By Kurt A. Patton, MS, RPh

A Standards-Based Approach to Preventing Tubing Misconnections

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To prevent **tubing misconnections**, we need to become less accepting of unplanned equipment changes or supply shortages.

The Scope of the Problem

The Joint Commission, ISMP, FDA, and others have issued advisories in recent years about a low-frequency, but high-risk hazard involving the inadvertent connection of medical tubing going into a patient to products or devices not intended for connection via that tubing or point of entry into the patient. Today's complexity of care makes this a very serious issue in need of consideration and prevention strategies. At the simplest level, consider a patient receiving both an intravenous solution and an enteral feeding. Even with only these two products running into the patient, there are risks: Because the enteral product is designed to be non-sterile, it may be either a solution or a suspension and, most importantly, is intended to enter the gastrointestinal tract via a feeding tube. The IV solution, in contrast, is sterile and may be administered directly into the IV access port. Although not intended for ingestion, it could be ingested without harm, in marked contrast to administration of the enteral nutrition product via an IV access port.

However, this simple example is not typical of many hospitalized patients, who may have peripheral IV access, central venous access, epidural or intrathecal access, peripheral nerve block access, bladder access, peritoneal access, arterial lines, and oxygen lines, both passive and pneumatic. Each of these points of access are connected via clear plastic tubing, too many of which share a luer lock connection design. This complexity is further enhanced when some clear plastic tubes have extension sets or additional Y-designed access ports that allow a secondary solution to run through the same line.

Alerts Issued

In April 2006, the Joint Commission issued a Sentinel Event Alert on this subject.[1] At that time the Joint Commission's database of sentinel events contained nine cases of tubing misconnections, eight of which resulted in fatalities. They reported four enteral feeding solutions connected to intravenous access points, one case of barium contrast connected to an IV access point, one case of enteral feeding connected to a peritoneal dialysis port, two cases of blood pressure insufflator tubes connected to IV access ports, and one case of IV fluids connected to a tracheostomy tube. The Sentinel Event Alert also referenced data collected by the USP that cited more than 300 misconnections similar to the ones in the Joint Commission database, but also widening the array of errors to include epidural solutions, bladder irrigations, blood products, and indwelling catheters of various types. The health care workforce knows these are not proper connections and significant complications or fatalities could occur, but due to a lack of systems or adequate prevention strategies, these errors have occurred.

ISMP issued a safety alert in June 2004 on this subject[2] and highlighted a case leading to fatal air embolism from a sequential compression device that was connected to a needle-less IV tubing port. It was reported that excessive force was used to make the connection between dissimilar fittings. The tubing quickly disconnected itself due to the air pressure, but it was already too late for the patient.

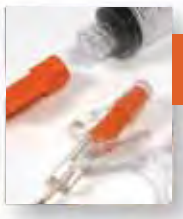
Prevention Strategies

Now that we are aware of these potential errors, what can we learn from the experience of others, and how can we create a greater degree of patient safety in our hospitals? The Joint Commission requires organizations that experience a sentinel event to analyze the situation and prepare a root cause analysis, along with a corrective action plan. Root causes reported by these hospitals included the use of tubes and equipment for unintended purposes, positioning errors, proximity errors, movement of the patient from one location to another, and staff fatigue. While these conclusions are helpful, we still need to design prevention strategies and engineering controls to prevent similar problems from occurring elsewhere. The standards framework from the Joint Commission provides an excellent template from which we can design specific prevention strategies.

Human Resource Standards

Staff education and training can help prevent technical or knowledge-based errors. For example, the staff needs to know that they cannot administer non-sterile solutions intravenously and usually cannot administer suspensions or other non-clear solutions intravenously, with the exception of propofol and IV fat emulsions. All clinical staff members probably already know this, but there are subtler, supportive lessons we can learn from reported tubing misconnection errors.

The first is about tubing and fittings. If it does not fit easily, it probably should not be connected. Hospital staff frequently deals with supply shortages, unexpected equipment changes, or brand changes. We have become too accustomed to these situations and learn how to "work around" such shortages. We become inventive, at times, in order to serve our patients, but in this situation, we must not improvise. We need to train staff that if you have to force the connection, if you have to tape the connection, or if you have to connect multiple adaptors, you are at risk for a critical error. From the events reported by ISMP and the Joint Commission, we learned that staff may tape tubing together and force dissimilar connectors together. So if it does not



fit, stop, get help in analyzing the situation, and determine if the tubing should actually be connected.

There is another training issue that is important for both clinical staff and non-clinical staff. If staff experiences a tubing disconnection, they must not immediately reconnect without first tracing the connection, verifying its appropriateness, and checking labels. We cannot immediately reconnect the first two loose ends that we see, we need to first verify that they should be connected. In addition, clinical staff needs to be encouraged to turn on the lights in a patient room to make sure they can see what they are doing. Waking up the patient is a relatively minor consequence compared to a tubing misconnection. Similarly, non-clinical staff needs to be trained that if they inadvertently cause a disconnection, they should never reconnect without first seeking help from clinical staff. We need to make non-clinical staff comfortable in asking for help, so they do not fear repercussions that give them incentive to connect tubes they should not be touching at all.

Patient Rights Standards and Patient Care Standards

While staff training may be our first consideration, we must also consider educating the patient to make them our safety partners. The Joint Commission's Rights Standard RI.3.10 requires that we teach patients about their responsibilities in the care process. We can teach them the importance of seeking help if lines or tubes become disconnected. As patients move in their bed or seek to ambulate, they may cause tubes to disconnect. Oftentimes, patients do not want to impose upon staff and they – or their families – may reconnect lines incorrectly. We need to train patients and their families never to do this, but rather to seek help. Remind patients to seek help, not by holding up the disconnected lines, but rather by saying, "I moved and caused a disconnect. Please help me in proper reconnection."

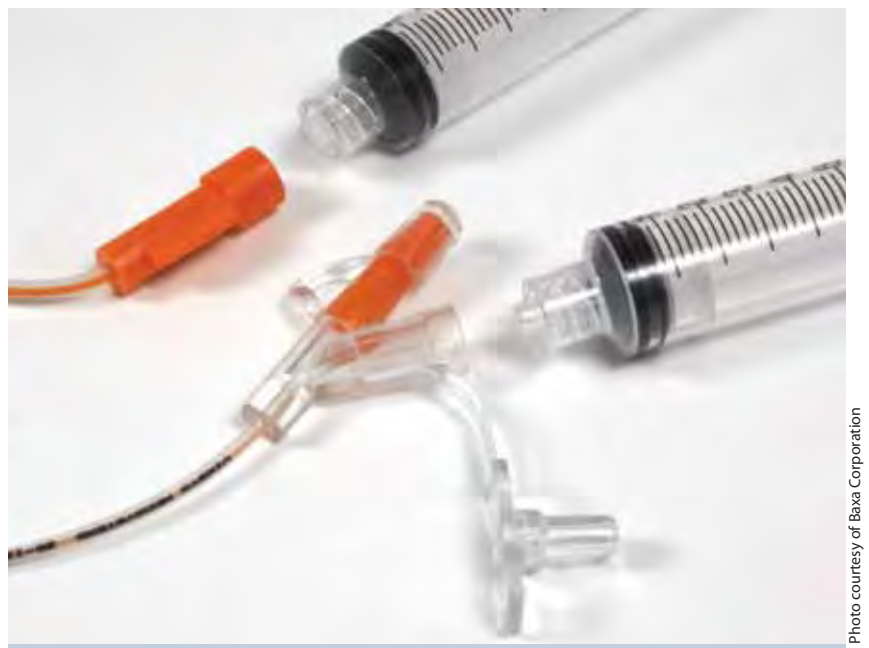
Patient Care Standard PC.6.10 establishes expectations for patient education, and standard PC.6.30 establishes an expectation to "evaluate comprehension." Too often, we think of patient education as a task to check off as "completed" when we meet with patients or provide printed handouts. However, our goal should be to continually provide and reinforce education until comprehension is achieved. It is critical to teach patients about lines and tubes, and the importance of correct reconnections. We can also teach them to encourage their staff to turn on the lights at night, trace the lines, and to make sure the reconnection is done properly.

National Patient Safety Goals

Safety Goal 2E requires hospitals to implement a "handoff communication process." At times, staff members struggle with what to include in this process. During a shift-to-shift handoff or a transfer handoff, it is essential to review and trace all the tubes, connections, ports of access, and products being administered to a patient with your handoff partner. For instance, think of a complex ICU patient going to radiology for a diagnostic test or a nursing change of shift for this kind of patient: It is essential to review these connections; with buried lines and central access via a peripheral location, it is not immediately clear what true access is and where solutions are being administered.

Medication Management Standards

Standard MM.4.20 addresses sterile product preparation and creates an expectation for visual inspection of the product to be administered. While it is important to train staff to make sure there is no precipitate matter in the sterile product, repetitive visual inspection is also important to help prevent tubing misconnections. As mentioned previously, it is a standardized expectation that only clear solutions get administered intravenously, except in those few locations that might use lipid emulsions as either nutrition or an anesthetic agent. If the solution about to be connected



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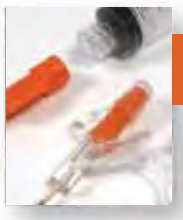
to an IV access port is opaque, your staff should see that as a stop sign. Enteral feeding products are most often opaque and should never be connected to the IV port.

Standard MM.4.30 addresses pharmaceutical labeling. Although the standard speaks to standardized labeling to prevent errors, none of the elements of performance under that standard specifically address tubing. But as a hospital designs its labeling policies, I suggest that they also incorporate the concept of labeling tubing. With both solutions and tubing labeled, it becomes easier to properly connect those items.

Performance Improvement Standards and Leadership Standards

The Joint Commission's Performance Improvement Standards, specifically PI.3.20, introduce the concept of intensive analysis, of which one method is failure mode and effects analysis (FMEA). Each year, a hospital is expected to conduct at least one of these intensive analyses. The technique involves staff identification of all the things that could go wrong in a complex process, the repercussions if they do go wrong, and the probability of them going wrong. Hospitals sometimes struggle to identify an issue worthy of FMEA, but tubing misconnections is a great one to consider. The staff members that actually work with complex patients are in the best position to recall near misses and foresee the potential for error in their day-to-day practices. The end product of FMEA is the development of prevention strategies, which may include product changes, labeling expectations, handoff techniques, patient education expectations, and environmental issues, such as lighting.

The Joint Commission's leadership standards, specifically LD.3.70, require leaders to provide for the allocation of competent, qualified staff. The assignment of adequate numbers of trained staff to complex care environments is essential to preventing tubing misconnections. A second leadership standard, LD.3.80 similarly requires hospital leaders to provide adequate space, equipment, and other resources. To prevent tubing misconnections, we need to become less accepting of unplanned equipment changes or supply shortages. As we analyze our risk of tubing misconnections, we need to consider staff impressions on this subject. If staff members complain of frequent shortages or a frequent need to improvise, risk is



If the clinical staff experiences a tubing disconnection, they must not immediately reconnect without first **tracing the connection, verifying its appropriateness, and checking labels**.

increased. A staff with low expectations of their purchasing department may be more likely to force incompatible fittings together or otherwise improvise in a dangerous fashion.

A third leadership standard, LD.4.20, is also worthy of discussion. This standard establishes the requirement for new or modified processes to be well designed. Each time we change equipment or change suppliers, we change our processes. Changed processes can be well designed with advanced planning, staff involvement, and staff education on all shifts and covered departments. We need staff to be accustomed to well-designed change processes and have confidence in their purchasing department, so that if connections do not fit well, they will accept that it is not a substitution issue, but rather an incompatibility issue that should act as a stop sign for them.

Environment of Care Standards

Standard EC.1.10 requires hospitals to manage safety risks, and element of performance 4 calls for the hospital to conduct proactive evaluations of safety hazards. This is often done as a team process, conducting rounds through the patient care areas. The team conducting the rounds consists of unit clinical staff along with environment of care leaders, bio med specialists, and other content experts. The issue of tubing misconnections and prevention strategies is an excellent issue to analyze on these rounds. It provides an opportunity for the unit and bio med staff to understand each other's perspectives, issues, and concerns. Most importantly, if the equipment, the architectural design, or the environment in any way contributes to the risk of a tubing misconnection, the team can help identify that risk.

Standard EC.6.10 requires the hospital to manage medical equipment risks. Examining equipment that uses luer connections and limiting this type of connection to compatible devices is part of the planning effort called for by this standard.

Summary

The consequences of an incorrect tubing connection can be devastating to patients and caregivers. Fortunately, these incorrect connections happen infrequently. However, that lack of frequency can allow caregivers to think, "It won't happen in our hospital." The standards discussed in this article provide an opportunity to analyze practices, design changes for prevention, and reduce risk in your hospital. Do not overlook the opportunity to learn from near misses. If a staff member starts to make a mistake, but recovers it before an error occurs, find out what started the staff member down the path toward an error, how he or she realized an error would occur, and how the potential error was corrected. All hospitals should analyze and discuss near misses, and communicate the lessons learned from them. ■

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References and Resources

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