A Nurse's Role in the Biomedical Engineering Department

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Approximately three years ago, the Department of Biomedical Engineering at Brigham and Women's Hospital asked the question: "What impact would hiring a nurse into the department have on day-to-day operations?" As a result of that question, the department decided to hire a nurse. This article is a synthesis of almost three years of work trying to understand how a nurse working in biomedical engineering can positively contribute to patient safety and a more effective biomedical engineering department.

When the job description was first written, little was known about what a nurse in biomedical engineering would actually do. While that first description gave general guidance, our experience with the role served as an agent of change, gradually transforming a very general job description into a well defined list of job functions that effectively contributed to patient safety and a smoother running biomedical engineering department.

It ought to be noted that while the department's nurse, called the bedside technologies specialist (BTS) is referred to often in this manuscript, the BTS is not the sole agent within the department responsible for ensuring these major functions operate smoothly. It was only with the cooperation and collaboration of the entire department working as a team that a positive impact on patient care was achieved.

What follows is a list of major job functions that grew out of our work. When looking at this list and how it was formed, it's impossible to avoid seeing how this position is a natural extension of what a nurse does on a daily basis while caring for patients.

These skills transferred easily from direct patient care to supporting the operations of a biomedical engineering department.

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Liaison

First and foremost, a BTS' role in biomedical engineering is that of a liaison between the nursing and biomedical engineering departments. This is especially important not only in the operations of both departments, but on a strategic level as well. At the strategic level, having a BTS in the department can contribute to the long-term planning related to bedside technologies by understanding not only what current technologies are being utilized, but how they are being utilized.

When considering everyday operations, the BTS role can be invaluable when difficult clinical problems arise. While most biomedical engineering departments have a well-defined, well-functioning plan on how routine trouble calls are triaged and handled, the BTS can handle the second call to biomedical engineering. The second call happens when the clinician reports that "the problem is still not fixed." There are several reasons for this second call. However, experience has revealed it is generally because the initial problem was either poorly communicated by the clinician, poorly understood by the technician, or a combination of both. Having a BTS on staff to assist with this second call helps in two ways:

First, the BTS can interview the clinician involved to ascertain what the problem was and how the initial technical intervention did not solve the problem. This interview can reveal some important details, including whether the clinician has realistic expectations as to what the equipment can do. There have been times when the interview revealed a lack of training on the device, which manifested itself in unrealistic expectations on the part of the clinician. When this happens, the BTS can use the opportunity to enlighten the nurse, and provide an impromptu in-service on the device. Furthermore, this sort of interaction can act as a barometer to gauge institutional competence with a particular device. If a biomed department receives the same types of calls where clinicians seem to have difficulty with the

same device or a particular function of the same device, then a plan should be created to correct the knowledge deficit.

The interview can also be used to measure the competence of the technical staff taking the call. If it is discovered that the clinician has reasonable expectations, with an appropriate solution the BTS can go back to the technician and the department to understand the nature of the technical knowledge deficit. This too is a good time for an impromptu discussion of the nature of and solution to the problem.

It should be noted that whenever anyone acts as a liaison between two departments, the use of diplomatic skills is absolutely essential. The toughest part of this liaison function is establishing a good working relationship with both the clinicians in the hospital as well as the technical staff in biomedical engineering. Having to be the one to shed light on knowledge deficits to either side of the problem can be difficult for those involved. Having to correct a colleague's misperception of a device in which they ought to be experts is best done tactfully, with the goal of educating instead of casting blame.

An example of this occurred when one of the hospital's most technologically sophisticated nurse educators gave me a "second call" one afternoon. She attached her patient to a portable bedside physiological monitor. While she was able to display the cardiac, respiratory, and SPO2 waveforms perfectly on the bedside monitor, she was unable to network the monitor into the hospital central monitoring system. As a result, the alarms, while clearly audible in the room, could not be annunciated on the unit's central station. She called biomedical engineering, and as it turned out, one of the department's most competent technicians took the call. After troubleshooting the issue, he came to the conclusion that the nurse may have improperly programmed the device. But when he told the nurse his conclusions, she got upset and called me. When I arrived, the nurse and technician were upset. After reviewing the software configuration and finding it properly configured, I traced the CAT-5 cable from the network connection in the wall to where it interfaces with the device. It was connected to one of two CAT-5 connections, which were right next to one another and clearly marked. Instead of being connected to the connection with the universal networking symbol next to it, it was connected to the one labeled AUX. I realized the network cable was attached to the wrong connection and after switching the connection, it worked perfectly. This was something that both the nurse and technician ought to have caught, but due to the patient's deteriorating condition and increased activity in the room, both missed it. I brought the technician into the room, turned the device around and asked him: "What's wrong with this picture?" Within seconds, he asked "How could I have missed that?" "The same way she did," I told him, "she ought to have caught that too."

This particular second call ended with the technician calling the nurse back into the room, and after explaining to her how he didn't catch the problem the first time, he pointed out the difference between the nearly identical network and auxiliary CAT-5 connections, and which was the proper connection. The nurse and technician both learned a lesson, solved a problem, and everyone left with no hurt feelings.

Education

A prime opportunity for educational excellence is during the initial rollout of a new medical device. Once a decision is made on when and how a new device will be installed, the BTS can be most helpful in two ways. First, by understanding how the current device is used by the clinical community and how the new device will impact clinical practice. This is an important component because devices that are currently being manufactured are more complex than their predecessors.

For instance, not that long ago, an IV infusion pump infused with fluids and medication allowed the clinician to set the rate and volume to be infused (VTBI). It was a simple and unsophisticated means of infusing fluids and medications. The current state of the art pump allows a clinician to enter the flow rate and punching in the VTBI is only the starting point of programming the device. Current IV devices are actually sophisticated computers that require careful programming. Some IV therapy devices are even being networked into the hospital pharmacy information center.

Since there is nothing in nurses' education that prepares them for sophisticated programming or networking, the BTS can help vendor educators to carefully construct the educational curriculum that focuses on the strengths and weaknesses of the local clinical culture. This is particularly helpful when working with a vendor educator who comes in with a "canned" lecture that does not take into consideration what the new

device is replacing or the clinical culture in which the device will be used.

The second area of opportunity related to education in which a BTS can have a significant impact is by simply ensuring that all clinicians obtain the proper training. This is particularly difficult because of the round-the-clock nature of medical care. Weekends, off-shifts, and per diem clinicians never seem to be around when in-servicing sessions happen.

The BTS is in a unique position to negotiate with nursing management and vendor educators in several key areas. First, vendor educators must make a commitment to provide the carefully constructed curriculum to all shifts, including weekends. Second, the nursing management must make the commitment to take the necessary steps to ensure his/her nurses make it to the training.

Ensuring 100% attendance prior to rolling out a device is neither convenient nor is it cheap. For nurses to be trained, they need to be relieved of patient care duties. This requires additional staff during in-servicing days and this is an added expense. Alternatively, if a manager gives permission for the nurse to come in on a day off for the training, then this is an expense as well.

The BTS can have a positive impact in safe patient care by ensuring both the vendor educator and local nursing management fulfill these two commitments, thereby providing training to 100% of the staff, before the device is rolled out into the clinical environment.

Evaluation

Evaluation of bedside technologies is another area where the BTS can help. As mentioned previously, bedside technology devices are becoming increasingly complex; many with multiple modes of operation and programming options. The BTS is in a unique position to interact with both vendors and the clinical community to ensure proper devices are purchased to appropriately match the clinical use model.

The BTS can adequately understand that while purchasing a device with all the bells and whistles is desirable, knowing the culture of use for a particular device can make a difference between purchasing what is needed versus over-purchasing unnecessary functions.

To illustrate this example, consider the purchasing of defibrillators for an entire institution. As many know, there are several different defibrillators that can be purchased. There are the easy to operate, airport-grade defibrillators, and there are the more complex full-function defibrillators. It would be easy to say "just buy the full function defibs," not only for acute clinical areas but also for outpatient and ambulatory clinics. Aside from financial considerations, taking into account the competence of the nursing staff to operate the full functioning defibrillator would be critical to this decision. Knowing that distant ambulatory clinics have a practice model, which is not based on acute care and staff with appropriate clinical skill levels, can help build a case for the lower end. This decision not only saves money, but perhaps patients' lives as well.

Investigation

When a sentinel event happens, the often multi-factorial nature of the event makes it difficult to sort out facts. When a medical device is indicted by clinical staff as a major contributor to an incident, investigation and evaluation of the incident by a clinical engineer in conjunction with the BTS can speed up the investigation process. The multi-disciplinary team can also add depth to the understanding of the incident. By reviewing device logs and clinical interviews, the team brings technical and clinical strengths that have the potential to lead to a quicker understanding of the incident.

This type of collaboration is best illustrated using an IV pump as an example. Today's sophisticated IV therapy devices have many different types of logs that can be downloaded for the retrospective analysis of alleged incidents. On occasions when a pump is indicted in a claim to have over- or under-infused a medication, taking a team approach to the investigation can either substantiate or refute the claim. The team would consist of the clinical engineer, biomedical engineering technician, and bedside technologies specialist. The investigation would begin with a clinician involved with the incident going over the sequence of events. The team gathers as much data as possible, including date, time, and nature of the incident. After the engineer and technician examine both the device and tubing for physical damage and clues to the incident, they would download data logs from the device. Some IV pumps have logs that focus on the technical problems related to the device, which the engineer would review for clues that would shed light into the problem. Concurrently, the BTS would review logs related directly to the user. Most IV pumps have logs that display every single entry made by a clinician in excruciating detail. These data

logs will give a keystroke analysis of each and every button pressed during programming.

Additionally, these logs also record alarm states. For example, the pump displays an anti-free flow mechanism alert. The BTS can use the start and end time of the alert to estimate how much unintentional fluid was over-infused due to the malfunctioning anti-free flow mechanism.

Once the BTS and clinical engineer have gone over their respective logs within the context of an accurate explanation from the clinician, the pieces of the incident generally fall into place. On occasions when use error can be clearly demonstrated, having data logs is invaluable in presenting a conclusion to the clinician involved. Once we, as local investigators, have pieced together our interpretation of the incident, the device and data logs will be returned to the manufacturer for their analysis.

While this example relates to IV pumps, many other patient care technologies, including defibrillators and monitoring systems, also contain data logs that contain data necessary for successfully investigating incidents locally. The key is to have a multi-disciplinary team that includes a BTS.

Regulatory Liaison

The two largest national regulators of biomedical engineering equipment and practice, the FDA and the Joint Commission (JCAHO), provide guidance on regulations of devices as well as the environment in which the devices function. The BTS, again, is in a unique position to receive data from and report to these agencies.

From an operations standpoint, having a good relationship with the MedSun Project—the FDA's post-market surveillance effort—is a great way to start. Whenever a medical device is found to be defective or contributed to either minor or sentinel event, the hospital is compelled by law to file a report with the FDA. The MedSun Project is a conduit for facilitating this report. Additionally, if the BTS who serves as the MedSun representative, is looking for information on medical devices that have been reported to the FDA, the Project is an excellent place to begin a search. The search capabilities are a benefit of membership to the Project. If the hospital is a participating member of MedSun, the BTS can send a query to the Project by supplying keywords such as model, manufacturer, or even parts. MedSun staff queries the FDA database related to medical device failures and delivers a comprehensive list of reports. This is helpful when trying to put incidents occurring at your institution into the context of what is happening nationwide. It also provides valuable information when dealing with the vendors of the medical devices in question.

Likewise, JCAHO is a good resource for the biomedical engineering department in general, and the BTS in particular to understanding the current requirements of the department. For example, this past year JCAHO's National Patient Safety Goal #6, relating to alarms on patient care technologies, was a major issue for biomedical engineering departments, and being able to access information from this organization is helpful in preparing for inspections.

No discussion on the topic of outside agencies would be complete without mentioning ECRI. This private agency is a marvelous source of information related to current recalls as well as insights to medical devices. The BTS ought to be involved with this agency. Involvement with it will ensure the timely delivery of up-to-date information related to the bedside technologies used in the biomedical engineering department.

Communication

Coupled with the major function of education, the BTS must be an effective communicator of information. When mission or even life-critical information must be relayed to the clinical community regarding the bedside technologies they use, having an effective communication system is a real advantage.

There are many vehicles for passing information on to clinicians from the very simple e-mail clinical alerts to more sophisticated methods involving the creation of electronic documents. Being able to effectively communicate with the clinical community will increase awareness of actual and potential problems.

Conclusion

The past three years have revealed many opportunities for clinical excellence within a biomedical engineering department by adding a nurse to the department's staff. The roles that were most easily adapted for the department were those of liaison, educator, investigator, and communicator. All of these roles were realized as part of the nurse's basic education, and have the potential of transferring well into the everyday operations of a biomedical engineering department, thus contributing positively to patient safety. ■