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How Healthcare Providers Prevent Tubing Misconnections

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Abstract

Urinary catheters must be inserted and maintained by a healthcare practitioner. As a result, it is critical that health care personnel be skilled and informed in preventing urinary tract infections in patients receiving indwelling catheters. A large majority of health care personnel lacked appropriate knowledge and practice in CAUTI prevention. The chance of understanding improved dramatically if health care providers had obtained urinary catheter procedure training and held a bachelor's degree. Health care personnel with master's or doctoral degrees, enough knowledge, training in urinary catheter operations, and 20 years of work experience were more likely to have adequate practice. As a result, health care personnel should closely adhere to hospital-acquired infection prevention recommendations and regularly refresh their CAUTI prevention knowledge and practice through reading and short-term training. Healthcare workers should also improve their educational standing. Hospital administrators should give adequate on-the-job continuing training in CAUTI prevention. Researchers should do further research utilizing observational study techniques to determine real practices.

Keywords: *Urinary catheter, CAUTI prevention, healthcare practitioner.*

Introduction

Patient safety

Patient safety is a set of organized activities that create cultures, processes, procedures,

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behaviors, technologies, or environments in health care that regularly and sustainably lower risks, minimize the occurrence of avoidable harm, minimize the likelihood of error, or mitigate the impact of error when it occurs. Patient safety refers to the prevention of errors and negative outcomes for patients associated with medical care. While health care has become more successful, it has also grown more complex, with the increased use of new technologies, medications, and therapies.

The unintentional misconnection of intravenous, arterial, epidural, nasogastric, urinary, or other indwelling catheters endangers patient safety. Misconnecting epidural infusion tubing or oxygen tubing to an intravenous catheter can be fatal, and an accidental intraarterial injection of medications intended for intravenous administration can cause thrombotic problems and need amputation in up to 30% of cases. These misconnections are especially prevalent in critical care units, where patients have many catheters in place at different locations and multiple infusions are provided concurrently. Intensive care unit workers usually provide care for numerous patients at the same time, resulting to sensory and information overload, which increases vulnerability to mistakes. ,

A low nurse-to-patient ratio has been linked to medication mistakes and higher mortality in some contexts. The most prevalent cause of unintended intraarterial injection is when an intravenous drug user is unable to aspirate blood from a patent vein due to prior injection thrombosis. In this situation, the user thinks the needle's tip is in a vein rather than an artery. Erroneous and unintended direct injection into an artery by a nurse or physician is less prevalent than the non-medical situation. It can happen in a variety of ways, including inadvertently cannulating an artery instead of a vein or failing to mark an arterial catheter properly. ,

When a patient is hypotensive, the radial artery, which runs down the lateral portion of the forearm in around 1% of the population, is more likely to be cannulated inadvertently and mistaken for a vein. Drug injection into the arterial system can produce ischemia due to direct vascular damage, drug toxicity, thrombosis, or a combination of the above. Some medications are extremely irritating to the endothelium, resulting in thrombosis and necrosis, whilst others are less likely to cause chronic harm. Propofol and midazolam are frequently used to induce general anesthesia intravenously because they have a decreased incidence of limb ischemia in the event of an accidental intraarterial injection. ,

Unintended arterial injections frequently cause necrosis, which may need amputation. Inexperienced personnel require competent supervision, particularly in high-risk settings such as the critical care unit, emergency department, and operating room. Colour labelling can assist to avoid misconnection mistakes across infusion systems, although alternative Luer-lock connections may provide a better option in the future. Ultrasound can help prevent unintentional arterial cannulation during central venous catheter placement, especially if blood pressure remains low despite vasopressor treatment. Arterial lines should be properly identified. Artery and central line pressure traces should be visible on the monitor. Limbs having arterial lines should be constantly checked for symptoms of ischemia. Urgent consultation with a vascular surgeon, radiologist, or anesthesiologist can assist.

The implementation of preventative techniques, including sufficient education, enabled employees to detect the danger of misconnections and potential harmful outcomes. Clinical personnel used line tracing and reconciliation in their practice, which improved patient outcomes.

Forms of misconnection

This research aims to investigate: What do nurses know about tubing misconnections between enteral and intravenous systems? The study presents a grounded theory-generated model that

helps healthcare professionals understand the possibility of a misconnection and what happens when one occurs. Answering this question lays the groundwork for future actions and research aimed at developing safer medical devices. Grounded theory, as an inductive method, gives insight into the nurses' mental paradigms.

Causes

Tube and catheter hookup errors are very prevalent. If a misconnection is not detected and remedied in a timely manner, it might have fatal consequences. To make matters worse, drugs and dietary supplements are frequently supplied via these channels, and incorrect tube placement might result in a potentially hazardous chemical being delivered to the wrong places.

Factors resulting in misconnections and misplacement include:

- Connect feeding tubes to ventilator port.
- Use catheters for undesired uses, such as IV extension tubing for drainage, epidurals, and central lines, either intentionally or accidentally.
- Inserting feeding tubes in the lung instead of the stomach.
- Universal connections link catheters with different functions.

Risk, outcome, impact.

Understanding and avoiding tube misconnections have been hampered by the same obstacles as other patient safety concerns. The traditional research and epidemiological approaches used to study healthcare concerns have not been successfully applied to healthcare safety. Healthcare safety specialists believe that underreporting and nondetection of mistakes in healthcare, at both the national and institutional levels, are impediments to recognising risks to patient safety, learning how to prevent errors, and quantifying errors. Only two studies have established population-level medical mistake rates: the Harvard Practice Study and the Australian Study. Acquiring safety data is difficult on many levels, including extensive efforts in retrospective data collection, active case identification, complex data mining from technological sources, or expensive observational studies to identify representational data. Medical malpractice claims statistics do not completely reflect mistake rates. Epidemiological data is not accessible across care settings, and the conclusions of published research that focus on one specialty or technique are not generalizable. ,

The healthcare business continues to rely on reporting systems to collect safety data, but hurdles to reporting, such as cultural norms, impede development. Cultural disincentives to reporting errors are frequently related to long-standing punitive healthcare practices, which include threats of legal and regulatory action, as well as institutional disciplinary actions. Poor character judgements made by professional peers and coworkers might have a detrimental impact on reporting behaviours. In addition, faults may go undetected. According to James Reason, the author of Human mistake, poor mistake detection is a substantial obstacle to learning from errors and thereby reducing recurrence. ,

Analysis of patient safety data is critical for informing the industry about potential threats to safe care and developing proactive approaches to patient safety. To Err Is Human, a landmark paper by the Institute of Medicine (IOM), identified a lack of knowledge with safe procedures in the sector and advocated for an increase in safe practices. Lack of proof has been a significant impediment to advancement. The IOM has issued further papers emphasizing the importance of expanding the safety knowledge base through "systems" examination of errors. The IOM has consistently urged healthcare facilities to become learning organizations with improved organizational agility in response to safety issues. Before healthcare providers can respond agilely to safety concerns, they must understand how to analyze and learn from unfavorable

occurrences, as well as communicate the resultant information about safe procedures.

PREVENTING TUBING MISCONNECTIONS

The Joint Commission issued a Sentinel Event Alert in April 2006 regarding tubing misconnections caused by enteral feedings being accidentally injected into intravenous lines, with potentially fatal consequences. A color-coded enteral tubing connector design was created to visually distinguish between enteral and intravenous tubing. In addition to tubing design, use these suggestions to avoid tubing misconnection errors:

- Connect tubing under suitable lighting. • Avoid modifying or adapting IV or feeding devices as this may affect their safety features.
- When reconnecting lines, trace them back to their sources to assure security.
- During handover, double-check connections and trace all tubes back to their origins.
- All healthcare professionals, including nurses, pharmacists, and physicians, must acknowledge the fundamental difficulties that lead to error-prone workplaces.
- Effective communication on medical mistakes can promote autonomy and increase patient safety.
- Error reporting benefits patients and providers by reducing their impacts.
- All physicians make mistakes, and it's important to foster peer support among colleagues.

Medical mistakes and near misses should be reported as soon as they are identified. Healthcare workers are frequently the first to detect a change in a patient's condition that might indicate an unfavorable occurrence. A culture of personal accountability leads to long-term greater reporting, which minimizes mistakes.

Why assess knowledge and practice?

Earlier research has found KAPs among HCWs in various circumstances. A survey of 686 HCWs in Ethiopia found that 73.3% had sufficient knowledge, 54.8% had a positive attitude, and 61.5% used preventative actions. The knowledge levels of these participants had a negative correlation with their attitude and practice ratings. Another research in Turkey discovered that 91.66% (n = 251) of HCWs correctly answered knowledge-based questions and 85.96% (n = 251) of precautionary measures questions, with knowledge scores significantly related with preventative behavior. According to research conducted in Nepal, 76% of HCWs indicated acceptable knowledge, 54.7% reported good attitudes, and 78.9% reported behavioral practices; knowledge was shown to be positively related to attitudes and practices. A global systematic review with 20 research encompassing 12,072 HCWs revealed that 75.8% had excellent knowledge, 74.6% had favorable attitudes, and 79.8% had good behaviors with COVID-19. ,

Previous Studies

The knowledge and practice of health care personnel in CAUTI prevention is of major relevance. Mohammed et al.'s 2022 study intended to analyse health care professionals' knowledge, practice, and associated variables about CAUTI prevention in South Wollo zone public hospitals. Mohammed et al.'s 2022 study found that 72.2% [95% CI: 67.9-76.5%] of health care professionals had acceptable knowledge. This was greater than studies done in Pakistan (51.88%) and Egypt (37.23%) of respondents who were evaluated as having adequate knowledge. , However, Mohammed et al.'s 2022 finding was lower than a research done in a chosen hospital of Mangaluru, India (80.85% of respondents rated average level of knowledge).

It was also lower than a survey conducted in Nigeria (76.7%) of those who achieved fair level of understanding. Variations in findings might be attributed to changes in study sample size and participant socio-demographic factors.

In Prasanna and Radhika's 2015 study, educational status was a significant predictor of knowledge level. Health workers with a bachelor's degree were approximately twice as likely to have appropriate knowledge as those with a diploma. This conclusion was consistent with research done in India and selected hospitals in Nellore. This might be because health care personnel with higher education levels can get more information via the learning process. However, in this study, master's and doctoral students had higher levels of knowledge, but there was no significant correlation.

On the other hand, Mohammed et al.'s 2022 study found that health care personnel who received training were roughly twice as likely to have appropriate knowledge as those who did not. This outcome was similar to investigations conducted at Nellore. This might be because upgrading health professionals' knowledge of infection prevention concepts through training could improve their previous comprehension and result in a satisfactory score on knowledge questions.

The study also found that 56.4% [95% CI: 51.7-61.1%] of health care personnel practiced an appropriate degree of CAUTI prevention. This study revealed a significant gap in CAUTI preventive practice among hospital professionals. To eliminate unnecessary indwelling urinary catheter usage, a multidisciplinary approach is required. Furthermore, a reminder to halt the sequence of catheter usage is useful to minimize CAUTI. In addition, following a procedure reduced catheter reinsertion rates and catheter days. This statistic was greater than a research conducted in Egypt, when 16.1% of respondents had a decent degree of practice. However, it was lower than a research performed in Nigeria, where 71% of respondents reported excellent levels of practice. Only 35.6% of health care professionals got infection prevention training, which might explain the study's lower findings.

According to Mohammed et al's 2022 study, educational status is a crucial element in achieving an acceptable level of practice. Master's and doctoral students were nearly five times more likely to have appropriate practice than diploma holders. The plausible reasoning for this might be because health care workers with higher education levels were able to get more abilities through their advanced learning process.

Experience among health care personnel was a key component in achieving an optimal level of practice. Professionals with 20 years or more of work experience were nearly six times more likely to have a sufficient level of practice than workers with 9 years or less of work experience. Another study found that having more work experience was substantially connected with excellent infection prevention practices. The high positive connection of this finding might be explained by the fact that as health care professionals' work service years grew, they were regularly exposed to infection prevention principles, gained experience, and improved practical implementation competence.

Health care workers with good understanding were roughly three times more likely to practise appropriately than those with insufficient awareness of CAUTI prevention. This conclusion is consistent with research done in Nigeria, which found a substantial association between practice and knowledge. However, this was challenged by another research.

Furthermore, when we compared health care personnel who received training to those who did not, we found that they were roughly twice as likely to have a sufficient level of practice. Another study found that health care providers who received infection prevention training were more likely to practise infection prevention than those who did not. The probable rationale for

this result might be that training could increase the knowledge and expertise of health care workers, allowing them to readily learn basic ideas, standards of practice, and execute them properly.

A large majority of health-care personnel lacked knowledge and experience in CAUTI preventive practices. Possible explanations for this include lower educational standing (the presence of diploma holders) among health care personnel, a lack of CAUTI prevention training, and short term of work experience. Furthermore, it might be attributed to insufficient health infrastructure in the studied locations.

To increase patient safety, a variety of measures should be used.

Avoid injecting medications or air bubbles into the artery lines. Injecting medications or air straight into an artery poses a high risk of thrombotic consequences. A little air bubble in an arterial line might cause substantial morbidity. Effectively oversee junior employees. The physician in this scenario most likely had minimal expertise with severely sick patients. Inserting an artery line without a transducer and flushing system at the bedside was a rookie error. Adequate supervision by a more experienced staff member would almost certainly have avoided this tragedy.

Before beginning a treatment, be sure you are sufficiently prepared. In this scenario, the physician placed an arterial line sans arterial line tubing, a transducer, and a flush bag that was available at the bedside. The lack of proper planning directly contributed to the misconnection problem.

Trace the line from the catheter to the infusion pump. This is an important safety precaution that should become a habit to avoid misconnections and incorrect medication delivery. Color-coding separate lines is critical to avoiding unintentional misconnection to an intravenous catheter. Some arterial line tubing & transducers have colors such as red to aid in identification.

Use different Luer locks for each infusion system. The universally compatible Luer lock technology has been recognized as an unintentional cause of misconnection issues. Different Luer lock connections have been proposed for various infusion delivery systems to prevent venous, arterial, epidural, and enteric feeding infusions from becoming misconnected. Clearly indicate the placement of the intravascular catheter. When a patient is hypotensive and the flow through the catheter is not obviously pulsatile, it is possible that a physician will not realize they have cannulated the radial artery rather than the forearm vein. In this case, the operator attempted to cannulate the radial artery and appeared to assume they had succeeded. However, the high-pressure alert on the infusion pump did not go off, most likely due to low arterial blood pressure.

Correct hypotension before placing an arterial or central venous catheter. Ultrasound can assist avoid unintentional arterial cannulation during central venous catheter placement, particularly when blood pressure remains low despite vasopressor treatment. Two-dimensional ultrasonography reveals the thick wall of an artery, whereas Doppler ultrasound detects pulsatile flow in the artery. Show arterial and central venous pressures on the monitor. Before administering any injections, turn the stopcock on a three-way tap in the line while viewing the pressure trace on the monitor to ensure that the line is venous rather than arterial. When the patient stays extremely hypotensive and pressure readings cannot determine whether the catheter is in an artery or a vein, it may be useful to analyze the partial pressure.

Maintain communication between workers placing the catheter and those providing drugs. Infusion systems in the critical care unit are frequently complex, and explaining how the lines are linked is a vital element of the handover process when passing patient care from one staff member to another. Cannulate arteries with a healthy collateral blood supply. Adults' arterial

blood pressure is most measured through the radial and dorsalis pedis arteries. When cyanosis and poor perfusion are detected and there is no history of unintentional arterial injection, the catheter should be withdrawn. In this example, an inadvertent vancomycin injection resulted in arterial thrombosis, but the arterial catheter was left in place to allow for urokinase and heparin infusion, followed by a repeat angiography.

Conclusion

A large majority of health care personnel lacked appropriate knowledge and practice in CAUTI prevention. The chance of understanding improved dramatically if health care providers had obtained urinary catheter procedure training and held a bachelor's degree. Health care personnel with master's or doctoral degrees, enough knowledge, training in urinary catheter operations, and 20 years of work experience were more likely to have adequate practice. As a result, health care personnel should closely adhere to hospital-acquired infection prevention recommendations and regularly refresh their CAUTI prevention knowledge and practice through reading and short-term training. Healthcare workers should also improve their educational standing. Hospital administrators should give adequate on-the-job continuing training in CAUTI prevention. Researchers should do additional studies utilizing observational study techniques to determine real practices.

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