

Safety Considerations for Administering Intravenous Prostacyclins to Pulmonary Hypertension Patients in the Hospital Setting

The following recommendations are the result of the findings from a national telephone and national electronic survey of PH centers by Kingman, et.al (2010) and are not intended to supersede individual hospital policies. The intent of this document is to suggest safety measures that have been helpful in facilities treating patients with pulmonary hypertension.

1. Pharmacy Considerations:

- It is strongly recommended that each facility develop clear, concise, standardized order sets for each of the prostacyclin infusions used in the inpatient setting.
- Require mandatory education and competencies on prostacyclins for pharmacists and technicians

Use of Back up cassettes or bags:

- Decide whether back-up Flolan® or Veletri® bags (or cassettes) will be kept on the nursing unit.
- Consider limiting the presence of back-up prostacyclin on nursing units, as removal of high risk parenteral medications from nursing units has been shown to reduce medication errors (WHO, 2007).
- Due to the short half life of this drug and to provide emergency accessibility, storage of Flolan® on the unit is generally desirable if a refrigerated medication dispensing system is available. This requirement may also apply to Veletri®, depending on the drug concentration being delivered.
- If a common medication refrigerator is used, consider whether the risks of mix-up between patients outweigh the benefits of keeping back-up Flolan® and Veletri® on the nursing unit. In general, storage of different preparations in the same refrigerator is discouraged.
- Due to the longer half life of Remodulin®, it may not be necessary to store back-up Remodulin® cassettes or bags on the nursing unit, unless they can be kept in a secure location, unique to the patient, such as a medication dispensing system. If Remodulin® is kept on the nursing unit, and it does not fit in the medication dispensing system, do not store it in the refrigerator with Flolan® or Veletri®, as Remodulin® does not require refrigeration and increases the opportunity for a mix-up.
- In order to avoid mix-ups among “look-alike” drugs, if prostacyclin back up cassettes or bags are kept on the nursing unit, physically separate Flolan®, Veletri® and

Remodulin®. (National Coordinating Council for Medication Error Reporting and Prevention, 1999).

- Clearly identify which prepared products require refrigeration.

Medication Preparation:

- Remodulin® comes in several concentrations. The recommendation is to match the concentration used by the patient at home in order to avoid potential calculations errors when the patient returns to their usual concentration. Remodulin® is available in multiple concentrations and can be purchased by hospital pharmacy on a consignment type basis and purchased only if used.
- Contact the pulmonary hypertension physician's office or the patient's specialty pharmacy upon admission to obtain the patient's dose, dosing weight, concentration and pump rate. Confirm with the patient that this is correct, and that the pump is actually infusing at this rate. If a titration schedule exists, obtain a copy and send it with the patient to the floor; post it in the room next to the patient's bed as well as in the medication record.
- Double check all calculations for concentration and infusion rate.
- Ensure pharmacy labels are easy to read, including name, date, concentration and pump rate.
- Ensure that all information is clearly stated in the medication administration record, including the time for next cassette change, and whether ice packs are required.
- If using cassettes, consider using a different color cassette, or a different color or type of label for Remodulin®, Veletri® and Flolan®.

Miscellaneous:

- Pharmacy presence in the ICU has been shown to reduce medication errors (Lucian, Leape, Donald, Berwick, & Bates, 1999).
- If patients are on hospital pumps, consider software pump technology that minimizes possibility of entering wrong rates (Fields & Peterman, 2005).
- To avoid confusion between the 2 epoprostenol products, consider using brand names of Flolan® and Veletri®, rather than epoprostenol, in the medication administration record, labels and orders.

- Consider using ice packs and 24 hour mixes when Veletri® is below 15,000ng/ml concentration rather than mixing every 12 hours, to lessen the number of opportunities for errors.
- Consider using the same diluent as the specialty pharmacy uses to mix Veletri®, in order to keep the process the same in the hospital (either normal saline or sterile water). Whatever diluent is chosen for Veletri®, it should be physically separated from the Flolan® diluent. Flolan® can only be reconstituted with Flolan® diluent

2. **Hospital Unit Considerations:**

Upon Admission:

- Document pump type, concentration, dose, location of catheter, and last dressing change. If pump is changed to hospital pump or a change is made in concentration, this should be clearly documented.
- Consider placing a sign over the head of the bed stating "Flolan®/Veletri®/Remodulin® infusion".
- Place markers on the Flolan®, Veletri®, or Remodulin line near connection sites stating "Do Not Flush" and "Dedicated Flolan®/Veletri®/Remodulin® line."
- A second nurse should sign off whenever a new cassette or bag is placed or whenever a dose change is made (WHO, 2007).
- Avoid interruptions to nurses while administering prostacyclins, as studies have shown a high correlation between interruptions and IV medication errors (Biron, Loiselle, & Lavoie-Tremblay, 2009), (Pape et al. 2005).
- At the beginning of each shift, document that the pump is running correctly and at a rate that matches the order on the medication administration record.
- Include patients in the medication administration process to the fullest extent possible, as they have been highly trained, especially when patients are kept on their home infusion pumps. (Grantham, McMillan, Dunn, Gassner, & Woodcock, 2006). Ask the patient or caregiver to confirm name, concentration, dose, and pump rate at each cassette or bag change, and whenever a rate change is made.
- Ice Packs: Flolan® requires ice packs if more than 8 hour bag/cassette is used. Veletri® only requires ice if 24hour infusions are used and the concentration is <15,000ng/ml.

3. **Administrative Considerations:**

- Decide whether to keep patients on their home infusion pumps or transition to hospital pumps.
- Determine which nursing units may initiate prostacyclin therapy and which units may care for patients on prostacyclin therapy.
- If MRI is needed, a plan should be in place for how this will be accomplished for patients on home infusion pumps. Additional tubing may be needed in order for the pump to be placed outside the MRI room, or the infusion may be changed to an MRI compatible pump.
- Better staffing levels and higher percentage of professional nurses correlates with lower error rates (McGillis, Doran, & Pink, 2004), (Whitman, Kim, Davidson, Wolf, & Wang, 2002)
- Bar-coding systems can reduce errors. (Anderson & Wittwer, 2004).

Nurse Training:

- Conduct regular pump training for all nurses on units where pulmonary hypertension patients are likely to be admitted. This training may be provided in conjunction with specialty pharmacies, particularly when home infusion pumps are used in the hospital setting. Training should include operation of the CADD Legacy Pump® and the CADD MS-3 Pump®. If the KRONO-5 Pump® is used for miniaturization, then this should be included as well. At a minimum nurses should be comfortable with changing the pump rate and priming the tubing.
- If the hospital has a rapid response team, they should be trained in the use of the home infusion pumps and be familiar with prostacyclin infusions.

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