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**Channel:** Devices                      **FDA:** Not Specified                      **Last Updated:** 04/09/2020

**[COVID-19] Large-Volume Infusion Pumps—Considerations When Used with Long Extension Sets outside Patient Rooms to Help Reduce Staff PPE Use [ECRI Exclusive User Experience Network]**

## Product Identifier(s)

[Capital Equipment]

Devices: (1) Large-Volume Infusion Pumps, (2) Extension Sets

## Problem

1. In some cases, infusion pumps can be used with extension sets outside of the patient room to protect the clinical personnel and conserve personal protective equipment (PPE) as a temporary measure during the COVID-19 pandemic.
  1. Repeated entry into the patient room to manage infusion (e.g., adjust the rate, respond to alarms, replace infusion bags, administer IV medications) can result in frequent requirement to use PPE with COVID-19 patients.
  2. It may be appropriate to consider the use of long extension sets from outside the patient room, provided that a convenient method to route the IV tubing into the room without keeping the door open exists or it is possible with minor facilities modifications.
2. Long extension set use can affect infusion pump performance; however, it is likely acceptable with most common infusion flow rates.
3. Use of long extension sets may not be suitable for all patients or infusions and does not void the need for regular patient assessment (e.g., catheter site assessment).

## ECRI Recommendations:

### *Supply Chain*

1. Stock extra sets or long pump administration sets to meet this need. Note that extension sets may be either microbore/small bore or macrobore, and that both may be needed.

### *Nurse Managers/Nurse Leadership/Pharmacists/Medication Safety Officer*

1. Identify the infusion use cases for which delivery with long extension sets is appropriate, which includes balancing the patient medication needs/critical infusions, PPE conservation, pump performance limitations, and patient infection risks.
2. Identify the most suitable extension sets for use.
  1. Review the combined priming volume of extension sets and any primary administration set. Note that to achieve the desired tubing length to reach the patient, multiple extension sets connected in series may be required.
  2. Extension sets can be either microbore/small bore or macrobore (regular bore) tubing, which have some different considerations for use.
    1. Microbore/small bore tubing may be a better option for most common flow rates.
      1. Microbore/small bore tubing has a lower priming volume in comparison to macrobore tubing.
      2. Microbore/small bore tubing is less compliant than macrobore tubing, which can help with timely downstream occlusion alarms. Some alarm delay should still be expected in comparison to use without extension sets, especially with low flow rates.
      3. Microbore/small bore tubing use increases the fluid flow resistance, which may affect the flow rate accuracy with some pumps.
      4. Increased fluid flow resistance can also result in frequent downstream occlusion alarms, making the pump unusable at high flow rates.
    2. Macrobores tubing use may also be considered.
      1. Macrobores tubing has a significantly higher priming volume than microbore tubing.

2. Macrobore tubing is more compliant than microbore tubing, which may cause significant delays with downstream occlusion alarms, especially with low flow rates.

### *Clinical Engineering*

1. Ensure sufficient power plugs are available for all pumps held in the hallways.

### *Nursing Staff*

1. All patients and infusions may not be suitable candidates for delivery with a long extension set.
  1. Patient suitability should be assessed on a case-by-case basis by balancing the patient medication needs/critical infusions, PPE conservation, pump performance limitations, and patient infection risks.
  2. Performance limitations with extension sets may be unacceptable for some high alert drugs or critical infusions (e.g., vasopressors, other drugs that will be titrated to effect). If unacceptable, utilize pumps in the patient room instead.
  3. Ensure continued adherence to facility policy with periodic patient assessment (e.g., catheter site assessment).
  4. Do not use an ajar door to route the tubing into the patient room because this can defeat the purpose of patient isolation.
    1. Route the IV tubing into the patient room without keeping the patient room door open.
    2. Request facilities staff for assistance if needed.
    3. If the IV tubing is routed into an airborne negative pressure isolation or droplet isolation patient room, smoke tests should be conducted by maintenance/engineering when centralized/local electronic room monitoring is not available or if airborne rooms are made by using portable HEPA filters.
  5. When using any long extension sets (microbore/small bore or macrobore) be aware of the following:
    1. Flow rate accuracy may be affected with some pumps. Specifically, underinfusion could occur because of the increased back pressure.
      1. Ensure periodic review of the infusions to confirm that the setup is not adversely affecting medication delivery.
    2. Downstream occlusion alarms may be delayed.
      1. Review the entire fluid path to confirm that it is not obstructed in any way.
    3. Priming volume increases with the added extension sets.
      1. Ensure that the combined priming volume of extension sets and any primary administration is reviewed. Note: To achieve the desired tubing length to reach the patient, multiple extension sets connected in series may be required.
    4. Macrobore extension set priming volume is greater than microbore extension set priming volume.
    5. For secondary infusions or bolus injections, the increase of priming volume increases the importance of appropriately flushing the line to ensure that the patient receives the full intended dose at the intended rate.
    6. Increase of priming volume can also lead to a delay in medication reaching the patient if the set is not primed with medication or flushed after injection.
    7. Failure to account for the priming volume increase could lead to increased drug waste and/or lack of timely dose delivery.
    8. Several administration set connection points increase the infection control risks associated with IV infusions.
      1. Ensure that any extension connections are complete and secure.
      2. Any Y-site or needle-free access ports should be appropriately protected with the use of port caps with a disinfectant solution within the cap to reduce the patient infection risk.
      3. Any Y-sites or needle-free access ports that have been on the floor should not be used.
    9. Organize pumps and extension sets to minimize tripping hazards inside and outside of the patient room.

### **Background:**

- ECRI has tested several major large-volume infusion pumps with 20 feet of microbore tubing.
  - Based on our limited lab testing, the performance is acceptable with commonly used flow rates.

- In our testing for pump flow accuracy, all of our measurements corresponded to the manufacturer accuracy specifications. Note: Several manufacturer instructions for use (IFU) do state that variables including increased backpressure because of extension sets may affect flow rate accuracy. While this was not observed in ECRI lab tests, it could materialize as underinfusion in a clinical setting.
  - Occlusion alarms were delayed in comparison to the manufacturer specifications for time to occlusion alarm at flow rates below 5 mL/hour.
  - At high flow rates (e.g., 300 mL/hour), increasing resistance to fluid flow because of the microbore tubing extensions resulted in frequent occlusion alarms, which made the pump unusable.
- Microbore/small bore tubing is generally smaller in diameter than macrobore tubing. Microbore/small bore tubing inner diameter can differ between manufacturers from 0.5 to 1.5 mm.
- Fluid viscosity is also a factor with the pump performance (e.g., D50%) produces more pressure as NSS at the same flow rate. This could lead to further performance effects when using long extension sets.,
- The [attached Excel chart](#) may also aid in estimating the pump performance with long extension tubing, however it has not been validated by ECRI. This educational tool was developed by Robert Butterfield (Principal at RDB Consulting) and Ben Powers (VP R/D Ivenix) to assist clinicians wishing to infuse through very long lines. Actual results may vary dependent on pump characteristics and settings as well as fluid properties and temperature. Use only as a generic guide.
- Several manufacturers are providing specific guidance in regards to the use of extension sets with their infusion pumps (also attached as Source Documents):
  - [BD letter](#)
  - [ICU Medical letter](#)
  - [B Braun letter](#)
  - [Baxter letter](#)
  - [Ivenix letter](#)
  - [Smiths Medical letter](#)
- The following Guidance article also contains information regarding the use of extension sets with infusion pumps: [Click here](#).

## UMDNS Term(s)

Infusion Pumps, Multitherapy [13215]

## Geographic Region(s)

Worldwide

## Suggested Distribution

Clinical/Biomedical Engineering, Critical Care, Emergency/Outpatient Services, Nursing, Risk Management/Continuous Quality Improvement, NICU, Pharmacy, IV Therapy, Materials Management

## Comment

- This alert is a living document and may be updated when ECRI receives additional information.