

## Dehydration and Fluid Therapy Guide

**Background:** Dehydration occurs when the loss of body fluids (mainly water) exceeds the amount taken in. Fluid loss can be caused by numerous factors such as: fever, heat exposure, vomiting, diarrhea, lack of food and water intake, poor diabetes control, and skin injuries (infections, burns, etc).

**Possible Sign and Symptoms of Dehydration** (depending on severity):

- Dry mouth
- Increased thirst
- Decreased urine output (concentrated urine)
- Decreased skin turgor
- Weakness/Lethargy
- Muscle cramping
- Dizziness
- Heart palpitations
- Confusion
- Fainting
- Vital changes (Increased HR and RR, decreased BP)

***Severe dehydration can be life threatening and requires emergent medical intervention.***

### **Treatment:**

It is crucial to recognize the sign and symptoms of dehydration and begin fluid replacement in a timely manner. There are three principle methods of fluid replacement:

#### **1) Oral fluid replacement**

The oral route is the preferred option for mild dehydration as it is cheap, effective, and easily administered. There are several oral solutions that can be used. An example of a common oral re-hydration solution (ORS) that can be prepared at home contains 8 teaspoons of sugar, ½ teaspoon of salt, and 1 L of water. ORS is especially effective because it contains both salt and sugar, which contribute to its rapid absorption by the gut. It is important to avoid large amounts of pure water since water is not actively absorbed by the gut since glucose and salts are needed in combination to accelerate the absorption process. Large amounts of pure water (about 2 Liters) can also offset the person's electrolyte balance. Sport drinks can be problematic as well since the concentration of sugars in these drinks is far greater than the body's osmolality of 290 mosmols.

Oral re-hydration solution should be given if the person can tolerate it. Unfortunately, this is sometimes difficult to accomplish in patients with significant vomiting, diarrhea, or altered level of consciousness. Vomiting itself does not mean that oral re-hydration can not be given. As long as more fluid enters the body than exits, re-hydration will be accomplished. It is safe to give adults as much fluid as they can tolerate, guided by their thirst sensation, as long as they do not have kidney or heart failure. Patients with normal functioning kidneys will excrete the excess fluid.

Oral re-hydration solution can prevent many of the complications of dehydration caused by diarrhea, vomiting, or other sources of fluid loss. However, dehydration can not always be reversed with oral solutions. Additional fluid replacement is required with intravenous fluids or an alternative infusion technique called hypodermoclysis (subcutaneous infusion).

**2) Intravenous re-hydration:**

Intravenous (IV) therapy involves the administration of fluids directly into the vein. It is the fastest way to deliver fluids throughout the body and should be considered in situations requiring urgent fluid resuscitation (i.e. severe blood loss, burns, etc). A number of fluid solutions can be given depending on the person’s electrolyte balance and fluid deficits. These solutions can be administered intermittently, continuously, or in the form of a bolus depending on the fluid requirements.

There are two main types of intravenous solutions: 1) Crystalloids 2) Colloids. Crystalloids are aqueous solutions of mineral salts and water soluble molecules that are readily used in hospitals and other clinical settings. They come in various compositions (please see table below). Colloids are solutions that contain large insoluble molecules, such as gelatin, as this helps to keep fluid in the blood vessels as oppose to re-distributing to all body compartments. Colloids are reserved for situations where crystalloids are ineffective in stabilizing blood pressure and close monitoring is often required for their use.

**Composition of Common Crystalloid Solutions**

Name	Na+ (mmol/L)	Cl- (mmol/L)	Glucose (mmol/L)	Other Electrolytes (mmol/L)
Normal Saline	154	154	0	0
Ringer’s Lactate	130	109	0	Lactate = 28 K+ = 4 Ca 2+ = 3
‘Half’ Normal Saline	77	77	0	0
D5W (5% Dextrose in water)	0	0	278	0
2/3 (Dextrose) & 1/3 (NS)	51	51	185	0

After the crystalloid solution is chosen, deciding on the infusion rate is the next step. Three main factors need to be considered: A) Deficits B) Maintenance C) On-going losses.

- A) **Deficits:** This is a subjective estimate, from the patient’s history, of the fluid losses that have occurred. A rough estimate is made based on the persons losses

(frequent diarrhea, vomiting) and a fluid bolus might be administered. Normal saline or Lactate Ringer's solution are often used for boluses.

**B) Maintenance:** Takes into account the basal metabolic rate and any insensible losses (skin, respiratory tract, feces). The maintenance rate can be approximated for adults using this simple formula:

- 4 ml per kg for the first 10 kg of body weight;
- 2 ml per kg for the next 10 kg (11-20kg);
- 1 ml per kg for any weight greater than 20 kg

Example: Calculating maintenance fluid requirements for 70 kg male.

0-10 kg:  $10 * 4 \text{ ml} = 40 \text{ mL}$

11-20 kg:  $10 * 2 \text{ mL} = 20 \text{ mL}$

21-70 kg:  $50 * 1 \text{ mL} = 50 \text{ mL}$

Total = 110 mL/hr

**C) On-going losses:** On-going losses are approximated based on frequency of vomiting and diarrhea. Often a naso-gastric tube and urine catheter are used to help estimate fluid loss. On-going fluid loss is added to maintenance fluid to approximate the required fluid intake as closely as possible.

### 3) Hypodermoclysis

Hypodermoclysis is the subcutaneous infusion of fluids. It is a useful and easy hydration technique suitable for mildly to moderately dehydrated adult patients, especially the elderly. Subcutaneous fluids are indicated for patients who are unable to take adequate fluids orally and in whom it is difficult or impractical to insert an intravenous line. This method is safe and has no serious complications. Several research studies have shown that the efficacy of fluid absorption with hypodermoclysis was identical to intravenous fluids. The absorption rate can be increased by adding hyaluronidase (an enzyme that breaks down the connective tissue).

The main use of subcutaneous fluids has been in the geriatric and palliative care settings. Oral fluids are often difficult to administer in patients who have cognitive impairments, vomiting, nausea, and swallowing problems often related to stroke. Intravenous therapy for hydration is often difficult outside the hospital setting since it requires close supervision by medical staff, which is often difficult to arrange. Thus, due to its safety and ease of administration, hypodermoclysis is a useful alternative to intravenous hydration. The most frequent adverse effect is mild subcutaneous edema that can be managed with local massage. Adverse effects such as local catheter reactions, local site pain, cellulitis, electrolyte imbalances, and pulmonary edema are extremely rare complications.

**Practical Tips for Intravenous Fluid and Hypodermoclysis**

<b>Intravenous Therapy (peripheral)</b>	<b>Hypodermoclysis (subcutaneous)</b>
<p><b>Sites:</b>                      - Peripheral vein: any vein that is not in the chest or abdomen (usually hands, arms, legs, and feet). Arm and hand veins are typically used.</p> <p><b>Equipment:</b>                      - Solution bag (please refer to above for types), tube with drip chamber, needle with cannula [18-20 gauge - all purpose for infusions and drawing blood], alcohol swabs, and sterile occlusive dressings                      * Cannula and tubing should be changed every 48-72 hours.</p> <p><b>Volume and Rate:</b>                      - Total volume and rate will be dictated clinically by total fluid deficits, maintenance and on-going losses as mentioned above.                      - Important to monitor for signs of fluid overload (pulmonary edema, peripheral edema, increased JVP).</p> <p><b>Procedure for RN (requires MD order)</b>                      1) Explain procedure to patient.                      2) Wash hands and select peripheral vein (upper extremity usually)                      3) Assemble fluid bag and tubing.                      4) Clean desired skin site with alcohol swab                      5) Insert needle, bevel up, into peripheral vein at 30-45 degrees until blood is visible. Push plastic cannula forward and then remove needle.                      6) Secure plastic cannula using adhesive dressing.                      7) Flush the cannula with normal saline (10cc) to ensure its patent.                      8) Connect cannula with plastic tubing and bag while adjusting appropriate rate (MD order)                      9) Document in chart (rate of fluid infusion)</p>	<p><b>Sites:</b>                      - Ambulatory patient: abdomen, upper chest, above the breast, inter-costal space, and scapular area                      - Bedridden patient: thighs, abdomen, outer aspect of upper arm</p> <p><b>Equipment:</b>                      - Solution bag (usually normal saline), tube with drip chamber, a 21 or 23 gauge long-tube butterfly needle, alcohol swabs, and sterile occlusive dressing                      * Needle and tubing should be changed every 1-4 days.</p> <p><b>Volume and Rate:</b>                      - Subcutaneous infusion by gravity at a rate of 1 mL/min at one site (total of about 1.5L/24 hrs); 2 separate sites can be used for a total of 3L/24hrs                      - 1-2 L of fluid can be given overnight to avoid tubes during the day</p> <p><b>Procedure for RN (requires MD order):</b>                      1) Explain the procedure to patient.                      2) Wash hands and select appropriate infusion site (listed above)                      3) Assemble fluid bag and tubing.                      4) Swab desired skin site with either alcohol swab or povidone-iodine skin preparation using circular motion. Avoid contact with sterilized site.                      5) Insert needle, bevel up, into subcutaneous tissue at 45-60 degree angle.                      6) Secure needle and tubing with occlusive dressing.                      7) Adjust rate according to MD order.                      8) Date and initial dressing/tubing                      9) Document fluid infusion in meds chart                      10) Check on patient periodically, especially in first hour to ensure infusion site is correct, there is no signs of edema, leakage, disconnection, or fluid overload</p>

<p><b>Procedure for CCW (monitoring)</b></p> <p>1) Check the peripheral insertion site regularly to ensure there is no swelling or redness. Swelling at the site can indicate that IV is not properly in the vein. Redness can indicate skin infection or inflammation of the vein (phlebitis). It is important to notify RN if any of these things are seen.</p> <p>2) Blood tracking into tubing indicates that the fluid is not running fast enough to oppose the flow of blood. To correct this, lift the bag higher in the air or tell the RN to increase the infusion rate.</p> <p>3) Calculating drip rate: Drip rate in drops/min = Total ml/Total minutes * drops/mL 50 ml/hr = 9 drops/min 100 ml/hr = 17 drops/min 150 ml/hr = 25 drops/min 200 ml/hr = 33 drops min *Ensure that drip rate is appropriate. Notify RN if any discrepancy.</p>	<p><b>Procedure for CCW (monitoring)</b></p> <p>1) Check on patient periodically, especially in first hour to ensure infusion site is correct, there is no signs of edema, leakage, disconnection, or fluid overload - If any of these are noted, please notify RN.</p>
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**References:**

Barton A, Fuller R, Dudley N. Using subcutaneous fluids to rehydrate older people: current practices and future challenges. QJ Med 2004; 97(11); 765-768.

Burton DR. Maintenance and replacement therapy in adults. UpToDate. January 2006.

Sasson M, Shvartzman P. Hypodermoclysis: An Alternative Infusion Technique. Am Fam Physician 2001; 64; 1575-8.

Internet: Emedicine: Fluid replacement therapy (February 2006)

Internet: Wikipedia: Intravenous fluid therapy (January 2008)