

Avoiding Catheter and Tubing Mis-Connections

Patient Safety Solutions

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► STATEMENT OF PROBLEM AND IMPACT:

Tubing, catheters, and syringes are a fundamental aspect of daily health care provision for the delivery of medications and fluids to patients. The design of these devices is such that it is possible to inadvertently connect the wrong syringes and tubing and then deliver medication or fluids through an unintended and therefore wrong route. This is due to the multiple devices used for different routes of administration being able to connect to each other. The best solution lies with introducing design features that prevent misconnections and prompt the user to take the correct action.

Other causes or contributing factors include:

- ▶ *Luer connectors. Used almost universally in a variety of medical applications to link medical devices, including fluid delivery (via the enteral, intravascular, spinal, and epidural routes) and insufflation of gas (in balloon catheters, endotracheal cuffs, and automatic blood pressure devices), they have been found to enable functionally dissimilar tubes or catheters to be connected.*
- ▶ *Routine use of tubes or catheters for unintended purposes. This includes using intravenous (IV) extension tubing for epidurals, irrigation, drains, and central lines or to extend enteric feeding tubes.*
- ▶ *Positioning of functionally dissimilar tubes used in patient care in close proximity to one another. For example, use of an enteral feeding tube near a central intravenous catheter and tubing.*
- ▶ *Movement of the patient from one setting or service to another.*
- ▶ *Staff fatigue associated with working consecutive shifts.*

Tubing and catheter misconnections can lead to wrong route medication errors and result in serious injury or death to the pa-

tient. Though these errors are highly preventable and can often be easily averted, multiple reports of patient injury and death from such wrong route medication errors indicate that they occur with relative frequency (1-7). This includes erroneous administration routes for aerosols.

In the United States of America (USA), nine cases of tubing misconnections involving seven adults and two infants have been reported to the Joint Commission's Sentinel Event database, resulting in eight deaths and one permanent loss of function (8). Similar incidents have been reported to other agencies, including the ECRI Institute, the United States Food and Drug Administration, the Institute for Safe Medication Practices (ISMP), and the United States Pharmacopeia (USP). Data from these groups reveal that misconnection errors occur with significant frequency and, in a number of instances, lead to deadly consequences (9,10).

The most common types of tubes and catheters involved in the cases reported to the Joint Commission are central venous catheters, peripheral IV catheters, nasogastric feeding tubes, percutaneous enteric feeding tubes, peritoneal dialysis catheters, tracheostomy cuff inflation tubes, and automatic blood pressure cuff insufflator tubes. Examples include specific misconnections involving an enteric tube feeding into an IV catheter (four cases); a blood pressure insufflator tube connected to an IV catheter (two cases); and the injection of intravenous fluid into a tracheostomy cuff inflation tube (one case).

In the United Kingdom, between 2001 and 2004, there were three reports of death, and from 1997 to 2004 there were four reports of harm or near misses following wrong route errors when oral liquid medicines, feeds, and flushes were administered intravenously (11). A review of the National Reporting and Learning System in the United Kingdom identi-

fied 32 reported incidents in which oral liquid medicines were administered by the intravenous route, seven incidents in which epidural medication was administered via the intravenous route, and six incidents in which intravenous medication was administered via the epidural route from 1 January 2005 to 31 May 2006.

► ASSOCIATED ISSUES:

While various approaches to preventing catheter misconnection and wrong route administration have been suggested, meticulous attention to detail when administering medications and feedings (i.e. the right route of administration) and when connecting devices to patients (i.e. using the right connection/tubing) is a basic first step. By implementing preventive measures—many of them simple and inexpensive—wrong route administration errors can be effectively eliminated.

► SUGGESTED ACTIONS:

The following strategies should be considered by WHO Member States.

1. Ensure that health-care organizations have systems and procedures in place which:
 - *Emphasize to non-clinical staff, patients, and families that devices should never be connected or disconnected by them. Help should always be requested from clinical staff.*
 - *Require the labeling of high-risk catheters (e.g. arterial, epidural, intrathecal). Use of catheters with injection ports for these applications is to be avoided.*
 - *Require that caregivers trace all lines from their origin to the connection port to verify attachments before making any connections or reconnections, or administering medications, solutions, or other products.*
 - *Include a standardized line reconciliation process as part of handover communications. This should involve rechecking tubing connections and tracing all patient tubes and catheters to their sources upon the patient's arrival in a new setting or service and at staff shift changes.*
 - *Bar the use of standard Luer-connection syringes to administer oral medications or enteric feedings.*
 - *Provide for acceptance testing and risk assessment (failure mode and effects analysis, etc.) to identify the potential for misconnections when purchasing new catheters and tubing.*

2. Incorporate training on the hazards of misconnecting tubing and devices into the orientation and continuing professional development of practitioners and health-care workers.
3. Promote the purchasing of tubes and catheters that are designed to enhance safety and to prevent misconnections with other devices or tubes.

► LOOKING FORWARD:

1. Physical barriers (e.g. incompatibility by design) should be created to eliminate the possibility of interconnectivity between functionally dissimilar medical tubes and catheters to the extent feasible.
2. Specific labeling of device ports is advocated to avoid connecting intravenous tubing to catheter cuffs or balloons (3).
3. The use of different, dedicated infusion pumps for specific applications such as epidural infusions has also been proposed (12).
4. Using only oral/enteral syringes to administer oral/enteral medications and avoiding the use of adapters and three-way taps are part of several draft proposals from the United Kingdom's National Patient Safety Agency to prevent wrong route errors (13).
5. A combined preventive strategy of performing risk assessments to identify existing misconnection hazards, encouraging manufacturers to design dissimilar catheters and tubes to be physically impossible to connect ("incompatibility by design"), acquisition of equipment whose design makes misconnections unlikely, and policy implementation to minimize misconnection occurrences has been advocated (14,15).
6. The colour-coding of tubing and connections should be standardized. The European standardization body has studied the colour-coding of tubing and connectors in certain applications and has recommended exploring alternatives to Luer connectors in selected applications (16).
7. Industry-based standards and engineering design for medical tubes and catheters that are organ-specific or need-specific and do not interconnect should be established and promoted.

► STRENGTH OF EVIDENCE:

- Expert consensus.

► APPLICABILITY:

- Wherever patients are treated, including hospitals, mental health facilities, community settings, ambulatory clinics, long-term care facilities, clinics, practices, home-care agencies.

► OPPORTUNITIES FOR PATIENT AND FAMILY INVOLVEMENT:

- Encourage patients and families to ask questions about medications given parenterally or via feeding tubes, to assure proper medication delivery.
- Educate patients, families, and caregivers on the proper use of parenteral sites and feeding tubes in the home care setting and provide instruction on the precautions to take to prevent wrong route errors.

► POTENTIAL BARRIERS:

- Staff acceptance of the concept of wrong route error prevention.
- Staff acceptance of never modifying incompatible connectors to allow connections.
- Cost of converting to non-connectable delivery systems.
- Inability to create an approach or standardization of systems.
- Difficulties with a consistent or reliable supply chain for some countries.
- Insufficient generally accepted research, data, and economic rationale regarding cost-benefit analysis or return on investment (ROI) for implementing these recommendations.

► RISKS FOR UNINTENDED CONSEQUENCES:

- Possible treatment delays to obtain compatible equipment if compatible connections are not available.

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