Multiple IV Infusions Webinar
Questions and Answers Document

Webinar sponsored by:
AAMI Foundation/Health Technology Safety Institute
Infusion Nurses Society
Institute for Safe Medication Practices (ISMP)
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Webinar archived at: http://www.aami.org/htsi/infusion
Follow-up questions can be addressed to mark (dot) fan (at) uhn (dot) ca.

Question 1
We are in the process of purchasing pumps. Given the recommendations for bolus administration, should we be looking for a pump that allows secondary programming on an existing continuous medication infusion?

The recommendation to administer a pump controlled bolus from an existing primary infusion by programming the secondary infusion was provided as a safer option for organizations that have existing pumps with this feature. However, pumps that allow secondary infusions to be programmed on a primary infusion (i.e., continuous infusion of a medication) present a risk of a secondary medication being initiated on a primary line with a continuous medication infusing (e.g., high-alert medication such as a vasopressor, opioid). If this were to occur, the primary medication would be administered at the rate of the secondary infusion (dead volume of the medication in the primary tubing), and then would be interrupted altogether.

Thus, a safer option is to consider a pump with a dedicated bolus feature, and ensure that the feature is enabled for all drugs where boluses are necessary. If the pump is a smart pump, appropriate hard and soft limits should be established for each bolus infusion in the drug library.

Given the range of tasks associated with IV infusion delivery and the variation in clinical practice between patient care areas in a healthcare organization, it is important that the pump selection process include a human factors analysis of how each potential product will perform in each environment of use and with each type of user. Previous work on the selection of smart infusion pumps is available at: http://www.ehealthinnovation.org/?q=node/576

A helpful resource paper regarding the application of human factors to the procurement process can be found in the AAMI Human Factors Horizons publication: http://www.aami.org/publications/HFHorizons/index.html

Question 2
The need to run a secondary infusion below a maximum flow rate to prevent unintended concurrent flow from the primary line wasn’t something I was previously aware of. Is the rate
the same for all infusion pumps? Where might I find this information to know what the maximum rate is for the pump I am using?

There are multiple factors that affect whether the primary infusion will unintentionally flow simultaneously with the secondary infusion including:

- the secondary infusion flow rate,
- the head height differential (distance between the top of the fluid level in the primary and secondary IV bags) between the IV bags,
- the characteristics of the back check valve on the primary IV tubing,
- the viscosity of the fluids,
- the height difference between the IV bags and the infusion pump, and
- other considerations.

A suggested maximum secondary flow rate may be specified on the packaging of the IV tubing and/or in the infusion pump manual, but if not, you should contact the infusion pump manufacturer to inquire about this rate. It is also important that staff are educated on the maximum flow rate, and how to handle situations where a higher flow rate on the secondary line is required. To ensure the primary infusion is not flowing sympathetically during a secondary infusion, both the primary and secondary drip chambers should be observed to ensure only the secondary drip chamber is active (recommendation #1 presented in the webinar).

**Question 3**

In the webinar you mentioned the risks of connecting multiple stopcocks. We put 2 stopcocks together for our central venous pressure (CVP) line so that it can be transduced as well as be used for an IV infusion. On occasion, we also need to join 2 stopcocks together to build a bridge for a Swan Ganz catheter. Are you suggesting we change these practices? If so, what would you suggest?

The recommendation against joining 3-way stopcocks aims to minimize medication leaks and is intended to apply to the connection of multiple primary continuous medication infusions. The use of stopcocks as you described does not fall within the scope of this recommendation. We do not recommend you change your practice of using stopcocks on transduced CVP lines or your practice of building bridges for a Swan Ganz catheter.

**Question 4**

Do you plan to provide specific recommendations to pump manufacturers as a result of this study?

Yes - in the next phase of the study we are investigating specific strategies to reduce the risks discussed in our presentation. We anticipate that these findings will contribute to recommendations that are directly applicable to pump manufacturers.

**Question 5**

The dead volume issue can be significant depending on the drug and the patient’s status. Do you know if there are any pump manufacturers that are working with manufacturers of manifolds, connectors, and even those that make central line catheters?
Some pump manufacturers are actively investigating means of mitigating dead volume risks, however we are not aware of any explicit plans by pump manufacturers to optimize connector or catheter designs to minimize this issue.

**Question 6**
The information you presented was based on observations of an emergency department, an outpatient clinic, and critical care areas. However, multiple IV infusions may also be administered in other care areas such as a general medical-surgical ward units, or an operating room. Would your recommendations also be applicable to those units?

In short, yes. We feel that the topics addressed by the recommendations presented in the webinar and report
(http://www.hqontario.ca/en/mas/mas_ohtas_tech_mii_20120530.html) are generalizable to any environment where patients receive multiple IV infusions because the tasks associated with the issues targeted by the recommendations are the same, or similar. However, during the field study, the observations in each type of patient care area highlighted new issues, suggesting that additional issues not addressed by our recommendations are likely present in the environments excluded from this study.

**Question 7**
According to the new INS recommendation/guideline, the usage of an IV set was increased to 96 hours to decrease risk of infection. This would counteract the recommendation to change lines frequently to account for dead volume. How would this work?

None of our recommendations specifies how frequently to change an IV set (guidelines for this in addition to INS are also available from the Centre for Disease Centre for Disease Control; page 19, no 1: http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf). In the webinar we mention that when changing the concentration of a primary continuous medication infusion, attaching and priming new tubing would help to minimize the time to achieve steady state in the infusion system (i.e., a delay in the patient receiving the new concentration because of dead volume).

We encourage each institution to consider its line changing policy and weigh the risks (e.g. potential infection) against the risk of inadvertently bolusing or significantly under-dosing a medication due to dead volume in the tubing.

The risk of having high-alert medications left in the tubing (e.g., when discontinuing a medication) or the wrong dose for the infusion rate of a life-sustaining medication (e.g., when changing concentrations) must be considered as there have been reports of severe harm and death. The reports involve high-alert medications such as inotropes, opioids. Changing the tubing when changing the IV medication to a different strength can help to reduce these risks.

Until solutions that automatically account for these dead volume issues emerge (e.g., user friendly infusion pumps that can account for the dead volume), changing the tubing along with the solution must be considered to lower the risk of harm.
Question 8
Are you making any recommendations regarding selection of IV disposables that minimize dead space? (e.g., using low compliance tubing, purchasing the shortest tubing possible)

Not at this time. We recommend you consider this in your purchasing decisions, and also consider any unintended consequences a particular selection could have on other aspects of infusion delivery in consultation with front-line staff.

Question 9
What are your thoughts on infusion of multiple primary lines (all are on their own pump) using the lower 'y' sites on the patient primary lines.

One concern with joining together multiple primary tubing sets at the lowest y-port connector (i.e., below each pump) instead of using a multi-lead or multi-port connector is that there is significantly more dead volume in the shared tubing space. If medications need to be titrated or tightly controlled, this setup could result in unacceptable time delays to achieve the desired physiological effect. Additionally, if more than two lines are joined together using y-port connectors (e.g., medication A is connected to medication B’s lowest y-port, and medication B is connected to medication C’s y-port), not only are the dead volume issues magnified, but it may be harder to keep track of how the system of lines is connected, which could increase the likelihood of a line identification error. As always, when joining infusions together, compatibility needs to be considered.

Question 10
Is there a consistent level of education that schools of nursing must maintain? How often is this assessed? There have been many changes for basic nursing practice in IV therapy in just the past 5 yrs.

Academic curriculum requirements are governed differently across North America. During our study we conducted interviews with baccalaureate nursing programs and post-graduate critical care training programs in Ontario and discovered that several key infusion principles that guide multiple IV infusion management (e.g., principles of dead volume, hydrostatics as it relates to secondary infusions) are not formally included in the curriculum to be taught and assessed. Standards used to guide curriculum development in these programs do not explicitly highlight these key principles.

Academic nursing education programs as well as hospital-based training programs (e.g., RN orientation, unit orientation, continuing education) should investigate their current infusion-related curriculum and consider expanding the syllabus to include the key infusion principles discussed in our report Multiple IV Infusions Phase 1b: Practice and Training Scan.

Question 11
Do you recommend the use of multi-channel IV pumps over single channel pumps?

No, we have no evidence to support the relative safety of one style of pump over the other. Depending on the style of pump selected there are many physical implications to how the pumps connect to an IV pole and how the tubing gathers both upstream and downstream of the pump. Organizations purchasing new pumps should evaluate the
impact of these differences within their specific physical environments of use prior to making a purchasing decision.

**Question 12**
Have you found problems using a 3-way stopcock instead of the three-port adaptor?

We are not sure we fully understand what is meant by a 3-port adapter. Please email us if you would like a follow-up response.

**Question 13**
How do you recommend starting multiple infusions, taking into account the dead space with new lines (e.g. length of catheter itself from connector port to patient)

We do not have specific recommendations regarding this question and the topic of dead volume at this time.

The correct management of dead volume is a challenging one and depends on numerous factors, some of which include the:

- patient’s condition,
- clinician’s judgment and understanding of the IV system,
- type of medications involved, including the
  - onset of action,
  - half-life, and
  - flow rate.

Multiple lines are often initiated one at a time (albeit it can be in quick succession for patients who are critically ill). In circumstances where a patient is unstable, drugs are often titrated rapidly to overcome the dead volume. Your question speaks to the high cognitive demands placed on expert practitioners to handle these situation based on various patient parameters that they continuously monitor, assess, and act upon.

For routine IV medication line changes done on a stabilized patient, one critical element to consider is how lines are primed, particularly with respect to critical or life-sustaining medications. It is often helpful before exchanging the infusions to a port, to ensure that the intended medications are admixed well together right to the end of the multiple line prior to initiation, particularly medications with a short-half life (e.g., vasopressors). In cases where life-sustaining medications are used, the change of lines needs to occur seamlessly to ensure that there is minimal interruption in the administration of these medications to prevent destabilizing the patient.

**Question 14**
I am an infusion safety practitioner at my health system. We do not recommend placing tape on our infusion pumps as they make the pumps difficult to clean and present an infection control problem. We recommend that only the tubing is labelled for each particular drug both at the stopcock/manifold site and where the tubing leaves the pump. Our channels identify the drugs on our infusion pumps. What are your thoughts on this?
We do not have any specific information about the effectiveness of labelling IV pumps to mitigate line identification and IV bag-pump mismatch errors at this time. During our field study, we observed a range of practices with respect to labelling infusion pumps with tape. Some of these practices were shown in the photos during the webinar presentation to highlight these findings.

We observed that labels added to pumps sometimes contained information that is not automatically displayed by pumps programmed with a drug library (e.g., IV access site information). Often such practices develop out of need, and other related issues. Therefore, pump generated displays may not necessarily provide all the information nurses may be looking for. We will be addressing the topic of labeling in our simulation study related to line identification in the next phase of research and will be able to share further observations on their effectiveness at that time.

**Question 15**
Should drug companies look into different colored IV tubing to help distinguish between IV lines?

The use of colour to distinguish between medications is often suggested but has several limitations. First, there are very few distinguishable colours than there are even classes of drugs. This is compounded further by the fact that the colour has to remain transparent because practitioners need to see the tubing. Secondly, there exists a risk of selecting the wrong coloured tubing, both unintentionally (e.g., in error) and intentionally (e.g., if there is a shortage of the tubing colour required). These limitation and more present opportunities for line misidentification and so other solutions should be considered.

**Question 16**
Many primary infusion sets do not have a clamp along the tubing above the pump. What can I use to prevent sympathetic primary flow when running a secondary infusion quickly or administering a secondary infusion from a large IV bag?

Usually sympathetic flow can be prevented by using primary tubing with a back check valve and ensuring a sufficient head height differential between the primary and secondary IV bags. We have encountered similar scenarios and can tell you that hospitals worked with their pump and/or tubing supplier to obtain custom IV tubing sets with clamps in their preferred locations. This would mitigate the use of surgical clamps for this purpose, which we have previously observed.

Further increasing the distance between the IV bags may also increase the likelihood that only the higher bag will flow due to the increased pressure differential between bags.

**Question 17**
Regarding not using bridges, practically what do you use? Putting things into ports makes more dead space and our vendors have not shown us anything that could do more than two together.
We are not certain we understand the question and believe it may be a difference in terminology. Please email us if your question has not been answered already.

**Question 18**  
What are the disadvantages of using Multiple IV Infusions?

Multiple IV infusions are a critical and requisite element of IV therapy, particularly for complex and acute patients. Our Multiple IV Infusions Phase 1b: Practice and Training Scan report describes risks and is available at:  

**Question 19**  
When should we expect the phase 2 report to be released?

The phase 2 report (the final report of the study) will include the findings of our simulation lab study and Ontario-wide survey as well as new recommendations. We anticipate the final report will be released in Spring/Summer 2013.

**Question 20**  
Would the adoption of a Transfer of Accountability patient handover policy and procedure reduce the incidents of mislabelled lines and incorrect pump programming?

The effectiveness of transfer of accountability policies for mitigating multiple IV infusions risks has not been studied. As with all policies, their effectiveness is limited by many factors including how practical they are, how comprehensive they are, how well communicated they are, and the processes and tools put into place to support the policy, as well as broader issues such as organizational culture. A transfer of accountability policy can be part of a broader process to that facilitates a detailed assessment of the IV line and pump set-up to help detect and mitigate errors.