferred to these organizations.

How to Claim Your Credits

For each CME activity, ASE requires the participant to fill out an evaluation on ASEUniversity, where all ASE CME/MOC credits are earned. Once the evaluation is complete, the CME certificate is automatically generated, and the member has the option to print or save it. For your convenience, ASE houses your CME transcript with a record of all credits earned on ASEUniversity. If a member needs to reprint their certificate, it is right at their fingertips.

ASE is here to serve all of your CME/MOC needs. If you have ideas of other activities ASE should offer, please reach out to ASE Director of Education Christina LaFuria at clafuria@asecho.org.

>> **BONITA ANDERSON**, *MApplSc, DMU, AMS, FASE, ACS, Prince Charles Hospital, Brisbane, Australia,* and **BARRY CANADAY**, *MS, RN, RDCS, RCS, FASE, Oregon Institute of Technology, Klamath Falls, Oregon,* and **GEORGE KRAMER**, *DVM, UltravetMobile, Bohemia, NY,* each referred five or more people to join ASE in the past year. For this effort, as a part of the Member Referral Program, they earned a free 2017 ASE membership.

>> **MERRI L. BREMER**, *EdD, RN, MCS, RDCS, FASE,* is the new incoming president of the Intersocietal Accreditation Commission Echocardiography.

>> **LINDA GILLAM**, *MD, FASE, Morristown Medical Center, Morristown, NJ and Past President of ASE* has been appointed to the MACRA Episode-Based Resource Use Measures Clinical Committee.

>> **BRANDY HATTENDORF**, *MD, FASE, Children's Hospital Los Angeles, Los Angeles, CA, and member of the ASE Education Committee*, has been selected as an honoree at the 2016 Save a Child's Heart (SaveAChildsHeart.org) gala on November 15, 2016 at the Sony Picture Studios.

>> **AMER JOHRI**, *MD, FASE, Queen's University, Bath, Ontario, Canada, and Vice Chair of the ASE Council Vascular Ultrasound Steering Committee*, was selected to travel to China in August 2016 to share his experience with clinician scientists at the Sun Yat-Sen University in the Guangzhou Higher Education Mega Centre, one of China's top institutions for higher learning.

>> **MICHAEL L. MAIN**, *MD, FASE, Saint Luke's Mid America Heart Institute, Kansas City, MO, and chair of the ASE Advocacy Committee*, was officially appointed to the American Medical Association (AMA) CPT Advisory Committee as the primary Advisor representing ASE. This appointment gives the cardiovascular imaging field a strong voice when echocardiography CPT codes are edited, introduced, or reviewed.

>> **SUNIL V. MANKAD**, *MD, FASE, Mayo Clinic, Rochester, MN,* received the ASE Richard Popp Excellence in Teaching Award.

>> **LAWRENCE MCELROY**, *RDCS, FASE, former director of echocardiography at Arkansas Heart Hospital, Little Rock, AR,* received the Contemporaries Award of $250 for his large oil on canvas, Portrait of Gabriel Sword, at the 58th annual Delta Exhibition.

>> **MARYELLEN H. ORSINELLI**, *RN, RDCS, FASE, The Ohio State University Medical Center, Columbus, OH,* received the ASE Cardiovascular Sonographer Distinguished Teacher Award.

>> **JUAN CARLOS PLANA**, *MD, FASE, Baylor College of Medicine, Houston, TX, and co-chair of the ASE Education Committee,* received the Gold Medal - Inge Edler, at the gala of the Spanish Society of Cardiac Imaging for his contribution to the field of oncology echocardiography.

>> **RICHARD L. POPP**, *MD, FASE, Stanford University Medical Center, Palo Alto, CA and Past President of ASE* received the European Society of Cardiology Gold Medal honoring his work in echocardiography. It is very unusual for an American to receive this award.

>> **VERA RIGOLIN**, *MD, FASE, Northwestern University, Chicago, IL, and ASE President Elect*, was invited to give the prestigious Navin C. Nanda Oration during Echo India 2016.

>> **L. LEONARDO RODRIGUEZ**, *MD, FASE, Cleveland Clinic, Cleveland, OH* was selected as a founding co-editor of *CASE*, ASE's new open access cardiovascular imaging case reports journal. *CASE* will publish its first issue in early 2017 (CVCaseJournal.com).

>> **PARTHO SENGUPTA**, *MD, FASE, Mount Sinai Medical Center, New York, NY,* has been selected to present a talk at TEDMED 2016 that will take place in Palm Springs, CA and is simulcast throughout the world.

>> **STANTON K. SHERNAN**, *MD, FASE, Brigham and Women's Hospital, Boston, MA,* received the ASE Outstanding Achievement in Perioperative Echocardiography Award.

>> **MARTIN G. ST. JOHN SUTTON**, *MBBS, FASE, Hospital of the University of Pennsylvania, Philadelphia, PA,* received the ASE Physician Lifetime Achievement Award.

>> **LLOYD Y. TANI**, *MD, FASE, University of Utah Healthcare, Salt Lake City, UT,* received the ASE Excellence in Teaching in Pediatrics Award.

>> **DAVID H. WIENER**, *MD, FASE, Thomas Jefferson University, Philadelphia, PA* received the ASE Meritorious Service Award.

>> **KAREN G. ZIMMERMAN**, *BS, ACS, RDCS, RVT, FASE, Webber Heart Center, Munson Healthcare, Traverse City, MI* was selected as a founding co-editor of *CASE*, ASE's new open access cardiovascular imaging case reports journal. *CASE* will publish its first issue in early 2017 (CVCaseJournal.com).

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ASE'S MISSION

ASE is committed to excellence in cardiovascular ultrasound and its application to patient care through education, advocacy, research, innovation, and service to our members and the public.