



*Providing necessary resources for the biomed community has been a driving force behind AAMI from the outset. An early committee meeting is shown here.*



*A 1975 meeting of the Board of Examiners for Clinical Engineering*

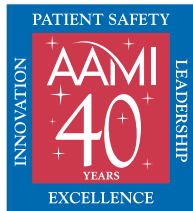


*This 1971 photo shows the BMET Certification Program receiving approval from the AAMI Education Committee. With its certification program, AAMI helped launch the biomedical equipment technician and clinical engineering professions.*



*Bill Staewen's biomedical shop at Johns Hopkins Hospital, circa 1960.*

# AAMI and the Engineering Community



## Pioneering Engineer Recalls Launch of In-House Clinical Engineering Service in 1962

*Longtime AAMI member William S. Staewen tells of his experiences launching one of the first organized medical equipment programs at Sinai Hospital of Baltimore.*

**I was invited** to establish medical engineering services at Sinai Hospital of Baltimore in 1962 after working as a medical instrumentation engineer at the Johns Hopkins Hospital for almost three years. While I had been principally involved in research projects at Hopkins, my mission at Sinai was to be

intimately involved with patient care equipment. This was the vision of Dr. Bernard Tabatznik, Director of Cardiology.

This mission included not only maintaining and repairing equipment, but also operating equipment during procedures such as cardiac catheterization, open heart surgery, elective cardioversions, and cardiac pacemaker implantation. All of these medical procedures were just being developed. Not only did I have to become expert with a number of new devices, but

I also had to become proficient in the basics of cardiology and electrocardiology. I was fortunate to have some very good medical mentors.

It also became immediately obvious to me that the medical, nursing, and technologist staff needed considerable assistance and training in the proper and safe use of various electromedical devices. Therefore one of my first tasks was to prepare and schedule inservice programs for the clinical staff.

Preventive maintenance, repair, and testing of the electromedical equipment presented some unique challenges. Test equipment specific to medical devices generally wasn't available. Thus I had to design and fabricate my own defibrillator, electrosurgical and pacemaker analyzers. And, of course, at this time there were no medical device standards.

In 1964 reports started to appear in the medical literature concerning electrocution hazards involving indwelling pacemaker electrodes and medical apparatus. Suddenly the whole medical engineering world changed and it was obvious that an in-house Clinical Engineering Department would be an essential part of most hospitals. So we thought!



## Early AAMI Leaders Saw Need for Engineering Expertise

In the mid-1960s, the number of medical devices in hospitals was exploding, as was the complexity of those devices. AAMI's early leaders were concerned about who was watching all of that equipment. Service was provided almost exclusively by manufacturers. Hospitals struggled to get their hands on service manuals and spare parts. Few hospitals had engineers on staff, and even fewer had organized medical equipment maintenance programs.

AAMI's physician leaders knew that the engineering community was a hugely important partner in the effort to ensure the safety of medical instrumentation. Their services were badly needed in hospitals to manage these devices that were becoming so central to patient outcomes. In response, AAMI undertook several initiatives to help promote the biomedical equipment technician and clinical engineering professions.

*Our concern was that we had a lot of people using this complex instrumentation, but nobody was maintaining it.*

AAMI founder John Abele

*I had a nagging feeling that somebody in the hospital ought to be keeping a closer eye on that equipment.*

Bob Stiefel, on his first job at the University of Rochester—Strong Memorial Hospital in the mid-1960s



### **Hospitals Magazine Survey: Manpower Needed to Maintain Biomedical Equipment**

As more sophisticated equipment becomes available to hospitals with 51 to 100 beds, the problem of maintenance of biomedical equipment will become critical because they do not have the qualified personnel necessary to maintain it. . . . There is a serious lack of manpower to maintain the biomedical equipment that is available.

—Survey reported in the June 1, 1971, issue of *Hospitals*

*This pyramiding series of major responsibilities [for medical equipment] cannot be handed over to the “local handyman.” . . . there is no substitute for a reliable “in-house” capability consisting of a comprehensive staff of skilled, well-informed technicians with suitable tools and adequate working facilities.*

John C. Norman, MD and Lester Goodman, MD, *Medical Instrumentation* Sept/Oct 1966

## 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

1967

AAMI helps develop the first biomedical equipment technician (BMET) training programs and studies the need for the profession in partnership with the Technical Education Research Center (TERC).

# The Engineering Professions: Early Beginnings

## Biomedical Equipment Technician Profession

Medical equipment maintenance programs in the armed forces became common after World War II. In the private sector, AAMI's early leaders helped develop the first training programs for biomedical equipment technicians (BMETs). In 1967, the Technical Education Research Center (TERC), an independent, nonprofit research organization based in Cambridge, MA, and funded by the U.S. Office of Education, developed a two-year post-high school curriculum for BMETs. AAMI helped the center conduct a study of the need for biomedical equipment technicians in the health field, improve the BMET curriculum, and set up pilot teaching programs. AAMI also received funding to research and promote the profession at the hospital level.

### BMET Training Programs: A TERC Legacy

"When the development [of a curriculum] is completed in late 1970, it is projected that TERC will be able to provide course descriptions, laboratory guides, equipment lists, and general examinations that schools can adapt and adopt. Present indications are that the curriculum will be a two-year course of study with heavy emphasis on electronics and instrumentation and introductory work in 'biomedicine.' "

—W. D. Hubbard, "The development of educational programs in biomedical equipment technology,"  
*Medical Instrumentation*, July 1969



*AAMI researched the need for BMETs and sold hospitals on the idea. The hospitals had no idea how much it cost them to maintain instruments or how to do it. So AAMI told them.*

AAMI founder John Abele

*An early meeting of the BMET Board of Examiners, which would create AAMI's CBET certification program.*

### 1967 TERC Study of the Need for BMETs

Present opportunities for adequately trained BMETs: 4600

1970 projected need for adequately trained BMETs: 10,800

Average 1967 BMET salary: \$7,500 per year

BMETs Needed	Hospitals	Industry	Research Institutes	Total
1967	600	3,600	400	4,600
By 1970	1,100	8,100	1,600	10,800

By comparison, the Bureau of Labor Statistics estimates that there were 29,000 people employed as BMETs in 2004.

1969

Electrical safety scare led to a highly successful AAMI electrical safety workshop, held in New York. AAMI electrical safety exhibit created.

1971

BMET certification exam developed by Lt. Col. Burt Dodson. First AAMI Board of Examiners appointed. First exam given in the fall of this year.

# Clinical Engineering Profession

In AAMI's early years, the value of engineering expertise in the healthcare environment was just being recognized. AAMI's early leaders played a major role in putting the clinical engineering profession in the spotlight. AAMI's early efforts to promote the profession included seminars, a dedicated newsletter, and the launch of the certification program. Those efforts continue today in AAMI's publications and book series, the Annual Conference, and the efforts of the Technology Management Council (TMC).



The AAMI Education Committee discusses certification of clinical engineers.



## AAMI's *Clinical Engineering News* Launched in 1973, Distributed Nationwide

AAMI launched the newsletter *Clinical Engineering News* in January 1973. Its editor was Cesar A. Caceres, an AAMI founder and early advocate of the clinical engineering profession. In November 1973, the AAMI foundation received a \$50,000 grant from the Fannie E. Rippel Foundation to provide a year's subscription of the newsletter to every hospital and hospital-related association in the U.S. in order to promote the importance and utility of clinical engineering. It was also sent to all fourth year medical students. Subsequent grants ensured the nationwide distribution of the newsletter for many years.

## Robert H. Stiefel, CCE

Bob Stiefel, Chair, AAMI Board of Directors, 2006–2008, became a clinical engineer in the mid-1960s and has been involved with AAMI since the early days. He has been a leader in providing programming to the engineering community over the years, serving frequently as a course instructor, author, and committee chair. He has been the longtime chair of AAMI's Clinical Engineering Management Committee. He has also served on numerous AAMI standards committees, the *BI&T* Editorial Board, the Finance Committee, the Nominating Committee, and the AAMI Foundation. He is currently director of clinical engineering at the University of Maryland Medical Center.



# 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

1972

Eleven BMETs are the first to become certified.

1973

AAMI board approves clinical engineering certification program.

1974

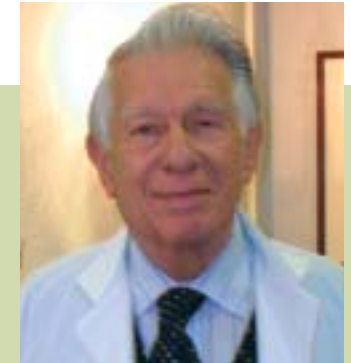
Six clinical engineers selected to serve as the initial Board of Examiners for the clinical engineering certification exam.

*Cesar Caceres realized that the term “biomedical engineer” did not truly describe what clinical engineers were doing in hospitals. Biomedical engineers typically work in industry, education, or government, not hospitals. Caceres felt that the hospital needed the judgment and experience that clinical engineers provided.*

Tom Hargest

### **Cesar Caceres, MD**

Cesar Caceres first joined AAMI’s Board of Directors in 1969, then served as AAMI’s president from 1971 to 1972. An early advocate for the clinical engineering profession, he coined the term “clinical engineer” in the mid-1960s. He organized several conferences for AAMI on topics such as clinical engineering and rising healthcare costs; won research grants for AAMI, many on topics related to clinical engineering; and edited several books on clinical engineering. He had a practice in internal medicine for 53 years and today is executive director of the Institute for Technology in Health Care in Washington, DC.



### **How Clinical Engineering Got Its Name**

By Cesar A. Caceres, MD

In the mid-1960s, a philanthropist from New Jersey who ran the Fannie A. Ripple Foundation was interested in what could be done for elderly ladies. He had heard we were involved in electrocardiographic computerization at the Public Health Service Medical Systems Development Laboratory. When he asked me what we were doing, I told him it was Clinical Engineering: trying to put Engineering into the Clinical world of medicine, so that our various disciplines could work hand in hand to improve health care in the reality of the practicing medical world.

Through daily contact I had grown to realize that the solution to healthcare is not just in the hands of scientists doing research or academicians or physicians with hands-on medicine—it must be in Clinical Engineering with a goal-oriented, problem-solving approach combining multiple talents.

The Ripple Foundation, after visiting us, gave out several grants to intensive care units and funded several AAMI projects.

*Since medicine is turning with ever increasing dependence to the engineer . . . some common understanding of the mutual problems must be sought. It is the purpose of AAMI to bring about such an understanding.*

John Merrill, MD, *Medical Instrumentation* editorial, July/August 1966

1982

First AAMI Regional Meeting, later renamed the Mid-Year Meeting, held in Philadelphia, PA.

1983

International Certification Commission for Clinical Engineering and Biomedical Technology formed through merger of the AAMI Certification Commission and the American Board of Clinical Engineering. AAMI serves as secretariat of the ICC.

# Electrical Safety Scare Puts Engineering Professions, AAMI in the Spotlight

The electrical safety scare of the early 1970s helped to solidify the importance of the BMET and clinical engineering professions to the hospital community. AAMI played a leading role in responding to the scare. Leaders such as John (Jack) Bruner, Dave Kelch, John Post, David Lubin, and many others helped the association respond. AAMI launched a series of electrical safety education programs and created a traveling electrical safety exhibit to educate medical audiences about the issue. In 1971, AAMI's first published standard focused on electrical safety. These efforts gained AAMI significant recognition in the hospital community for the first time.

*The AAMI electrical safety exhibit was taken to many medical meetings to educate the doctors. The message was as basic as the importance of using a three-prong, grounded plug, something we all take for granted today.*

John Post

## Electrical Safety Scare—Real or Imagined?

While concerns about electrical safety in hospitals had been prevalent throughout the 1960s, it was not until 1969 that the concerns gained widespread attention. Dr. Carl Walter, a well-known surgeon at the time, asserted in a series of major articles and television broadcasts that 1,200 patients were being accidentally electrocuted in U.S. hospitals each year. In 1971, Ralph Nader published an exposé citing that number in the *Ladies Home Journal*, and later even inflated that number to 5,000 deaths annually. National attention focused on the issue. Many hospitals developed in-house medical equipment management programs for the first time in response to the concerns.

The base claims behind the electrical safety scare—that at least 1,200 people were being electrocuted every year in U.S. hospitals—ultimately were debunked. But the scare did focus nationwide attention on equipment safety and ensured that basic safe electrical practices were implemented nationwide.



## 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

1986

Lt. Col. Burt Dodson, Jr. receives the first AAMI Leadership Award.

1991

First annual clinical engineering management seminars held.

1992

The certification program adds a 3-year renewal process to add value and increase credibility to the CBET, CRES, CLES, and CCE programs.

*It has taken a long time—over a decade after ‘the slaughter in our hospitals’—to be able to say with reasonable certainty that it simply didn’t happen. The 5,000 bodies were never found because there weren’t any.*

From *Electricity, Safety and the Patient* by John M.R. Bruner and Paul F. Leonard, page 194

**John M.R. Bruner, MD**

John (Jack) Bruner, an anesthesiologist at the Peter Bent Brigham Hospital in Boston, MA, played a leading role in helping AAMI respond to the electrical safety scare of the 1970s. Along with John Post and Dave Kelch, he helped design AAMI’s electrical safety exhibit. He was also an active participant in standards committees related to electrical safety and blood pressure measurement over the years.



**David Kelch**

Dave Kelch, an electrical engineer, helped AAMI put together its electrical safety exhibit in the late 1960s. He went on to play an active role in AAMI over the years, serving in the 1980s on the publications committee that helped set up AAMI’s new journal, *Biomedical Instrumentation & Technology*. He spent more than 30 years working in Hewlett-Packard’s medical division.



*AAMI’s electrical safety committee discussing the safe current limits standard.*

1997

In response to the changing U.S. environment, the United States Certification Commission (USCC) is established. The U.S. Board of Examiners, BMET and CE, report to the USCC, which in turn reports to the ICC.

**AAMI Took the Lead on Electrical Safety Education**

March 1968 • AAMI provided members a bibliography on electrical hazards, injuries, and related accidents.

December 1970 • AAMI held the first **electrical safety workshop** in New York City. An audience of 200 listened to doctors, engineers, and industry representatives make practical presentations with Q&A sessions on how to use equipment safely. That workshop would grow into a successful nationwide series that helped put the young association on a firm financial footing for the first time.

February 1970 • AAMI presented its **electrical safety exhibit**, “Seven Steps to Electrical Safety,” for the first time at the 1970 annual meeting of the American College of Cardiology, New Orleans. This exhibit presented seven practical steps to improve electrical safety in the hospital and demonstrated testing devices for the determination of safe or unsafe conditions. The exhibit was shown for several years at major medical meetings throughout the United States. A **brochure** by the same name was also created and distributed to great demand wherever the AAMI exhibit was shown.

September 1971 • AAMI’s subcommittee on electrical safety published its **safe current limits standard**, “Recommended AAMI safety standard for electromedical apparatus, Part I: Safe Current Limits,” in *Medical Instrumentation*.

December 1971 • AAMI helped develop a **film series** for nurses, technicians and physicians on electrical safety in the hospital. These films were designed to foster a clear understanding of safe conditions, and reduce the hazard of electrical shock to patients and hospital staff. Topics included “How electricity works,” “Electrical safety in general care” and “Electrical safety in special care.” Delmar Snider, MD, Stanford University Hospital and Dave McKinney, University of California Medical Center, worked on the films.

2003

AAMI launches Technology Management Council, which serves the interests of and provides benefits to BMETs, CEs, and other medical technology professionals.

# AAMI Certification Programs Bring Recognition, Prestige to BMET, CE Professions

AAMI's early leaders and those in the emerging engineering professions knew that a credible certification program would help the new BMET and clinical engineering professions gain recognition and acceptance in the healthcare community. Toward that end, separate efforts were launched to develop certification programs for each profession. The goals of both programs were to:

- help America's healthcare community identify qualified individuals with the skills required to support increasingly complex biomedical equipment systems;
- provide a means by which those individuals could be recognized for their unique experience and knowledge;
- provide definition to the developing profession; and
- improve patient and public healthcare safety by creating a certification of competence.

*The defining factor in AAMI's relationship with and programming for BMETs was the development of the BMET certification exam by Lt. Col. Burt Dodson in the early 1970s. He had a major role in training Air Force BMETs and took his knowledge and developed and tested the first BMET exam for AAMI.*

Mike Miller

*The visionaries of the industry at that time saw the clearly growing need to recognize and identify individuals with the unique skills necessary to adequately support the technology-driven healthcare future they saw unfolding.*

Mike Carver

## Growth of the CBET Program

In the early 1970s, AAMI leaders recruited Lt. Col Burt Dodson, who had managed a successful medical equipment support operation for the U.S. Air Force, to help them develop training programs for biomedical equipment technicians and eventually institute a certification program to solidify the growth of this new profession.

AAMI facilitated the many planning sessions that followed and, in 1971, established the pioneering Certification Commission. By establishing criteria for experience, knowledge, and education, the Certification Commission defined the minimum qualifications necessary for certification of BMETs. By the fall of 1971, the commission was ready to administer the first certification examination. A predominantly military group of veteran and well-accomplished BMETs received the first examination. In April 1972, the first AAMI CBET certificates were issued to the 11 individuals who passed.

A certification program for radiology equipment specialists (CRES) was added in 1979, and another for laboratory equipment specialists (CLES) in 1981.



## 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

*The title Certified Biomedical Equipment Technician (CBET) has long been the single most recognized and universally accepted credential by which BMETs can publicly demonstrate both their commitment and achievement in their chosen profession. In the credential-oriented U.S. healthcare environment, the letters CBET engender confidence, mutual respect, and acceptance by other healthcare professionals.*

Mike Carver

**Burt Dodson, Jr.,  
CCE**

Lt. Col. Burt Dodson, Jr., authored the first biomedical equipment technician certification exam and played a leading role in the establishment and growth of AAMI's certification programs over the years. He went on to serve as AAMI's first non-physician president from 1978 to 1979. Dodson's many contributions to the BMET profession were recognized in 1977 with the first SBET Lifetime Membership Award. From a 23-year career in the Air Force Medical Services, he joined the multi-hospital corporation Sunhealth (now Premier) and was the chief operating officer at retirement.



**Michael E.  
Carver, CBET, CCE**

Mike Carver has been involved with AAMI's certification programs for more than 20 years. He has chaired the International Certification Commission, the United States Certification Commission, and the BMET board of examiners. Carver had a 22-year career with the United States Air Force, where he directed worldwide clinical engineering operations, and recently retired from ARAMARK Healthcare Clinical Technology Services.



*Burt Dodson, Jr. [left] discusses AAMI's new certification program at an AAMI annual meeting.*

**Two Firsts**

In 1972, Herman D. Hubbard [left] of Fitzsimons Army Hospital in Aurora, CO, became the first person designated a certified biomedical equipment technician. Thomas Hargest earned the first certification as a clinical engineer in 1974.



**The Only One:  
Virginia Biomedical Engineer  
Holds All Four AAMI Certifications**

Christopher D. Riha of Virginia is the first and only person to earn all four certifications offered by AAMI. He earned the CBET designation in 1983; CLES in 1993; CRES in 1994, and in 1998 added the initials "CCE" to his name.



**It Pays to be Certified**

On average, respondents to a 2005 AAMI salary survey reported earning 5.7% more than those who were not certified.

# Growth of the Clinical Engineering Certification Program

The Clinical Engineering certification program had a very different launch than that of the CBET program. AAMI began the process by working with an Engineering Foundation-sponsored study group to initiate development of a program for the certification of the qualifications of clinical engineers. In September 1974, AAMI announced that six clinical engineers had been selected for certification by eminence after acclamation and public scrutiny.

These engineers constituted the initial Board of Examiners for clinical engineering certification. Tom Hargest was elected a chairman of the Board of Examiners by the group after its first meeting. This initial board of examiners developed responsibilities, rules and regulations for the Board; reviewed and approved certification procedures; and reviewed pending applications. At AAMI's 1975 Annual Meeting, 47 clinical engineers were formally certified. Over the 25 years that AAMI ran the program, more than 400 clinical engineers were certified. The application process for the CCE program under the International Certification Commission was suspended in 1999.

## Thomas S. Hargest, III

Tom Hargest holds AAMI certificate 001 in clinical engineering and served as the first chairman of the Board of Examiners for Clinical Engineering. He played an active role in AAMI through the years, serving as a director, vice president for clinical engineering, and chair of AAMI's Board of Directors from 1987 to 1988. He is retired from a post as director of clinical engineering at the Medical University of South Carolina.



*The first six clinical engineers certified by AAMI in 1974.*



Thomas Hargest  
Board Chairman

Saul Aronow

David Lubin

Malcolm Ridgway

Alexander Schwan, Jr.

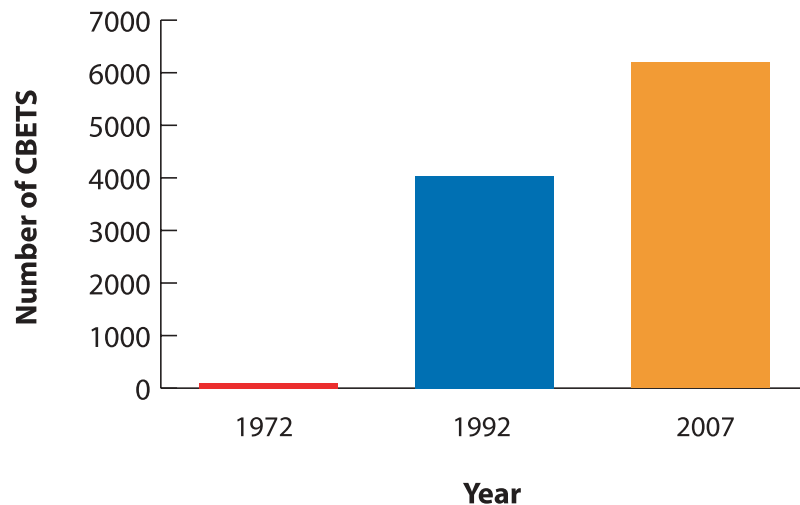
George N. Webb

# 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY



*Merger negotiators toast the newly formed International Certification Commission in 1983. Pictured from left are Cedric Walker, Barry Feinberg, and Gailord Gordon.*

**Growth in the Total Number of Certified Biomedical Equipment Technicians**



### Certification Milestones

- **1983 Merger Joined AAMI, ABCE Certification Programs**

In parallel with the AAMI process, the American Board of Clinical Engineering (ABCE) was also certifying clinical engineers. Having similar purposes, AAMI and ABCE were primarily differentiated by their audiences. The ABCE targeted graduating CE students, while AAMI's focus was directed toward experienced CEs and BMETs currently working in the clinical environment. A merger between these two clinical engineering certification programs became official at AAMI's 1983 Annual Meeting. The merger consolidated AAMI's Certification Commission and the ABCE into a new entity, the International Certification Commission (ICC).

- **U.S. Certification Commission Established in 1997**

By the mid-1990s, the growing complexities of certification in the U.S. environment and the expanding international focus of the ICC necessitated development of a body with a purely U.S. focus. In June 1997, the U.S. Certification Commission was established. Not only did this increase support for U.S. activities, but it further allowed the ICC to focus its efforts more equitably among international constituents.

- **The International Certification Commission Today**

Today, the International Certification Commission (ICC) consists of certifying bodies and other interested organizations from around the world and serves as an overarching framework certifying Biomedical Equipment Technicians and Clinical Engineers. A common misconception is that when an individual becomes certified as a CBET, CRES, or CLES, they are certified through AAMI. In actuality, they are certified through the ICC, of which AAMI is the Secretariat.



## BMET Newsletter Launched in 1974

*BMET News* premiered in late 1974 to provide a forum for BMETs to comment on and discuss educational, technical, governmental, certification, and other issues for resolution by the BMET community. The newsletter was published bimonthly until 1984, when its content was merged into *AAMI News* and the AAMI journal.

A 1975 BMET organizational meeting.



### 1975 Article Highlights Need for BMET Certification, Representation

The following article is excerpted from "Why a BMET Society?" published in *BMET News*, May-June 1975, by David E. McCanna, CBET, Trumbull Memorial Hospital, Warren, OH.

The BMET of the 1960s, where was he? Nowhere. Nobody recognized us except on an individual basis. Few companies supplied literature. . . . Often we had to prove to the salesman that we were qualified to repair the machine, if we could get parts lists, schematics, etc.

I was hired [by a hospital] in 1968 as a rather highly paid mechanic since "the hospital only has a few hundred of those machines, you wouldn't be doing that full time anyway." . . . After I began my present job in 1968, I found the civilian life of a BMET not so rosy. I started to look for an organization to help improve our position. I wrote dozens of organizations in the hopes of finding one that was interested . . .

Then I heard about the TERC report on the BMET career field and contacted them. They, in turn, advised me that AAMI was investigating the needs for certification. My first letter to AAMI was dated November 27, 1970 . . . I asked "are you going to open a registry?" No more than 5 days later a letter came back with the greatest news I had heard in many a day, and, I quote Mr. Miller, executive director of AAMI: "At the present time, an AAMI subcommittee is working on an examination for biomedical instrumentation technologists. . . . This examination would be the first step in an AAMI program for the certification of technologists."

. . . Where else but AAMI would we find an organization willing . . . to establish a program for us? Who else is prepared to establish meetings and seminars for the BMET? AAMI presently has had over twenty such meetings. Who else has gone to the government on behalf of BMETs? AAMI did. They went to the civil service and fought for a change in the classification of the BMET to a professional.

AAMI is the best organization to represent us, and they are the only one who cares about us. . . . The reason they do it: "to improve the health care industry."



# 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

# Society of Biomedical Equipment Technicians (SBET) Launched in 1976

The Society of Biomedical Equipment Technicians was officially launched in March 1976 at AAMI's 11th Annual Meeting. Through the late 1990s, SBET worked to advance the training of BMETs and to promote the profession. That role within AAMI is played today by the Technology Management Council.

## SBET Presidents

1976	Joe Squatrito	1986	Terrance C. Clemans
1977	Charles Pavesi, Jr.	1987	Jessie F. Williams, Jr.
1978	Barry Altman	1988–89	Terrance C. Clemans
1979–80	John W. Cates	1990–95	John Koberstein
1981	Vincent Rauscher	1995	Robert Hugh Larkin
1982	James Wallace	1996	Steve Haupt
1983–85	Raymond E. Walroff		

## Charles A. Rawlings, PhD, CCE

Charles A. Rawlings, AAMI's president from 1982 to 1984, played an active role in developing AAMI's certification program, eventually heading up both the BMET Board of Examiners and the Certification Commission. He designed and directed the Seminar in Biomedical Instrumentation, an intensive short-course for BMETs and CEs that would be presented for 34 years at various universities in the United States. He was recognized in the 1980s for his service to the BMET community with a lifetime membership in the Society of Biomedical Equipment Technicians. He was also Editor-in-Chief of *Medical Instrumentation* from 1987 to 1989, and served on the AAMI Foundation. He is professor emeritus of electrical and computer engineering at Southern Illinois University, where he directed biomedical engineering for 33 years.



# The Professions Today

## What do BMETs do?

Biomedical equipment technicians (BMETs) are responsible for servicing and maintaining medical equipment and technology for hospitals and other healthcare facilities, manufacturers, and third-party service organizations around the world. Skilled technicians help acquire, install, use, maintain, and train healthcare personnel to use cutting-edge medical equipment. BMETs also coordinate contracts and play a key role in investigating device-related problems.

## Employment Projected to Grow

The long-term employment outlook for BMETs is strong. The U.S. Department of Labor projects that the number of jobs in the U.S. will increase between 21 and 34 percent through 2010. With the rapidly expanding elderly population, demand for healthcare professionals will remain high. As medical equipment becomes increasingly complicated, the need for highly trained technicians will be a necessity for hospitals and healthcare facilities in all parts of the world.

*This job is a perfect fit—  
working with people,  
managing projects,  
troubleshooting  
equipment repair, and  
knowing what we do  
makes a difference.*

Vickie Snyder, Fairview  
Southdale Hospital



# AAMI's Technology Management Council (TMC) Supports BMETs, Clinical Engineers

In December 2003, AAMI announced that it would create a new Technology Management Council, or TMC, to better serve the interests of biomedical equipment technicians, clinical engineers, and others who provide management and support services related to medical technology. The idea for the committee grew out of a study of AAMI's technology management members which showed that new services were needed.

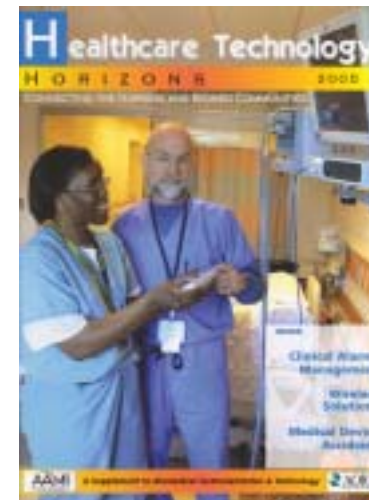
The council is designed to provide the clear focus necessary to enhance the recognition and services that technology managers need and deserve. It includes 21 AAMI members and a five-member Executive Committee.

The TMC's goals are to:

- Work to increase the recognition of technology managers and their important role in health care.
- Serve as a focal point for formulating AAMI policies and programs for technology managers.
- Assist staff and the AAMI Board with the development of strategic and business plans.
- Work to optimize communications between this segment of the membership and other members of the healthcare community.

*This is a great step forward, and will serve as an important avenue to advance the interests of BMETs and clinical engineers.*

TMC chair  
Ray Laxton



*The TMC has launched a series of supplements to AAMI's journal, Biomedical Instrumentation & Technology. Healthcare Technology Horizons focuses on issues of interest to the nursing and biomed communities; IT Horizons has explored information technology issues in healthcare.*

40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

In Response to Member Needs . . .

## AAMI Launches Major Benchmarking Project, ECRI Assigned a Lead Role

AAMI has selected health research agency ECRI to conduct the first phase of a benchmarking project designed to help clinical engineering departments evaluate their performance, procedures, and policies at a standardized manner.

The ambitious project is a top priority for AAMI's Technology Management Council (TMC), which was formed in 2004 to help AAMI better serve the interests of biomedical equipment technicians, clinical engineers, and other managers of medical technology.

According to Ray Laxton, TMC chair, "this is a groundbreaking endeavor, because reliable benchmarks for clinical and biomedical engineering simply do not exist. The project has the potential to make an enormous contribution to our field."

For years, benchmarking has posed a challenge in the clinical/biomedical technology field, in part because responsibilities and data vary so significantly from one facility to the next. As a result, it has been



Ray Laxton



Jonathan Goss

difficult to develop benchmarks to measure the value of technology management and hospital departmental and employee performance.

Nonetheless, hospitals and the clinical engineering and biomedical technology engineering community are constantly seeking information to assist them in benchmarking certain practices—on issues ranging from a department's costs to the number of devices the typical technician maintains at a given facility.

CONTINUED ON PAGE 3

*This Council is an important mechanism for AAMI to get a new perspective on the needs of technology managers and provide a means for addressing those needs.*

TMC member Steve Yelton, PE, of Cincinnati State Technical and Community College



## TMC Accomplishments

In its first three years, the TMC has implemented a number of important new benefits and services for BMETs, CEs, and other medical technology professionals. Among them:

- **Joint Commission Guidance**—Access to Joint Commission officials through a Q&A column and appearances at the Annual Conference. Plus, a new online community where AAMI members can share Joint Commission news and experiences.
- **New Career Resources**—Salary and fringe benefit surveys, a new CD filled with career tools and tips, a job fair at the Annual Conference, and free resume postings.
- **Increased Outreach to Biomedical Societies**—An online speaker's bureau to help societies find speakers for their meetings, a special new membership category for biomedical societies, and guidance to help societies organize and grow.
- **IT Resources**—The publication of three editions of a special IT-focused magazine and a new CD featuring useful IT articles and other resources.
- **Promotion of the Field**—The distribution of more than 7,000 brochures to attract new biomedes to the field.
- **Best Practices**—A new "best practices" column in AAMI's journal, a "Best Practices" award at the AAMI conference, and a major ongoing project to develop benchmarking data for CE departments.
- **Outreach to Nurses**—The development of two special editions of a publication focused on issues of mutual interest to biomedes and nurses.



## Ray Laxton

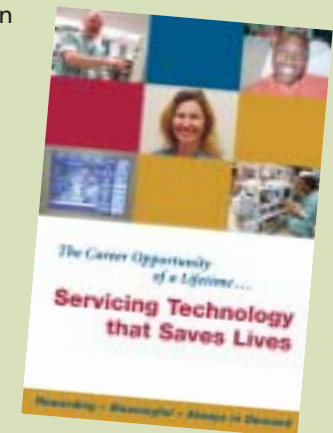
Ray Laxton currently chairs the Technology Management Council (TMC). He was previously a member of the BMET Task Force and serves on AAMI's Board of Directors.



He is director of clinical engineering with Clarian Health Partners/Aramark CTS.

*A survey of AAMI members helped the TMC identify the priorities and projects that we needed to tackle; and I'm happy to say the TMC has delivered more than was promised.*

TMC Executive Committee member Dave Francoeur, TriMedx Healthcare Equipment Services



# Engineering/Technician Tools

## Test Equipment in the Early Days of Clinical Engineering

by William S. Staewen

When I first started practicing medical engineering at Johns Hopkins Hospital in 1960 and later at Sinai Hospital of Baltimore in 1962, there was no commercially available test equipment for patient care devices such as defibrillators, patient monitors, electrosurgical machines, and blood pressure monitors. This pretty much held true into the 1970s. My colleagues in the field and I had to improvise most of the test equipment we used to evaluate and repair clinical instrumentation.

Most of the test devices I had to fabricate were very simple. To test electrosurgical units (ESU), for example, I used a voltage divider consisting of high wattage, non-inductive resistors in series with a light bulb. The values of the resistors were selected to cause the light bulb to be lit at specific output levels of the ESU. Occasionally we had to evaluate specific characteristics or effectiveness of the ESU simulating actual conditions. We would get the hospital kitchen to donate a steak that we used as a simulated patient. Of course, the steak was never wasted!

My home-grown defibrillator analyzer also consisted of a high wattage voltage divider that included a 1 ohm resistor across which I connected an

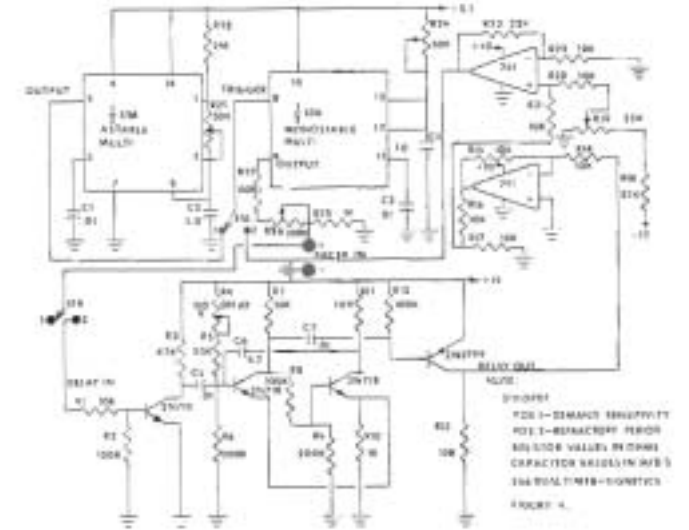
oscilloscope to analyze the  $I = E/R$  waveform. DC defibrillators were introduced around 1960 with their characteristic damped sinusoidal waveform. I would photograph the waveform and compute the area under the curve to determine the energy in watt-seconds.

I also designed and built my own external demand cardiac pacemaker analyzer. This instrument would measure the pulse rate, current amplitude, pulse width, demand sensitivity, refractory period, and sine wave frequency response. I still used this analyzer well into the 1990s.

We had to rely greatly on conventional test equipment to facilitate testing of medical devices. In Baltimore, we were able to obtain oscilloscopes, various test meters, waveform generators and electronic components at very low cost from a local prison. This military "surplus" equipment was sold through the prison to nonprofit organizations such as hospitals.

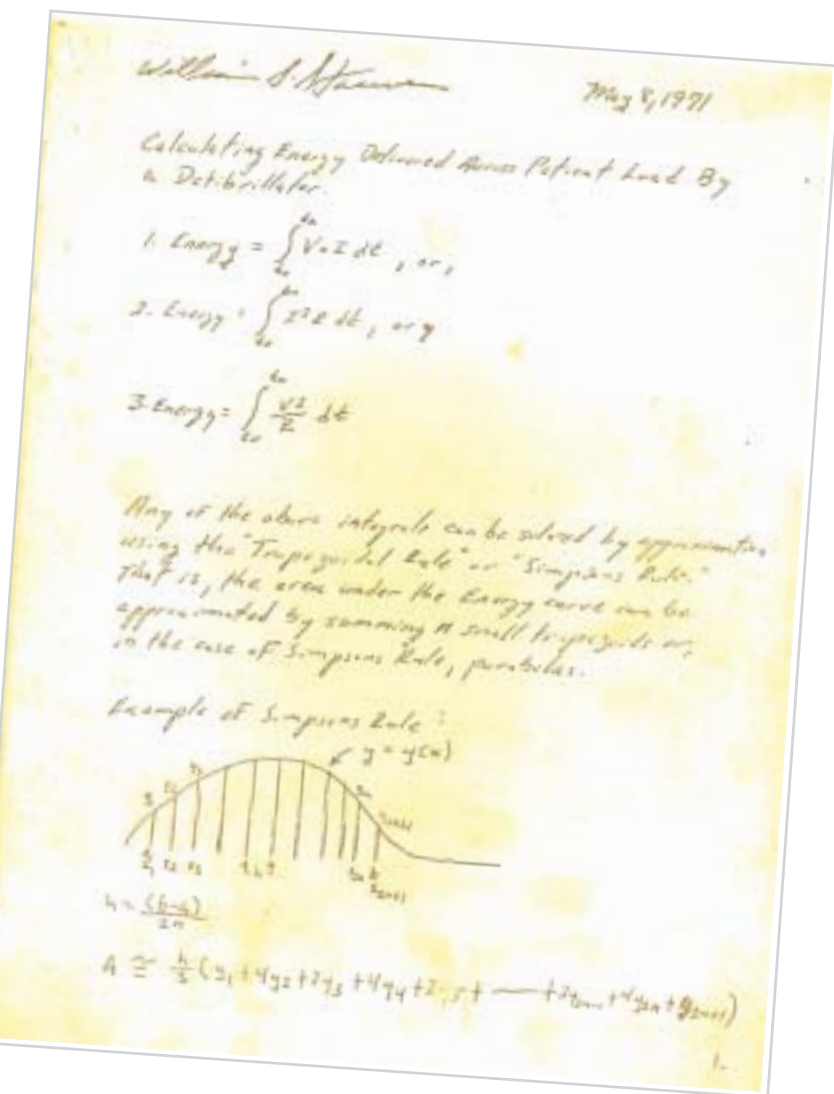


*In this shot of Bill Staewen's biomedical shop in 1960, the equipment rack with an empty panel is an electromyograph he was building. It is used to analyze nerve and muscle activity.*



*Schematic for Bill Staewen's external demand pacemaker analyzer.*

# 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY



Bill Staewen's notations on his methodology to compute defibrillator energy.

## Hickok Tube Tester

By Bob Stiefel

For a number of years after transistors were introduced, many devices still used vacuum tubes. It took many years before solid state electronics could match the characteristics of some vacuum tubes. One of many serious drawbacks of many vacuum tubes is that they wear out relatively quickly. When a device stopped working properly, one of the first things we would test would be the vacuum tubes—in particular, vacuum tubes in amplifier circuits.



Photo courtesy of Brent Jesse of audiotubes.com

Eventually, solid state electronics improved to the point that pretty much all applications for vacuum tubes were replaced by transistors and then integrated circuits. Gradually, the old ECG recorders and electrosurgical units that used vacuum tubes were replaced with solid state equipment. In some cases, we had to wait for some old physicians to retire before we could retire the cath lab system that they swore gave the only valid results.



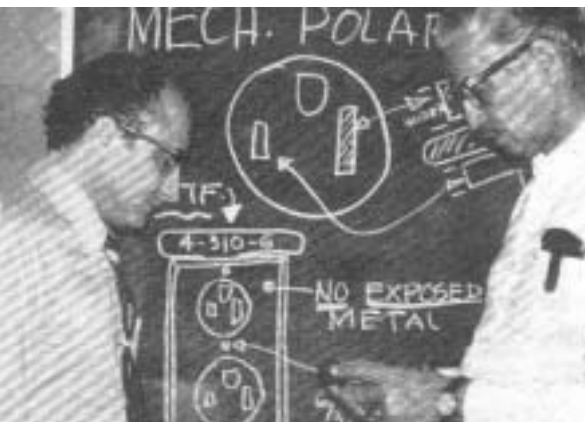
Bob Stiefel in a 1970s photo.



Photo courtesy of Brent Jesse of audiotubes.com

## Early Devices for Medical Safety

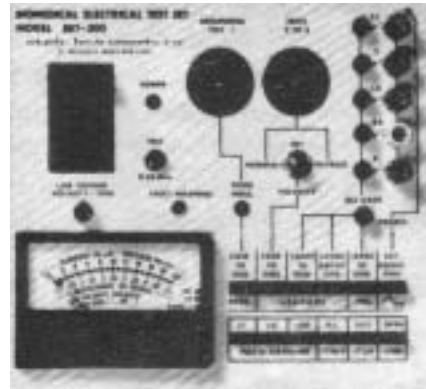
Denes Roveti helped form Ohmic Instruments Co. in the fall of 1969 at the request of David Lubin, who was the electrical safety officer at Sinai Hospital in Baltimore, MD. Lubin, a pioneer in electrical safety, was the first to use x-ray photos to show the defects in power line plugs used on medical equipment. He was the major catalyst and contributor to high reliability hospital-grade plugs and receptacles, and served for several decades on code committees. Ohmic was among the earliest companies to make electrical safety devices, and was an early exhibitor at AAMI annual meetings.



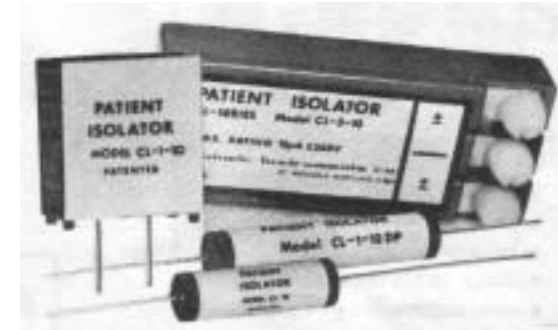
This 1970 photo shows Denes Roveti [left] and David Lubin discussing electrical safety.



The CS-45 Conductive Shoe Tester was used to check safe shoe conductivity before entering an operating room.



The rugged BET-200 Biomedical Electrical Test Set has changed little over the years and is still in production today.



In 1971, a patient isolator called the Shock Eliminator was patented. They are placed in series with every lead and are designed to open to avoid electrical shock during an EKG.



The RIN Receptacle Interrogator was introduced in 1974 to check the electrical safety of receptacles by ensuring proper wiring.



The LR-200A was a leakage resistance meter made to meet the NFPA and NEC 1971 standards. This unit became the SI-100, which is still in production.

# 40 YEARS OF PEOPLE, PROGRESS, AND PATIENT SAFETY

# Technician Tools Then and Now

Fluke Biomedical, a division of Fluke Corporation, has been serving customers of biomedical test equipment for more than 30 years, and has witnessed the steady evolution of the tools of the trade. The most obvious change from the old units to today's devices is the change in size. The early equipment was much heavier and more awkward. New technologies have reduced the overall size and made the units easier to use with simpler interfaces, better displays, and streamlined operations. Here, photos of old devices (on left) are coupled with today's versions (on right).



## International Electrical Safety Analyzer

The ISA470 uses an analog meter and has only five lead jacks, whereas the ESA601 has a digital display and can accommodate 10 leads. The ISA470 is built into a heavy Formica case, making it a cumbersome unit for onsite testing. Alternatively, the ESA601 comes in a smaller, lighter, and more durable package, ideal for portable testing.



## Defibrillator Analyzer

The QED-IIIS was a large unit that used an analog meter and was not capable of testing external pacemaker functionality. The QED 6H is lightweight and uses a digital display to play back the output waveforms. In addition to standard defib testing, the QED 6H has extended ECG simulation capability, programmable autosequences, and can also test transcutaneous pacemakers.



## ECG Simulator

The ECG-II is a large, heavy unit with many buttons, creating a burdensome manual user interface. The PS400 is small and easy to use with autosequencing capabilities, allowing users to perform ECG and QA testing more quickly.



## Electrosurgery Analyzers

The RF301B is a large and bulky ESU analyzer with an analog meter to measure current and power. The new RF303RS boasts a higher quantity of test loads, digital display, and simple interface, packaged in a more lightweight and compact case.



## Ventilator/Gas-Flow Analyzer

The old ventilator tester weighed nearly 40 lbs, vs. the VT MOBILE, which weighs approximately 1 lb. The VT MOBILE is a small, battery-operated unit that can perform bidirectional flow, volume, pressure, and oxygen concentration measurements.



## Ultrasound Wattmeter

The UW-1 was housed in a heavy wood case and used a latex membrane which was permanently filled with a water/antifreeze solution. This technology was inferior to today's technology because air would diffuse through the membrane, providing unstable and inaccurate readings if not regularly calibrated. The UW5 accepts ultrasound signals up to 10 MHz vs. the UW-1, which was capable of accepting signals up to only 1 MHz.