Like many biomedical equipment technicians (BMETs), Donald Gillespie came into the field with little idea of what to expect. An airplane mechanic until about nine years ago, he was looking for a career where he could make a difference in people’s lives. “Working for a hospital—that sounded like the best thing ever,” he recalled.

Following a job search, Gillespie landed at an entry-level job with a hospital-affiliated home health company in Greensboro, NC. There, he said, he spent most of his time repairing oxygen concentrators and liquid-oxygen units, as well as double- and triple-checking regulatory paperwork. “I was a biomed, but really in name only,” he explained. “At the time it was great, but looking back, I wouldn’t describe it as challenging.”

Eventually, Gillespie decided that it was time to take another step forward. On the strength of his six-plus years of experience, he applied for and passed the Certified Biomedical Equipment Technician (CBET) exam before joining the team at Cone Health, which also is based in Greensboro. “I can’t even describe how big a change that was,” he said. “I was basically thrown to the lions.”

In his most recent position within the five-hospital system, Gillespie was the sole BMET at Annie Penn Hospital in Reidsville, NC. “It’s small,” he said of the 110-bed facility, “but it’s certainly busy. And when you’re the only biomed in the entire shop, it can be really hard just to keep up.”

That was especially the case during the previous year or so, as an ever-growing number of installation projects cut into the
time he had for routine work. “Because everything’s on the electronic health record (EHR) now, anything that comes in has to be hooked to the network. So for me, on top of my normal day-to-day duties”—like handling work orders and responding to stat calls—“I was always on the phone talking with vendors and then working with the information technology (IT) techs to get things connected,” said Gillespie.

Recognizing how quickly healthcare technology is changing, and how biomeds’ responsibilities are shifting as a result, last year Gillespie decided to return to school. His mission: spend the next two years at at Guilford College in Greensboro taking coursework in programming, cybersecurity, and other IT-focused areas, with the ultimate goal of earning a degree in computing technology and information systems. Once he’s finished (in fall 2018), he plans to return to Cone Health with the skills he deems critical for success in this field.

“What I’m aspiring to do is to be a sort of liaison between the BMETs, the IT department, and health informatics,” he explained. “The hard part right now, when you’re in such a huge network landscape, is that communicating among these departments can be like playing underwater telephone.” If he can provide the link that helps people do their jobs, and if he can understand the interplay among their various roles, “everything will be a little easier for everyone involved,” Gillespie predicted.

Seeing the Big Picture
While Gillespie is completing his degree at Guilford College in Greensboro, other experienced healthcare technology management (HTM) professionals are keeping up with the times by enrolling in similar programs across the country. At Purdue University in Indiana, for example, many of the students in the school’s Healthcare Engineering Technology Management program also are employed in the field. “They were qualified for their jobs when they were hired,” explained the program’s director, Barbara Christe, PhD. “However, when they go to apply for a manager position, they’re told they need a bachelor’s degree,” she added.

The Purdue program offers both a two-year associate’s degree and four-year bachelor’s degree. In its literature, the school notes that graduates of its associate’s program become healthcare technology specialists, BMETs, biomedical electronics technicians, and clinical and biomedical engineers. The baccalaureate program, on the other hand, is designed to meet the “growing need for engineering technicians in the clinical environment who can support the rapidly expanding use of technology in patient care.”

Students in this track, many of whom already have an associate’s degree, learn to “integrate the technical/electrical/computer aspects of medical equipment with the needs of the medical staff and patients.”

According to Christe, that focus on integration reflects the ongoing evolution of the field. “The technical needs of the clinical

 BMET: I, II, III

HTM-related jobs run the gamut from biomedical equipment technicians, to clinical engineers, to specialists in areas such as radiology or network integration. However, one of the most common career paths in the field involves the I, II, III progression through the BMET ranks. All BMETs install, maintain, calibrate, and repair clinical equipment according to their respective facility’s medical equipment management plan. Here’s how the three BMETs differ:

BMET I. This is an entry-level position. The BMET I requires guidance and direct supervision by more-experienced HTM professionals when handling advanced assignments.

BMET II. Individuals at this intermediate level require minimal supervision and often assist less experienced technicians.

BMET III. These BMETs have demonstrated a mastery of the full range of tasks typically handled by HTM professionals outside of clinical engineering. They’re also capable of training others in the field and often spend time educating clinical staff as well.

“What I’m aspiring to do is to be a sort of liaison between the BMETs, the IT department, and health informatics.”
— Donald Gillespie, a biomedical equipment technician who is currently studying information systems at Guilford College in Greensboro, NC

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“Every one of our students gets multiple job offers before they graduate. To me, that’s a sign that the industry is hungry for young, experienced, and educated people who really understand new technologies and how to manage the risks that are associated with them.”

— Frank R. Painter, professor and internship program director in the Clinical Engineering Program at the University of Connecticut in Storrs, CT

setting are becoming more advanced every year,” she said. “As technology has evolved, our curriculum also has evolved.” For example, within the last several years, the Purdue program has added networking skills and systems analysis to its offerings, as well as training in tools like asset tracking. Process improvement and equipment life cycle management are two other hot topics, said Christe, as is integrating equipment with the EHR.

Christe, who was a clinical engineer (CE) at a hospital in Connecticut before returning to school to earn her doctorate, said that many of the program’s students eventually wind up working with outside service organizations. “Instead of just the traditional person who might work in a hospital in a shop supporting equipment, they’re getting these broader, overarching, project-based positions where they’re looking at systems” and their effect on care delivery in multiple departments, she said.

It’s a similar story at the University of Connecticut in Storrs, CT, where Frank Painter, MS, CCE, adjunct professor and program director of the school’s highly regarded clinical engineering internship program, shepherds between 8 and 12 students per year into area hospitals to gain on-the-job experience in real healthcare settings. Students in the program, which is offered through the school’s biomedical engineering department, obtain an MS BME (master of science in biomedical engineering) degree while completing a two-year internship at one of more than a dozen facilities across southern New England. Most then go on to jobs in hospital-based clinical engineering departments, though some take positions with independent service organizations, equipment planning firms, or medical equipment manufacturers. Painter said that UCONN graduates have taken positions in safety and risk management, acquisition and integration, and design and installation, and a couple grads became medical device project managers at the Food and Drug Administration. “Every one of our students gets multiple job offers before they graduate,” he noted. “To me, that’s a sign that the industry is hungry for young, experienced, and educated people who really understand new technologies and how to manage the risks that are associated with them.”

Something for Everyone

The industry is hungry for new and experienced hires, said Andrew Currie, MS, CBET, director of clinical engineering at The Johns Hopkins Hospital in Baltimore, MD. “We’re always looking for someone who can jump right in. We’ve hired students with no experience, and we’ve trained them in what they’ve needed to know. However, more often we take people who have had years in the field, mainly because that’s what’s presented to us,” he said.

When reviewing applications for open positions, Currie said that he and his colleagues look for two things: “First, you need to be curious about electronics—it’s really as simple as that. And then you need to be a real go-getter, and self-motivated to learn new things. Because you’re never going to know it all, you have to be able to teach yourself as you go through a system or the different parts of a device.” Those individuals who are ultimately hired then advance in their careers based on how well they do. “It’s pretty basic stuff,” Currie said. “You have to show that you’re capable of fixing complex issues with medical equipment; that you can save money for the hospital and our department; that you can work independently, you can take on calls, and you’re good with project management; and that you have the communication skills to train other people and work as part of a team. If you can demonstrate proficiency in all of those areas, that becomes the basis for promotion and advancement.”

Career trajectories for people in his department, which includes 45 CEs and BMETs serving two separate hospitals, typically follow one of two tracks, explained Currie. “We have a technical track”—the standard I, II, and III—“for those biomed
who want to stay focused on fixing equipment, and we have a team-lead and management track, for those people who want to get into managing the team and managing equipment and systems.” The department also includes a few specialty positions, like a human factors engineer who evaluates workflows and the use of medical equipment and issues that cause adverse patient events. In addition, some end up leaving the department to work in other areas within Johns Hopkins. One biomedical technician is now handling medical equipment projects for the construction department. Another decided to focus on financials and is now the purchasing director for Johns Hopkins Health System. Still others have taken jobs in areas ranging from computer networking (within the IT department) to surgical services management. Where people end up in their career at Johns Hopkins "really is up to the individual and what they're skilled in and what they're happiest doing," said Currie. "The knowledge that they gain in the biomed world is very flexible and often very general, and it can be applied to a lot of different areas. There's a little bit of everything for everybody."

A ‘Team Sport’
One individual who has used that line of thinking to make great strides in her career (see the September/October 2013 BlaT cover story, “Changing Faces”) is Carol Davis-Smith, MS, CCE, vice president of clinical technology with Kaiser Permanente in Oakland, CA. Davis-Smith, who provides strategic leadership and support to Kaiser Permanente’s HTM teams in seven regions, said that she never has a “typical day” on the job—a key reason why she loves her work. “It’s really what attracted me to clinical engineering, and it’s what attracts a lot of people to this field—the dynamic nature of what we do.” In her case, Davis-Smith said, “there’s so much going on all the time. I’m constantly looking at different parts of the puzzle, trying to understand this system of systems and what happens when one system interacts with another.”

Kaiser Permanente has three groups of “HTM/clinical technology” professionals, explained Davis-Smith. BMETs and opera-

CONTINUING EDUCATION: THE KEY TO CAREER PROGRESS

At UCONN, the goal is not to teach students everything they’ll need to know in their careers. That, said Frank Painter, would be impossible. “Because technology is changing so quickly, all we can do is try to bring them up to date so that when they graduate, they’re ready to go.” He and the hospital clinical engineering directors affiliated with the program, as well as other mentors who work with students during their internships, try to impress upon graduates the need for “keeping their noses in the books,” said Painter. “They have to go to professional meetings, they have to go to training classes, they have to go to seminars and listen to webinars.” Those who take that advice to heart “typically do very well,” he added.

His recommendation for anyone who wants to stay on top of their profession is to meet potential employers and network with colleagues with similar interests. Enlisting in professional societies also is a good idea. UCONN students, Painter noted, are required to join the New England Society of Clinical Engineering, American College of Clinical Engineering, and AAMI, so they begin to appreciate the value of these organizations.

A Need for HTM Faculty
A huge challenge facing the world of HTM is that the healthcare industry’s appetite for technologically adept professionals is outpacing the ability of academic institutions to produce them. “Part of the problem,” noted Barbara Christe of Purdue University, “is that it’s hard to find enough people to teach these skills. If we want to grow the discipline and produce more graduates,” not only at Purdue but at schools everywhere, “we need more folks with hospital-based experience in the management of technology to become academically credentialed faculty members.” Christe admitted that for most, the idea of “taking a pay cut to enter academia” probably is not high on their list of career goals. Still, she said, “we really do need more people to become teachers. The future growth of HTM depends on it.”
tions managers handle what she described as the “traditional operations-type functions,” including corrective and preventive maintenance and other day-to-day, “keep-the-lights-on” activities. Next, a team of CEs and clinical systems engineers is responsible for project-related work throughout the organization, from routine replacement of medical devices to installing new systems as part of major construction projects. They also work on medical device integration to the EHR and collaborate with IT to maintain network security. Finally, medical equipment planners, many of whom have clinical backgrounds, don’t provide traditional technical support. Instead, Davis-Smith explained, “they’re responsible for making sure that when architects and engineers design new spaces, whether it’s an individual room or an entire building, all the necessary equipment is accounted for.” In addition to medical devices, that includes other related necessities, such as plumbing and electric. “They work very closely with our CEs and clinical systems engineers to ensure that everything we need is designed into the system.”

Davis-Smith, who holds a BS in bioengineering technology and an MS in clinical engineering, believes that long-term success as an HTM professional requires strong collaboration skills (“it’s a team sport”) and critical thinking skills (“nothing is black and white anymore”). To progress into management positions or potentially all the way to the C-suite, developing great business acumen is a must, said Davis-Smith. “And not just the business of managing medical

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**Soft Skills: Critical to Success in HTM**

Many of those interviewed for this article mentioned that “soft skills” are no longer optional for HTM professionals. As Donald Gillespie of Cone Health put it, “Those kinds of skills, the people skills, can’t be emphasized enough. You’re no longer working with just your own biomed team; you have to know how to communicate with people from other departments.”

Abbe Meehan, RCC, president and owner of TEC Resource Center in Farmingdale, NY, agreed. Meehan, a corporate trainer and coach who was previously in charge of training and development at Modern Medical Systems (now Crothall Healthcare) and has spoken about soft skills at a number of AAMI conferences, said that good communication is important for several reasons. For one, she said, “Biomedics have to realize that they’re not only servicing medical equipment, they’re also helping the people who are using that equipment.” During interactions with clinicians, not listening well or communicating clearly can influence the patient experience. “If a nurse has a run-in with a technician right before they go in to see a patient, that can carry over,” Meehan explained. “And it can ultimately show up in patient surveys—in poor reviews of the care that’s provided.”

The stereotypical biomed, according to Meehan, “tends to want to just fix equipment and not have to deal with people.” But careers in HTM don’t unfold in isolation. “It’s very important to understand that you need to pick up your head up and pay attention to your customers. You have to be able to put yourself in their shoes.” Part of that involves thinking about how what you say might be perceived. “If you make the effort to speak in their language as opposed to the technical language you might use around your colleagues, that can go a long way,” added Meehan.

For example, Meehan said, if a nurse comes to you with an equipment problem, before you ask for details on the device, show that individual you understand their needs. “If you start the conversation with something like, ‘I know it’s of the utmost importance to get this equipment up and running as quickly as possible,’ instead of jumping right into the mistakes that were made, or your need for serial numbers, or all the things you’ll have to do in order to get it fixed, that demonstrates you know what’s important to them.” Meehan recommended learning to think and speak in this “customer-focused” language—it will help you build relationships that will make your job easier, as well as lead to better patient care.

“It’s very important to understand that you need to pick your head up and pay attention to your customers. You have to be able to put yourself in their shoes.”

—Abbe Meehan, president and owner of TEC Resource Center in Farmingdale, NY
devices—you also need to understand the business of healthcare.” Toward that end, “you may need to pursue a bachelor’s degree, and in some cases an MBA might be helpful, but I think there are plenty of opportunities to build these skills through on-the-job experience as well,” she said. Her best advice: find a mentor, spend as much time as possible observing “and paying attention to what’s going on around you,” and take the initiative when learning opportunities arise. “Ask to be invited to sit in on meetings that you might not normally be a part of,” said Davis-Smith. “It’s a great way to get a better sense of the bigger picture.”

Career Development
Larry Hertzler, vice president of technical operations with Aramark in Charlotte, NC, feels similarly about the need for all-around education for biomeds who want to move into management. “If you want to be a CE manager or a technology manager, you have to be well versed on all the issues that are on the table, whether it’s alarm management, cybersecurity, or anything else.” At Aramark, which serves about 550 hospitals across North America, those who demonstrate the right technical and leadership skills and a desire to advance in their career can, in time, assume management roles. “We really look at it as a learning position that is constantly evolving,” said Hertzler. “The type of people who are successful are the ones who at their core love to change. They’re always adapting to what’s going on around them.”

According to Hertzler, one challenge is that many organizations fail to provide the resources technicians need to make adaptation possible. He’d like to see more continuing education programs that focus on IT skills, for example. “If people entering the profession can get the basic fundamentals in electronics and IT while they’re in school, and then use those ongoing education opportunities and on-the-job training to develop specific skills once they’re in the field, I think they’d be prepared for just about anything.” At Aramark, Hertzler said, everyone in the organization, including managers and support staff, is required to take an internal course on the basic skills needed in the CE-IT landscape. Beyond that, advanced coursework in CE-IT topics is offered on a continuous basis for technicians and managers, who partner with clients in initiatives surrounding EHRs, CE-IT, and cybersecurity.

At GE Healthcare, where Scott Nudelman is a general manager of biomedical services, the approach they take toward employee development also recognizes the changing landscape of healthcare. “If you think about what biomed was like 20 years ago, it was still part of facilities management. To be a good BMET, you needed electromechanical skills, a good understanding of device clinical applications, and an adequate library of service manuals.” Now, as things have become more software driven and IT-centric, said Nudelman, “there’s less and less stuff that a biomed can actually fix, and it’s more about literally being that manager of healthcare technology.” At GE, “we used to do 98% of the service work ourselves,” explained Nudelman. “Now, we find ourselves outsourcing more because of proprietary service software or supportability issues.”

The result: A BMET I, for example, can advance his/her technical, project management, and customer service skills to advance to a BMET III. For biomeds who display the skills and desire to advance to management, they can be a biomed site leader for a small one- to three-person site or advance to overseeing multiple sites and having direct reports. In addition, many biomeds and engineers use their knowledge and skills to move into other roles within GE, such as quality, sourcing, installations, operations management, and sales.

“Because they’ve walked the walk, they are able to excel in other roles, relate to the customer, and keep up with the ever-changing healthcare industry,” said Nudelman. “It’s very different working in an independent service organization versus being an in-house...
The HTM Professional, Today and Tomorrow

We asked Shelly Crisler, MS, CCE, a biomedical engineer with the Veterans Health Administration Center for Engineering and Occupational Safety and Health in St. Louis, MO, for her thoughts on the skills and education requirements that HTM professionals need today that they didn’t need 10 years ago. We also asked her to predict what the profession would need to know 10 years down the road. Here’s what she said.

Today, HTM professionals need:

Exceptional communication skills. This is especially the case in the virtual environment, Crisler noted. “Many things that are said over email/instant message/text message are shortened and can be taken negatively, whereas 10 years ago most communications were via phone calls or in person.”

Prioritization skills. “As we’re more accessible to more people in a virtual environment, it’s increasingly important to be able to prioritize requests, meetings, and other communications and work.”

Technological proficiency. It’s increasingly important that HTM professionals understand programming languages, computer networking, and cybersecurity; they also need to understand technology functionality and how it is used to address clinical/patient needs.

To be able to work efficiently. They also need to understand interfaces and work with multiple complex systems that connect to each other.

To understand the need for patient safety. The ability to conduct thorough and timely medical device/system incident investigations (ability to detect emerging signals) is critical.

A honed sense of professionalism. It’s important to be professional in everything you do (this includes being mindful of what is posted online on Facebook, LinkedIn, or personal websites).

To be able to interpret and manipulate “big data.” To write effective reports and look for trends to implement improvements, interpreting big data is essential. Along those same lines, knowledge of informatics and data pathways/communications is important. “Everything produces data now. We need to understand how it’s passed and where it’s all ending up,” as well as how to secure it and move it safely among systems.

To learn when to stop. With laptops and devices making work accessible from anywhere, “it’s easy to be consumed with work all hours of all days. Time management and focusing on life outside of work is definitely more of an acquired skill now than it was 10 years ago.”

Crisler predicted that in the future, HTM professionals will need:

To know how to network even the simplest devices, because everything will store data.

A thorough understanding of cybersecurity and interoperability.

To understand interfacing, as telehealth systems and wearable technology is likely to increase, and its data may be transmitted to clinical hospital systems.

Skills managing technology outside of the traditional hospital environment, as patients will increasingly rely on this technology in their homes. “The patient’s home is the eventual future of medical equipment and patient comfort, so we need to be prepared for that move someday, even if it starts small.”

Increased flexibility and willingness to learn. Because technology is changing so quickly, “the demand for relevant education is going to be very high, and the turnover rate for many positions is also going to be high.”

Skills in interdisciplinary project management. Integration and the purchase of new equipment “takes a village, so you have to be able to coordinate and communicate with a variety of people in and out of the hospital.”

To focus on teamwork and the accomplishments of teams rather than individuals.
biomed—there are more opportunities to grow and stay in the biomed field."

**Making a Difference**

One biomed who has forged ahead is Shelly Crisler, MS, CCE, a biomedical engineer with the Veterans Health Administration (VHA) Center for Engineering and Occupational Safety and Health in St. Louis, MO. Her current position, Crisler said, entails supporting the HTM departments in all VHA hospitals across the country. She describes her office as a “one-person” team, though she does draw upon experts in the field and is mentoring two trainees with degrees in biomedical engineering. “We spend a lot of our time working on patient safety issues involving medical devices,” she explained. Sometimes that includes coordinating medical device recalls or helping facilities conduct incident investigations. “We want to make sure that we really get to the root cause of any incident. We also work to ensure that if it’s something that might affect other VHA locations, or it’s high risk in any way, that those other hospitals understand what they need to do to mitigate the risks in their facilities.”

Crisler has worked with the VHA for her entire career. After earning a bachelor’s degree in biomedical engineering from Saint Louis University in 2003, she went on to get her master’s in healthcare technologies management from Marquette University in 2004. Her first job out of school was as a biomedical engineer intern at a VHA hospital in Portland, OR, where she eventually went on to become chief biomedical engineer. Later, she took a position in Minneapolis managing medical equipment projects across nine VHA hospitals in the upper Midwest.

Four years into that job, her current position became available in St. Louis, which is very close to where she grew up. “I thought it would be great to work closer to home and to help the VHA from a national position,” she recalled. She was selected for the job and has worked in the position since 2012.

Crisler said that she learns something new every day. And as she works to improve safety within the VHA, she’s thankful she chose the career that she did: “I feel like I’m making a difference in the way we deliver healthcare. That’s what makes this job so rewarding.”

**DIFFERENT JOBS, DIFFERENT CAREER PATHS**

What’s the difference between a clinical engineer (CE) or biomedical engineer and a biomedical technician (BMET), tech, or biomed? Here are a few of the basic differences, as well as salary and job outlook information from the U.S. Department of Labor.

**CE or biomedical engineer.** CEs *clinical engineer is usually* the term used in hospitals, but some are called biomedical engineers) usually hold a four-year engineering degree. In manufacturing, biomedical engineers design and develop medical devices. In the hospital setting, on the other hand, CEs are typically further up on the hierarchy than BMETs, and may work with others in their facility to set procurement policy (for example). CEs can expect their career to include considerable project management, personnel supervision, and data analysis. They also should expect to take part in accident investigations involving medical devices to help determine what went wrong and how things can be improved. **Median pay (2014):** $86,950 per year/$41.81 per hour. **Typical entry-level education:** bachelor’s degree. **Work experience in a related occupation:** none. **On-the-job training:** none. **Number of jobs (2014):** 22,100. **Job outlook (2014–24):** 23% (much faster than average). **Employment change (2014–24):** 5,100

(source: [www.bls.gov/ooh/architecture-and-engineering/mobile/biomedical-engineers.htm](http://www.bls.gov/ooh/architecture-and-engineering/mobile/biomedical-engineers.htm)).

**BMET, tech, or biomed.** BMETs test, repair, and maintain medical devices and equipment, typically within hospitals and other healthcare facilities. Many hold a trade school technical degree from a two-year associate’s program, whereas four-year college degrees are rare. BMETs must attend regular training courses to stay up to date with changing technologies and the requirements of specific equipment. In the future, this will become even more important as additional networked devices are brought into the hospital environment. **Median pay (2014):** $45,660 per year/$21.95 per hour. **Typical entry-level education:** associate’s degree. **Work experience in a related occupation:** none. **On-the-job training:** moderate-term on-the-job training. **Number of jobs (2014):** 48,000. **Job outlook (2014–24):** 6% (average). **Employment change (2014–24):** 2,900 (source: [www.bls.gov/ooh/installation-maintenance-and-repair/medical-equipment-repairers.htm](http://www.bls.gov/ooh/installation-maintenance-and-repair/medical-equipment-repairers.htm)).