Ontario
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Qualité des services de santé Ontario

OHTAC Interim Recommendations: Multiple Intravenous Infusions Phase 1b

Ontario Health Technology Advisory Committee

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Background

In Phase 1b of the Multiple Intravenous Infusions research project, an exploratory ethnographic analysis was conducted by the Health Technology Safety Research Team to address the following objectives:

- to identify safety issues with the potential to cause patient harm stemming from the administration of multiple intravenous (IV) infusions
- to identify how nurses are being educated on key principles required to safely administer multiple IV infusions

Note: *In the Phase 1b field study, nurses in the 12 clinical units were observed administering multiple IV infusions. For the sake of consistency within and among Phase 1b reports, the term* nurse *is used throughout, but we recognize that other health care professionals, including physicians, respiratory therapists, and dialysis technicians, may also be involved in the administration of multiple IV infusions.*

Conclusions

- The administration of multiple IV infusions to a single patient is a complex task with many potential associated patient safety risks.
- The observation and interview data collected in Phase 1b of this study have highlighted varying degrees of awareness of these risks on the part of nurses, hospital administrators, educators, regulators, and technology vendors; few systematic efforts have been implemented to reduce these risks.
- Improvements to infusion and infusion-related technology, education standards, clinical best practice guidelines, hospital policies, and unit work practices are required to reduce the risk potential.
- Further investigation of mitigating strategies is required and will be conducted in Phase 2 of this research.

Application of the Precautionary Principle

The precautionary principle dictates that even if the cause and effect data are not fully established scientifically, precautionary measures should be taken. (1, 2) The recommendations in this report are derived from direct observational and interview data. While these methods of field study yield a rich source of data, there are limitations to applying these methods—mainly that the prevalence of a particular issue cannot be established. The rationales for the recommendations in this report were based on the potential for particular types of errors (i.e., the existence of failure modes) rather than on the direct observation of errors, for 2 reasons:

- The frequency of errors for each individual failure mode is not high enough for all to be detected in the time allotted.
- The failure modes are not identified a priori to allow for routine inspection.

Nonetheless, some errors were directly observed during the study.

The failure modes identified in the Phase 1b report have the potential to occur during tasks related to administering multiple IV infusions; these tasks are routine elements of patient care across Ontario. Although not all errors necessarily lead to patient harm, in some cases a patient may incur serious harm, and even death. The findings of the Phase 1b field study are consistent with those of other studies that highlight the severity of infusion errors. (3, 4)

Furthermore, research highlighting the prevalence of infusion errors (5-7) correlates with United States Food and Drug Administration (FDA) statistics (8) showing that between 2005 and 2009, more than 56,000 infusion pump incidents were reported, including 710 deaths. While the failure modes associated with these incidents and those described in the literature may not include all of the failure modes identified in the Phase 1b field study, the precautionary principle dictates that even if the cause and effect data are not fully established scientifically, precautionary measures should be taken.

The analysis in the Phase 1b report and the recommendations provided here encourage a cautious and measured approach to improving safety in IV care. While modifications to infusion systems and related work practices are suggested to improve the safety of infusions administered via a large-volume infusion pump, substitution of gravity infusions for pump-controlled, large-volume infusions is not recommended, given the many advantages provided by large-volume infusion pumps. All findings and recommendations should be implemented with careful appraisal of the risks and benefits of doing so for each specific context.

OHTAC Recommendations

1. When initiating a secondary medication infusion (often referred to as a *piggyback* infusion), nurses should verify that the secondary infusion is active—and that the primary infusion is not active—by viewing the activity in both drip chambers. Full drip chambers should be partially emptied to restore visibility.

2. *Continuous* high-alert medications* should be administered as primary infusions. *Continuous* high-alert medications should not be administered as secondary infusions. No secondary medications should be connected to high-alert primary continuous infusions. (9)

3. Secondary infusions should be attached to primary infusion sets that have a back check valve. If infusion sets without back check valves are also available, multiple strategies should be employed to ensure that the types of tubing available are easily differentiated, and that the likelihood of a mix-up is minimized.

4. Hospitals should work towards the use of gowns that have snaps, ties, or Velcro on the shoulders and sleeves to facilitate line tracing and gown changes. Metal fasteners (e.g., metal snaps) should be avoided to prevent patient burns if a gown with metal fasteners goes into the magnet room of an MRI suite. (10)

5. If an "emergency medication line" controlled by an infusion pump is set up, it is strongly suggested that the associated primary IV tubing be labelled as the emergency medication line at the injection port closest to the patient. The label should be prominent and visually distinct from all other labels in the environment.

6. When setting up multiple IV infusions at the same time (e.g., a new patient requires many ordered infusions immediately, routine line changes), infusions should be set up 1 at a time, as completely as possible, before setting up the next infusion. Set-up tasks required for each infusion vary and may include:
   - labelling (e.g., IV tubing, pump)
   - spiking and hanging the IV bag
   - connecting the IV tubing to the pump
   - programming the IV pump
   - connecting the IV tubing to the appropriate location (e.g., patient access, manifold)
   - starting the pump (unless a secondary infusion must be set up prior to starting the pump, or other infusions need to be connected to a multi-port connector before flushing)

   Minor modifications to this recommendation are required for routine line changes.

*The Institute for Safe Medication Practices defines high-alert medications as "drugs that bear a heightened risk of causing significant patient harm when they are used in error." For more information, visit: http://www.ismp.org/tools/highalertmedications.pdf

7. Multiple 3-way stopcocks joined together in series to connect multiple IV infusions into a single line are prone to leaks, which may often be undetectable. Hospitals should provide multi-port or multi-lead connectors, and nurses should use these connectors to join multiple IV infusions into a single line, as required.

8. Hospitals should develop a policy to limit the practice of manually increasing the infusion rate to administer a medication bolus of a primary continuous infusion. If a separate medication bolus cannot be prepared, and the bolus is administered using the primary continuous infusion pump/pump channel, then the nurse should program the bolus dose parameters (i.e., total amount of medication to be given over a defined duration) into the pump without changing any of the primary infusion parameters. Some examples of how to specify the bolus dose parameters include the following:
   - programming a bolus using a dedicated bolus feature in the pump (preferred, if available)
   - programming a bolus using the pump's secondary feature but without connecting a secondary IV bag (pump will draw the bolus from the primary IV bag)

9. Hospitals should ensure that their smart pump drug libraries include hard upper limits for as many high-alert medications as are appropriate for each clinical area, in order to prevent the administration of a bolus by manually increasing the primary flow rate.

References

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