Most national transfusion guidelines describe the standard of care for blood product transfusion to be slow and carefully monitored, however clinical situations arise wherein rapid administration is necessitated.[1,2] Indications for rapidly administering blood products or fluid include (not limited to):

- hemorrhagic shock
- massive bleeding from:
  - trauma
  - peri-operative blood loss
  - obstetrical massive hemorrhage

In the aforementioned scenarios when hemodynamic stability is significantly compromised (example systolic blood pressure less than 80mmhg) a rapid fluid and blood delivery (RFBD) system may be indicated. An RFBD is capable of administering fluids and blood products much more quickly than free flow or pressure bag intravenous administration, for example the Smiths Level One rapid infuser at 650ml/minute.[3] These devices also warm the blood or fluid to help prevent against hypothermia and subsequent acidosis.

Recall from the laminar flow equation that flow is proportional to the radius to the 4th exponent:

$$Q = \frac{\pi P r^4}{8 n l}$$

Q flow
P pressure
r radius
n fluid viscosity
l length

Thus resistance decreases four fold for every increase in radius by a factor of one. The predominant limiting factor for how quickly an in-compressible fluid moves through a tube is the radius. Translating that to clinical practice, the larger bore intravenous catheter (or interosseous catheter) the greater the flow capability. It therefore follows that infusing a fluid/blood product quickly requires the largest bore catheter attainable. The Ontario regional blood co-ordinating network recommends the following iv catheter choices for blood or blood product infusion:[2]

Recommended IV access

Blood Component/Product	IV Access
Red blood cells – rapid transfusions in adults	16-18G (Gauge)
Red blood cells – routine transfusions in adults	20-22G
Other blood components/products	Any size is adequate
Pediatrics	22-25G
All components and products – adults and pediatrics	Central venous access devices (CVAD)

Figure 1.0 – Recommended IV access, from ORBCN 2022[2]

For adults a 16 or 18 gauge intravenous catheter is recommended for rapid blood administration, for pediatrics 22-25gauge (or largest available to be obtained). Central venous catheters (CVC) can also be used, however a single shorter large bore CVC is preferred over a multi-lumen longer CVC as the resistance of the former is much lower.

RFBD systems typically employ proprietary tubing that has a large inner diameter and can withstand higher pressures. Crystalloids, collloids, packed red blood cells (PRBC) and fresh frozen plasma (FFP) can be administered via an RFBD, however platelets and cryoprecipitate should not.[4] The fluid or blood product is warmed to 38-42 degrees, typically with built-in mechanisms to capture air bubbles and pressure limits (300mmHg).

CAUTIONS:

- It is recommended that medications not be co-infused with blood products simultaneously.[1]
- Pressure in the infusion system (blood product bag, RFBD, infusion tubing) should not exceed 300mmHg as this can cause hemolysis and bag rupture.[5]

Consider a common RFBD system used in Ontario hospitals, Level 1 fast flow fluid warmer.

Level 1

- Always read and be familiar with manufacturers guidelines
- Obtain largest bore peripheral IV access possible, separate from any medication infusion sites
- Prime the proprietary rapid infuser tubing per manufacturer's guidelines
- Perform blood product infusion checklists per individual institution policy
- Attach the tubing as close to the IV hub as possible (try never to use extension tubing that is not rated for high pressure/high flow)
- Open proximal then distal clamps in tubing and observe the tubing and patient for leaks and proper infusion at the site (watch for hematoma/interstitial fluid accumulation)
- Pressurize the pressure chamber with the top lever, observing the adjacent pressure gauge
- Carefully observe the site of infusion at the patient, watching for signs of displaced iv catheter and interstitial infusion

1 Push the bottom end of the Heat Exchanger firmly into #1 block.

2 Snap the Heat Exchanger into Guide.

3 Slide #2 block down firmly.

4 Move the pinch clamp connector on the Patient Line of the Gas Vent/ Filter Assembly next to the Luer connector. Close the pinch clamp.

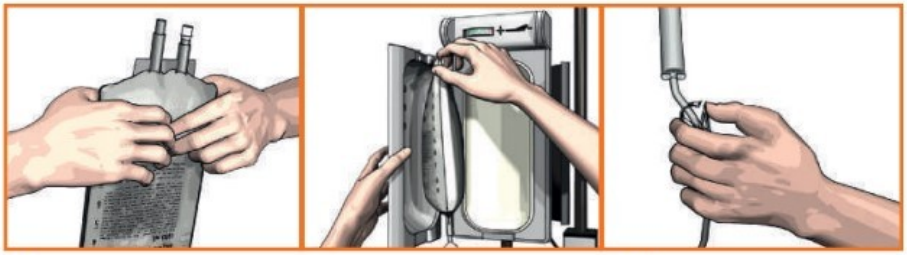
5 Open #3 Clamp Slot door. Press down on the metal tab and pull door down and away from Clamp Slot.

6 Insert the Patient Line in the Clamp Slot and push it back into the slot.

7 Push door up to engage the top hinge and then push door in to engage the metal tab to close.

8 Press Gas Vent/Filter Assembly into #4 block.

9 Close pinch clamps above the Heat Exchanger and below the IV Fluid bag spikes.



10 Remove air from IV Fluid bags:

- Using aseptic technique, pierce bag port membrane with disposable set spike.
- Withdraw spike, squeeze out ALL air, and re-spike bag.

11 Hang spiked IV Fluid bags in Pressure Chambers.

- Choose the hook that allows the bag port to hang freely in the indented slot at the bottom of the chamber door.

Close the doors and secure the latches.

12 Prime through the Gas Vent/ Filter Assembly:

- Open pinch clamp/s below IV Fluid bag spike, squeeze drip chamber and prime the line through the Gas Vent/Filter Assembly.
- Open remaining pinch clamp/s below IV Fluid bag spike/s to prime additional line/s.
- When lines are primed, close pinch clamps, leaving 1 open for infusion.

13 Press the green Power ON button.

14 Open pinch clamp below Gas Vent/Filter Assembly to prime the patient line and remove all air, and then close the roller clamp.

15 Make patient connection.

16 Open roller clamp on the patient line to begin infusion.

17 Move Pressure Chamber lever to the + position.

When IV Fluid bag empties:

1. Move the Pressure Chamber lever to the – position.
2. Close the pinch clamp below empty IV Fluid bag.
3. Move lever on the other Pressure Chamber to + position and open pinch clamp to begin infusion.
4. Open door of de-pressurized Chamber and replace empty IV Fluid bag with new bag with ALL air removed (Steps 10 & 11).
5. Alternate between Pressure Chambers.

Level 1 H-1200 Fast Flow Fluid Warmer.[6]

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