Has the Art of Nuclear Medicine Disappeared, or Has It Just Changed?

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It was interesting entering the field of nuclear medicine as a student in 1988 and as a staff technologist in 1989. Looking back now, I see that our field was then at a time of great change. My recollections and often brief tangential explanations during class lectures now cause me to ponder what my students think about the somewhat archaic way nuclear medicine was performed then. But some days I ponder whether things might actually have been better, as NMTs had to perform studies using what I have called the art of nuclear medicine. What do I mean by this? For those who have entered the field since that time, let me try to explain some of the many differences in the way NMTs delivered patient studies to physicians, compared with today.

First, there were film and film cassettes and all the possible associated points of error and artifacts we constantly had to deal with. Double-emulsion film had to be loaded properly in the film cassette. (This was a type of film somewhat unique to nuclear medicine. Most other imaging modalities used single-emulsion film. Also, for processing, we would share a darkroom with most of these other modalities, and we had to make sure we picked the right type of film from a lead-lined bin that included film used for other modalities as well.) In the nearly completely dark processing room (only a red safety light was on), if we did not correctly line up and secure the edge of the film under small holders on either side of the cassette, we might have a "dropped film" when used in certain film formatters or persistence scope camera boxes. A dropped film could disable the system until someone dug into the box and removed the film. Film could be handled only by the edges, as grease from fingers could affect the end product. In the darkroom, we had to correctly remove the exposed film, properly orient it on the automatic film processor, choose the right type of fresh film from the bin, and reload the cassette. Usually, this would have to be done twice because the film cassette would have 2 sides. As a student, I went to some clinic sites in which I would get stuck in the darkroom and have to just change out film cassettes all day. Changing film cassettes had to be done correctly, as did maintaining the automatic film processing unit. Maintenance included cleaning the rollers on a regular basis to prevent roller streaks on the film and properly balancing the chemicals, wash, and temperature of the unit. If any of these were out of balance, various artifacts could occur.

Next was actual formation of images on the film. If film cassettes were double-sided (had 2 pieces of film), we had to be careful not to double-expose the film. At the top of the film cassette, the slide that covered it would have an indicator (usually a black or white strip) that could be used to keep track of whether the film had been exposed. If the technologist did not flip the slide cover to the correct color, a double exposure of the film could occur. Also, exposure to any daylight would ruin the film, and from time to time this mistake would happen and images would have to be redone or retaken. In addition, most systems had no digital backup. Every camera system could be unique, and the processes were not standarized. I worked with a variety of image-formation processes. Some actually took a Polaroid-type film picture directly off a persistence scope (literally snap a picture, pull the chem-pack and film out of the camera, wait 60 seconds, and peel the picture off the backing). Other image-formation processes included film boxes attached to persistence scopes, film formatters, and, later, magnetic tape reel-to-reel "digital" backups. Each of these setups involved challenges in obtaining a usable image that physicians could read. My particular favorite was the film box attached to a persistence scope. To generate a usable image, we had to turn a contrast knob to adjust the brightness of the "dots" (counts) on the persistence scope by using trial and error or guessing. Many variables were involved, such as the body habitus of the patient, the amount of activity used for the study, the count rate, and possibly voltage fluctuations affecting the brightness of the dots. Often, a handwritten chart was available on the unit to help in guessing the proper brightness to use. I actually became quite adept over time at figuring all this out and not having to repeat images after the film was developed merely because the settings had been wrong. If you had a reel-to-reel magnetic backup tape, you could run it back and adjust the brightness, but only one of our cameras had this capability. So each image was a one-shot attempt followed by processing the film and then repeating if the image did not come out. Getting everything right in this process the first time was what I considered an art form. I certainly am not advocating going back to this type of image formation for NMTs!

The next big event in the evolution of film development was the daylight film processor. Now, we could avoid having to continually load cassettes and could simply load

a machine once at the beginning of the day with one or more boxes of film (like a copier with paper) and send the image digitally via computer directly to the film processor, which would spit out a film. This was a major advancement that lasted only a short time because, in most facilities, color printers replaced these processors within a few years after they had become common. Eventually, high-resolution workstations were used, and now images may even be sent directly to smart phones for physicians to read.

Another lost art form and difficult aspect of our field in the past was computer processing of images. All computer programs were homemade, and especially when I was a student, there was no standard method of computer processing among different systems or different hospitals. Therefore, what was learned at one site was completely different from what was learned at another. Literally, programmers would be hired to make up processing techniques based on each camera system. Some of those used by industry today were the more popular or well-documented ones from Cedars-Sinai, the University of Alabama at Birmingham, and Emory University, but back in the day there were no standards across the industry. Positioning of patients was also a challenge, as most studies were done with a planar camera. Whereas today most planar views can easily be acquired with a patient supine under a tomographic camera system, with only the camera moving around the patient, back then we had a real challenge getting certain projections. We also had to make sure the orientation was correct for each study, depending on many factors. Finally, the film had to be labeled correctly. Because we would hand-label the film using a grease pencil or permanent marker, we had to make sure right was right and left was left, etc. A mislabeled film could lead to a misdiagnosis. Most labeling is completely automated today as long as the image is acquired in a certain format.

So things in the past were much more difficult but the NMT was also a much more active player in generating the end product, which to me was an art form: very hands-on and little or no automation. Although most aspects of what we do are automated today and we have a much easier job in that regard, I fear that something has been lost in the process and we are more about pushing buttons now. But perhaps that is unfair as there are still aspects of what we do that can be considered an art form; they simply have changed from the past. I would hope that technologists are doing more than just pushing buttons and are checking all of the auto-everything, including processing, to make the end product the technically best-quality image possible. Of course, the patient care aspects of what we do have not changed, and these too are an art form in knowing how to explain procedures and work with the patients and their families appropriately in all facets of good care. All these skills remain the same as in the past. What is amazing is to step back and look at our field then and some 25 years later and realize all the absolutely fantastic things we are doing today versus what we were doing then. I look forward to seeing what our profession will look like in 2038—25 years from today!

> "I long to accomplish a great and noble task, but it is my chief duty to accomplish small tasks as if they were great and noble."
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> —Helen Keller

In this edition of *JNMT* we have 2 original continuing education articles, one dealing with a unique study on the effects of different types of syringes and residual activity and the other on report 160 of the National Council on Radiation Protection and its consequences for our field. There is also an invited editorial on opportunities outside our field for students who may be finding it difficult to get that first job or others looking for NMT positions. There are several imaging articles on topics such as sentinel node biopsies, ordered-subset expectation maximization and filtered backprojection, and treadmill exercise tests and camera-based renal clearance calculations. Other articles include a practice management article on a SharePoint calendar system to help increase patient throughput in a high-volume PET/CT facility and a professional development article on pregnancy-screening strategies. There are 4 interesting teaching case studies, one of which is featured on our cover. I am very pleased with the number of teaching case studies that we have received in the last 6 months and encourage everyone to continue to submit these going forward as we build our teaching file online. We also have a book review on a PET and PET/CT study guide, as well as several SNMMI-TS Chapter biographies.

Many thanks to the entire SNMMI *JNMT* team, which includes authors, reviewers, guest editors, associate and consulting editors, and the entire SNMMI publication staff, who truly make the *JNMT* possible each quarter. Without everyone contributing, we would not be able to have this outstanding journal.

I wish everyone (you and yours) a happy holiday season as 2013 comes to a close, and I hope to see you at the SNMMI mid-winter meeting in Palm Springs, California, February 6–9, 2014.

Finally, for the Facebook discussion this quarter I would like to hear your thoughts on whether the art of nuclear medicine has disappeared or perhaps just changed. Please go to www.snm.org/facebook and add your comments.

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