



# ASPAN

American Society of PeriAnesthesia Nurses

## Clinical Practice: Frequently Asked Question

**Q: Looking for a method to calculate IV fluid replacement for children and adults for the NPO hours, operative and post anesthesia period?**

**A:**

### **A: ADULT FLUID REPLACEMENT**

Three-part formula for calculating fluid to be replaced intraoperatively:

1. Deficit—defined as the time the patient is NPO to the time surgery begins  
Formula is the maintenance rate X the number of hours the patient has been NPO  
Also account for fluid losses from NG suctioning and bowel preps
2. Maintenance—defined as the time of incision to closure:  
Based on the 4 – 2 – 1 formula  
4 mL/kg/hr for 0-10 kg weight  
2 mL/kg/hr for the next 10 kg weight  
1 mL/kg/hr for each kg greater than or equal to 20

Example:

Weight in kg = 70

4 mL/kg/hr for the first 10 kg = 40

2 mL/kg/hr for the next 10 kg = 20

1 mL/kg/hr for each kg greater than or equal to 20 = 50

40 + 20 + 50 = 110 mL/hr

A shortcut for patients weighing greater than or equal to 20 kg is weight in kg + 40

Example:

Weight in kg = 70 + 40 = 110 mL/hr

3. Surgical losses
  - Blood
    - Replace 3-4 mL crystalloid/ml blood loss or 1 mL colloid/1 mL blood loss
    - Replace blood at 1 mL/1 mL loss + crystalloid or colloid
  - Evaporation from open wound
  - Third-spacing from fluid redistribution

Estimation of Evaporation and Third-Space Losses—additional maintenance fluid based on amount of tissue trauma

1. Minimal procedure, e.g. herniorrhaphy 2-4 mL/kg/hr
2. Moderate procedure, e.g. cholecystectomy 4-6 mL/kg/hr
3. Major procedure, e.g. bowel resection 6-8 mL/kg/hr

Schedule for Replacement During the Surgical Procedure:

First hour: 1/2 the deficit + maintenance + replacement for blood loss

Second hour: 1/4 the deficit + maintenance + replacement for blood loss

Third hour: 1/4 the deficit + maintenance + replacement for blood loss

Example:

80 kg patient scheduled for total hip replacement, NPO for 10 hours

Deficit = 10 hours NPO X 120 = 1200 mL

Maintenance = 120 mL/hr

Blood loss replacement (EBL = 300 mL) = 3 ml crystalloid X 300 = 900 mL

1st hour = 600 (1/2 the deficit) + 120 (maintenance\*) + 300 mL LR (blood loss replacement) = 1020 mL

2nd hour = 300 (1/4 the deficit) + 120 (maintenance\*) + 300 mL LR (blood loss replacement) = 720 mL

3rd hour = 300 (1/4 the deficit) + 120 (maintenance\*) + 300 mL LR (blood loss replacement) = 720 mL

Total = 2460 mL

\*Additional fluid may be added to the hourly maintenance to account for evaporation and tissue trauma losses

Estimated adult blood volumes

Male = 70-75 mL/kg

Female = 55-67 mL/kg

## B: PEDIATRIC FLUID REPLACEMENT

### Fluid Resuscitation Guidelines

- Start fluid resuscitations
  - 20 mL/kg of isotonic crystalloid (Normal saline or Lactated ringers)
  - Bolus over 5-20 minutes
  - Repeat boluses of 20 mL/kg as needed to restore blood pressure and perfusion
  - Adjust rate according to cause of shock state
- Do not administer fluids containing glucose
- Blood and blood products are recommended for replacement of volume loss in pediatric trauma patients with inadequate perfusion despite administration of 2-3 boluses of 20 mL/kg of isotonic crystalloid (PALS, 2006)

### HOURLY MAINTENANCE FLUID REQUIREMENTS FOR INFANTS AND CHILDREN

Body Weight (kg)    Hourly Requirement

1-10 kg    4 mL/kg/hr for each kg body weight

11-20 kg    40 mL/hr + 2 mL/kg/hr for each kg

greater than or equal to 20 kg    60 mL + 1 mL/kg/hr for each kg greater than or equal to 20 kg

Based on 1 mL of fluid per 1kcal of calorie expenditure.

Estimated blood volume (EBV)

Infant: 80-90 mL/kg

Child: 70-80 mL/kg

Maximal allowable blood loss should not exceed 20% of EBV, depending on pre-op hematocrit

### References:

1. American Society of PeriAnesthesia Nurses. Fluid and Electrolytes. In: *Redi-Ref for Perianesthesia Practices*. Cherry Hill, NJ: ASPAN; 2015:69-71.
2. American Society of PeriAnesthesia Nurses. Perianesthesia Care of the Pediatric Patient. In: *Redi-Ref for Perianesthesia Practices*. Cherry Hill, NJ: ASPAN; 2015: 154.

*This FAQ has been reviewed and updated July 2019*