Pediatric Hemorrhage/Massive Transfusion of Blood Products Administration Guideline

Indications	Signs and symptoms	Indication PEARLS
History of significant blood loss Penetrating trauma Blunt injury to abdomen Pelvic instability Long bone fractures Traumatic brain injury (TBI)	Hypotension/tachycardia: age appropriate Tachypnea: age appropriate Restlessness; confusion Weakness, dizziness Pale, cool, clammy skin (can be limited to extremities)	• Pediatric patients can maintain normal hemodynamics for **up to 20%** of their blood loss before showing a decrease in SBP. • **Tachycardia** is an early indicator of shock in the pediatric patient. • **Hypotension** in the pediatric patient can be a *late sign and ominous* sign of prearrest.

Special Considerations for Administration:	Blood Product Administration PEARLS
1. **Pediatric Equipment Availability:** ○ **IV/IO catheters, IV tubing, Rapid/Warm infusers** 2. **Size of child AND rate of blood loss** 3. **Do NOT delay treatment if patient meets criteria for administration** 4. **Consult with local Pediatric Centers for guidance as *early as possible*: Call EARLY, Call NOW, Call FAST!** 5. **Neonate population: < 3 months or < 3-5 kg early consultation, frequent reassessments recommended**	• **PRBCs and FFP should be given via WARM infuser with rapid infusion capability, when available.** • Two vascular sites should be obtained - Blood product administration requires a dedicated site. • Avoid mixing LR and PRBC in the same IV/blood tubing line or using as dilutant, when possible. • Consider all possible causes of shock and treat as appropriate. • **LAB VALUES** to continually monitor: ionized calcium, PT/INR, hemoglobin, FIB, Platelet, Base Deficit

Stable Blood Loss
- External hemorrhage: Control with tourniquet, hemostatic gauze, pressure dressing
- Obtain venous access, weigh patient in kg or use length based resuscitation tape
- Lactated Ringers 10mL/kg
- Closely monitor vitals, temperature, **keep patient warm**, check lab values

Tachycardic Blood Loss
- Administer Warmed PRBC 10mL/kg
- Warmed FFP or liquid plasma 10mL/kg
- Continually monitor lab values: ionized calcium, potassium, PT/INR, hemoglobin, FIB, Platelet count, Base Deficit (VBG/ABG)
- Internal hemorrhage: Consider Pelvic binder

Hypotensive Blood Loss
- Hypotension identification, age appropriate: 4-6 year old SBP < 90, 7-16 year old SBP < 100
- Administer Warmed PRBC 20 mL/kg, Maximum of 40 mL/kg, need for definitive surgical control of blood loss
- Warmed FFP or liquid plasma 20 mL/kg
- *Consider* TXA, initiate within 3 hours of injury, 15 mg/kg IV over 10 min (*Max 1 gram),* infusion of 2mg/kg/hr x 8 hours or until bleeding stops

SCAN HERE: References, equipment, and more information

Children's Medical Center Dallas
888.730.3627
Cook Children's Medical Center Fort Worth
682.885.3901
Medical City Children's Dallas
1.800.SICK.KID

Age/Kilograms **1:1:1 Ratios PRBC: FFP: Platelets**	**PRBC** ***1 unit approximately 360 mL*** **DOSE: 10-20 mL/kg**	**FFP/Liq. Plasma** **10-20 mL/kg**	**Platelets** **5-10 mL/kg**	**Cryo**
< 3 months (3-5 kg) GREY	30-50 mL (~12 doses/unit*)	**Same** as PRBC dose	1 unit pooled/10kg **OR** **Half** PRBC dose apheresis	**Request** Medical Direction
3-5 months (6-7 kg) PINK	60-70 mL (~6 doses/unit*)			
6-11 months (8-9 kg) RED	80-90 mL (~4 doses/unit*)			
12-24 months (10-11 kg) PURPLE	100-110 mL (~3 doses/unit*)			
2-year-old (12-14 kg) YELLOW	120-140 mL (~3 doses/unit*)			
3–4-year-old (15 kg-18 kg) WHITE	150-180 mL (~2 doses/unit*)			
5–6-year-old (19-23 kg) BLUE	190-230 mL (~2 doses/unit*)			
7–9-year-old (24-29 kg) ORANGE	240-290 mL (~1.5 doses/unit*)			
10–11-year-old (30-36 kg) GREEN	300-360 mL (~1 unit*)			
> 40 kg (10-20mL/kg)	400-800 mL (1-4 units*)	1-4 units	1 pack	10 units

Reference: 2019 Broselow – Luten zones, Broselow ® Pediatric Emergency Reference Tape

From a survey conducted assessing the practices of Trauma Service Area (TSA) E, 15 agencies and hospitals responded to the North Central Texas Trauma Regional Advisory Council (NCTTRAC) Pediatric Massive Transfusion Survey, 2020. Outside of using pressure bags on blood tubing, push-pull stopcock method or an approved blood tubing IV pump, the following devices are used regionally and the addition of emerging products to assist with warmed blood product administration for the bleeding pediatric patient. NCTTRAC and the pediatric committee does not endorse any medical product below, this is simply a compilation of the devices used in our region. Significant differences in performance can be found from device to device, clinicians should be aware of each device's limitations to match procurement to the planned clinical use.

Device Name	Manufacturer	Additional Information
Level 1® H-1200 Fast Flow Fluid Warmer or Level 1® HOTLINE® Blood and Fluid Warmer	ICU MEDICAL	https://www.smiths-medical.com/en-us/brands/level-1
Belmont® Rapid Infuser buddy lite™	Belmont Medical Technologies	https://belmontmedtech.com/rapid-infusion-pump
3M™ Ranger™ Blood/Fluid Warming Unit	3M™	https://multimedia.3m.com/mws/media/1099581O/ranger-fluid-warming-systems-brochure.pdf up to 500 mL/min
HypoThermX® HX100 and LG IV Blood and Fluid warming systems	EMIT™ Corporation	http://www.emitcorp.com/products.html 50-200 mL/min
Thermal Angel® Blood and IV Fluid Infusion Warmer	Estill Medical Technologies	https://thermalangel.com/products/comparison/
LifeFlow® Fluid Infuser and LifeFlow® PLUS Blood & Fluid Infuser	410 Medical ™	https://410medical.com/applications/pediatric/
QinFLOW The Warrior Modular System Blood and Fluid Warmer	QinFLOW	https://www.qinflow.com/effectively-warming-blood-iv-fluids-transfused-through-rapid-intermittent-bolus-flow-methods/
Quantum™ Blood & Fluid Warming System	LIFEWARMER™	https://www.lifewarmer.com/products/

Broselow®-Luten Zones

It is *always preferable* to measure the patient using a Broselow® Pediatric Emergency Reference Tape to determine the color zone.

For situations in which the child cannot be measured, patient age may be used to select the zone.

Zone	Patient weight	Age
3 kg, 4 kg, and 5 kg zones	3 kg, 4 kg, and 5 kg	< 3 mos
Pink	6–7 kg	3–5 mos
Red	8–9 kg	6–11 mos
Purple	10–11 kg	12–24 mos
Yellow	12–14 kg	2 yrs
White	15–18 kg	3–4 yrs
Blue	19–23 kg	5–6 yrs
Orange	24–29 kg	7–9 yrs
Green	30–36 kg	10–11 yrs

PEDIATRIC VITAL SIGNS Age/weight/ZONE 1:1:1 Ratios PRBC: FFP: Platelets	**Systolic Blood Pressure**	**Heart Rate (BPM)**	**PRBC DOSE: 10-20 mL/kg**	**FFP/Plasma 10-20 mL/kg**	**Platelets 5-10 mL/kg**	**Cryo**
< 3 months (3-5 kg) GREY	> 60 mmHg	100-180	30-50 mL	**Same** as PRBC dose	1 unit pooled/10kg **OR** **Half** PRBC dose apheresis	**Request** Medical Direction
3-5 months (6-7 kg) PINK	> 70 mmHg	100-180	60-70 mL			
6-11 months (8-9 kg) RED	> 70 mmHg	100-180	80-90 mL			
12-24 months (10-11 kg) PURPLE	> 75 mmHg	80-150	100-110 mL			
2-year-old (12-14 kg) YELLOW	> 75 mmHg	80-150	120-140 mL			
3–4-year-old (15 kg-18 kg) WHITE	> 75 mmHg	80-140	150-180 mL			
5–6-year-old (19-23 kg) BLUE	> 80 mmHg	70-120	190-230 mL			
7–9-year-old (24-29 kg) ORANGE	> 85 mmHg	70-120	240-290 mL			
10–11-year-old (30-36 kg) GREEN	> 90 mmHg	60-100	300-360 mL			
> 40 kg (10-20mL/kg)	> 100 mmHg	60-100	400-800 mL	1-4 units	1 pack	10 units

Though rapid delivery of fluid or blood products is commonly recommended for the urgent reversal of shock, little attention has traditionally been paid to HOW rapid infusion should be accomplished, and no consensus opinion exists on the optimal volume or rate of infusion. (Piehl-Park et al, 2021)

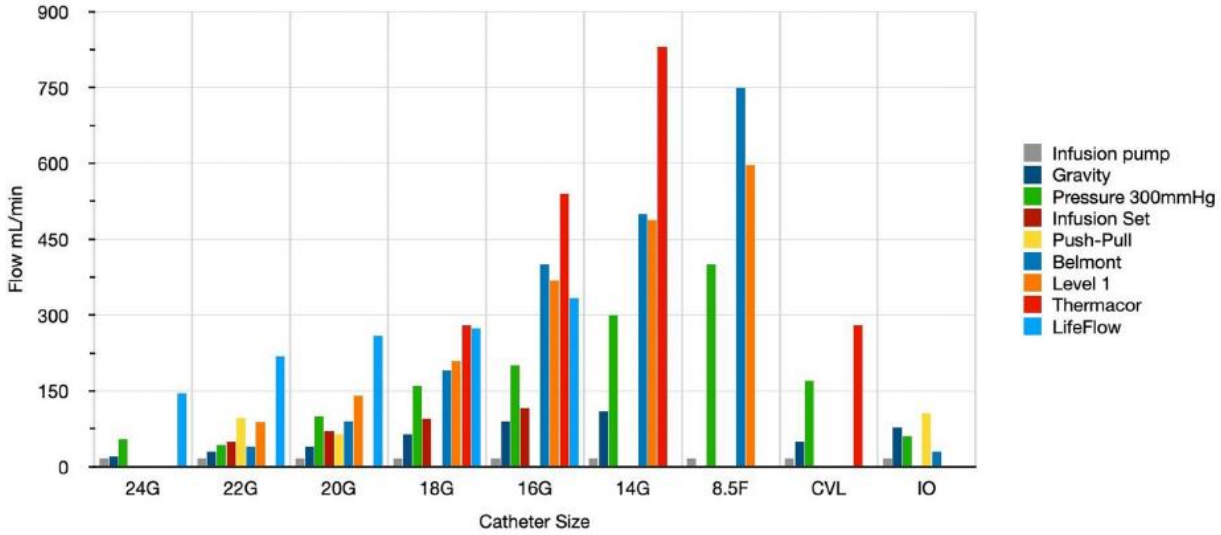

Fig. 3 Pressure-flow relationship of various vascular access devices [48, 53, 67–60]

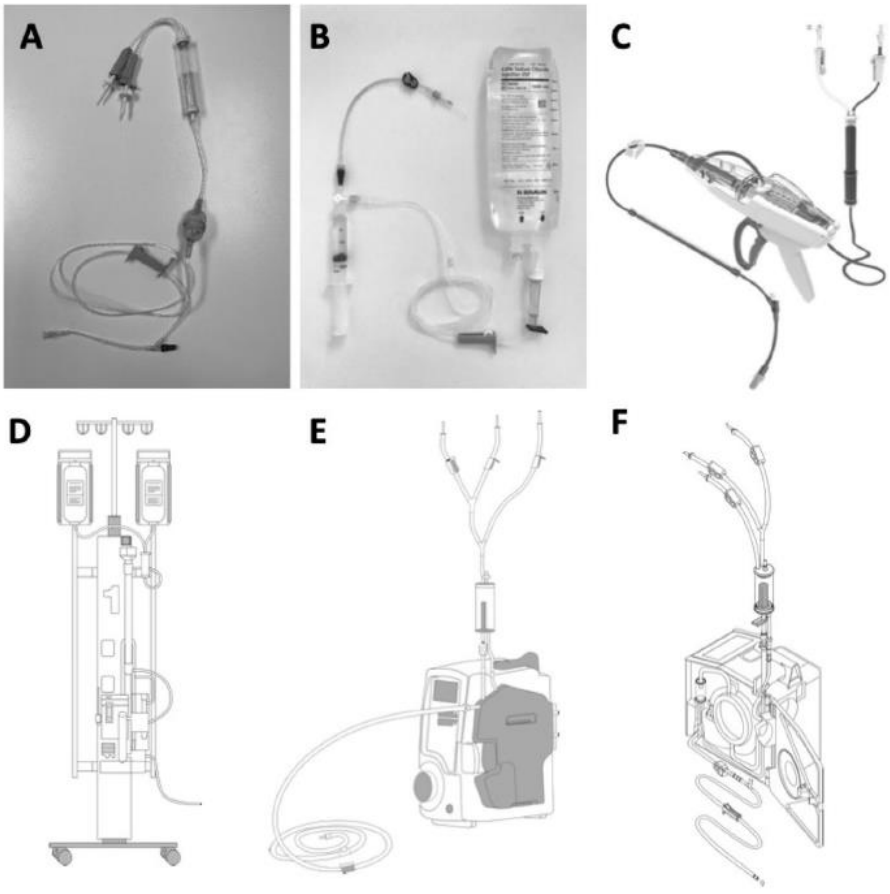

Fig. 4 Rapid infusion devices: **A** Hospira® Blood Infusion Set; **B** "push–pull" syringe and stopcock set; **C** LifeFlow®; and powered rapid infusers with warming capacity: **D** Smiths Medical Level 1® H-1200; **E** Smisson-Cartledge Biomedical ThermaCor® 1200; **F** the Belmont® Rapid Infuser RI-2. (Adapted from Belmont Medical Technologies, Smiths Medical, and Smisson-Cartledge product information brochures. LifeFlow image courtesy of 410 Medical.)

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Alameda County Medical Center- Massive Transfusion Protocol

Stanford Hospital & Clinics Massive Transfusion Guideline

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