



# Get Connected

## Mike Hurst at Baxa Corporation reviews the history of enteral feeding tube to IV line misconnections, and argues that the time is right for change



Mike Hurst, RPh, MBA, is Vice President, Infusion Systems at Baxa Corporation. A national expert on syringe pump intermittent IV infusion technology, Mike successfully managed the Swedish Medical Center pharmacy in Seattle, and has 10 years' experience as a pharmaceutical industry consultant. He developed dilution, compounding, drug solution expiration tables and IV pharmacy operational recommendations that set the standard for the most common intermittent syringe infusers. At Baxa, Mike has developed the Rapid Rate Infuser – the standard for Adenoscan infusion for cardiac stress monitoring. Currently, he supports business development and pharmacy process improvement activities. Mike holds a BS in Pharmacy from the University of Washington and an MBA from City University, Bellevue.

The recognition that IV and non-IV drugs should be administered in separate devices is supported by documentation of wrong-route medication errors in medical journal articles dating back to the late 1960s. The problem of misconnections, particularly enteral and breast milk being injected intravenously into neonates, still happens to this day despite warnings from virtually every affiliated professional and regulatory agency. This article argues that hospitals should do a top-to-bottom assessment of whether their systems can absolutely prevent non-IV fluid tubing from being misconnected to IV lines and take the appropriate measures to correct any deficiencies.

### HISTORY

Journal articles dating back to the late 1960s and early 1970s discuss the issue of wrong-route medication errors. In the years since, many articles have been written on medical errors related to tubing misconnections. The Institute for Safe Medication Practices (1), for example, has written about oral to IV misconnections more than a dozen times since its inception in 1994. ISMP and other organisations have long advocated the use of non-luer connectors for administration of any non-parenteral drugs in order to prevent the possibility of an IV infusion of a non-sterile medication. Advocates for a new standard for enteral feeding include the Joint Commission on Hospital Accreditation (Joint Commission), which audits health systems for compliance to best practices, and the National Health Service (NHS) in the UK.

Historically, the gastric tubes used for neonatal and paediatric enteral nutrition support and oral liquid medication administration have incorporated luer fittings to allow hypodermic syringes to access the tube. Although safer non-luer tip 'oral' syringes were available, their oral tips could not mate with the tubes' luer connections. Worse yet, when a gastric tube was in place, a luer-tipped syringe was required for oral liquid medication and feeding administration. This scenario made it impossible to avoid the potentially devastating hazard of misconnection of a luer-tipped syringe or bag tubing containing a non-IV fluid to a parenteral intravenous access line (2-9).

Most facilities continue to use feeding tubes with luer connections because caregivers use stock hypodermic syringes to prepare and deliver enteral feeds. Further complicating the risk of misconnection is that the most common syringe-driver 'smart pumps' used in neonatal intensive care units are programmed to recognise only the brand and size of standard hypodermic syringes.

Using standard hypodermic syringes and readily available syringe pumps is easy and cost effective. However, this solution presents misconnection risks at every step of the process (10). To reduce the risk, some facilities have started adding large orange stickers to the syringes and tubes. These components are then considered 'safe' simply because they are orange. The tragic reality is that the risk of a potential misconnection remains as long as there are luer compatible connection points.

Over the past three decades, a number of manufacturers have attempted to address the issue of wrong-route administration through adapters, non-standard connectors and other individual product designs. The challenge of creating a safe enteral feeding solution is this lack of standards for the desired components. With the exception of the step connector (commonly referred to as a 'Christmas tree' connector) used at the distal end of many adult feeding sets, there is no enteral standard for manufacturers to design their products to meet.

Without a defined standard that would prevent adaptation or modification for luer compatibility at all connection points for enteral feeding, it is difficult for manufacturers to create complementary products that they do not manufacture. For example, the companies that make the feeding tubes do not necessarily manufacture the enteral feeding pump sets, or the feeding formula container. Therefore, one manufacturer's connection solution may not fit with another's.

The optimal response to the patient safety risk must account for all of the potential points of failure in the process. Any

400  
300  
200  
100

comprehensive solution must prevent practitioners from making a misconnection by adapting accessories to fit an inappropriate connection through force, or any other creative mechanism. There has not been a precedent for such a solution in the past because none of the pump, container and tubing combinations that are currently on the market are designed to administer only enteral feedings.

## PROPOSALS FOR CHANGE

National professional and regulatory organisations involved in this issue agree that the problem of enteral misconnections is far too common and must be solved. This position is the logical response to decades of literature documenting the risks and impact of errors, some of which are summarised in the references. Every alert cited represents just a fraction of the actual number of tragic and near tragic events that have occurred with misconnections.

American Society for Parenteral and Enteral Nutrition (ASPEN) has published standards for specialised nutrition support in hospitalised paediatric patients that consider the dangers of oral to IV misconnections (10). Among their recommendations is the development of a dedicated nutrition support team to coordinate service delivery among departments and professional groups. This 'nutrition support service' would be charged with developing "... performance improvement mechanisms to initiate policy, procedure, and/or protocol changes that enhance the safety and efficacy of parenteral and enteral nutrition with the goal of improving patient outcomes" (11).

The US FDA assembled an advisory board to establish and publish guidelines for safe enteral feeding. The first meeting was in October 2006 in Washington DC. Some of the organisations that participated included the FDA, Joint Commission, USP, ISMP, ASPEN, ECRI, Premier Inc, Sharp, Baxa Corp, VIASYS Inc and the MD Anderson Medical Center.

The Joint Commission issued a Sentinel Event Alert on 3rd April 2006, warning of the significant risk posed by 'tubing and catheter misconnection errors' (17). The Joint Commission noted that at least six deaths were attributed to tubing misconnections, and countless other near misses had likely occurred. The Alert strongly recommends that healthcare organisations do not purchase non-intravenous equipment that integrates tubing connectors that can physically mate with a female luer IV line connector of any form. The Alert also clearly states that a standard luer syringe should never be used for oral medications or enteral feedings. The final statement of the Alert urges product manufacturers to implement 'designed incompatibility' to prevent misconnections of tubes and catheters.

Furthermore, the Joint Commission's National Patient Safety Goals for 2008 will require facilities to demonstrate that they

are actively working to eliminate the oral to IV misconnection risk before 2008 evaluation cycles (18).

The *Journal of Neonatal Nursing* published an article that detailed the implementation of an enteral nutrition and medication administration system utilising oral syringes in the neonatal intensive care unit (NICU) (19). The study's conclusions included the assertion that "converting to oral syringe delivery of medications and enteral formulas utilising enteral-only tubing eliminated the necessity for Luer-Lok IV tubing and syringes, thereby reducing the potential for wrong-route error."

Tubing misconnections are a worldwide issue. The UK's National Health Service (NHS) – through their National Patient Safety Agency – issued a National Public Safety Alert on 28th March 2007 regarding the risks of misconnections (21). The Alert was in response to 33 documented safety incidents involving oral liquids and IV administration between 1st January 2005 and 31st May 2006. This was after years of incidents that included multiple fatalities.

This enteral alert summary was simple: "Enteral feeding systems should not contain parts that can be connected to intravenous syringes, nor have end connectors that can be connected to intravenous or other parenteral lines." The deadline for compliance with this Alert is 30th September 2007.

## CONCLUSION

Tubing misconnections that have allowed enteral feedings and breast milk to be infused intravenously have injured and even killed adults and neonates for decades. Now that new solutions are becoming available to address this issue, it is time for hospitals to do a top-to-bottom assessment of what dangers exist in their own institutions and implement a solution to prevent misconnections in neonatal and other critical care settings. ♦

*The author can be contacted at  
mike.hurst@baxa.com*

## References

1. [www.ismp.org](http://www.ismp.org)
2. Akron, Lawsuit coming for women killed by enteral KPhos, *Ohio Beacon Journal*, 2nd March 2007  
<http://www.ohio.com/mlid/ohio/16817458.htm>.
3. Fechner G; Du Chesne A; Ortmann C and Brinkmann B, Death due to intravenous application of enteral feed, *Int J Leg Med* 116, December 2002
4. Garcia MJL, Monrabal IS and Cerda RFD. Accidental intravenous administration of semi-elemental formula in an infant, *Clin Pediatr*: pp757-758, December 1992
5. Guzman DD, Teoh D and Velez LI, Accidental intravenous infusion of Golytely® in a 4-year-old female, *J Toxicol Clin Toxicol*, 40(2): pp361-362, 2002

6. Huddleston K, Creekmore P and Wood B, Administration of infant formula through the intravenous route: consequences and prevention, *J Matern Child Nurs*: pp40-42, January/February 1994
7. Kennelly C and Barnes S, Letters to the editor: inadvertent IV administration of enteral formula, *Am J Crit Care* 7(1): p80, January 1998
8. Ryan CA, Mohammed I and Murphy B, Normal neurological and developmental outcome after an accidental IV infusion of expressed breast milk in a neonate, *Pediatrics*: 117(1): pp236-238, 2006
9. Wallace JR, Payne RW and Mack AJ, Inadvertent IV infusion of milk, *Lancet*: pp1,264-1,266, 1972
10. Diligence PL, Technology prevents IV and feeding tube mix-ups: finding the wrong fit, *Materials Management in Health Care*: pp24-28, April 2006
11. ASPEN Board of Directors, Standards for Hospitalized Pediatric Patients, *NCP* 11: p5
12. Wessel J, Balent J, Crill C and Klotz K, Standards for Specialized Nutrition Support: Hospitalized Pediatric Patients, *Nutrition in Clinical Practice*: pp103-116, February 2005
13. ISMP Medication Safety Alert! Enteral feeding given IV, 4th April 2003, <http://www.ismp.org/Newsletters/acutecare/articles/A2Q03Action.asp>
14. ISMP Medication Safety Alert! 22nd April 2004. GoLyteLy bowel prep given IV. [http://www.ismp.org/Newsletters/acutecare/articles/20040422\\_2.asp](http://www.ismp.org/Newsletters/acutecare/articles/20040422_2.asp).
15. ISMP Medication Safety Alert! Problems persist with life-threatening tubing misconnections, 17th June 2004, <http://www.ismp.org/newsletters/acutecare/articles/20040617.asp>.
16. ISMP Medication Safety Alert! Preventing accidental infusion of breast milk in neonates, 5th June 2006, <http://www.ismp.org/Newsletters/acutecare/articles/20060615.asp>.
17. Joint Commission Sentinel Event Alert, Tubing Misconnections – A Persistent and Potentially Deadly Occurrence, 3rd April 2006, [http://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea\\_36.htm](http://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea_36.htm).
18. Joint Commission National Patient Safety Goals for 2008, [http://www.jointcommission.org/NR/rdonlyres/OA05D3F3-B396-46DC-A5B3-42ADF25B3A4E/0/08\\_potential\\_OME\\_NPSG.pdf](http://www.jointcommission.org/NR/rdonlyres/OA05D3F3-B396-46DC-A5B3-42ADF25B3A4E/0/08_potential_OME_NPSG.pdf).
19. Copeland D and Appel J, Implementation of an enteral nutrition and medication administration system utilizing oral syringes in the NICU, *Neonatal Network* 25(1): pp21-24, 2006
20. Premier Case Study, Premature infants safer because of new feeding system, <http://www.premierinc.com/quality-safety/tools-services/safety/topics/tubing-misconnections/downloads/neonatal-case-study.pdf>.
21. National Patient Safety Agency (UK), NPSA Patient Alert 19, Promoting safer measurement and administration of liquid medicines via oral and other enteral routes, 28th March 2007, [www.npsa.nhs.uk](http://www.npsa.nhs.uk).
22. [http://www.viasyshc.com/prod\\_serv/prodDetail.aspx?config=ps\\_prodDtl&prodID=270](http://www.viasyshc.com/prod_serv/prodDetail.aspx?config=ps_prodDtl&prodID=270).
23. [www.baxa.com/helpthemgrow](http://www.baxa.com/helpthemgrow)