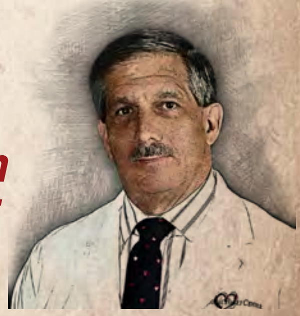
ECHO

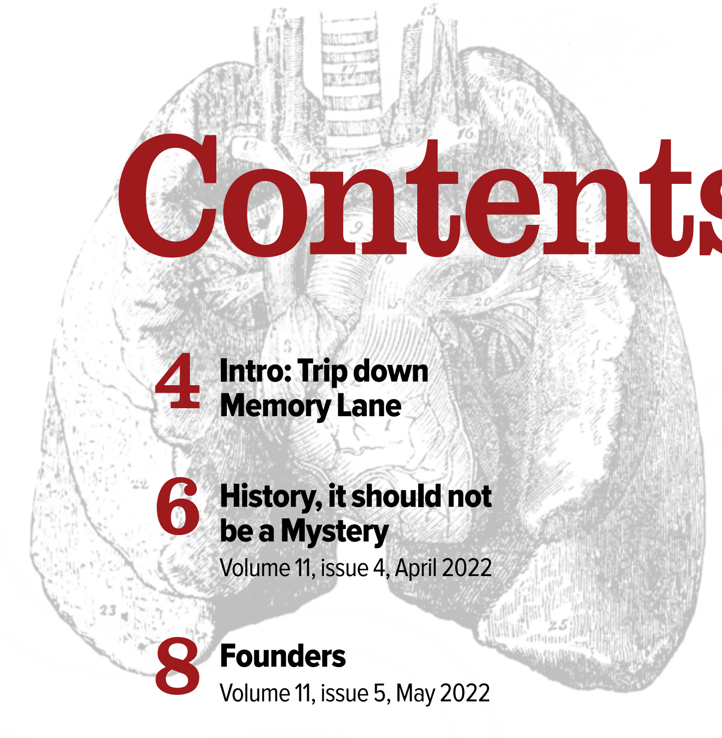
Special History Issue

LOOKING BACK AS WE CELEBRATE ASE'S 50th YEAR

A Compilation of History Articles about ASE from ECHO *Magazine by Alan S. Pearlman, MD, FASE*



SPECIAL HISTORY ISSUE/JULY 2025



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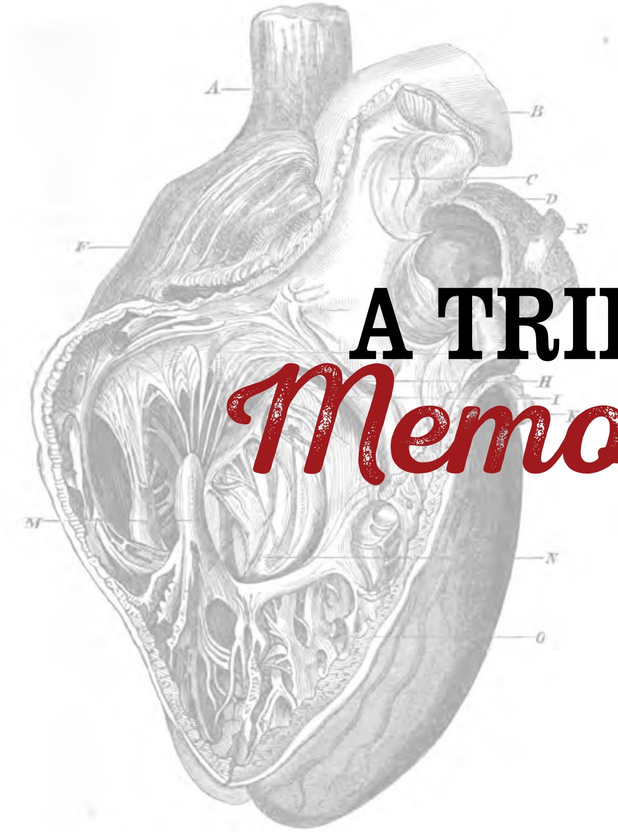
EDITORS' NOTE

In this special history issue, we bring together articles that were previously published in ECHO magazine. Thank you to Alan S. Pearlman, MD, FASE, who wrote all the original articles between 2022 and 2024. We hope you enjoy reading this special issue.

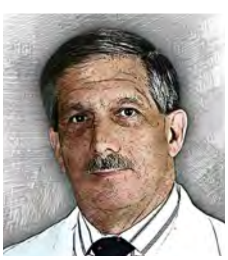


A TRIP DOWN *Memory Lane*

In the annals of echocardiography, the year 2025 is noteworthy. It marks the 50th Anniversary of the founding of the American Society of Echocardiography (ASE) and has not only generated heightened interest in the evolution of ASE but also led ASE members – and other clinicians who depend upon echocardiographic findings to care for their patients – to reflect upon the remarkable changes in the field of cardiovascular ultrasound that have happened within our lifetimes.

This compilation contains over a dozen history-oriented articles that I wrote for ASE's *ECHO* magazine in the past several years. The articles speak for themselves; however, a few introductory words may provide some background.

During his term as ASE's 32nd President (2021-2022), Raymond Stainback MD, FASE, suggested that "the historical aspects of ASE" ought to be honored and encouraged me to write a series of such articles for publication in *ECHO* magazine. I believe that the impetus for this project had to do in part with the reality that many current ASE members think of cardiovascular ultrasound as a widely respected diagnostic technique. Some may be too young to remember that when echocardiography was introduced as a clinical technique, it was met with considerable skepticism. The pioneers in the field



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

believed – quite strongly – that echocardiographic findings helped them to take better care of their patients. I believe that Dr. Stainback thought that younger ASE members would be interested in how the discipline of echocardiography has evolved; in effect, "how we got to where we are today." The co-editors of *ECHO* magazine at the time, Meryl Cohen MD, FASE, and Ben Eidem MD, FASE, agreed that this was a worthwhile endeavor.

Between March 2022 and April 2024, I wrote a total of 13 history-oriented articles; all of them are now conveniently packaged in this compilation. My intent was not to discuss in detail the "chronology of echocardiology," but rather to focus on some topics that I found noteworthy. I am not a trained historian. As some may know, I majored in English Literature in college and took a lot of required pre-med science classes. Squeezing history courses into my schedule was not an option. My chief qualifications for the "history" project probably reflect that I've been around for a long time (I joined the ASE in the late 1970s) and that I enjoy writing. The articles in this compilation are not organized chronologically; instead, they discuss topics that I thought were relevant to the evolution of echocardiography. The articles do not focus on the history of the ASE, although there is some unavoidable overlap. I hope that newer members of the echo community find them interesting, and that long-time members enjoy reminiscing.

The second and third articles in this compilation were written to highlight the 2022 ASE Scientific Sessions, the first such ASE meeting held "in person" following the COVID-19 pandemic. The next four articles focus on the profession of cardiovascular sonography, from the early pioneers to the development of training programs and methods to enhance the quality of training, to some current challenges such as the emphasis on "throughput," the risks of work-related musculoskeletal disorders, and the potential upsides of artificial intelligence. Since, from the early days, the pioneers recognized that echocardiographic quality was optimal when sonographers and physicians worked as partners, I thought that an early focus on cardiovascular sonography was particularly fitting.

The remaining articles discuss a mixture of noteworthy topics, including pediatric echocardiography, perioperative echocardiography, the National Board of Echocardiography, the history of ASE's professional staff, and some interesting facts about Doppler echocardiography. But rather than reading about them, I hope you'll just read them!

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HISTORY, *it should not be a* MYSTERY

Much has been written about the importance of History. In the 18th century, Irish Statesman Edmund Burke is purported to have said "Those who don't know history are destined to repeat it." In his book The Life of Reason, published in the early years of the 20th century, the philosopher George Santayana (who was born in Spain but spent much of his life in the U.S.), wrote "Those who cannot remember the past are condemned to repeat it." In a 1948 speech to the House of Commons, Sir Winston Churchill paraphrased Santayana, noting that "Those who fail to learn from history are doomed to repeat it."

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

I am not a trained historian; my interest in history stems mostly from the reality that I've celebrated a large number of birthdays. Nevertheless, I am struck that those who do not know history might have a fuzzy understanding of how we got to this point, and an overly narrow view of where we may be headed.

Hence, I was delighted to learn that current ASE leaders were quite interested in looking back in order to look forward. I would note that ASE was founded in 1975, and the first leaders of the Society were in their 40s, and the membership numbered in the hundreds. As the years have gone by, ASE has grown substantially, and many of our newer members are currently in their 20s, 30s, and 40s. However, our founders are now in their 80s, and I suspect that while some of our younger members have heard their names, they don't know very much about the people who founded ASE, or why it made sense to do so, or what our field of echocardiography was like in the "early days." I was not present in Indianapolis in the fall of 1975 when the American Society of Echocardiography was founded (I was living

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in Lyon, France in the midst of a research fellowship), but I remember seeing my first echocardiogram in 1971 and recall that at that time echocardiographic findings were of little practical interest and viewed by many with skepticism. The times have changed dramatically; echocardiography is now the most widely used cardiac imaging modality and used routinely to help manage patient care.

Current ASE President Ray Stainback, MD, FASE, had some excellent suggestions for "a process honoring the historical aspects of ASE." He and other ASE leaders noted that the expansion of ASE's ECHO magazine to a monthly format would provide the means to disseminate a series of articles focusing on this topic. The co-editors of ECHO magazine, Meryl Cohen MD, FASE, and Ben Eidem MD, FASE, were equally enthusiastic and asked me to help with this project.

I suspect that as we gain some experience in preparing a series of articles about relevant developments in our field and our organization, this project will evolve over time. As I've thought about it, some articles might focus on specific leaders and the issues they faced during their terms of service. However, we might also choose to focus on more general topics (for example, how and why the first ASE Councils were founded and who played a major role in their evolution, or the ways in which the field of echocardiography has evolved over nearly 70 years). As noted earlier, a clearer understanding of how we got here may help us continue to evolve in ways that benefit our profession, our organization, and – most importantly – our patients.

So, with that background, this is the first in a series of articles that address historical aspects that should be of interest to ASE members, and to those who are not yet members – but ought to be. Over time, I hope to include some photographs and the results of interviews (and – perhaps – video recordings of those interviews so that interested members not only can read about the details, but also can see the principals and hear their voices). As we learn how best to do this, we will see how the project evolves.

We may not be able to cover every area of potential interest but would be delighted to hear from members who might want to learn more about specific topics. Email us at dmeyer@asecho.org. We would give these ideas our careful consideration, and would try to address them when feasible.

Stay tuned.

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Founders

During the 2022 ASE Scientific Sessions, the ASE Foundation will hold its 13th annual Research Awards Gala. At this event, ASE will honor two luminaries: Dr. Harvey Feigenbaum and Dr. Liv Hatle. ASE's current leaders selected these two luminaries as notable physician-investigators who have played major roles in the evolution of echocardiography as a clinical discipline. Most long-term members of ASE will be familiar with their names and career accomplishments, but since ASE's founding in 1975, our organization has grown considerably in size, scope, and diversity. Accordingly, some of our newer members, and those whose primary clinical activities do not focus on general cardiology in adults, might not be familiar with the important contributions that Drs. Feigenbaum and Hatle have made to our field.

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

It would be easy – and accurate – to state that Drs. Feigenbaum and Hatle are certainly among the founders of clinical echocardiography. Before discussing some of their key contributions, let's consider the meaning of the term "founder." When used as a noun, a *founder* of an organization is a person who brings that organization into being; he or she has a passion for establishing that organization, getting it off the ground, and helping it to succeed. It may be easy (at least, if you live in Seattle) to identify Bill Gates and Paul Allen as the founders of Microsoft, and Jeff Bezos as the founder of Amazon, but I believe that identifying the "founders" of the discipline of echocardiography is a bit more difficult. It's also worth remembering that, when used as a verb, the word "*founder*" describes what happens when a ship fills with water and sinks! Hence, I would not want to imply that Drs. Feigenbaum and Hatle were the only "founders" of echocardiography, since such an assertion would cause this brief article to founder. Nevertheless, I would argue – vigorously – that Drs. Feigenbaum and Hatle

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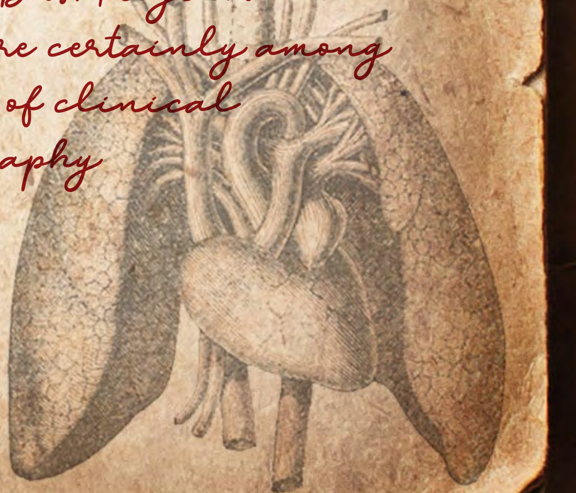

have made many key contributions to the evolution of echocardiography, and it is quite fitting and proper to honor their important accomplishments. I would also acknowledge that since 1953, when Edler and Hertz first described the use of ultrasound to examine the human heart, many others have played important roles in the remarkable advances in echocardiographic technology, techniques, and applications that have made echocardiography the extraordinarily powerful diagnostic method that it is today. My failure to mention the many others who have made important contributions to our field is not intended to minimize – or to overlook – their achievements.

Harvey Feigenbaum, MD, FASE

Dr. Feigenbaum has been a lifelong Hoosier. He was born in East Chicago, Indiana, and received his AB and MD degrees (with honors) at Indiana University (IU). After a medical internship in Philadelphia, he returned to Indianapolis for residency training and joined the faculty at IU, in 1962, as an instructor in the department of medicine. He is currently a Distinguished Professor of Medicine at IU and a member of the Krannert Institute of Cardiology. He told me once that since he does not play golf, he prefers to continue working, writing, and teaching.

Dr. Feigenbaum is the founder of ASE, its first President, the founding editor of the *Journal of the American Society of Echocardiography* (JASE), and the recipient of far too many awards to list individually. Others have often referred to Dr. Feigenbaum as the "Father of Echocardiography," but he is always quick to point out that he was not the first person to use echocardiography, and not even the first American to use echocardiography. Rather, he considers the term "Father of Echocardiography" to reflect his influence on his many "professional offspring" and the large group of colleagues who learned echocardiography from him. It is fair to acknowledge that

Others have often referred to Dr. Feigenbaum as the "Father of Echocardiography"

Dr. Feigenbaum has taught all of ASE's leaders through visits to his laboratory in Indianapolis, and through his books, publications, and lectures. He has always been quick to note that he does not consider himself an "imager," but rather a clinical cardiologist who discovered that echocardiography helped him take better care of his patients.

During the more than 50 years that he has been at the forefront of clinical echocardiography, Dr. Feigenbaum has made more contributions than can be described in this short article. He and his colleagues were the first to use echocardiography (initially using A-mode, and later M-mode) to evaluate for pericardial effusion, to identify the septal and posterior left ventricular (LV) walls and to measure wall thickness, to describe and validate techniques for evaluating LV size and function quantitatively, and to examine regional wall motion in patients with known or suspected coronary disease. He and his colleagues were also among the first to use 2-dimensional (2D) echocardiography to examine LV size and function, to image the coronary orifices, and to study the pulmonic valve. They also championed the

I believe it fair to say that if it were not for Dr. Feigenbaum, there might be no ASE and no JASE, and many of us would have had very different professional careers.

use of echocardiography at rest and with stress as a practical means to identify inducible wall abnormalities as an indicator of significant coronary artery narrowings. In addition to his interest in using echocardiographic methods for a variety of clinical applications, he highlighted the value of novel methods for recording echocardiographic data, such as the use of strip chart recorders for M-mode findings, and video tape recorders for real-time 2D data. Dr. Feigenbaum was an early, vocal, and effective proponent for digital echocardiography, which not only facilitated side-by-side comparison of images at rest and with stress, but also allowed echocardiographers to store, view, and study tomographic and volumetric images, and Doppler velocity profiles, conveniently, remotely, and in a readily accessible manner. Digital echocardiography certainly enhanced the way we teach, and our ability to share images with other caregivers.

Another important contribution, which I believe has been somewhat overlooked, was Dr. Feigenbaum's early recognition that non-physicians might be well-suited to acquire high-quality echocardiographic images and data. If memory serves, I believe that Dr. Feigenbaum was the first to teach a "sonographer" to perform echocardiographic studies, and to champion the value of cardiac sonographers as skilled professionals who enable the acquisition of high quality, complete studies that many physicians had (and still have) neither the time nor the experience to perform themselves. The sonographers with whom I was fortunate to work over many years taught me a great deal, and I'm confident that my own experience has not been unique.

I believe it fair to say that if it were not for Dr. Feigenbaum, there might be no ASE and no JASE, and many of us would have had very different professional careers.

Those members who are interested in the history of echocardiography, and who plan to participate in the 33rd Annual Scientific Sessions of the American Society of Echocardiography in Seattle between June 10-13, 2022 (whether in person, or virtually), should note that on Monday, June 13, the Feigenbaum Lecture will be given by Dr. Feigenbaum himself. He will discuss the "History of Echocardiography: A Personal Perspective". Don't miss this unique opportunity to learn about the history of echocardiography by someone who helped to write it!

Liv Kristin Hatle, MD, FASE

Dr. Liv Hatle is a Norwegian physician who was raised in the far north of Norway, near its border with Finland and Russia, and who developed a passion for hemodynamics and sunny weather. She studied in Trondheim, specializing in internal medicine and cardiology, and worked briefly as a faculty member at the University Hospital in Oslo. Subsequently, she served for nearly 20 years as a consultant cardiologist at the University Hospital in Trondheim, Norway's former Viking capital. Later in her career, Dr. Hatle moved to Riyadh, Saudi Arabia, as the Deputy Chair of the Department of Cardiovascular Diseases at the King Faisal Specialist Hospital and Research Center. Before retiring from clinical work, she held appointments at the University Hospitals in Linkøping, Sweden and in Leuven, Belgium. She now spends much of her time on the Mediterranean coast of Spain, and is said to be one of the most avid gardeners in her community.

Perhaps serendipitously, the University Hospital in Trondheim was located quite near the Norwegian Institute of Technology (now known as the Norwegian University of Science and Technology, NTNU). This proximity allowed her to work with a young engineer at the Norwegian Institute of Technology, Bjorn Angelsen, PhD. In the 1970s, investigators in Japan, the United States, and France were using pulsed Doppler instruments to study cardiac flow. Dr. Angelsen developed a device which he termed the Pulsed Echo Doppler Flowmeter (hence the acronym PEDOF), later adding continuous-wave Doppler, which allowed the user to record higher flow velocities than those that could be measured using pulsed Doppler methods. Norwegian investigators, including Drs. Hatle and Angelsen, used the PEDOF device to evaluate the magnitude and time course of the pressure drop across the stenotic mitral valve. They adapted the results of prior invasive hemodynamic studies in order to develop a non-invasive method to measure the "pressure halftime," and thereby to determine the orifice area of the stenotic mitral valve. Subsequently, Hatle and Angelsen used the PEDOF device to estimate pulmonary artery systolic pressure from the velocity of tricuspid regurgitation, and to measure the pressure drop across the stenotic aortic valve.

Dr. Hatle was not content simply to describe these exciting approaches, and thought it equally important to teach others how to use Doppler methods.

Dr. Hatle was not content simply to describe these exciting approaches, and thought it equally important to teach others how to use Doppler methods. She introduced the PEDOF device to American investigators, and spent two years as a Visiting Professor at Stanford University, and as a Visiting Scientist at the Mayo Clinic. During this time, she not only helped others to develop skills in recording and analyzing Doppler velocity curves, but also helped to derive new insights into diastolic left ventricular function and pericardial disorders. Dr. Hatle is soft-spoken and avoids self-promotion; her "boundless modesty" was noted when she was awarded an honorary doctorate from the Katholieke Universiteit Leuven in 2020 and described as "one of the *grandes dames* of cardiology." Dr. Hatle has a remarkably detailed and sophisticated understanding of cardiac hemodynamics, and through her teachings helped to stimulate the evolution of clinical echocardiography services into "noninvasive imaging and hemodynamic laboratories."

Many individuals have contributed to the evolution of echocardiography, and space constraints do not allow an extensive discussion, in this article, of those who have made noteworthy contributions. Nevertheless, there is no doubt that the important contributions of Dr. Feigenbaum and Dr. Hatle certainly deserve to be honored at the ASE Foundation's 2022 Research Awards Gala. Please join me in applauding their accomplishments, and in thanking them for helping all of us to take better care of our patients!

ASE 2022 SCIENTIFIC SESSIONS – NOW THEY ARE *History*

Recently, I attended the 33rd Annual Scientific Sessions of the American Society of Echocardiography, held at the Seattle Convention Center from June 10-13. Organized as a "hybrid" event, with both online and in-person components, this was the first Scientific Sessions at which in-person attendance was an option since the 2019 Scientific Sessions held in Portland, Oregon. This year, program chairs Sharon Mulvagh MD, FRPC, FASE, FACC, FAHA, and Carol Mitchell PhD, ACS, RDMS, RDCS, RVT, RTR, FASE, FSDMS, (Carol wins the "most degrees" contest!) did a spectacular job in crafting an excellent meeting with lots of learning opportunities, and the chance to see old friends (and make some new ones). It was an opportunity that I found most welcome after spending several years in hibernation. An extra treat was the chance to catch up with Dr. Liv Hatle, one of the *grandes dames* of cardiology.

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

At the meeting, I was reminded of a few things about the history of ASE. ASE has continued to grow and evolve over the years, welcoming new and established users of cardiovascular ultrasound whose daily work may involve one of many different clinical disciplines. The 2022 Scientific Sessions included program tracks for practitioners whose daily work involves a wide range of clinical areas, including Adult Congenital Heart Disease, Cardiac Sonography, Pediatric and Congenital Heart Disease, Perioperative Echocardiography, Point of

The members who attended the Scientific Sessions represented diverse backgrounds, and their clinical interests reflected this spectrum.

Care Ultrasound, Vascular Ultrasound, and Veterinary Cardiology. The members who attended the Scientific Sessions represented diverse backgrounds, and their clinical interests reflected this spectrum.

Those who visit the ASE website will note that "ASE is the largest global organization for cardiovascular ultrasound imaging serving physicians, sonographers, nurses, veterinarians, and scientists." Importantly, but not surprisingly, one of ASE's Core Values is diversity. In his August 2019 President's Message, Madhav Swaminathan (ASE's 30th President) wrote that "ASE has, fortunately, always had a diverse membership of echo enthusiasts since its inception."[1] President Swaminathan went on to write "The history of the ASE is rooted in diversity," and to recall that when founded in 1975, Dr. Harvey Feigenbaum, the Society's founding President, "recognized the value of diversity by including a noted radiologist as the vice-president."[1]

ASE has, fortunately, always had a diverse membership of echo enthusiasts since its inception.

He said "I didn't want this to be a total cardiac organization. I wanted anybody who's willing to do a good job at cardiac ultrasound, irrespective of their training or their label, is more than welcome to be part of this organization."[3] He has noted that in his view, diagnostic ultrasound does not inherently belong to any physician specialty, and that whoever demonstrates a desire to do the examination well is entitled to perform it. The point to emphasize is that ASE has been – from the beginning – an inclusive organization focused on promoting high quality care and not limiting membership to individuals who came from any particular clinical specialty. The 2022 Scientific Sessions reinforced this perspective and, in my view, demonstrated how the Society continues to navigate this course quite successfully.

Dr. Feigenbaum has written excellent review articles about the history of echocardiography,[2] and has addressed this topic on different occasions. In a 2009 interview, he discussed the "Beginning of Echocardiography," and spoke about the founding of ASE.

Dr. Pearlman and Dr. Hatle at the 2022 ASE Foundation Research Awards Gala.

Dr. Feigenbaum's interview also reminded me of a terrific resource available to anyone who is interested in the history of echocardiography and the related history of ASE. In 2009, ASE leaders arranged for interviews that were filmed professionally and resulted in a set of videos that can be viewed on ASE's YouTube channel. These interviews were conducted primarily by Dr. Randy Martin, who served as ASE's 14th President from June 2003-June 2004. For those who don't know him, Dr. Martin has made many important contributions during his long career. One of these involved serving as a professional journalist. From 1994-2009, he was a Medical Correspondent for Cox Television's ABC affiliate in Atlanta. He earned three Emmy nominations, and his outstanding journalistic work was celebrated in 2004 when he was awarded the Howard L. Lewis Lifetime Achievement Award by the American Heart Association. He is an experienced and skilled interviewer. Assisted by Drs. Al Parisi (ASE's seventh President) and Jules Gardin (ASE's ninth President), Dr. Martin interviewed 19 of the 20 individuals who had served terms as ASE President between 1975 and 2009. Dr. Parisi interviewed Dr. Martin.

During the 2022 Scientific Sessions, Dr. Martin (with a little help from me) interviewed five additional Past Presidents (Drs. Sanjiv Kaul, Jim Thomas, Patty Pellikka, Neil Weissman, and Vera Rigolin). We are in the process of editing these interviews for length, and they too will be available online later in the year. Our plan is to continue to update this "living history" document by interviewing additional Past Presidents during the 2023 Annual Scientific Sessions.

To my surprise, most of the ASE members with whom I spoke in Seattle were vaguely aware that the 2009 interviews existed. I see no need to repeat, or attempt to summarize here, the recollections of our Past Presidents and their perspective on the history of echocardiography and of ASE. However, I would strongly encourage all who are interested in the history of our profession and our organization to view this series of videos on ASE's YouTube channel entitled "Recollections of ASE's Founders and Past Presidents."

Also, rather than re-visiting the recollections of specific Past Presidents in future articles included in *Echo* magazine, my current inclination is "to focus on more general topics." It seems to me that the stories told in the YouTube interviews cannot be replicated in a written summary, since the interviews not only cover a range of specific issues, but also allow the viewer to see the faces and to hear the voices of the Society's past leaders. A few of them (Drs. Al Parisi, David Sahn, and Dick Kerber) are no longer with us, but hearing their voices and seeing their facial expressions keeps them alive in our memories. I hope that many members will watch and enjoy the interviews. They provide a fabulous history lesson.

ASEcho.org/PastPresidentVideos

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Cardiac Sonography – HOW DID THIS IMPORTANT PROFESSION BEGIN?

A previous article in *Echo* magazine[1] noted that ASE has now facilitated a series of online video interviews of 25 ASE Past Presidents, with plans to interview another group who recently completed terms as President. These videos can be accessed from the ASE website and viewed on YouTube, and they provide interested members (especially younger members – but not limited to that demographic) a means to see the people who served as ASE leaders, listen to them discussing their first experiences with echocardiography and the ASE, and hear about some of the major issues demanding their attention during their presidential terms.

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

These interviews will give ASE members a palpable sense of some of the people who helped the Society to advance to where it is today. However, it would be misleading – and indeed wrong – to imply that ASE's leaders deserve all the credit for the successes that our field, and our Society, have witnessed. In truth, many other groups have played noteworthy roles in the evolution of echocardiography and ASE. This and future articles will focus more specifically upon those important groups.

Since its inception, ASE has encouraged the value of diversity. Membership has always been open to any and all clinicians and scientists who understand the value of cardiac ultrasound in patient care and the importance of excellence in its clinical application, and who are committed to providing the right test to the right patient at the right time. One feature that

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makes echocardiography unique among clinical techniques – in the United States and increasingly in other parts of the world – is the **partnership** between physicians and sonographers that is an inherent part of this clinical discipline. In an Editor's Page written early during my tenure as Editor-in-Chief of JASE I noted that "As practiced in the United States, echocardiography is – and has been for many years – a team sport."[2] I also wrote "In a team sport, unless all team members play their best, the result may be a poor outcome."[2] I believe that these words, written more than 13 years ago, continue to ring true.

So how did the profession of cardiac sonography begin, and how has it evolved? Before addressing those questions, a few relevant points are of note. First, this is a big topic, and space limitations dictate that I address it in a series of shorter articles rather than in a single lengthy treatise. Second, while I have been blessed to work with – and to learn from – many wonderfully skilled cardiac sonographers, where possible I will focus on sonography rather than sonographers. This may seem a subtle distinction, but I worry that if I were to emphasize individuals, I might offend some sonographers who I have inadvertently neglected to mention by name. Of course, I could simply list – in either alphabetical or chronological order – every one of the sonographers with whom I've been fortunate to interact over my long career, but this would be more akin to a writing a phone book rather than a story. I've heard it said that while a phone book includes many interesting characters, the plot is hard to follow!

"As practiced in the United States, echocardiography is – and has been for many years – a team sport."

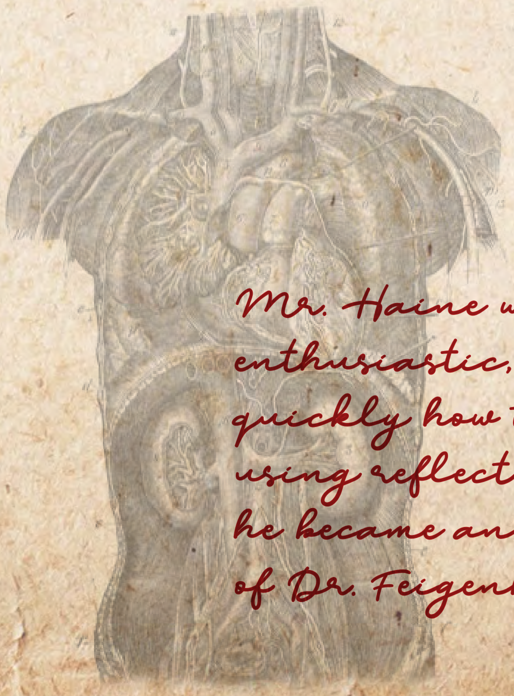
ASE membership records remind me that over the years, cardiac sonographers have made up 30-40% of ASE's membership. An online statement from the Mayo Clinic[3] notes that "Cardiac sonographers ... are healthcare professionals specially trained to use imaging technology to help physicians diagnose heart problems in patients." How did this "healthcare profession" get started, and how has it evolved?

I believe that the story starts with sonography, while specialized applications such as cardiac sonography came later. It is always difficult to identify with certainty what (and who) came first. In a recent publication on the history of echocardiography,[4] which I commend to readers interested in that topic, the authors acknowledge that "it is often very difficult to establish scientific precedence," and they note that frequently, "when investigators were trying to solve the same problems but communication was less easy than now and publications were less accessible…they worked independently." I believe that the same points pertain to the introduction and evolution of sonography. With that proviso, I believe it appropriate to mention two people who, while not called "sonographers" at the start of their careers, appear to have been very early entrants into the field.

The first is Charles L. Haine, who was hired in the mid-1960s by Dr. Harvey Feigenbaum at the recommendation of his secretary. As a young man, Mr. Haine was not a very good student. He was a high school dropout who joined the U.S. Navy, where he earned the equivalent of a high school diploma. He flunked out of college and had trouble holding a job. He was hired "out of desperation," and at the recommendation of Dr. Feigenbaum's secretary (who later became Mrs. Haine). Dr. Feigenbaum was eager to investigate practical applications of cardiac ultrasound, but he was the director of the Cardiac Cath Lab at Indiana University and did not have the time to perform A-mode and M-mode scans himself. Apparently, Mr. Haine was not only enthusiastic, but also learned quickly how to examine the heart using reflected ultrasound, and he became an important member of Dr. Feigenbaum's research team. Eventually Mr. Haine did go back to school and became a very successful academic optometrist. In 2011, he retired as Associate Dean of Clinical Affairs at Western University of Health Sciences College of Optometry in Pomona, California.

Another of the first "sonographers" to work in the United States was Joan P. Baker MSR, RDMS, RDCS, FSDMS. At the age of 23, she left her native England to do ultrasound exams with a neuroradiologist at the Stanford Medical Center. I first met Joan in 1977, when her husband Donald W. Baker, a professor in the University of Washington's (UW) Center for Bioengineering, recruited me to join the UW faculty. I'm indebted to her for providing a considerable amount of background material that I've adapted in preparing this article. Ms. Baker reminded me that as a teenager in the British midlands, she had dreams of attending medical school but had difficulties in passing the foreign language requirement needed at the time to gain admission to a school of medicine. She was good in sciences and decided to pursue a career in radiology, which required good science grades but had no foreign language requirement. She went to London as a teenager, and eventually took a position at The National Hospital for Nervous Diseases. There, she was introduced to ultrasound and nuclear medicine, largely – she recalls – because she was the youngest radiographer with the least experience, and nobody else was interested in those fields. At the time, ultrasound was chiefly used for brain scanning.

In late 1964, Ms. Baker's boss returned from a medical meeting where he met an American neuroradiologist from Stanford who invited Ms. Baker to come to the United States (U.S.) to work "for a year." In early 1965, she arrived at Stanford, and she has lived in the U.S. ever since! She recalls that when she arrived, the neuroradiologist for whom she worked initially proclaimed – proudly – that he had "found the on/off switch." One Monday morning a young physician from the cardiology department came to the radiology department holding Dr. Feigenbaum's 1965 article "Ultrasound Diagnosis of Pericardial Effusion."[5] The physician mentioned that they had a patient in the hospital with a pericardial



Mr. Haine was not only enthusiastic, but also learned quickly how to examine the heart using reflected ultrasound, and he became an important member of Dr. Feigenbaum's research team.

effusion and wondered if Ms. Baker could detect the effusion using her ultrasound equipment. She was able to do so.

However, the earliest clinical applications of ultrasound may have been in the field of "Physiatry," now known as "Physical Medicine and Rehabilitation." Ultrasound was used as therapy for muscle injuries – indeed, I remember receiving ultrasound therapy for a muscular injury I suffered as a collegiate athlete in the early 1960s. The initial applications of cardiovascular ultrasound for diagnosis, rather than therapy, probably occurred in Europe and Japan in the 1950s. We should also recall that ultrasound technology has been of considerable and longstanding importance in the field of obstetrics. Dr. Ian Donald of Glasgow apparently used ultrasound as a diagnostic tool in his obstetrics and gynecology practice as early as 1955.

She recalls that when she arrived, the neuroradiologist for whom she worked initially proclaimed – proudly – that he had "found the on/off switch."

The evolution of clinical ultrasound was accompanied by the introduction and evolution of professional organizations formed to represent the interests of the practitioners and applications of clinical ultrasound. In 1952, a group of physiatrists formed the American Institute of Ultrasonics in Medicine (AIUM); in 1968, that organization retained the acronym AIUM but changed its name to the American Institute of Ultrasound in Medicine. In 1964, AIUM leaders modified the focus of the AIUM to include colleagues who used ultrasound for both diagnostic and therapeutic purposes. At AIUM's 1969 meeting, a small group of non-physician "technical specialists" advocated for a technical society to represent the interests of non-physicians and non-physicists who were involved in performing ultrasound studies in various clinical settings. This resulted in the formation, in 1969, of the American Society of Ultrasound Technical Specialists (ASUTS). The name "technical specialist" was apparently used in the draft ASUTS Constitution and selected in lieu of "technologist" or "technician," which were controversial terms in the field of radiology. Since non-physician "technical specialists" who worked in the field of radiology were termed "radiologic technologists," or "radiographers," the term "sonographer" eventually won support. In 1980, the ASUTS changed its name to the Society of Diagnostic Medical Sonographers (SDMS) and won formal recognition by the American Medical Association.

The different professional organizations that have represented "sonographers" in various clinical disciplines deserve some additional discussion. One of the important tasks for these professional organizations was the development of appropriate training programs and professional standards. These issues also will be addressed in a future article in this series.

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HOW DID Cardiac Sonographers BECOME Cardiac Sonographers?

An article in last month's *Echo* magazine[1] focused on the early days of sonography in the United States. This discussion ended by noting that establishing a new profession included the need to develop appropriate programs for training practitioners, and professional standards that could be used to judge the trainees' skills.

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

In the 1970s, the field of echocardiography gained acceptance, clinical applications were documented and became part of the practice of cardiovascular medicine, and the value of skilled sonographers was increasingly evident. One obvious question is "how did cardiac sonographers acquire their skills?" My own recollection, augmented by very helpful input from a group of cardiac sonographers (see Acknowledgment below) who were early participants in the field, suggests some patterns. At first, there were no "training programs." I'm reminded of the rise of cardiovascular medicine as a clinical specialty. In his book "American Cardiology: The History of a Specialty and Its College," W. Bruce Fye MD, MACC, FASE, noted that in the early part of the 20th century, a physician who owned an ECG machine and knew how to interpret electrocardiograms could claim to be a cardiologist.[2] Cardiology fellowships did not exist, and a young physician who was intrigued by heart disease had no need to learn cardiac catheterization or echocardiography or nuclear cardiology or cardiac electrophysiology, because those techniques had not yet been invented!

A physician who owned an ECG machine and knew how to interpret electrocardiograms could claim to be a cardiologist.

I believe that the pioneers in cardiac sonography found themselves in similar circumstances. They had no need to learn tomographic imaging planes or to master the principles underlying Doppler hemodynamics or myocardial strain analyses because those technologies did not yet exist. Instead, the enthusiastic young sonographer of the 1970s had to learn the basics of cardiac anatomy and the physical principles governing the application of reflected ultrasound. They also had to understand how controls on early ultrasonoscopes could be adjusted in order to optimize and record the information gathered. But where and from whom could they learn this information? While the options expanded and became more sophisticated as the field evolved, early on there were no formal training programs. The "teachers" were often relatively junior physicians who themselves were learning the same skills. My own memories, and the recollections of a group of sonographers who could be considered among the "founders" of the profession, are concordant on this point. Physicians and sonographers often learned together, side-by-side, and they sometimes quarreled over who got to hold the transducer! This was particularly true when two-dimensional echo became a reality. As is even more the case today than 50 years ago, physicians had other clinical demands and did not always have the time needed to perform a careful and "complete" echo exam themselves. However, sonographers did not have those same clinical demands and were able to take the time to do a thorough and careful job. In Europe, where I worked for a year as a research fellow many years ago, physicians did their own scanning, and they focused on the clinical question(s) at hand. Their studies were often not comprehensive and not always optimized; once the clinical question had been addressed, the echo exam was over.

Early in my own career, I remember getting together with our small group of sonographers and a few fellows in the late afternoon to go over all of the day's cases in reading sessions that often lasted well beyond what today would be considered as "mandatory clock-out time." I learned as much from the sonographers as they did from me, and we had a chance to discuss – as a group – cases, findings and their potential clinical implications, and technical issues. This was not only a great learning experience, but it also fostered collegiality, enhanced technical uniformity, and helped us all to understand our laboratory's expectations. The small group of "founders" who graciously provided their own recollections described similar reading sessions in their laboratories, and they had similar memories of what we all fondly remember as the "good old days". I could argue that clinical echocardiography has become the victim of its own success; the clinical workload has increased steadily, and clinicians are eager to know the results of testing – and will make management decisions based on those results – before the ECG electrodes have been removed from the patient! While not intending to sound bitter, I would observe that administrators seem to expect today's cardiac sonographers to crank out a pre-determined number of studies, to download the images and measurements into the institution's PACS system (Picture Archiving and Communications System), and to clock out in time to make the late afternoon bus. And … especially … to obviate the need for overtime pay! For many reasons, staying late to read echo studies with

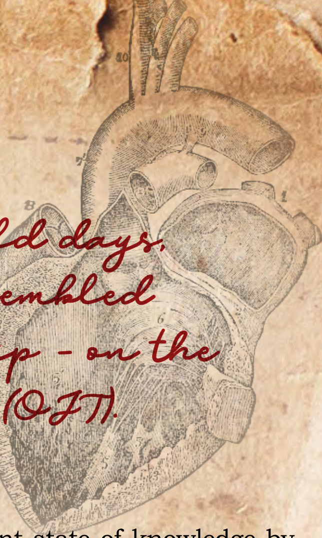
> **The enthusiastic young sonographer of the 1970s had to learn the basics of cardiac anatomy and the physical principles governing the application of reflected ultrasound.**

the docs is not an option. And I find this situation to be disappointing.

In the good old days, “training” resembled apprenticeship – on the job training (OJT). The focus of training was likely determined by the clinical and academic interests of the cardiologist(s) with whom one worked, and by the rapid expansion of the clinical settings in which echocardiographic findings were thought to be valuable. In some laboratories, M-mode echo remained the mainstay even after the introduction of cross-sectional, tomographic imaging. While today’s sonographers sometimes wonder “what’s the point of recording any M-mode,” the sonographers of yesteryear will remember thinking (and sometimes asking) “I just did a thorough M-mode exam – what’s the point of recording 2D images?” In some laboratories, Doppler was adopted early, while in others, the emphasis was on imaging – at least, until it became apparent that one could measure the pressure drop across stenotic valves using continuous wave Doppler.

How did the “founders” get involved in cardiac sonography when that discipline was in its infancy? Many of them came from “other” healthcare backgrounds but were intrigued by cardiac ultrasound. Some had worked as radiology techs but were eager to avoid radiation exposure. Some had worked as ECG or phonocardiography techs and found echocardiography to be more interesting, more exciting, and in some ways easier to understand. Some had clinical backgrounds, having worked as nurses, or as nursing assistants, or as medical corpsmen Let’s remember that in the 1970s, there was a mandatory draft, and for some bright young men, introduction to the medical field was a side benefit to their military service. Some had strong science backgrounds, and some were just eager to enter the new field of cardiac sonography.

At the start, someone interested in working as a cardiac sonographer would be lucky to find a (usually young) physician who was interested in this technique, looking for assistance, and willing to take the time to teach a sonographer. Eventually, however, different options for training evolved. Initially, a newcomer to the field



In the good old days, “training” resembled apprenticeship – on the job training (OJT).

might learn about the current state of knowledge by attending a weekend course. As the repository of information expanded, educational courses also grew in length – one month, three months, and eventually a full year, after which the trainee received a certificate documenting that they had completed a “training program.” Before long, more formal educational programs began to develop – usually affiliated with colleges and universities or with medical institutions. Sonography was considered – and continues to be considered – as an Allied Health Profession. Early on, formal educational programs in the Allied Health professions awarded their graduates a two-year Associate degree. Eventually Baccalaureate-level programs became the norm. Some of the early educational programs in cardiac ultrasound were based in San Diego, Oklahoma City, Philadelphia, and Seattle. Educational programs in cardiovascular technology, such as the one in Spokane, provided another approach to training in cardiac ultrasound.

As noted previously,[1] professional organizations formed in order to represent the interests of practitioners of clinical ultrasound. These included the American Institute of Ultrasound in Medicine (AIUM), the American Society of Ultrasound Technical Specialists (ASUTS) – which evolved into the Society of Diagnostic Medical Sonographers (SDMS), the National Society of Cardiopulmonary Technologists (NSCPT), and the Society of Non-Invasive Vascular Technology (SNIVT) – which morphed into the Society of Vascular Ultrasound (SVU). As the field of what would become known as “sonography” grew, these organizations recognized the need for educational programs. Some professional organizations included educational programs as part of their annual meetings. Another mechanism for enhancing knowledge resulted from the needs of manufacturers of ultrasound equipment. They hired practicing sonographers to serve as “applications specialists” so that when a new user bought an ultrasound instrument, the manufacturer could provide not only the equipment but also instruction on how to use the controls, and how to locate, recognize, and record clinically relevant findings! In the 1980s, journals such as the Journal of Diagnostic Medical Sonography (JDMS) and the Journal for Vascular Ultrasound (JVU) were founded by the SDMS and the SVU, respectively; these were also helpful educational vehicles.

Several organizations recognized the need to develop a registry of practitioners who had taken – and passed – a registry exam documenting their skills. Two pathways are noteworthy. The NSCPT evolved to represent individuals practicing different aspects of “cardiovascular technology,” including technical specialists who worked in laboratories performing cardiac cath, electrophysiology, ECG, vascular medicine, and echocardiography. The NSCPT began administering credentialing exams in 1968, initially focusing on cardiac cath; eventually other practice areas were included. Credentialing in a range of cardiovascular technologies is now offered under the auspices of Cardiovascular Credentialing International (CCI).

While some sonographers trained in cardiac ultrasound as part of a cardiovascular technology program, many sonographers trained in an ultrasound program.

While some sonographers trained in cardiac ultrasound as part of a cardiovascular technology program, many sonographers trained in an ultrasound program. The ASUTS began in 1969 as an organization representing technical specialists who used ultrasound in different clinical settings, including cardiology. The Examination Committee of the ASUTS evolved into an organization known as the ARDMS – the American Registry for Diagnostic Medical Sonography – which was incorporated in 1975. To persuade the Council on Medical Education of the American Medical Association (AMA) to recognize diagnostic sonography as a new profession, the ARDMS was tasked with documenting the responsibilities of and need for “technical specialists,” writing a basic education syllabus, developing both written and practical examinations, and providing a mechanism to document skills in sonography. In the 1990s, a new agency known as CAAHEP, the Commission on Accreditation of Allied Health Education Programs, was founded and tasked with overseeing the accreditation of educational programs in the health sciences. Three committees on accreditation are particularly relevant to cardiac sonographers: the Joint Review Committee on Education in Cardiovascular Technology (JRC-CVT), the Joint Review Committee on Education in Diagnostic Medical Sonography (JRC-DMS), and the Committee on Accreditation for Advanced Cardiovascular Sonography (CoA-ACS). CAAHEP commissioners represent a large number of sponsoring organizations, reflecting the substantial range of health education professions. Readers of this magazine will recognize the American College of Cardiology, the American Society of Anesthesiologists, and the American College of Emergency

Physicians. Health professions less familiar to some readers include the American Art Therapy Association, the Association of Medical Illustrators, and the International Association of Fire Fighters. In addition to the committees on accreditation listed above, CAAHEP sponsors with a focus on cardiovascular sonography include the American Society of Echocardiography, the American College of Cardiology, the American Institute of Ultrasound in Medicine, the Society of Cardiovascular Anesthesiologists, the Society for Vascular Surgery, the Society for Vascular Ultrasound, and the Society of Diagnostic Medical Sonography.

Since the first "cardiac sonographers" picked up a transducer almost 60 years ago, the field of cardiac sonography has evolved tremendously. Starting with on the job "apprenticeship" training and a few prophetic educational programs, the field has grown dramatically. The next in this series of articles about the history of Cardiac Sonography will focus in more detail on the evolution of educational programs, and the expansion of career opportunities for cardiac sonographers. Stay tuned!

ACKNOWLEDGMENT

I wish to express my profound gratitude to a group of cardiac sonographers who have been involved in echocardiography for as long as I have been. These talented professionals have contributed to our field in too many ways to mention in this space, and their accomplishments have been recognized – publicly and appropriately – in other venues. I am grateful to them for sharing with me some recollections of their introductions to the field, and for their efforts to keep my own recollections "honest." Listed alphabetically, they include David Adams, Joan Baker, Carolyn Gardner, Sandy Hagen-Ansert, Kitty Kisslø, Oi Ling Kwan, Jane Marshall, and last – but certainly not least – Alan Waggoner. Thanks too to Merri Bremer and Carol Mitchell for their valuable comments.

Since the first "cardiac sonographers" picked up a transducer almost 60 years ago, the field of cardiac sonography has evolved tremendously.

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CARDIAC SONOGRAPHY: Evolving Training Programs AND Expanding Professional Opportunities

A previous article in *Echo* magazine[1] discussed how, in the 1960s and 1970s, cardiac sonographers became cardiac sonographers. During these "early days" of echocardiography, a relatively small number of enthusiastic investigators in a relatively small number of laboratories were evaluating various clinical applications of echocardiography and working to persuade their (often skeptical) colleagues that echocardiographic findings could enhance the care of their patients. The cardiac sonographers who entered the field of echocardiography during this period were generally young, enjoyed working with patients and doctors (back then they were not called "clients" and "providers"), had some experience in one or another medical field or a solid background in the sciences, and were eager to learn how to use this new diagnostic technique and to understand how the findings contributed to patient care.

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

As echocardiography gained widespread acceptance, the value of – and need for – skilled cardiac sonographers became increasingly apparent. And so did the need to train and hire more of them. As discussed previously,[1] on-the-job training gave way to educational courses of gradually increasing length and completeness. Soon it became evident that the most comprehensive training would be achieved through formal educational programs. Creating a complete and accurate list of early educational programs would be difficult at best, but the different ways in which formal educational programs

began is illustrated by two programs that started in the 1970s.

One approach was based on existing training programs for radiologic technologists, in which trainees were immersed in basic courses for the first year. In the second year of studies, they could opt to specialize in one or another clinical discipline such as diagnostic radiology or nuclear medicine or radiation therapy or diagnostic ultrasound. In the early 1970s a cardiovascular technology program was started at Grossmont College, a community college located east of San Diego in El Cajon, CA. After completing a one-year core curriculum, students in this program were able to develop clinical skills in one of three areas: invasive (Cath lab), noninvasive (which included ECG and echocardiography), or vascular technology.

An alternate approach focused on training in diagnostic ultrasound. Training programs that were not "radiology based" had a practical appeal because diagnostic ultrasound does not involve ionizing radiation, and because diagnostic ultrasound is used by a range of different clinical specialties. The first four-year baccalaureate program in diagnostic ultrasound was founded in 1974 at Seattle University, a private Jesuit school in downtown Seattle, WA, by Joan Baker MSR, RDMS, RDCS. Joan (whose training included both nuclear medicine and ultrasonography) was asked to take responsibility for the university's Department of Allied Health, which included baccalaureate level programs in five disciplines: medical technology, radiation therapy, cytotechnology, nuclear medicine, and ultrasound. Initially, the allied health program at Seattle University was based administratively in the Department of Engineering; subsequently the program was housed in the College of Nursing. I'm personally familiar with this program because some of the very best sonographers who worked in the laboratory I directed at the University of Washington (between 1978 and 2006) were students – and subsequently teachers – in the Seattle University program.

As echocardiography gained widespread acceptance, the value of – and need for – skilled cardiac sonographers became increasingly apparent.

Responsibility for oversight of medical educational programs also evolved over the years. In the early 1970s, a request to establish the new profession of diagnostic ultrasound technology was submitted to the American Medical Association (AMA) by the American Society of Ultrasound Technical Specialists (ASUTS) and accepted by the AMA's Allied Medical Emerging Health Manpower Division. Having recognized the profession of "ultrasound technical specialist," the AMA's Allied Medical Emerging Health Manpower Division required the ASUTS (which later evolved into the Society of Diagnostic Medical Sonographers, SDMS) to address a series of tasks, including developing a relevant job description for the ultrasound technical specialist, and describing training programs for accreditation. The AMA's Department of Allied Medical Professions and Services, which became known as the Committee on Allied Health Education and Accreditation (CAHEA), worked with the ASUTS to develop the Essentials of an Accredited Educational Program for the Diagnostic Medical Sonographer. A group of collaborating organizations, which included the American College of Cardiology, the American College of Radiology, the American Institute of Ultrasound in Medicine, the AMA, the American Society of Echocardiography, the American Society of Radiologic Technologists, and the SDMS, were involved in drafting the Essentials, which was finally approved in 1982. The Joint Review Committee on Education in Diagnostic Medical Sonography (JRCDMS) was formed and initially responsible for accrediting educational programs in diagnostic medical sonography. In 1982, the educational program at Weber State University (a public university in Ogden, Utah) was the first diagnostic medical sonography program to be accredited. Over the next ten years, JRCDMS accreditation was granted to a total of 56 ultrasound schools. Of these, 37 were based in academic institutions, 18 were hospital-based, and one was a proprietary organization.[2]

The CAHEA ceased to exist in October 1993 and was succeeded by the Commission on Accreditation of Allied Health Educational Programs (CAAHEP). As noted previously,[1] the CAAHEP includes Committees on Accreditation for a wide range of medical professions. The three most relevant to cardiac sonography are the Joint Review Committee on Education in Cardiovascular Technology (JRC-CVT), the Joint Review Committee on Education in Diagnostic Medical Sonography (JRC-DMS), and the Committee on Accreditation for Advanced Cardiovascular Sonography (CoA-ACS). According to its 2021 Annual Report,[3] CAAHEP had accredited 2,241 programs in 27 different professions by the end of the 2020-2021 fiscal year. As of June 30, 2021, CAAHEP had granted accreditation to a total of 397 programs in Diagnostic Medical Sonography, 97 programs in Cardiovascular Technology, and two programs in Advanced Cardiovascular Sonography. Note that these data apply to accreditation of *educational programs*; ASE also strongly supports accreditation of *echo laboratories* and *credentialing of cardiovascular sonographers.*

As educational programs for cardiac sonography expanded, so did professional opportunities. In the 1970s, cardiac sonographers used early ultrasound instruments to examine patients with known or suspected heart disease. As instrumentation advanced, sonographers had the opportunity to employ new techniques: two-dimensional echocardiography, spectral Doppler, color Doppler flow imaging, three-dimensional echocardiography, speckle-tracking assessment of myocardial strain, and so forth. Advances in technology and expanding clinical applications required continued learning. As laboratories became busier, some experienced sonographers took on administrative roles, with responsibilities for laboratory organization, quality control, and ongoing education of their more junior colleagues. Importantly, sonographers did not just teach other sonographers – countless cardiology fellows and physicians have been educated by their sonographer colleagues. In ideal settings, this has been a two-way street; sonographers have helped physicians to learn the nuances of data acquisition and enhanced the physicians' skills at interpreting ultrasound images as well as flow velocity and strain recordings. At the same time, sonographers have also learned some clinical medicine from their physician partners, which has helped them to obtain clinically pertinent images and related data.

As educational programs for cardiac sonography expanded, so did professional opportunities.

Professional opportunities for cardiac sonographers also have expanded. Some sonographers have taken on primarily supervisory roles. Others have taken positions in industry, serving as applications specialists helping to familiarize users with new equipment and diagnostic capabilities. Some sonographers, working in industry with ultrasound engineers, have provided important input into the development new technology. Others have worked with physician "luminaries" to refine new clinical applications. Clinically based sonographers have taken on responsibilities for quality control, writing protocols, and helping to assure that laboratory performance is consistent with requirements for laboratory accreditation. Some sonographers have served as educators in sonography schools in their area. Others have moved away from the clinical arena and become active in research studies, not only in busy academic laboratories but also in "core echo laboratories" involved in multi-center study design, data collection and analysis, and manuscript preparation.

In recent years, I have been gratified to see more published manuscripts written – very effectively – by cardiac sonographers. I've lamented the reality that most sonographers are not rewarded for writing manuscripts, not given time to write manuscripts, and not promoted because they have written first-author publications. Notwithstanding these obstacles, it has been clear to me that sonographers are certainly knowledgeable enough, smart enough, and organized enough to take an active role in research and to write and publish high-quality papers in high-impact journals. I hope this trend will continue to expand.

In the early 2000's, the need for cardiac sonographers able to practice at an advanced level led ASE to form an Advanced Practice Sonographer Task Force,[4] chaired by Carol Mitchell PhD, RDMS, RDCS, RVT, RT(R), FASE. In 2009, this Task Force proposed professional roles for an Advanced Cardiovascular Sonographer (ACS), who would ensure that "a proper echocardiographic examination is performed on every patient."[5] Depending on the laboratory's needs and environment, an ACS might review the clinical indications for a clinical echo study, review the recorded images for quality and completeness, and assist the clinical sonographer – when needed – to obtain additional data. Providing in-service educational opportunities for laboratory staff might be another role. In some centers, the evolution of structural heart programs has provided additional opportunities for advanced cardiac sonographers with substantial clinical experience and technical expertise to be involved in interventional procedures as members of the Heart Team. Dr. Mitchell has emphasized that while an ACS "would not practice independently but would always work under the supervision of one or more physician echocardiographers,"[5] they must have considerable knowledge and technical skills and must meet one of the prerequisites for the Cardiovascular Credentialing International (CCI) ACS Certification Examination. An editorial comment accompanying Dr. Mitchell's article re-emphasizes the potential roles for an ACS and discusses some potential obstacles (generally related – as usual – to reimbursement issues).[6]

The prerequisites for sitting for the CCI ACS board examination have evolved from those listed in Dr. Mitchell's 2009 article;[5] for those readers interested in the details, the specifics can be found online.

To summarize, over the past 50 years, educational programs in cardiac sonography have expanded and evolved considerably, and so have job opportunities. Given the dynamic nature of cardiovascular ultrasound, and the continual enhancements in instrumentation and expansion of clinical applications, these trends seem likely to continue.

ACKNOWLEDGMENT

Once again, I must express my gratitude to Joan P. Baker MSR, RDMS, RDCS, and to Carol K. C. Mitchell PhD, RDMS, RDCS, RVT, RT(R), FASE, for their remarkable expertise, support, and willingness to tutor me on many of the details discussed in this short article.

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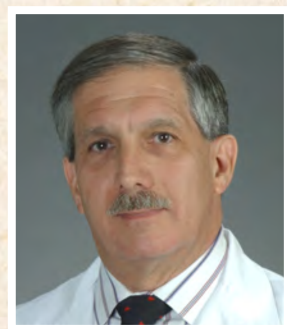
CARDIAC SONOGRAPHY:

Challenges Going Forward

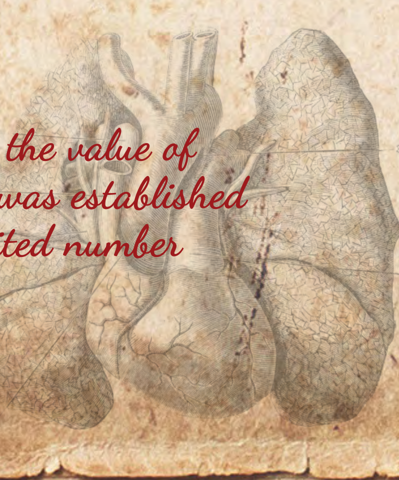
Recent articles in *Echo* magazine have discussed how the profession of cardiac sonography got started in the 1960's,[1] how cardiac sonographers became cardiac sonographers in the 1970's,[2] and how training programs and professional opportunities have evolved.[3] To use a culinary analogy, my goal in writing these short articles was not to prepare a multi-course feast complete with wine parings and a dessert trolley, but rather to provide an amuse bouche intended to enhance interest in the history of (cardiac) sonography for those who are thinking about becoming cardiac sonographers, those who now work as cardiac sonographers, and those who depend upon the skills of cardiac sonographers to take optimal care of their patients. Lengthier and more authoritative sources[4] will be of interest. Since those currently working in the field will be familiar with more recent developments, in this final essay on the topic of cardiac sonography, I'd like to focus on what I see, going forward, as several challenges.



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

In the early days, the value of echocardiography was established in a relatively limited number of disorders. In the 1970s and early 1980s, I remember reviewing the studies "du jour" with the sonographers and a few cardiology fellows late in the afternoon. The number of studies was small, and requesting physicians were not eager to know the results because they were not convinced of

In the early days, the value of echocardiography was established in a relatively limited number of disorders.



the clinical value of echo findings. Sonographers were expected to complete a few studies each day, and we reviewed and discussed each of these as a group. The demands on laboratory personnel were not excessive, but the educational opportunity was considerable. Fast forward to the current era, where sonographers often have a "quota" of studies to complete each day, and where the goal is to load the digital files onto the laboratory's picture archiving and communications system (PACS) in time to make the afternoon bus. Now, reviewing studies as a group is difficult at best, and it seems to me that the importance of "volume" has taken precedence over learning. I'm not referring to ventricular or atrial volume, but instead to the number of studies performed, and the volume of relative value units billed – all without incurring any "overtime" charges! Keeping up with new technologies and new clinical applications is challenging, but it's also what makes the field so rewarding to practitioners and – most importantly – valuable to patients.

Now, reviewing studies as a group is difficult at best, and it seems to me that the importance of "volume" has taken precedence over learning.

Some might view the demand for echo exams as "job security," but there are downsides. A very important downside – one that may not have gotten enough attention – is the prevalence of work-related musculoskeletal disorders (WRMSDs). As the demand for echo studies has grown, and the settings in which exams are performed have expanded, cardiac sonographers are expected to do more studies, sometimes in challenging work environments. According to the Society of Diagnostic Medical Sonography (SDMS), WRMSDs (also termed "musculoskeletal strain injuries" or "cumulative trauma disorders") are caused or worsened by workplace activities. They are painful and involve the muscles, ligaments, tendons, and nerves. WRMSDs are not unique to cardiac sonography (or other sonography specialties), but – because they usually develop gradually – they can be overlooked.

A nice review of WRMSDs was published in 2017.[5] WRMSDS result from repeated exposure to physical risk factors, which are generally related to scanning techniques. If considered on a case-by-case basis, scanning techniques are not harmful per se. But when done repeatedly or for long periods of time, coupled with insufficient time for recovery, performing echo examinations can confer several physical risks, including:

A. ***Force:*** the physical effort needed to perform a given task. Pushing, pulling, pinching, gripping, and lifting are examples of activities that require force.

B. ***Repetition:*** performing the same or similar tasks over an extended period, without adequate time for recovery. The risk of WRMSDs increases when repetitive motions are needed, especially when combined with increased force and awkward posture.

C. ***Awkward Postures:*** these happen when the sonographer scans while their body parts are positioned away from the "neutral" position. Examples might include flexion or extension of the wrist, forward flexion of the shoulders needed to reach, and bending or rotating the neck. Such postures put stress on the sonographers' joints and associated muscles. The farther from neutral and the longer the awkward posture is maintained, the greater the stress.

D. ***Contact Pressure:*** sustained contact between the sonographer's body part and an external object, such as resting the hip or forearm against the exam table.

When these loads are repeated, the body is not able to recover and trauma to the sonographer's muscles and tendons can result. Symptoms of discomfort and risk of injury can result from awkward postures of the arms, trunk, and neck, coupled with excessive downward force applied to the transducer. Frequent abduction of the sonographer's scanning arm, coupled with static loading of the muscles caused by pressure applied with the transducer, may result in shoulder injury – presumably caused by compression of parts of the sonographer's rotator cuff against their bony shoulder girdle, hypoperfusion of the muscles and tendons, and micro-trauma to the muscle fibers. Repeated twisting of the neck and trunk may result in back and neck pain, especially when combined with arm abduction. Sustained or forceful gripping, awkward postures, and repetition may lead to discomfort involving the hand, wrist, and elbow.

WRMSDs are common. The symptom reported most often is pain, which may be accompanied by joint stiffness, swelling, or muscle tightness, sometimes associated with numbness and tingling. A 2009 survey[6] indicated that 90% of sonographers reported shoulder pain, while 69% reported low back pain, and 54% reported work related symptoms involving their hand or wrist. WRMSDs affect other caregivers; surgeons, interventionalists, and physical therapists often note pain involving the neck, shoulders, back, and arms.

WRMSDs appear less likely when sonographers are attentive to their own health (doing stretching and strengthening exercises, eating wisely, and so forth).

I found the educational materials available on the website of Sound Ergonomics (a company located in the Seattle area) to be helpful. In performing echo studies, sonographers can lessen the likelihood of WRMSDs by moving the patient closer, positioning control panels so they are nearby, and repositioning the patient when needed (to avoid reaching). Helpful adjustments include positioning the monitor directly in front of the sonographer and at a proper height (to avoid neck flexion, extension, or twisting), scanning with a neutral wrist position (to avoid excessive wrist flexion or extension), keeping their arms close to the body (to avoid arm abduction), and choosing a comfortable chair that provides support for the shoulders, trunk, lumbar spine, and feet. WRMSDs appear less likely when sonographers are attentive to their own health (doing stretching and strengthening exercises, eating wisely, and so forth). When feasible, changing posture is also helpful. Two recent articles in Echo magazine from the Cardiovascular Sonography Council[7] and the Pediatric and Congenital Heart Disease Council[8] discussed the topic of WRMSDs and suggested some helpful approaches to prevention. When I began work on the current article, these articles had not been published, but they are quite relevant, and I encourage readers to review them.

A 2000 report[9] from the Department of Labor's Occupational Safety and Health Administration (OSHA) noted that nearly two million workers in the United States suffer from WRMSDs annually, with lost time from work in about 600,000 cases. OSHA estimated that direct costs attributable to WRMSDs are $15-20 billion, while total annual costs reach about $50 billion annually. While these figures do not represent the cost of WRMSDs in cardiac sonographers per se, given the likelihood of continued growth in echo services, and the high prevalence of scanning in pain, the "cost" of WRMSDs deserves the attention of sonographers, laboratory directors, and administrators.

I'm fond of the quote "It's tough to make predictions, especially about the future," which has been attributed to baseball player Yogi Berra, but also (with minor modifications) to Niels Bohr, Samuel Goldwyn, Mark Twain, and the 16th century French astrologer Nostradamus, among others. Hence, I'm reluctant to make predictions about developments that might influence the burden of WRMSDs. Obvious choices would include a lighter caseload, more time between cases, more flexible equipment with extra monitors, and control panels that can be positioned where convenient for the sonographer. There may be some fiscal downsides to these approaches.

An intriguing development is the growing availability and power of volumetric acquisition. A recent article from Dr. Roberto Lang's forward-thinking group at the University of Chicago piqued my interest. His team has documented and extolled the value of 3D echocardiography for a variety of applications, such as the accurate measurement of left ventricular and left atrial volumes, and the nuanced analysis of mitral valve morphology and function. Lang's group recently reported[10] that, starting with a volumetric dataset, one can extract multiple tomographic views in order to acquire the standard images now used for 2D echo analysis. They term this process "3D echo deconstruction," and it is possible that this approach could ***replace*** (rather than ***augment***) the conventional 2D echo study. From the perspective of WRMSDs, this approach could be a game-changer. Image acquisition would be much quicker and would not involve protracted efforts to optimize and acquire a large series of tomographic views, which ought to reduce the stresses that currently lead to scanning in pain. If this approach were implemented, I would anticipate that while the ***role*** of the sonographer would remain the same (to acquire optimal images needed to address the clinical concerns in each patient), their ***activities*** would change considerably. Instead of struggling to acquire a large series of images, which can take considerable time and may require stretching and reaching and twisting, the sonographer would need to identify those echo windows that provide optimal visualization of the heart, acquire the volumetric datasets, and then spend most of their time extracting needed views from the original dataset. This would mean spending less time scanning and more time examining the dataset. It would seem likely that this evolution of duties could markedly reduce the factors that appear to result in WRMSDs.

This may seem a "stretch" (pardon the pun) to those readers who view 3D echo as an advanced technique used in a few labs for research, but not a mainstream technique. I would simply observe that back in the late 1970s, when 2D echo was a novel technique, many practitioners claimed that "Surely there would be no need to perform 2D echo in every patient! This might be useful in some patients with coronary disease and asymmetric ventricular performance, or in some children with complex congenital heart disease, or in mitral stenosis when imaging the orifice area was needed. But certainly not in everyone!" I may not be around to see it, but I would not be the least bit surprised if – down the road – 3D acquisition were to become the norm. And this might be a game changer from the perspective of WRMSDs (and in many other ways). Time will tell.

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PERIOPERATIVE ECHOCARDIOGRAPHY–

Novel Applications in a New Environment

Although ASE was founded by a group of cardiologists, the organization has been enriched by inclusion of many other practitioners who use cardiovascular ultrasound as a central part of their professional activities. In recent articles in *Echo magazine*, I've focused on cardiac sonographers. I'd like now to turn to cardiac anesthesiologists, who also have made many important contributions to patient care and to the ASE. It's worth reiterating that from the start, ASE's founding president Harvey Feigenbaum emphasized that he did not want ASE "to be a total cardiac organization," and that "anybody who's willing to do a good job at cardiac ultrasound, irrespective of their training or their label, is welcome to be part of this organization."[1]

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

I'm struck that "perioperative echocardiography" exemplifies the value of collaboration between different specialists who realized that by using ultrasound technology, they could take better care of their patients. Early on, a few cardiologists were asked to come to the operating room (OR) when surgeons suspected a cardiac problem during a surgical procedure. This approach was undoubtedly helpful in selected cases, but surgeons were sometimes apprehensive about having cardiologists "scrub in" to perform transcutaneous or epicardial scanning in the OR during a sterile procedure. Furthermore, cardiologists had their own clinical responsibilities in the inpatient and outpatient settings, and were not eager to spend time in the OR,

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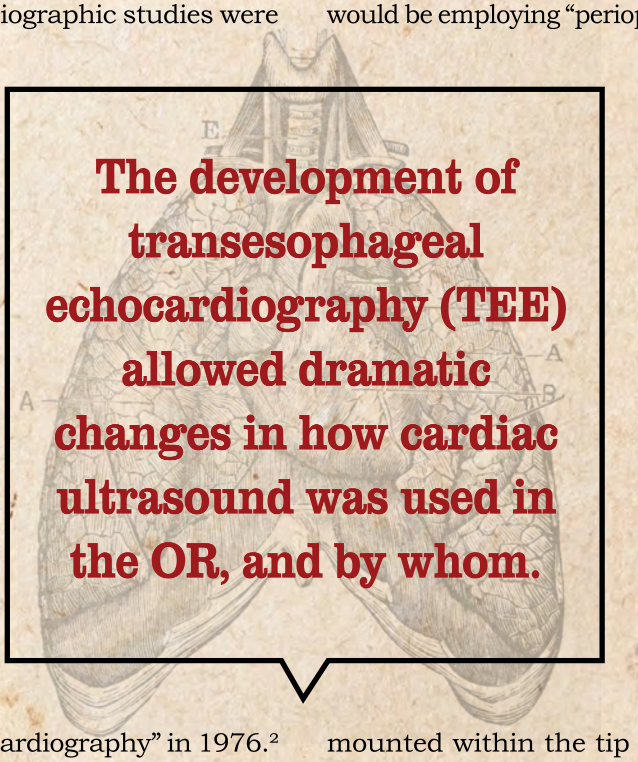
sometimes having to wait or to return to provide further assistance. Although echocardiographic assessment could be performed in the OR, and while the findings could be quite helpful, it became quickly apparent that depending on epicardial scanning by a cardiologist was not a practical approach in the OR setting.

The development of transesophageal echocardiography (TEE) allowed dramatic changes in how cardiac ultrasound was used in the OR, and by whom. In the mid-1970s, a young, innovative cardiologist – Dr. Lee Frazin – fashioned a novel device. At the time a junior faculty member at the Loyola University Stritch School of Medicine in Chicago, Dr. Frazin noted that M-mode echocardiographic studies were often technically limited in patients with chronic obstructive pulmonary disease or obesity. He reasoned that if an echocardiographic transducer could be passed into the esophagus, then diagnostic images could be obtained from behind the heart rather than through the anterior precordium. While the probe he designed and developed was rudimentary and the findings were not well suited to examining the left ventricle (LV) and valves, Frazin did establish the feasibility of "transesophageal echocardiography" in 1976.[2] And this was a key step in the evolution of "perioperative echocardiography."



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Some readers might wonder "why the term perioperative echocardiography?" Wouldn't "intraoperative echocardiography" be more accurate? Indeed, in the late 1970s and early 1980s, some cardiologists who did perform echocardiographic imaging in the OR believed that they were indeed performing "intraoperative echocardiography." However, colleagues who specialized in cardiovascular anesthesiology viewed things from a somewhat different perspective. They made the point – correctly, I believe – that anesthesiologists are "perioperative physicians." An important segment of their work is indeed done IN the OR, but cardiovascular anesthesiologists are also responsible for preparing the patient for surgery (including administering sedative medications and establishing adequate ventilation), sometimes before the patient is taken into the OR, and they are also responsible for supervising and treating the patient during recovery from anesthesia, often after they have been moved from the OR to a recovery unit. Also, proper patient management in a "peri-operative" setting might on occasion require the use of echocardiography. From this very appropriate perspective, it makes sense that a perioperative physician using cardiac ultrasound would be employing "perioperative echocardiography."

The evolution of TEE as a technique that might be used advantageously in the OR involved several sites. In 1980, at the Albert Einstein School of Medicine in New York, cardiologists Masayuki Matsumoto and Joel Strom and their colleagues described the use of TEE to monitor LV performance during open heart surgery.[3] In Hamburg, Germany, Drs. Michael Schlüter and Peter Hanrath and their colleagues initially used an M-mode transducer mounted within the tip of a conventional gastroscope to examine patients with obesity, emphysema, or chronic obstructive pulmonary disease, patients similar to those that motivated Frazin's initial studies. Subsequently, with the assistance of Jacques Souquet, PhD, a remarkably prescient scientist who – during a long and accomplished career – held several important positions in the ultrasound industry, Dr. Hanrath and his colleagues were able to use a 2D TEE probe to record cardiac images in 26 patients.[4] About the same time, in Palo Alto, California, the Varian corporation – working with Dr. Souquet – was developing and testing phased array 2D scanners.

To evaluate the clinical value of 2D TEE, ultrasound engineers at Varian worked with Dr. Nelson Schiller at the University of California, San Francisco (UCSF) and Dr. James Seward at the Mayo Clinic.

Three colleagues from UCSF provided some helpful details. Dr. Nelson Schiller, a friend whose accomplishments, energy, and novel insights I've admired for more than 40 years, was the 2014 recipient of ASE's Physician Lifetime Achievement Award. Dr. Mike Roizen – who I've known since we both attended Williams College many years ago – became the Chair of the Anesthesiology Department at the University of Chicago in 1985, went on to serve as Dean of the School of Medicine at SUNY Upstate, and became the first Chief Wellness Officer at the Cleveland Clinic. Dr. Mike Cahalan, with whom I had the good fortune to work in writing a 2002 guideline document on training in perioperative echocardiography,[5] received ASE's 2015 award for Outstanding Achievement in Perioperative Echocardiography. Dr. Cahalan became Chief of Anesthesiology at the University of Utah in 2001, and in a 2015 presentation at his department's Anesthesiology grand rounds, he discussed how he became involved in using TEE in the OR. [6] In the early 1980's, Dr. Peter Kremer (one of Dr. Hanrath's star cardiology fellows) came to UCSF to work in the echo lab with Dr. Schiller. Dr. Kremer brought with him – in his backpack – an m-mode TEE probe which he hoped to use in his studies at UCSF. Apparently, the UCSF cardiology fellows as well as Dr. Schiller were reluctant initially to get involved in the "invasive" use of ultrasound. Dr. Schiller contacted the UCSF chair of Anesthesiology, who sent Dr. Kremer to speak with Dr. Cahalan, at the time a young Anesthesiology faculty member investigating different anesthetic agents, thinking that Kremer might be able to evaluate TEE in the anesthetized patients participating in Cahalan's study. Long story short, Dr. Cahalan quickly recognized the value of TEE as a cardiac monitor, and he became an early proponent of intraoperative TEE. Dr. Schiller, who realized the value of this novel approach to intraoperative assessment of cardiac function, was very supportive and an important collaborator.

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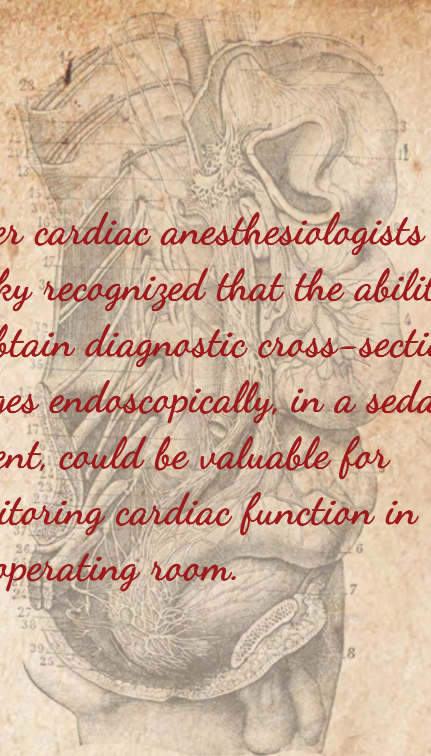
At UCSF in the early 1980's, Drs. Roizen and Cahalan took advantage of their access to 2D-TEE technology to study patients in the OR during cardiac and major vascular procedures. Dr. Roizen reminded me that in 1981, at the national meeting of the Society of Vascular Surgeons, he showed the 2D-TEE findings in a patient who developed an anaphylactic reaction during aortic reconstruction surgery, and its successful management. Drs. Roizen and Cahalan noted that TEE findings led to meaningful changes in the care of some patients, and thought that using 2D-TEE in the OR resulted in shorter ICU stays and less perioperative morbidity. A few years later, Dr. Cahalan was able to spend a sabbatical year in Europe, learning more about TEE. At the time, the Hamburg program was undergoing changes, so he chose to work with engineers Charles Lancée and Nicolaas ("Klaas") Bom and cardiologist Dr. Jos Roelandt, the head of the Echo Lab, at the Thoraxcentrum in Rotterdam. This group was very active in developing and applying innovative transducer technologies. Dr. Cahalan returned to UCSF convinced of the value of TEE as a practical intraoperative method for monitoring cardiac performance in real-time.

Other cardiac anesthesiologists quicky recognized that the ability to obtain diagnostic cross-sectional images endoscopically, in a sedated patient, could be valuable for monitoring cardiac function in the operating room. Hence, the intraoperative use of TEE caught on quickly at several major medical centers in the United States. In discussing a few examples, if I've inadvertently failed to mention others, my apologies to those investigators whose names I failed to acknowledge. Readers interested in a more extensive discussion of the "Evolution of Perioperative Echocardiography" may find it helpful to review chapter 11 in the 6th edition of *Kaplan's Cardiac Anesthesia.*[7]

Once the potential value of a "new" technique is apparent, its use generally spreads quickly to "early adopters" and eventually becomes part of general clinical practice. I believe that intraoperative TEE took such a path. In the 1980s, the ability to examine both global and regional LV systolic wall motion and wall thickening in real time was of major interest. At Johns Hopkins, cardiologists Eric Topol and Jim Weiss and their colleagues used intraoperative TEE to document improvement in regional LV wall motion after coronary revascularization.[8] At the Mount Sinai Medical Center (New York), anesthesiologists Steven Konstadt and Daniel Thys, collaborating with cardiologist Martin Goldman, used intraoperative TEE to evaluate for myocardial ischemia.[9] At UCSF, anesthesiologists John Smith and Mike Cahalan and their colleagues compared the ability of 2D TEE and electrocardiography for detecting intraoperative myocardial ischemia.[10] At Duke University, anesthesiologists Fiona M. Clements and Norbert De Bruijn, with the support of cardiologist Joseph Kisslo, described the use of 2D TEE to evaluate regional LV wall motion in the perioperative setting.[11]

Additional applications soon followed. As noted above, anesthesiologist Michael Roizen and colleagues at UCSF used 2D TEE, starting in 1980, to monitor LV size and function in patients undergoing intraoperative aortic occlusion at different levels.[12] In Japan, at the Saitama Medical School, cardiac surgeon Ryozo Omoto and his colleagues were early proponents of transesophageal Doppler color flow mapping; initially, they used this technique to visualize dissecting thoracic aortic aneurysm.[13] At the Cleveland Clinic, cardiologist William Stewart and cardiac surgeon Delos M. Cosgrove used epicardial 2D echo (and – subsequently – 2D TEE) to examine the mechanisms of mitral valve dysfunction in patients with mitral regurgitation undergoing surgical mitral valve repair.[14, 15]



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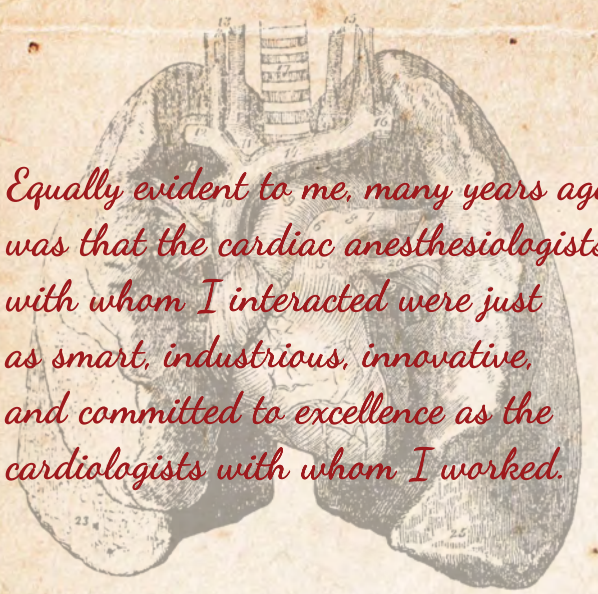
The evolution of perioperative echocardiography highlights the importance of having the right technique to use in the right place at the right time. Cardiologists who generally employ echocardiography in the inpatient and outpatient settings know that much of the early history of cardiac ultrasound was written by investigators using M-mode techniques. Although dependence on M-mode declined with the development of real-time sector scanning and Doppler techniques, it is fair to note that M-mode echocardiography continues to have some important clinical value. [16] While initial intraoperative TEE studies performed using M-mode technology did provide unique and clinically useful measures of LV dimensions and systolic function, this methodology was not ideal for use during surgical procedures. One obvious shortcoming was the limited spatial sampling and inability to visualize some of the LV wall segments, or to appreciate the complexity of chamber and valvular anatomy. Another – and equally important – shortcoming was the reality that M-mode findings are not nearly as easy to understand as tomographic cross-sections. Cardiac



Equally evident to me, many years ago, was that the cardiac anesthesiologists with whom I interacted were just as smart, industrious, innovative, and committed to excellence as the cardiologists with whom I worked.

surgeons could easily recognize a short axis view at the mid-ventricular level and could quickly "see," for example, global hypokinesis or regional dysfunction or a small, hyperdynamic heart. In a patient in the OR with hypotension, these different findings might suggest – respectively – the effect of an anesthetic agent, or regional ischemia, or hypovolemia. The development of 2D TEE was important not only because it expanded the applications of perioperative echocardiography, but also because cardiac surgeons found it easy to understand the images and to recognize the relevant findings quickly.

The clinical applications of intraoperative TEE have expanded greatly and discussing these in detail is beyond the scope (and space limitations) of this article. What seems quite apparent is that the evolution of transesophageal imaging and Doppler blood flow assessment provided an ideal tool for use in the perioperative environment. Equally evident to me, many years ago, was that the cardiac anesthesiologists with whom I interacted were just as smart, industrious, innovative, and committed to excellence as the cardiologists with whom I worked. The operating room was an ideal setting for a new tool and a new group of users to make novel and important contributions to patient care. And including cardiac anesthesiologists as very active participants in ASE activities has been a win-win-win situation for the caregivers, for the organization, and – most importantly – for our patients.

ACKNOWLEDGMENT

I want to express my gratitude to my friends and colleagues (listed alphabetically) Eugene A. Hessel II, MD (University of Kentucky), Michael F. Roizen MD (Cleveland Clinic Foundation), Nelson B. Schiller MD (University of California, San Francisco), and Daniel M. Thys MD (Columbia University) for their willingness to tutor me on many of the details discussed in this short article.

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THE NATIONAL BOARD OF ECHOCARDIOGRAPHY – *A Basis for Important Collaborative Accomplishments*

A recent article in *Echo* magazine focused on the evolution of perioperative echocardiography, and mentioned some early investigations done in the operating room (OR) by cardiologists and cardiovascular anesthesiologists - working together - using transesophageal echocardiography (TEE).[1] A related example of collaboration is also quite worthy of discussion.

The National Board of Echocardiography (NBE) began in the early 1990s; the evolution of the NBE provided an important opportunity for cardiovascular anesthesiologists and cardiologists to work together toward the common goal of documenting their expertise in the clinical use of echocardiography. The driving force behind this project was Arthur E. (Ned) Weyman MD, FASE, ASE's eighth President. As I recall, Dr. Weyman was Dr. Feigenbaum's first "echo fellow" at Indiana University. After doing some impressively innovative work with a very early 2D scanner developed in Indianapolis, Dr. Weyman moved to Boston in 1980, where he founded the Cardiac Ultrasound Laboratory at Massachusetts General Hospital. This developed into an incredibly productive academic laboratory in which many future leaders in cardiac ultrasound not only trained, but also were imbued with the importance of excellence. During his term as ASE President (1991-1993), Dr. Weyman became concerned that as the clinical use of cardiac ultrasound

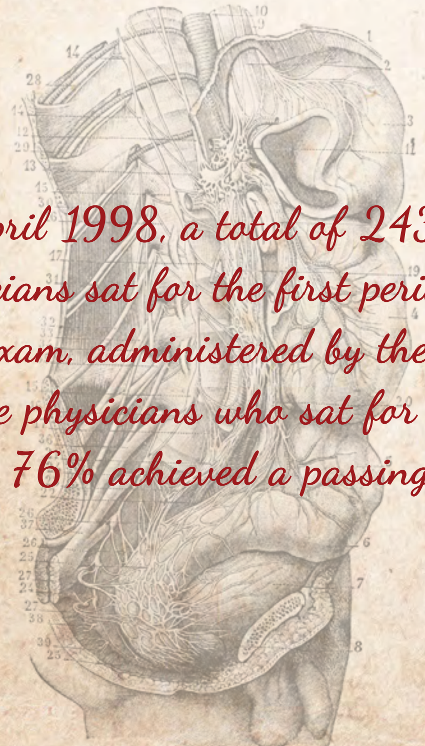
Contributed by **Alan S. Pearlman, MD, FASE**, ASE Past President, and Editor-in-Chief, Emeritus, *Journal of the American Society of Echocardiography* (JASE) expanded, echo studies were not always uniform and sometimes not of high quality. Approaches for evaluating the knowledge base and skills of cardiac sonographers already existed at the time,[2] and before long, ASE also became directly involved in developing a mechanism for accreditation of echo laboratories. Dr. Weyman thought it was important to develop an appropriate method for testing the skills of physicians who were responsible for providing echocardiographic services, including study interpretations. Discussions during meetings of ASE's Board of Directors resulted in the formation of the ASEeXAM Parent Committee. In late 1993, ASE President Julius M. Gardin MD, FASE, appointed Dr. Weyman to chair the ASEeXAM committee. Members of the ASEeXAM Parent Committee (listed alphabetically) included Drs. Chris Appleton, Ed Geiser, Steve Goldstein, Sanjiv Kaul, Mary Etta King, Art Labovitz, Mike Picard, and Tom Ryan. The committee members held several meetings to consider the material to be covered and to review the mechanics of writing valid exam questions. They also discussed who would be eligible to sit for the exam, how the exam should be graded, and the implications of achieving a passing grade. The committee agreed that the exam should be fair - but challenging - and that the purpose of the exam would be to document "special competency" in echocardiography. This was a key decision, since the committee also felt strongly that failure to pass the ASEeXAM should not be taken to imply that the examinee was incompetent. Rather, successful passage of the exam would indicate that the physician had achieved special knowledge and skills in clinical echocardiography, a noteworthy accomplishment. The committee members evaluated proposals from a series of testing organizations and decided that the National Board of Medical Examiners (NBME), founded in 1915 and based in Philadelphia, would be the right organization to oversee the process of physician assessment.

Dr. Weyman thought it was important to develop an appropriate method for testing the skills of physicians who were responsible for providing echocardiographic services, including study interpretations.

An important step in the process was "testing the test." The ASEeXAM committee created a pilot exam that was given in June 1995, during ASE's Scientific Sessions in Toronto. Minutes from the November 1995 meeting of ASE's Board of Directors remind me that 100 people took the pilot exam. While the exam was geared to test physicians, 79 physician echocardiographers, 11 anesthesiologists, and 10 cardiac sonographers signed up to take the pilot exam. In fact, the committee gave two exams, both of which included written questions and video case interpretations. Scores ranged from 80% to 34%, with a mean score of 67.4%. An a priori passing grade was not established, but if a score of 70% had been set as a passing grade, then two-thirds of the physician echocardiographers would have passed. As incoming ASE President in June 1995, I thought it was important to "walk the talk;" hence, I was one of those physicians who took the pilot exam. I am happy to report that my score was above the 70% threshold. The committee decided that an individual who had earned a passing grade on the ASEeXAM should receive a certificate documenting that noteworthy accomplishment and would properly be described as a "testamur" (a term describing someone who has satisfactorily passed an examination and received a certificate documenting that result).

Based on feedback from the pilot exam, the ASEeXAM Committee made some adjustments. They examined each of the 245 questions on the two pilot exams and found them to be psychometrically valid, with a single exception. They also expanded the video portion of the exam considerably. The Committee made plans to give the first "official" exam in June 1996 during the Scientific Sessions in Chicago. ASE's attorney recommended that the exam be administered by a separate corporation, and not by the ASE per se. To that end, ASEeXAM, Inc. was founded in 1996. Initial officers of this new entity were President Arthur E. Weyman, Vice-President Michael H. Picard, Secretary Steven A. Goldstein, and Treasurer Arthur J. Labovitz.

Because it did not focus on perioperative echocardiography, some cardiovascular anesthesiologists felt threatened by the ASEeXAM, and worried that they might be excluded from practicing echocardiography.[3] Accordingly, in 1996 the leaders of the Society of Cardiovascular Anesthesiologists (SCA) formed a Task Force for Certification in Perioperative Transesophageal Echocardiography. This group created an outline of knowledge categories to be tested through an examination, developed a series of multiple-choice questions based on videotaped cases, and – with the assistance of the NBME, ultimately developed an examination specific for perioperative TEE. In April 1998, a total of 243 physicians sat for the first perioperative TEE exam, administered by the SCA. Of the physicians who sat for this exam, 76% achieved a passing score.[3]



In April 1998, a total of 243 physicians sat for the first perioperative TEE exam, administered by the SCA. Of the physicians who sat for this exam, 76% achieved a passing score.

Soon thereafter, SCA leadership and the officers of ASEeXAM, Inc. began to discuss the idea of merging the two exam processes. In November 1998, the National Board of Echocardiography (NBE) was created by merger of the SCA Exam and ASEeXAM, Inc. The NBE is a not-for-profit corporation; according to its website,[4] the mission of the NBE is "To improve the quality of cardiovascular patient care by developing and administering examinations for physicians leading to certification that recognizes special knowledge and expertise in echocardiography." Equally important is the statement "The examination of special competence and certification in echocardiography is not intended to restrict the practice of echocardiography."

Initially, the NBE developed two examinations of special competency: one in adult echocardiography (the ASCeXAM) and the other in perioperative TEE (the PTEeXAM). Board certification in cardiovascular medicine follows requirements established by a series of guideline documents initiated by the first Core Cardiology Training Symposium (COCATS) sponsored by the American College of Cardiology (ACC) in 1994. Dr. Weyman and I were both co-authors on the echocardiography portion of that document, published in 1995.[5] Over the years, COCATS requirements have been updated several times; the most recent document[6] was published in 2015. To earn NBE certification in adult echocardiography, the successful cardiologist would need to pass the ASCeXAM, but would also need to document completion of an approved training program in cardiovascular medicine as well as additional training in adult echocardiography. Achieving the status of a Diplomate requires that the candidate document the number (and – depending on the nature of the certification being sought – the types) of studies performed and interpreted.

At the time, however, no similar training guidelines existed to support accreditation of fellowship training in cardiac anesthesiology and certification in perioperative echocardiography. Believing that consensus recommendations for training in cardiac anesthesiology (including perioperative TEE) were needed, a proactive approach was adopted. A joint ASE-SCA task force was created and chaired by Dr. Michael Cahalan. I was also a part of this writing group, whose recommendations for training in perioperative echocardiography were published in 2002.[7] After reviewing the requirements for subspecialty accreditation, the NBE helped to develop a proposal for subspecialty certification. Ultimately, the Residency Review Committee (RRC) for Anesthesiology approved the SCA's application to accredit cardiothoracic anesthesiology training programs. Board certification for adult echocardiography through the ASCeXAM began in 2001, while certification in Perioperative TEE through the PTEeXAM was first granted in 2004. Being recognized as a Diplomate of the NBE certainly deserves professional respect.

At present, the NBE Board of Directors includes representation from adult cardiology, pediatric cardiology, anesthesiology, and critical care/emergency medicine. The NBE's menu of offerings now includes a series of Examinations of Special Competence: in adult echocardiography (ASCeXAM®), in basic perioperative transesophageal echocardiography (Basic PTEeXAM®), in advanced perioperative echocardiography (Advanced PTEeXAM®), and in critical care echocardiography (CCEeXAM®). Re-certification exams in adult echocardiography and in perioperative TEE have also been developed, allowing physicians whose initial 10-year certifications have expired to update documentation of their skills and retain their status as NBE Diplomates. In addition, for the past seven years, the NBE has helped to organize a Spanish language, NBE-style examination by working with Spanish speaking colleagues in Latin America through the Sociedad de Imágenes Cardiovasculares de la Sociedad Interamericana de Cardiología (SISIAC).

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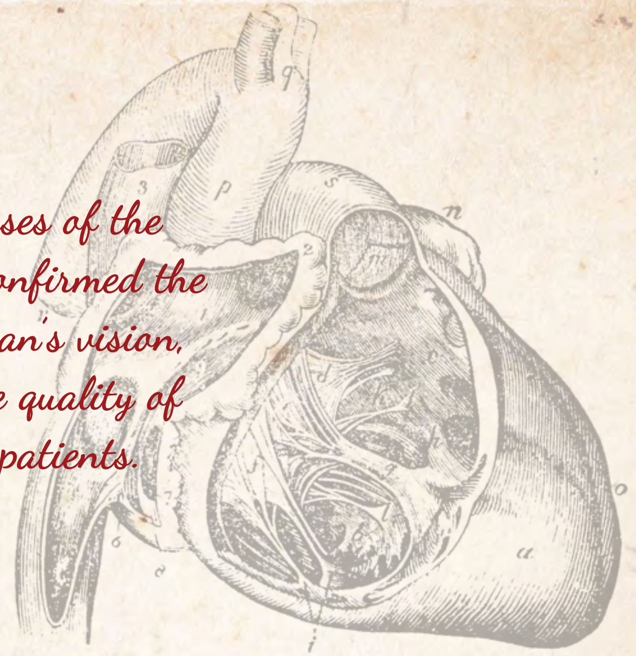
I believe that the principals who worked together to form the NBE were wise to adopt what appears to be a balanced structure, with representatives from both ASE and SCA functioning as equal partners. The role of NBE President has been filled by both cardiologists and cardiac anesthesiologists; the current President is Christopher Troianos MD, FASE, Professor and Chair of the Anesthesiology Institute at the Cleveland Clinic, while the President-Elect is Roberto Lang MD, FASE, Professor of Medicine and Director of the Noninvasive Imaging Lab at the University of Chicago. The NBE Board of Directors consists of representatives from those subspecialties in which cardiac ultrasound plays an important role (cardiology, cardiac anesthesiology, and critical care medicine). The use of cardiac ultrasound by other specialties continues to expand, and I would not be surprised if, in the future, the NBE were to become even more diversified.

The principal goal of the ASEeXAM, and the iterations that followed, was to improve the quality of echocardiographic studies. Importantly, it appears that this goal has been accomplished. As one of the original members of the ASEeXAM Committee reminded me, cardiology fellowship programs began to focus on echo training and to enhance the curriculum, at least in part because of the exam. More recent American College of Cardiology Core Cardiovascular Training Statements (COCATS) have increased the recommended time spent in echocardiography training. Increases in the number of textbooks devoted to echocardiog-

Ultimately, the successes of the NBE have not only confirmed the wisdom of Dr. Weyman's vision, but also enhanced the quality of care delivered to our patients.



raphy, and the courses specific to echocardiography (including several board review courses), are also noteworthy. Equally noteworthy is accreditation of fellowship training in cardiovascular anesthesiology, and recognition of the value of appropriate training in perioperative echocardiography. Board review textbooks have been written, and online practice exam simulations have been developed. I understand that psychometricians at the National Board of Medical Examiners have found that while the exam has not become easier over time, the passing grade has increased over the years, suggesting that the echocardiographic knowledge base among physicians in the field has expanded over the years.

The evolution of the NBE is an important example of how responsible professional organizations can take an active – and effective – role in promoting excellence in the performance and interpretation of cardiac ultrasound studies in patients in a wide range of clinical settings. It is also a noteworthy (and praiseworthy) example of how professional organizations can grow, adapt, and thrive by working together instead of competing with each other. Ultimately, the successes of the NBE have not only confirmed the wisdom of Dr. Weyman's vision, but also enhanced the quality of care delivered to our patients.

ACKNOWLEDGMENT

I must express my gratitude to my friends and colleagues (listed alphabetically) Stephen A. Goldstein MD, FASE, Michael H. Picard MD, FASE, Jack S. Shanewise MD, FASE, Daniel M. Thys MD, FASE, and Arthur E. Weyman MD, FASE, for their valuable input, which greatly enhanced the content of this article.

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A SHORT HISTORY OF

ASE's Scientific Sessions

On June 23-26, the 2023 ASE Scientific Sessions will be held in National Harbor, MD. This will be ASE's 34th Annual Scientific Sessions. Newer members of ASE may not be familiar with the evolution of this annual event, while some who have attended recent Scientific Sessions may have taken this meeting somewhat for granted.

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

Readers with strong math skills will figure out that the first ASE Annual Scientific Sessions were held in 1990, but the story starts a few years earlier. During the 1987-1988 term of ASE President Dr. David Sahn, ASE's Board of Directors discussed the idea of organizing and holding the Society's own national meeting. In 1988, with Dr. Sahn's support, Dr. Alfred Parisi, then the Chair of the Publications Committee, brought forward a proposal for discussion. Not surprisingly, several different viewpoints were raised. Some Board members argued that since all major professional organizations held their own national meeting, ASE should, too. Others expressed concern that the value of echocardiography should not be considered in isolation as a diagnostic imaging method, but rather should be viewed in a broader clinical context. They worried that if ASE were to hold its own national meeting, this would dilute the quality of echo research presented at the well-established national meetings of the American College of Cardiology (ACC) and the American Heart Association (AHA). Other issues of concern included the expense of organizing a new meeting, the reality that medical practitioners had many other opportunities to attend scientific

During the 1987-1988 term of ASE President Dr. David Sahn, ASE's Board of Directors discussed the idea of organizing and holding the Society's own national meeting.

meetings, and the uncertain fiscal viability of a "new" meeting focused specifically on cardiac ultrasound.

The January-February 1989 President's Message from Dr. Parisi, published in JASE (please remember that JASE was not published on a monthly basis until January 1998), mentioned that in July 1988 a preliminary survey indicated that the concept of holding our own national meeting was "favored by a 2:1 majority" of ASE members.[1] Dr. Parisi suggested holding the meeting "on a biennial basis starting in 1990" and speculated that "it should be a 3-day meeting possibly held in the last half of June at a site yet to be determined."[1] I would guess that Dr. Parisi suggested this timing to avoid conflict with the typical scheduling of the annual meetings of the ACC (March/April), the AHA (November), and the European Society of Cardiology (late August/early September). Dr. Parisi noted that "we will need to reach a final decision… sometime in the spring of 1989.

That decision was to go ahead with organizing and holding the first Annual ASE Scientific Sessions in June 1990. The Crystal City Marriott hotel in Arlington, VA, was selected as the meeting venue. As I recall, this site was selected for several reasons: it was convenient to a busy airport (at the time, Washington National Airport; now named Reagan National Airport), the location was relatively accessible to the majority of ASE members, the hotel appeared to have a sufficient number and size of meeting rooms and area for exhibitors, and it was available at that time. Dr. Julius M. Gardin was named as Chair of the Scientific Sessions Program Committee, and Dr. Randolph P. Martin was selected to serve as Co-Chair. I was given responsibility for the Abstract sessions. Planning for the meeting was certainly not as well-organized as in recent years, and at the time, ASE had a smaller staff to assist with planning. As a member of the Program Committee, I remember sitting with a group of colleagues in a meeting room in the basement of a Dallas hotel, probably in March of 1990 during the Annual Scientific Sessions of the ACC, helping to fine-tune the scientific program (speakers and topics) for the First ASE Scientific Sessions that would be held just 3 months later! As Dr. Gardin reminded me, sessions within tracks were arranged and re-arranged on a table by moving paper "blocks" on which sessions and individual presentations were handwritten. The benefit of personal computers would be a welcome development, but not for a few years!

FIGURE 1. 1990 Scientific Sessions brochure

I recall that the meeting planners and ASE leaders worried whether attendance at the first Scientific Sessions would be sufficient to justify holding future meetings of this nature. We thought that it might be reasonable to expect about 250 attendees. To everyone's great surprise and pleasure, 762 registrants showed up for the meeting! As I recall, the meeting planners arranged several "tracks" (the number was dictated by the number and size of the meeting rooms at the Marriott venue) that included plenary sessions, oral abstract presentations, and poster presentations. Exhibitors showed their products in an adjacent ballroom. The brochure for ASE's First National Scientific Sessions, lists some of the topics discussed at the meeting *(Figure 1)*.

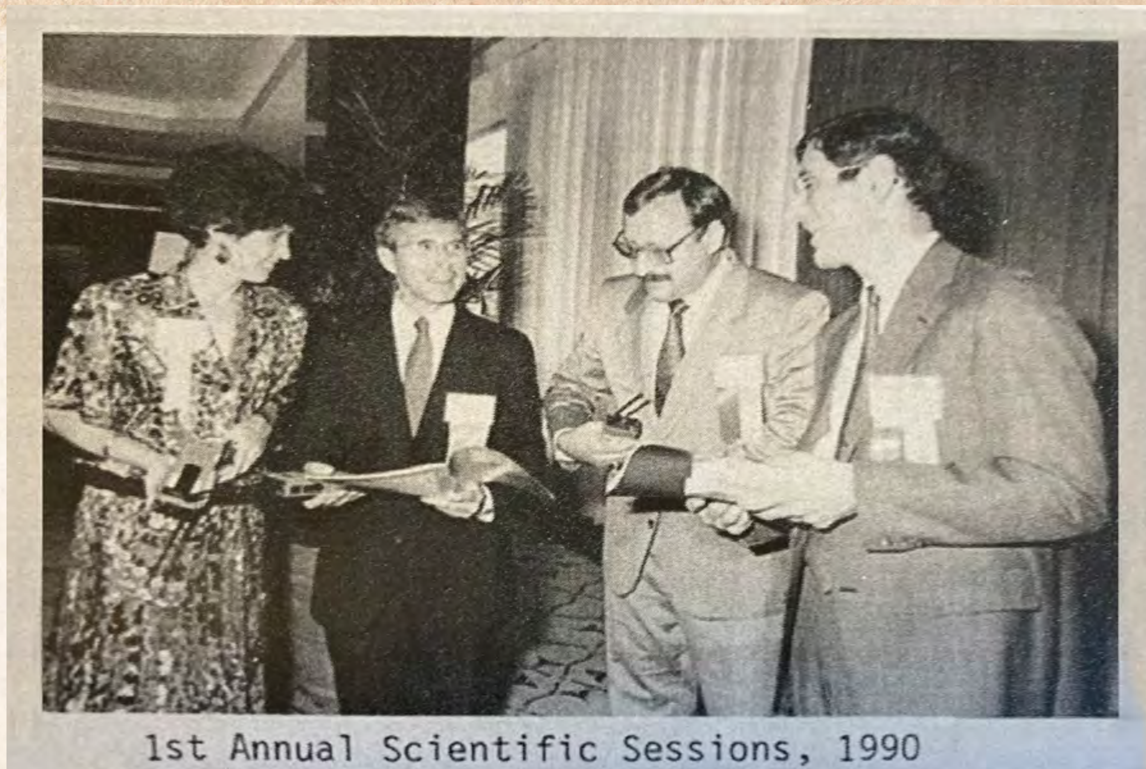

FIGURE 2. 1990 Scientific Sessions organizers

The organizers thought it important to be able to communicate with each other during the sessions. Today, everyone has their own smart phone and internet access is almost ubiquitous (certainly that is the case in hotels and conference centers), so contacting others can be done simply, quickly, and reliably. However, in 1990, the organizers had to depend on more quaint methods to keep in touch. *Figure 2*, which Dr. Gardin kindly provided, shows – from left to right – Sharon Perry CAE (ASE's executive director), Dr. Randy Martin (Program Co-Chair), Dr. Julius Gardin (Program Chair), and Dr. Alfred Parisi (ASE President). Astute observers will note that Ms. Perry, and Drs. Martin and Gardin, are holding bulky "walkie-talkie" devices that ASE had to rent so that the three of them could be in touch quickly. Lecture presentations were accompanied by 2x2 Kodachrome slides; the sophisticated presenters used dual Kodak carousel projectors! Showing video clips was not an option. Technology has certainly come a long way since 1990!

Based upon the success of the First Scientific Sessions, deciding whether to hold additional Scientific Sessions was a "no brainer." The Second Scientific Sessions was also held at the Crystal City Marriott in Arlington, VA. Dr. Martin served as Program Chair, I was the Co-Chair, and Dr. Harry Rakowski chaired the Abstract sessions. More than 1,000 registrants attended! The Third Scientific Sessions began the practice of rotating meeting venues. While most Americans (and most of our members) live in the Northeast, we thought it was important to give members from other parts of the country the opportunity to attend in person without always having to travel long distances. Hence, an effort was made to rotate meeting venues, including sites on the East and West coasts as well as nearer the center of the country. The Third Scientific Sessions was held in Boston in June 1992, during Dr. Weyman's term as ASE President, at the Marriott Copley Place Hotel. I served as Program Chair, assisted by Dr. Rakowski as Co-Chair. The Fourth Scientific Sessions was held in Orlando, in June 1993 at the Hyatt Regency Grand Cypress, with Dr. Rakowski as Program Chair. In June 1994, the Scientific Sessions was the first held on the West Coast, at the San Francisco Marriott Hotel; Dr. Jim Seward was the Program Chair. In 1995, the meeting was held for the first time in Canada, at the Sheraton Centre Hotel in Toronto. Rotating meeting sites continued; the 1996 Scientific Sessions was held in Chicago, the 1997 meeting returned to Orlando, the 1998 meeting was again held in San Francisco, and in June 1999, the 10th ASE Scientific Sessions was held in Washington D.C.

Over the years, the meeting continued to grow and evolve. One lesson was that most hotels did not have enough meeting room space to hold a series of simultaneous scientific presentations. Equally important was the need for a large exhibit area, convenient to the meeting sessions, so that the growing number of exhibitors could show their wares and interact with meeting attendees. Weather was another consideration; for example, large convention facilities in Anaheim, Dallas, Miami Beach, and New Orleans had plenty of space, but typical hot summer weather in mid to late June made these locations less than ideal. In June 2001, ASE Scientific Sessions moved to Seattle and for the first time, the meeting was held in a convention center. In more recent years, the Scientific Sessions have often been held at medium-sized convention facilities such as those in Boston, MA, Baltimore, MD, National Harbor, MD, Portland, OR, San Diego, CA, and Seattle, WA.

The first Scientific Sessions had a limited number of simultaneous sessions, in part because of the limited number of meeting rooms available. As attendance grew and larger facilities were booked, meeting content also grew in both size and diversity. A "sonographer track" was a new (and important) addition to the Fifth Scientific Sessions in 1995, and Sonographer Co-Chairs became a valued part of the Program Committee in 2014. With appropriate-sized meeting venues, organizers were able to target content to groups with specific interests. I am told that the 2023 Scientific Sessions will involve more than 400 faculty, and a total of more than 150 different "sessions" over a four-day period. At times, as many as 12 simultaneous sessions are planned, allowing (for example) concurrent focused discussions of artificial intelligence in echo, new guidelines for patients with hypertrophic cardiomyopathy, nomenclature in pediatric echo, and a series of business meetings for the various councils. As the Scientific Sessions have evolved over the past three decades, there is something for everyone. And I believe that the success of ASE's Annual Scientific Sessions has not diminished the quantity and quality of "echo research" reported during the annual meetings of the ACC and the AHA.

The feasibility of "virtual" presentations and attendance was proved during COVID, and the past several annual meetings have retained "virtual" in addition to "in person" attendance options. The ability to take advantage of virtual presentations allows those members who find it difficult to take time from work and to cover travel expenses to benefit from attending parts of the Scientific Sessions. However, I would argue strongly that participating in person is the best part, because it provides an opportunity for "networking," meeting with old friends and making new ones, and strengthening interpersonal relationships. When looking back on the first 20 years of ASE Scientific Sessions, Dr. Parisi is reported to have said that he was "proud that our meeting was able to showcase the same high-quality research seen at the large national meetings and yet maintain the comradery of a small, intimate gathering."[2] The term "comradery" can also be spelled "camaraderie" (both are correct); the word "camaraderie" is derived from the term "camarade," which the French use to describe a companion. To be fair, it appears that the French term was derived from Old Spanish, which borrowed it from the Latin term "camera," a room where one spends a lot of time. Nonetheless, the dictionary reminds me that "camaraderie" describes *"a spirit of good friendship and loyalty among members of a group."* For me, this is the highlight of the Scientific Sessions, and an important reminder that we are all part of the same team. We all learn from each other, teach each other, and are blessed to enjoy each other's company.

We all learn from each other, teach each other, and are blessed to enjoy each other's company.

I look forward to seeing many of you in June!

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OMG! HOW DID ASE GET ITS

Fabulous Staff?

Do you remember Henry Wadsworth Longfellow's poem about the "midnight ride of Paul Revere?" Were you taught that Paul Revere warned the citizens of Concord and Lexington (MA) that "the Redcoats are Coming?" As with many famous attributions, it seems that Paul Revere did not really utter those words. But any member of ASE who has attended one of the Society's recent annual Scientific Sessions will recognize the red coats (blazers) worn by the ASE staff who keep the meetings running like a fine watch. And the many members who have served on ASE committees, councils, or task forces know that it's ASE's terrific staff who keep the Society's activities on track.

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

I suspect that how ASE came to have its fantastic professional staff is a story unfamiliar to many members, but it's an interesting one that provides some lessons. Newer members may not realize that in the autumn of 1975, Dr. Harvey Feigenbaum founded ASE to create an organization representing practitioners of cardiac ultrasound. He thought that such a professional organization was needed to address inequities in reimbursement for ultrasound studies provided and interpreted by physicians from different specialty backgrounds. In the first years, the annual meeting of ASE members was held during the Annual Scientific Sessions of the American Heart Association, largely because the academic physicians who were the earliest adopters of cardiac ultrasound generally attended that meeting in order to present their newest research. The many important activities that are central to ASE's current portfolio evolved over time, but in the first years there was little need for a formal administrative structure. As I recall, during Dr. Feigenbaum's

Newer members may not realize that in the autumn of 1975, Dr. Harvey Feigenbaum founded ASE to create an organization representing practitioners of cardiac ultrasound.

Figure 1: ASE Board of Directors, June 2001. Sharon Perry is in the bottom row, at the far right. She preferred being included in a "group" photo rather than in a photograph of her alone, since she consistently thought that her role was to assist the Board, and not to lead it. While she may appear to be "off to the side", note how she managed to keep the Board members in perfect alignment, in a subtle but effective way! Some readers should be able to identify many of the 2001 Board members, but that's not the point of this article.

term as ASE's Founding President, correspondence was provided by his secretary in Indianapolis, Cheryl Childress. In 1979, the Society's "office" moved to Stanford, California, when Richard Popp became ASE's second President; his secretary, Gretchen Houd, dealt with ASE correspondence. Two years later, the Society's office moved down the coast to the University of California, Irvine, when Walter Henry became ASE's third President. Estelle Cohen, RN, who had accompanied Dr. Henry from the National Institutes of Health to UC Irvine, created a database of ASE members using an early computer system, looked after organizational activities, and provided administrative support.

An important inflection point occurred in 1983, when Dr. Joseph Kisslo became ASE's fourth President. Dr. Kisslo realized that as the Society continued to grow and as its activities expanded, it made good sense to have a permanent headquarters that did not move every two years to the office of whomever happened to be the next ASE President. In addition to his important involvement in the ASE, Dr. Kisslo was also active in the American College of Cardiology (ACC). Interested in investigating options for administrative support, he asked William D. ("Bill") Nelligan, III, CAE, then the Executive Director of the ACC, for suggestions. Mr. Nelligan recommended that Dr. Kisslo talk with Michael S. Olson, CAE, an Association Executive who ran an association management firm based in Raleigh, North Carolina. Serendipitously, Mr. Olsen's offices were conveniently located, not far from Dr. Kisslo's home. Dr. Kisslo did consider several other firms that were involved in the management of professional associations, but the path forward became very clear at a meeting in Mr. Olson's office, at which time Mr. Olson announced: "I'd like you to meet the person I'm proposing to run your society." That person was Sharon Perry, CAE, ***(Figure 1)*** who served as ASE's executive director for 18 years!

I was fortunate to work directly with Sharon during my term as ASE's 10th President, and even more fortunate to speak with her recently. Sharon reminded me that she grew up in "rural eastern North Carolina" and graduated from North Carolina State University with a degree in French. Early in her career, she worked for several years for Pan American Airways. I would bet that this experience honed her remarkable ability to deal with people (most of whom were not nearly as gracious as she) in a pleasant and effective manner. She told me that after leaving Pan Am, she worked with the North Carolina Welcome Centers. Her travel industry connections led to the Travel Council of North Carolina and the Olson Management Group (OMG). Sharon joined OMG in 1979, and the Travel Council was one of her first assignments. Sharon followed a course of study through the American Society of Association Executives (ASAE) and became a Certified Association Executive (CAE). While she had four years of experience in association management by the time Dr. Kisslo wisely selected her as ASE's first Executive Officer, Sharon reminded me that the range of Associations, and the kinds of activities they conduct, is quite wide.

Sharon recalls that when Mr. Olson gave her the responsibility for the "ASE account" in 1983, the Society had about 2,000 members. Sharon and one other OMG employee, Phyllis Johnson, handled most of ASE's organizational activities, including keeping a current member database, tracking and collecting dues, and corresponding with members through the "ASE Communicator," which – in the days before electronic communication – was sent to members via the U.S. Postal Service. Other OMG staff provided assistance for some projects, but their primary responsibilities were to other OMG activities and not to its ASE account. In fact, ASE did not employ Sharon and Phyllis; instead, the Society paid a "management fee" to OMG for the professional management services they provided.

In 1998, Mike Olson was selected to serve as the President of the ASAE; he moved to Washington, DC (the location of ASAE headquarters) and sold OMG to FirstPoint, an organization based in Greensboro, NC. FirstPoint had evolved from the Greensboro Merchants Association, and although ASE was apparently its largest client, FirstPoint had limited experience working with a medical society. Sharon noted that FirstPoint had little understanding of the inner workings and staffing needs of a professional society; for example, membership records and financial reports were generic ("one size fits all") for all of the client associations. The ability to tailor services and reports specifically to meet ASE's needs was extremely limited. As you can imagine, the importance of collecting "dues" was of relatively low importance to "hospitality center" clients; however, for the ASE, dues collection was a key activity needed to fund Society initiatives. In addition, it seems that several different FirstPoint Vice Presidents were responsible for different divisions under the organizational umbrella.

In 2000, David J. Feild, CAE, moved to Raleigh and became the CEO of FirstPoint Management Resources. David was familiar with the ASE since he had served as the Executive Vice President of the ACC, and in that role knew many of ASE's leaders. I had worked with David through ACC, and we shared a fondness for Bernese Mountain Dogs! David did add some stability to the management company, but he was not involved in day-to-day activities of the ASE. Sharon Perry remained responsible for ASE's management, and as the Society's portfolio of activities grew, Sharon added other staffers whose efforts were dedicated to ASE activities, although they were employed by FirstPoint Management Resources and did not work for the ASE per se. One of those young staffers was named Robin Wiegerink ***(Figure 2)***.

I also had the opportunity to speak with Robin at some length and learned that she grew up mostly in North Carolina where her father was a professor at the University of North Carolina in Chapel Hill. Robin attended Hope College (her mother's and father's alma mater), where she majored in Public Relations. Returning to North Carolina, Robin worked for an advertising agency that also handled associations, and eventually applied for a position at OMG, which had the reputation as the "best association management company in the area". As an employee at OMG, she worked for the Travel Council of NC and the International Council on Geriatric Cardiology. In

1994-95, one of Robin's OMG assignments was the role of ASE's Associate Executive Director. I learned that at that time, about 7 OMG employees worked on ASE-related projects (but most of them had additional, "non-ASE" responsibilities).

During my term as ASE President (1995-97), Robin lived in Seattle, and was employed by an association management company (Melby Cameron) based in the Seattle area, providing her with additional experience working as an Executive Director with several healthcare-related organizations. She also found the time to earn a Master of Nonprofit Leadership (MNPL) degree from Seattle University and a CAE from the ASAE. Robin moved back to the Raleigh-Durham area in 2000, and Sharon Perry quickly contacted her in a successful effort to persuade Robin to come back to FirstPoint. Robin reminded me that in 2000, FirstPoint assigned 12 staff to work on ASE-related projects, but these professionals did not work for the ASE, nor did they work exclusively on ASE-related issues. Apparently, there were occasional circumstances (I'll use the term "differences of opinion") where the FirstPoint perspective was not well aligned with ASE's organizational needs. One example mentioned to me was ASE's desire - in the early years of the 21st century - to develop its own website. Apparently, FirstPoint felt that ASE's online profile and activities should be part of FirstPoint's digital profile, and not a separate project controlled by the Society itself.

It became increasingly clear to ASE leaders that having the Society's administrative activities controlled by an association management organization, rather than by the ASE itself, had some important downsides. According to ASE Past-President Thomas Ryan, who was part of the leadership group between 2005-2009, one of those downsides was that other organizations began to recruit Robin. Under the contract with FirstPoint, ASE officers were not able to offer Robin the title of Chief Executive Officer,

Figure 2: Robin Wiegerink, seen to the right in this photo taken with some ASE staff during an ASE Foundation outreach program in West Virginia. From left to right: Andrea Van Hoever, Lori Smith, Mary Carmody, and Robin.

It became increasingly clear to ASE leaders that having the Society's administrative activities controlled by an association management organization, rather than by the ASE itself, had some important downsides.

or to set her salary at a competitive level. Tom reminded me that in 2007 ASE embarked upon a project to study the feasibility of hiring its own staff. Harry Rakowski MD, FASE (ASE's 12th President) and Diane Millman, Esq (ASE's very smart attorney at the time) provided important input. Sharon Perry was asked to serve as a consultant to this project. In the end, a wise decision was made. ASE chose not to renew its contract with FirstPoint, and to hire its own staff whose loyalties were to the Society and not to an outside company that sometimes had different priorities. Tom Ryan reminded me that it is not uncommon for a professional association to move from hiring its own staff to hiring a professional management company, but quite unusual for an organization to leave an association management firm in order to hire, supervise, and pay its own staff. It seems quite evident that ASE's has been a success story!

Robin reminded me that at the present time, ASE has about 17,000 members and 40 staff with a variety of responsibilities. Space does not allow me to discuss every staff member or their assignments, but I must confess that I've been in contact with many of them, and they could not be more helpful. ASE's staff may know how to "speak Southern," but they also know how to do their jobs in an effective, professional, conscientious, and gracious manner. Obviously, the staff have learned the skills modeled by Sharon Perry and Robin Wiegerink.

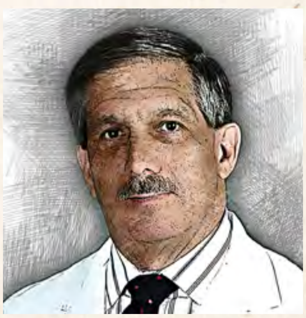
Robin and I agreed that it would be proper and fitting to mention several longstanding staff members. Mary Alice Dilday served for decades as ASE's Associate Executive Director and lastly as Vice President of Internal Relations. Mary Alice was a dependable and always knowledgeable source of information and good advice about the nuances of ASE's activities, and – as one of ASE's Past Presidents reminded me, she "knew where the bones were buried." Having retired a few years ago, Mary Alice is now herding her own cats, and not ASE committee members! I also had the good fortune to work with Rhonda Price, who was a key figure in the ASE Foundation's efforts to organize its Global Outreach program, allowing skilled sonographers and physicians, working on behalf of the ASE Foundation, to spend time and energy on a variety of medical "missions" in different locations in Asia, Central and South America, and several rural sites in the United States. By my count, the Global Outreach program has now affected nearly 20 sites, spreading knowledge and goodwill, and enhancing patient care. Another very noteworthy, skilled, and longstanding ASE staff member, Andrea Van Hoever, currently serves as the Deputy Director for both the ASE and the ASE Foundation. Andrea has provided support for over 21 years; she is exceptionally well-organized and has been a terrific resource to ASE members and to the International Alliance Partners.

Over the years, our two executive leaders (Sharon and Robin) have done a spectacular job in advising our volunteer leaders, providing continuity, identifying and hiring additional staff when new activities required additional administrative support, or when one or another staff member retired or moved on to other opportunities. I cannot comment individually on each of the ASE's current staff members, nor do I have the space to praise the professionalism and skills of the many staff who have helped me over the years. However, I can say with confidence that we are lucky to have such a fabulous professional staff.

Acknowledgment: I'm indebted to Sharon Perry, CAE; Robin Wiegerink, MNPL, CAE; Joseph Kisslo, MD, FASE; and Thomas Ryan, MD, FASE for taking the time to talk with me and to help me get the details right. I am fortunate to count them among my good friends.

DROLL DOPPLER *Details*

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



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

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

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

Who was Doppler?

I have seen Doppler's name listed in published articles as "Johann Christian Doppler," "Christian Johann Doppler," "Christian Johann Andreas Doppler," "Christian Andreas Doppler," and just plain "Christian Doppler." In his book "The Search for Christian Doppler," author Alec Eden unravels this confusing situation.[1] Doppler's father, Johann Evangelist Doppler, was a master stonemason in Salzburg, Austria. Johann Evangelist Doppler and his wife had two sons and two daughters. Their first son was named Johann Evangelist Doppler II. Their second son (and third child) was born in Salzburg in November, 1803. It seems possible that the surname "Johann" was erroneously attributed to Johann II's younger brother. In any event, Eden was able to find Doppler's birth and baptismal records in the Church of St. Andra in Salzburg. Those documents make it clear that the Doppler of the "Doppler effect," Johann Evangelist Doppler's second son, was christened "Christian Andreas Doppler." Doppler himself apparently never used his second name; his famous article "Uber das farbige Licht der Dopplesterne und einiger anderer Gestirne des Himmels", *[additional discussion below]* lists the author as "Christian Doppler."[2]

Old people who still watch News and Weather programs on television will be familiar with the Doppler technology used by the National Weather Service to map weather systems and to predict whether next Tuesday will be dry or a "soaker."

What about "Doppler Ultrasound"?

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

It should be apparent to readers that in 1842, neither Doppler nor anyone else had experience with, let alone imagined, "ultrasound." Hence, the term "Doppler ultrasound" could be viewed as a misnomer. The principle that Doppler proposed, which described a relation between frequency shifts and velocity, applied to visible light rather than to sound. Demonstration of the acoustic Doppler effect has been attributed to a Dutch chemist and meteorologist named Christophorus Henricus Diedericus Buys Ballot; his friends called him "Buys Ballot." In 1845, he tested Doppler's theory by arranging for a group of musicians to play a calibrated note while riding in an open car on a train on the Utrecht-Amsterdam line. Anyone who has listened to the pitch of an ambulance siren will not be surprised to learn that observers on the platform of a station heard the pitch of the calibrated note become higher as the train approached the station, and lower as the train passed by and moved away from the station. This supported the "acoustic Doppler effect" upon which Doppler ultrasound is based.[4]

The Japanese investigators who first applied this approach to the cardiovascular system thought that blood flowing toward an observer ought to be "warm" while blood flowing away from the observer ought to be "cool" – hence they depicted "flow toward" in red shades, and "flow away" in blue shades.

The Color of Color Doppler

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

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

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

PEDOF

Students of grammar (apparently an endangered species) will recognize that words written in ALL CAPITALS represent either a rant on a social media platform, or an acronym. Most readers will recognize the former, but some may not recall that an acronym is a word formed by a series of letters from a group of words. A familiar acronym is SCUBA, which is shorthand for "Self-Contained Underwater Breathing Apparatus." A simpler acronym is MS. Cardiologists and cardiac sonographers will recognize that "MS" stands for "mitral stenosis," but anesthesiologists might think that MS was shorthand for "morphine sulfate," a graduate student might think "Masters of Science," a psychiatrist might think of "mental status," a computer scientist would instantly recognize "Microsoft," and devoted follower of television programs would appreciate the reference to Marge Simpson. My point is that an acronym can be helpful for saving space in an article where the term for which it is shorthand is used repeatedly. The downside is that unless the acronym is defined clearly and unambiguously, it can be confusing.

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

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

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

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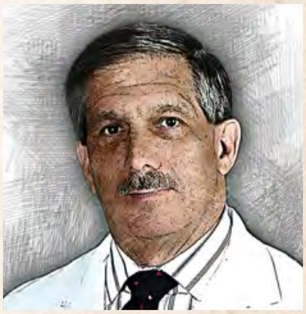
PEDIATRIC Echocardiography

In the early 1990s, ASE founded three Councils to represent three very important areas of echocardiographic practice. In the years that followed, other councils have been born, and – as the value of cardiovascular ultrasound in patient care continues to grow – the number and diversity of ASE Councils will surely continue to expand. The first three councils represented Cardiac Sonography, Perioperative Echocardiography, and Pediatric Echocardiography. The inception and evolution of Cardiac Sonography and Perioperative Echocardiography were discussed in several earlier articles in *Echo* magazine.[1-3] This article focuses on how the field of "Pediatric Echo" began.

As usual, identifying who was the first person to work in any discipline is difficult if not impossible, and pediatric echocardiography is no different. Often the first person to think of a new idea is not adept at implementing it, while sometimes the person credited with introducing a new application was a very effective proponent but was not the first to have used it. I do not know who was the "first" pediatric echocardiographer and am honestly not sure that it would be possible – or helpful – to claim to have identified such a person. Instead, I think it more relevant to acknowledge some of the early proponents of the value of echocardiography in children, and to discuss how they became involved in this field.

How to identify these pioneers? One obvious approach – and the one I've elected to follow – is to consider the pediatric echocardiography "gurus" (spiritual teachers) who were

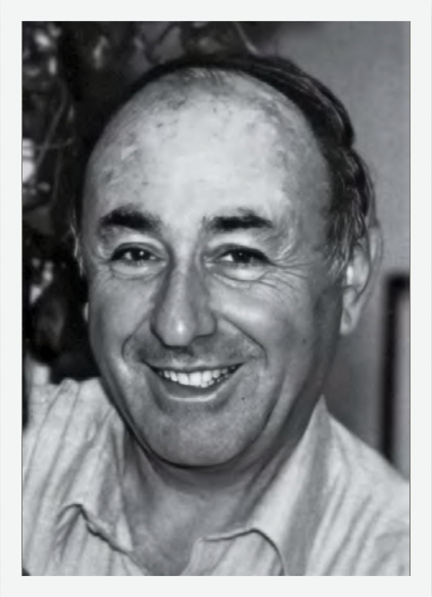


Contributed by **Alan S. Pearlman, MD, FASE,** ASE Past President, and Editor-in-Chief, Emeritus, *Journal of the American Society of Echocardiography* (JASE)

As usual, identifying who was the first person to work in any discipline is difficult if not impossible, and pediatric echocardiography is no different.

selected by ASE's Council on Pediatric and Congenital Heart Disease to receive the Founders' Award for Lifetime Achievement in Echocardiography for Pediatric and Congenital Heart Disease. Now given every other year, this honor has been awarded to nearly 20 remarkable individuals. Time and space limitations do not allow me to discuss all of them. Instead, I've opted – arbitrarily – to focus on the first four recipients of the pediatric Founders' Award. In the order in which they received the Award, they are Stanley J. Goldberg, MD (1997), J. Geoffrey Stevenson, MD (1998), Roberta G. Williams, MD (1999), and Norman H. Silverman, MD (2000).

In the "it's a small world, isn't it?" category, it turns out that Stan Goldberg and Harvey Feigenbaum were both undergraduate students at Indiana University (IU) in the 1950s. Dr. Goldberg told me that he was a year behind Dr. Feigenbaum, but did not get to know him until they were both medical students at IU in the latter half of the 1950s. I learned that in the mid-1960s, when Dr. Goldberg was a junior faculty member at UCLA, two engineers from the Bendix Corporation visited his laboratory and "said that they could make an ultrasound-tipped catheter that could be inserted into the left ventricle of an animal and used to measure flow." Although this was Dr. Goldberg's first encounter with ultrasound, he found the catheter difficult to steer and the signals hard to interpret. In the late 1960s, he ran into Dr. Feigenbaum at a meeting and learned that Dr. Feigenbaum and Dr. Richard Popp were using transcutaneous ultrasound to study the left ventricle. In the process of moving to Tucson in 1970 as Chief of Pediatric Cardiology at the University of Arizona (U of A), Dr. Goldberg asked the university to provide a Smith Kline Instruments echocardiographic device (the same equipment that Feigenbaum and Popp employed in their early studies in adults), which he used to evaluate his young patients. Dr. Goldberg visited the Feigenbaum laboratory and learned how to do better ultrasound exams in patients with congenital cardiac malformations. He said, "add me to the list of people who learned from Harvey."



Stanley J. Goldberg, MD

Still active clinically, Dr. Goldberg's practice now focuses on patients with lipid disorders, a topic of lifelong interest. Early in his career at the U of A, he co-chaired a panel on "Pediatric Echocardiography" at the American College of Cardiology's 1976 Scientific Sessions and lectured on that topic at too many national and international meetings to name. He was one of the original members of the Society of Pediatric Echocardiography (SOPE), an organization founded in 1975 "To provide a unique environment for the pediatric and adult congenital echocardiography community to collaborate with other imaging societies to promote networking, education, advocacy, research, and program development," according to its Mission Statement. Dr. Goldberg must be credited not only for his many individual accomplishments, but also for having the vision to put together a remarkable group of pediatric cardiology innovators in Tucson. The group of Drs. Goldberg, Hugh Allen, and David Sahn (known by some as the "Desert Dynasty") made many original observations in children using novel echocardiographic techniques which they helped to develop. Interacting with other "echo enthusiasts" and ultrasound engineers was of high importance. In the 1970s, visitors to Dr. Goldberg's laboratory included Drs. Joe Kisslo, Art Hagan, Ned Weyman, and Lilliam Valdes-Cruz (who was later recruited to join the pediatric cardiology faculty at the U of A); all of them made important accomplishments in the echocardiography world. Notable visitors from Europe included Drs. Otto Daniels (Netherlands) and Lindsay Allen (England), as well as Charles Lancée, a bright young Dutch engineer from the Thoraxcentrum in Rotterdam who was part of the team that invented the multiscan approach to cross-sectional echocardiography. Drs. Sahn, Allen and Goldberg also worked with Walter Henry and Jim Griffith from the National Heart and Lung Institute, who developed one of the first sector scanners. These collaborations allowed the Tucson group to use different real-time cross-sectional imaging systems to examine children with complex congenital heart disease. In 1975, Drs. Goldberg, Allen and Sahn published "Pediatric and Adolescent Echocardiography," the first text on that topic. Dr. Sahn served as ASE's sixth President and was the first pediatric cardiologist to hold that office. And, not surprisingly, Drs. Allen and Sahn were also recipients of the Founders' Award.

Dr. Jeff Stevenson graduated from Occidental College and received his MD degree from the Baylor College of Medicine in 1970. He did clinical training in pediatrics, and a fellowship in pediatric cardiology, at the University of Washington (UW). In 1974, he deployed to the Naval Regional Medical Center in San Diego, where he served as a staff pediatrician and pediatric cardiologist. During his tour of duty in San Diego, he was fortunate to interact with Dr. William F. Friedman, Chair of Pediatric Cardiology, who shared his interest in cardiac ultrasound. In 1976, Dr. Stevenson returned to Seattle as an Assistant Professor of Pediatrics on the tenure track in the Department of Pediatrics at the University of Washington (UW) School of Medicine. For almost 20 years, he was the Director of the Cardiac Ultrasound Laboratory at Seattle's Children's Hospital and Regional Medical Center.

Geoffrey Stevenson, MD

Dr. Stevenson was particularly active in the American Registry of Diagnostic Medical Sonography (ARDMS) and in ASE. He served two terms on ASE's Board of Directors and chaired the Pediatric Program for the Third Annual Scientific Sessions in 1982. This was the first Scientific Sessions at which pediatric/congenital heart disease sessions were included on each morning and each afternoon program, setting an important precedent. Jeff was also enormously helpful as an Associate Editor of JASE over the years 2008-2018, a period marked by substantial growth in the number of submissions focused on pediatric echocardiography. He was also a strong supporter of cardiac sonography. He served two terms on the Board of Directors of the American Registry of Diagnostic Sonography (ARDMS), chaired the ARDMS finance committee, and was active on a variety of ARDMS committees involved with examination development and certification. He was also a founding member of the International Cardiac Doppler Society, serving two terms as Treasurer of that organization.

Dr. Stevenson was one of the first clinical investigators to use pulsed Doppler echocardiography to evaluate intracardiac blood flow in children with a variety of disorders. In the 1970s and 1980s, pediatric cardiologists interested in cardiac ultrasound focused primarily on *imaging* anatomic features. Dr. Stevenson was among the first to appreciate the value of Doppler methods for distinguishing organized from disturbed intracardiac blood flow, and to focus on physiology and hemodynamics. In the ensuing years, echocardiographers learned that both anatomy and physiology are important, but it took some time for these initially disparate but inherently related elements to coalesce. His initial studies were done using a pulsed Doppler system developed in the UW Center for Bioengineering where a group of smart bioengineers, led by Donald W. Baker BSEE, were working to advance cardiac ultrasound technology. Initial studies, done with the help of sonographer Terryl K. Dooley, BS, employed a system that used time-interval histography to analyze the time course of Doppler shifts, a method that had important shortcomings but some clinical utility.

In the late 1970s, Dr. Stevenson worked with a brilliant young engineer named Marco Brandestini, BSEE, to evaluate the clinical applications of a digital multi-gate Doppler instrument that provided, for the first time, mapping of Doppler frequency shifts (in color) onto standard M-mode echocardiographic records. Working with colleagues in Seattle, Jeff was the driving force behind a series of investigations that defined multiple clinical applications of Doppler ultrasound in children with a variety of congenital cardiac disorders. He also had a strong interest in using transesophageal echocardiography in the operating room. He and Dr. Greg Sorensen (chief of Cardiac Anesthesiology at Seattle Children's Hospital) and their cardiac surgical colleagues demonstrated the value of pediatric TEE during the repair of cardiac defects. For his important contributions to the value of intraoperative TEE in children, Dr. Stevenson was awarded the 1992 *Christian Doppler Award of Echocardiography* by the International Society of Intraoperative Cardiovascular Ultrasound.

Dr. Roberta Williams grew up in Rocky Mount, NC. At age thirteen, she was examined by Dr. Helen Taussig, (one of the founders of the field of pediatric cardiology), a formative experience that led her to aspire to a career in cardiology. Appreciating the value of "North Carolina diversity," she earned her undergraduate degree from Duke and her MD from the University of North Carolina (UNC). As a senior in college, while working as a research assistant at UNC, she met Dr. Ernest Craige, the first Chief of Cardiology at UNC and a master clinician who was in the process of establishing several diagnostic techniques at UNC, including cardiac catheterization, vectorcardiography, phonocardiography, and pulse wave tracings. When Dr. Williams applied for a cardiology fellowship at Boston Children's Hospital (BCH) in the late 1960s, she already knew as much about heart sounds as the BCH faculty who interviewed her! After joining the BCH faculty in the early 1970s, she founded the echo laboratory, became the medical director of the surgical ICU, and worked in the operating room environment, correlating anatomic findings in children with congenital heart disease with the clinic consequences of the lesions identified. At the BCH, she had the good fortune to work with giants in pediatric cardiology and cardiac surgery, including Drs. Alex Nadas, Aldo Castañeda, and William Norwood.

Roberta G. Williams, MD

Dr. Williams recalled that the echo lab at the Boston Children's Hospital was founded in 1972 with a grant from the AHA for $15,000, which paid for both a Hoffrell M-mode machine and her salary for the year. She was soon joined by pediatric cardiology fellows Fred Bierman and Stephen Sanders, and later by Steve Colan, who made important contributions to the lab and to the field of pediatric echocardiography. They utilized a multiple view approach, including the subxiphoid window, with wide active element transducers (long focus) and the ability to flip the image when viewing from below. They found the subxiphoid views to be the most effective in diagnosing infants with congenital heart disease. The echo lab team coordinated closely with angiography (Dr. Ken Fellows in Radiology) and the surgical team to improve diagnostic accuracy in an era when surgical repair in infants was undergoing rapid evolution.

Having demonstrated her investigative and administrative skills at Boston Children's Hospital, Dr. Williams encountered a series of opportunities to provide major leadership at other institutions. From 1982-95, she served as Chief of Pediatric Cardiology at the University of California, Los Angeles. In 1995, she returned to UNC-Chapel Hill as Chair of Pediatrics. In 2000, she moved back to Los Angeles as Chair of Pediatrics at the Keck School of Medicine at the University of Southern California (USC), also serving as Vice-President for Pediatrics and Academic Affairs at the Children's Hospital of Los Angeles. Notwithstanding her administrative responsibilities, Dr. Williams has remained focused on how to provide better care to young patients with heart disease, especially during the sometimes complicated "transitions" between fetal and neonatal life, and between adolescence and young adulthood. She was the founding medical director for the Center for Healthy Adolescent Transition at the Children's Hospital Los Angeles and continues to see patients in that center's clinic.

Despite her busy academic and clinical activities, Dr. Williams made time to contribute to many professional organizations. She was a member of the ASE's first Board of Directors (1976-80) and served as ASE's Treasurer (1981-83). She was also very active in the American Academy of Pediatrics (AAP), the American College of Cardiology (ACC), and the American Heart Association (AHA). Her CV lists far too many important committee assignments and task forces to mention, but I note that she chaired the AAP's Section on Cardiology, co-chaired several of ACC's Bethesda Conferences, served on multiple NIH panels, and functioned as an adviser to a long list of educational institutions. Between 2009-2020, she was a consultant to the National Aeronautics and Space Administration (NASA). Now freed of many administrative responsibilities, she continues to mentor trainees and junior faculty, and remains active in patient care.

Norman H. Silverman, MD

Dr. Norman Silverman spent his formative years in South Africa. Following studies at the University of the Witwatersrand in Johannesburg, he left Johannesburg to pursue specialty training. In 1972, he moved to the San Francisco Bay Area to begin residency and fellowship training in Pediatrics, and has never left. He spent two years as a Cardiology Fellow at the University of California, San Francisco (UCSF). In 1974, he moved to Stanford University as an Assistant Professor of Pediatrics; a year later, he rejoined the UCSF faculty, where he rose to the rank of Professor of Pediatrics in Residence and served until 2002 as the Director of UCSF's Pediatric Echocardiography Laboratory. In 2002, he returned to Stanford as Professor of Pediatrics (Cardiology).

Dr. Silverman reminded me that technical issues influenced his introduction to echocardiography at UCSF. The UCSF radiologists had access to an M-mode system, but they considered that recording and interpreting an ECG signal (needed for timing of events) were deal-breakers. Perceptively, Dr. Silverman noted that "if cross-sectional imaging had been developed first, I believe that echocardiography would have remained in the hands of the radiologists." He also recalled that in the early 1970s, he and Dr. Nelson Schiller (recipient of ASE's 2014 Lifetime Achievement Award) were both UCSF cardiology fellows. Norman noted, wryly, that he and Dr. Schiller "shared the instrument on a 9 to 5 basis, which meant that Dr. Schiller had the instrument from 9 am – 5 pm, and I was able to use it after 5 pm!"

Among Dr. Silverman's many accomplishments, several stand out. Working with faculty colleagues in pediatric cardiology, he devised the left atrial to aortic root (LA/Ao) ratio, for many years the standard method for assessing left-to-right shunt size in premature neonates with isolated patent ductus arteriosus. With the advent of two-dimensional (2D) echocardiography in the mid-1970s, he worked with Varian instruments (based in the Bay Area) to modify their large transducer in a manner that allowed him to use it in infants and small children. He and Dr. Schiller also realized that a 2D scanner could be used to examine the heart from the cardiac apex, and they described the use of apex echocardiography for measuring left ventricular volumes (using the "apical biplane method of discs") and for evaluating congenital heart disease. Their landmark work helped to establish the importance of "apical views" in both pediatric and adult echocardiography. As technology evolved and clinical applications continued to expand, his interests also broadened. He was one of the early champions of the use of echocardiography in the fetus, and he introduced fetal echocardiography to some of the current leaders in that field.

An enthusiastic teacher and mentor, he helped to influence the early careers of many fellows with whom he worked, at both UCSF and Stanford, including Drs. Rebecca Snider, Gerard Martin, Michael Brook, Wayne Tworetzky, Mark Friedberg, John Simpson, and Meryl Cohen. For his exceptional skills as a teacher, Dr. Silverman was awarded ASE's 2008 "Excellence in Teaching in Pediatrics" award.

These four "founders" worked in different locations, with different equipment, different colleagues, and different clinical interests. However, their paths often crossed. Dr. Stevenson noted his appreciation for support provided by colleagues such as Drs. Goldberg, Allen, and Sahn in Arizona, and from Dr. Nils-Rune Lundstrom at Lund University in Sweden. Dr. Williams reminded me that early in their careers, Drs. Sahn, Silverman and she sometimes functioned as a "traveling show" extolling the virtues of different views of the heart. Using a linear array transducer with a long focus, Dr. Sahn emphasized the value of precordial views. Using a phased array transducer with a short and medium focus, Dr. Silverman was a proponent of apical views. Using a transducer with changeable short and long focus, Dr. Williams thought that the subcostal view was particularly helpful. Eventually, of course, they acknowledged that all three views were needed for a comprehensive assessment.

I believe that the careers of these four "founders" demonstrate some important common themes. First, while they came from different places and backgrounds, they were all captivated by opportunities to use novel non-invasive approaches to enhance their understanding of cardiovascular anatomy and function, and to provide a more sophisticated assessment of cardiovascular disease in children. This is particularly noteworthy because in the 1970s most cardiology specialists viewed cardiac ultrasound with great skepticism. Second, they understood the importance of technical excellence; "getting things done" was a goal, but "getting things done right" was even more important. Third, they all appreciated the importance of supporting each other and working with ultrasound engineers to make appropriate technical modifications needed to address the demands of examining children whose hearts were small and close to the transducer. A Venn diagram summarizing heart disease in children and in adults would show some overlap, but important differences between congenital and acquired disorders would be noteworthy. Technical factors often governed the conditions that could be evaluated and the speed of progress. The need for ultrasound probes with smaller footprints and higher carrier frequencies, the faster heart rates, the importance of right heart structures and the anatomic complexities in children required technical advances before the full value of echocardiography in children could be realized. That there were more adults than young children with heart disease meant that market forces encouraged technical developments in adult echocardiography before manufacturers focused on the equipment needed to study small children, whether in the outpatient setting, the operating room, or the maternal care clinic. Nevertheless, I'm struck that the founders of pediatric echocardiography, and the founders of adult echocardiography, shared the same motivation – to develop and employ novel non-invasive methods in order to enhance the care of their patients.

Acknowledgment: I'm indebted to Drs. Stan Goldberg, Jeff Stevenson, Roberta Williams, and Norman Silverman for their willingness to take some time to remind me of how they became interested in using cardiac ultrasound to enhance the care of children with heart disease, and for their friendship.

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