

Hydration

Objectives

When you complete this module you will be able to:

- Explain why pediatric and geriatric patients are most vulnerable to dehydration.
- Match clinical symptoms and laboratory values to states of dehydration and fluid overload.
- Differentiate between isotonic, hypotonic, hypertonic, colloid and crystalloid solutions used in intravenous therapy.
- Describe how to prevent and treat dehydration with oral intake.
- List medications and treatments that put patients at risk for fluid imbalance.
- Give advice for patients about when to seek medical care for dehydration.

Introduction

Hydration is a major topic in nursing. Maintaining a balanced body fluid status is a consistent objective in all nursing care plans. However, interventions intended to restore and correct fluid status vary greatly and depend on underlying medical conditions. For example, look at this assortment of cases in which balancing hydration is a critical need:

- A seven month old infant has a fever of 103.4 F. His diapers are dry for the past six hours. His fontanel appears sunken.
- A patient with congestive heart failure has audible rales in both lungs. He has been receiving intravenous therapy for two days.
- A sixteen year old head trauma patient weighs only 80 pounds due to anorexia nervosa. Her fractured jaw is wired. She receives parenteral nutrition through a central venous access device.
- An eighty year old woman is transferred to the hospital from a nursing home. She is treated for dehydration and delirium, a complication of influenza.
- A stage three COPD patient complains of abdominal discomfort, bloating, and muscular weakness. During the recent allergy season, he added oral glucocorticoids to his medications since his corticoid inhaler did not relieve his asthma.
- A patient scheduled for a colonoscopy starts vomiting during the night after taking the bowel preparation. She is too weak and shaky in the morning to come in for the test.

- A sixty-five year old man falls down the basement stairs. He complains of dizziness, tremors, and heart fluttering. In reviewing his medications you learn he is taking a diuretic, an ACE inhibitor, NSAIDs, and cephalosporin. In addition, he reports he is on a low salt diet to manage hypertension.
- A ninety year old woman with chronic kidney disease receives dialysis twice a week. Her blood pressure has increased to 180/100. She has gained eight pounds within a week. You note the presence of ascites.
- A woman in her eighth month of her first pregnancy presents with upper body edema, hypertension, and proteinuria.
- A fifty year old man is admitted after an industrial explosion. He suffers second and third degree burns over forty percent of his body. Within 24 hours treatment is started for hypovolemia and metabolic acidosis. The laboratory report indicates some electrolyte imbalances.

Overview

Over 90% of patients in the hospital receive intravenous therapy. Although one reason is to administer medications most safely and effectively, another reason is to maintain adequate circulation and prevent dehydration in the populations most at risk. These are the very young and the old. When blood circulation is inadequate the consequences are severe: cerebral edema can occur, seizures can be triggered, kidneys can shut down, and organs can be irreversibly damaged. Shock, coma and death are inevitable without intervention.^{1; 2; 3}

Here are the basic facts about hydration:

- Water makes up a third to a half of total body weight. The percentage is less in women, older people, and those who are obese.
- Water is divided into these compartments:

Extracellular accounts for 1/3 of the total. It is divided into:

Intravascular: within the blood vessels.

Interstitial or third space: surrounding cells.

Transcellular: in specialized cavities

such as those around the lungs, heart, and joints.

Intracellular accounts for 2/3 of the total.

- On an average, people take in two to three liters of fluid daily and lose about the same amount everyday through perspiration, urine, feces, and respiration.^{4; 5; 6; 7}

Osmolality

Osmolality is the key concept to understand on the topic of hydration. It is defined as the concentration of solutes in water or the ratio between solutes and water. The body maintains the same osmolality in both extracellular and intracellular compartments. It does this by shifting water around. The solutes that hold the water in a compartment are:

- Electrolytes (Na, K, Ca, Mg, Cl, Ph).
- Protein molecules, primarily albumin. ^{3; 8; 9}

Water and fluids move from one compartment to another through permeable membranes. This movement normally occurs because of differences in water and/or solute concentrations, the presence of carriers, and/or circulatory pressure (perfusion). The process is regulated by a combination of renal, metabolic and neurological functions.

Changes in blood osmolality initiate feedback mechanisms that restore fluid balance. When the fluid volume is too low, kidneys become less active and arterioles constrict to raise blood pressure. Simultaneously, low circulatory volume triggers these events that result in reabsorption of water and sodium:

- Release of renin-angiotensin-aldosterone and antidiuretic hormone (ADH)
- Inhibition of atrial natriuretic peptide (ANP).

When the volume is too high, kidneys become more active and arterioles dilate. These events trigger diuresis that results in loss of water and sodium:

- Release of ANP.
- Inhibition of renin-angiotensin-aldosterone and ADH.

Maintaining Fluid Balance

Normal fluid balance is lost through a cascade of events that happen over varying periods of time. This is a complicated process. Trauma and/or disease create organ dysfunction. Organ dysfunction creates an acid-base imbalance. Ensuing multiple electrolyte imbalances may alter fluid balance further.

Sodium is the main electrolyte affecting extracellular osmolality. When sodium is imbalanced, a potassium imbalance will eventually follow. A potassium imbalance impacts nerve and cardiac function and can be life-threatening. However, any electrolyte level that is too low or too high can present serious complications.

	Na ⁺	K ⁺	Mg ²⁺	Ca ²⁺	Cl ⁻	HPO ₄ ⁻
Normal ranges	135-145 mEq/L	3.5-5.0 mEq/L	1.3-2.1 mEq/L	Serum: 8.5-10.5	98-106 mEq/L	3.0-4.5 mg/dL

				mg/dL		
				Urine: 0-300 mg/24 hrs		

Some Serious Consequences of Electrolyte Imbalance ^{2; 10}

	Na too low	Na too high	K too low	K too high	Mg too low	Mg too high	Ca too low	Ca too high	Cl too low	Cl too high	P too low	P too high
Delirium	X	X	X		X	X	X	X			X	X
Weakness	X	X	X	X	X	X	X			X		
Seizures	X	X			X		X		X		X	X
Arrhythmias			X	X		X					X	X
Paralysis		X	X	X			X					

Although there are several regulatory mechanisms for restoring fluid balance, these mechanisms all have limitations. For example:

- The kidneys may take a few days to correct an imbalance.
- The lungs, although working quickly, tax the heart.
- Dietary intake may not be an option.
- Excessive diarrhea and vomiting, burns, or hemorrhaging may make a fluctuating situation impossible to regulate.
- Organ dysfunction or failure blocks normal feedback mechanisms from working.

Dehydration and Over-hydration

This course explores two major problems nurses will encounter: dehydration and over-hydration. Dehydration is defined as a decrease in total body water, causing clinical symptoms. Over-hydration, often called fluid overload, is too much total body water, causing clinical symptoms.

Dehydration can occur along with either an elevated or decreased sodium level. It is due to:

- Excessive vomiting and/or diarrhea.
- Use of diuretics.
- Hemorrhage.
- Severe burns.
- Renal disease.
- Adrenal disease. ^{2; 7; 11}

Over-hydration can be due to:

- Heart failure.
- Renal disease.
- Side effects of medications.
- Blood transfusions.
- Intravenous therapy.^{3; 5; 10}

Conditions Associated with Fluid Imbalance

Fluid imbalance occurs for many different reasons. Some are associated with natural changes within the lifespan. Some are due to trauma, disease or medical treatments. Those most at risk are the very young and the old. This is because of small body weight in the young and a lower percentage of total body water in the elderly.^{11; 12} Natural compensatory mechanisms that restore fluid balance have a shorter period of time to work in these vulnerable populations before clinical problems manifest.^{2; 11} The very young and those older people who are cognitively or physically disabled are vulnerable due to dependency on others.

Older people tend to dehydration because of unreliable thirst that usually makes people drink. They do not conserve water and sodium as well as younger people because they produce less aldosterone.^{1; 5; 11; 12} Older people are less able than younger people to metabolize and excrete drugs, compromising renal function already declining as aging occurs.^{12; 13} This may be compounded in some people who purposefully drink less to avoid trips to the toilet and/or incontinence.⁷

Some other conditions predisposing people to fluid imbalance are:

- Pregnancy.
 - Malnutrition.
 - Fasting.
 - Anorexia nervosa.
 - Massive weight loss.
 - Endurance athletics.
 - Living in a high altitude.
 - Long-standing parasitic infections.
- Limited immunity to infectious agents encountered in foreign travel.^{1; 14; 15}

(See Appendix A: Travel with infants and young children.)

Sometimes fluid imbalances inadvertently occur in the course of treatment that may ironically have been started to resuscitate or prevent fluid imbalances.

- Certain medications are known to alter kidney function and create fluid imbalances. Common among these are: diuretics, especially if combined with a low salt diet; ACE inhibitors; ARBs; NSAIDs; chemotherapeutic agents;

some antibiotics that include tetracyclines, aminoglycosides and cephalosporins; and anti-arrhythmics including digoxin and procainamide.^{2; 6; 12; 13; 14}

- Corticosteroids are another class of medications that commonly interfere with fluid and electrolyte balance. Hypokalemia and fluid retention are common side effects.
- Bowel preparation products used before diagnostic procedures such as a colonoscopy. These stimulate a large amount of fluid evacuation.¹³
- Accidental fluid overload from excessive IV therapy or as a complication of dialysis.^{9; 16}
- Refeeding syndrome from overly aggressive nutritional therapy. This is due to electrolyte depletion that accompanies cellular glucose uptake. Insulin carries glucose into the cells but brings intravascular electrolytes along with it.¹⁴
- Blood transfusions can create hyperkalemia and then hypokalemia because blood storage damages cells temporarily, allowing potassium to leak into plasma.⁵ Potassium imbalances alter cardiac and nerve function, indirectly shifting fluid balance.

Many chronic diseases are characterized by signs and symptoms of fluid imbalance. These diseases interfere with fluid balance mechanically, set up an electrolyte imbalance that cascades into fluid imbalance, or involve a hormonal dysfunction that disallows the normal fluid regulatory mechanisms to work. Some of the more common diseases that present fluid balance problems are:

- Renal disease.
- Heart failure, leading to pulmonary edema or venous congestion.
- Cirrhosis.
- Adrenal dysfunction causes volume deficit in Addison's disease and volume overload in Cushing's disease.
- Hypothyroidism.
- Uncontrolled diabetes mellitus, marked by diuresis and proteinuria.
- Diabetes insipidus, This is marked by diuresis which is due to a failure to make ADH or respond to it.
- Syndrome of inappropriate ADH production, causing water retention and excessive thirst.
- Chronic GI diseases, alcoholism, cystic fibrosis and estrogen-secreting tumors are other diseases that create fluid imbalances.^{1; 2; 4; 6; 9; 14; 17}

Acute Situations

Correcting a fluid imbalance becomes an emergency when the cause is significantly injurious or escalating and/or when the patient is particularly vulnerable. Acute situations include:

- Prolonged vomiting, diarrhea and/or fever.
- Hemorrhage.
- Burns.
- Systemic infection.
- Septic shock.
- Brain infections or trauma.
- Stroke.
- Severe acute pancreatitis.
- Massive edema/third-spacing.

Third-spacing occurs when fluid moves from the intravascular space into the interstitial space. This causes reduced cardiac output and hypotension due to inadequate circulating volume. Massive edema can occur in the lower legs, the abdomen, or the lungs if the serum albumin level is very low and therefore insufficient to hold water in the intravascular space. In cases of severe burns covering a large area of the body, increased capillary permeability and an inflammatory response causes a huge loss of protein within the first few days, radically altering fluid balance.^{2; 3; 8; 9}

Measuring Fluid Status

There is no single tool to measure fluid status. Osmolality is not a gold standard because tissues can still receive inadequate nourishment due to poor perfusion despite compensatory mechanisms activated to prevent shock.³ Hydration is assessed through a combination of these clinical and laboratory findings:

General Nursing Assessments

Vital signs: heart rate and rhythm, body temperature and blood pressure

Intake & output

Appearance of concentrated or dilute urine

Body weight change

Condition of mucous membranes

Capillary refill

Skin turgor/recoil at the forearm or subclavicular region

Presence of edema

Neuromuscular status

Alterations in consciousness

Lung sounds^{2; 11; 12; 18}

Additional Assessments for Pediatrics

Crying with few or no tears

No urine output for 4-6 hours or less than six wet diapers per day

Sunken fontanel^{15; 19}

Laboratory Tests

Normal values

Urine specific gravity

1.001 – 1.040

Urine osmolality

50 -1200 mOsm/kg H₂O (random)

(more accurate than specific gravity)

Serum osmolality

285 – 295 Osm/kg H₂O

Urine sodium

40 -220 mEq/day

Serum sodium

135 – 145 mEq/L

BUN

10 – 20 mg/dl

Serum creatinine

Female: 0.5 – 1.1 mg/dl

Male: 0.6 – 1.2 mg/dl

Ratio of serum creatinine to BUN

1:10

Creatinine clearance (GFR)

Female: 87 – 107 ml/min

Male: 107 – 139 ml/min

Hematocrit

Female: 37 -47%

Male: 42 – 52%

Hemoglobin

Female: 12 -16 g/dl

Male: 14 -18 g/dl

Lactic acid

Venous: 5 -20 mg/dl

Arterial: 3 -7 mg/dl

Albumin

3.5 – 5 g/dl

Ratio of albumin to globulins

1:1 or greater

2; 3; 9; 12; 14; 20

Specific imbalances of fluids and electrolytes produce many symptoms in common, creating a confusing picture. The same set of symptoms can occur at both ends of the

spectrum, in either hypo or hyper states. For example, both dehydration and fluid overload trigger dizziness, delirium, constipation, and a tendency to falling and accident proneness in the elderly.¹¹ The previous table of serious consequences of electrolyte imbalance showed a similar overlap of clinical symptoms. However, there are some distinct signs and symptoms that differentiate dehydration from volume overload.

Dehydration

Fluid Overload

Thirst	SOB
Hypotension	Jugular vein distention
Weakness	Bounding pulse
Weak, rapid pulse	Rales in lungs
↓ urine output	Edema in legs
Rapid, deep breathing	Ascites
Cool skin and extremities	Anorexia
Hypothermia	Nausea
Dry mucous membranes and skin	Malaise
↓ skin turgor	Headache
↓ capillary refill	Muscle cramps
↑ serum + urine osmolality	↓ serum + urine osmolality
↑ serum creatinine	
↓ creatinine clearance level	
↑ serum + urine Na	
↓ urine pH	
↑ lactic acid	
↑ albumin to globulin ratio	
↓ BUN	↑ BUN

2; 3; 7; 20; 21

Once dehydration is identified, the next step is to determine whether this condition is mild to moderate, or severe. Extremely low blood pressure, little or no urine, diminished responsiveness, seizures, sunken eyes, loss of skin elasticity/recoil or a 10 to 15% weight loss signifies severe dehydration in an adult.^{1; 3; 6; 7; 11} In a pediatric patient, dehydration is considered mild with a 3-5% weight loss, moderate with a 5-10% weight loss, and severe with a 10-15% weight loss.¹⁵

Treatment

Treatment for fluid imbalance consists of resuscitation for fluid deficit, resolution of fluid overload, and correction of associated electrolyte imbalances. The choice of treatment depends on the severity and cause of the imbalance, and the availability of facilities and healthcare services. It can be administered through:

- Oral intake.

The general recommendation for adults is two liters per day. However, a more accurate guide for elders is based on body weight:

$$(1500 \text{ ml} + 15 \text{ ml per kg} - 20)^{11}$$

Following this formula, an older person weighing 200 pounds may need to drink twelve glasses of fluid daily whereas a frail older person weighing eighty-eight pounds may need only eight glasses.

Dehydrated infants require oral rehydration in the form of a solution such as Pedialyte®, given in doses of a few tablespoons at a time every fifteen minutes. They may continue to breast feed every few hours. Bottle-fed infants may start on half-strength formula after a day of oral rehydration solution and then progress to full strength. Children over a year old may rehydrate with other clear fluids in addition to an oral rehydration solution.
15; 19

A recipe for homemade rehydration solution is:

- ½ teaspoon table salt
- ½ teaspoon salt substitute (potassium chloride)
- ½ teaspoon baking soda
- 4 tablespoons sugar dissolved in about a quart of water.¹⁵

- Hypodermoclysis.
This is primarily used in nursing homes. It is a continuous subcutaneous infusion that takes up to five days. A butterfly needle is inserted into the thigh, abdominal wall, or other sites. An initial bolus of an enzyme is given to promote absorption of fluid.^{21; 22}
- Intravenous therapy.
This consists of solutions categorized according to osmolality as compared to that of serum. Isotonic solutions have an osmolality the same as that of serum. They do not cause movement of water into or out of cells. Hypotonic solutions have an osmolality lower than serum. They cause cells to swell. Hypertonic solutions have an osmolality higher than that of serum. They cause cells to shrink.

Intravenous Rehydration

Colloids are those solutions known as plasma expanders. They replace proteins in the intravascular space that hold water there. This increases cardiac output and raises blood pressure. Examples are:

- Albumin 5% and 25% (Albaminar®, Albutein®)
This product is too costly for routine use.

- Hetastarch 6% (Hespan®)
- Dextran (Dextran®, Gentran®)
- Polygeline (Haemaccel®, Gelofusine®) ^{5; 8}

Crystalloids with isotonic properties correct dehydration by replacing electrolytes and restoring normal serum osmolality. Crystalloids with hypotonic properties hydrate tissues by causing water to move into cells. Examples are:

- Isotonic solutions: 0.9% NaCl solution
Ringer's lactate
Ringer's acetate
D₅W
- Hypotonic solutions: 0.45% NaCl solution
0.25 % NaCl solution with or without D₅W ^{4; 7; 8}

Correction of Fluid Overload

One of the consequences of fluid overload is cerebral edema. It is especially critical to avoid an increase in intracranial pressure in cases of stroke, brain surgery and head trauma. All patients at risk for fluid imbalance will be monitored for overload and treated as necessary. Treatments are:

- Diuretics.
A potassium supplement is generally given simultaneously.
- Dialysis.
This can be hemodialysis or peritoneal dialysis.²
- Intravenous administration of a hypertonic solution.
These solutions reduce the symptoms of fluid overload by causing water to move out of the cells. Solutions with a high osmolality must be infused through a central venous access device.⁴ Examples are: 10% or higher dextrose, 5% protein hydrolysate, and 3-7.5% saline.

Preventive Measures

Dehydration

Statistics show that one out of four people over 85 only drink about half of the fluids they need.¹¹ One intervention is to ensure an adequate oral intake during the day and then allow for no fluids two hours before bedtime. This is intended to allay anxiety about having to get up at night or be incontinent.¹²

Educate parents of young children to keep an electrolyte replacement product such as Pedialyte® on hand. These are preferable to sports drinks designed for people who sweat excessively and lose different electrolytes than those lost during diarrhea and vomiting.

(See Appendix B: Managing acute gastroenteritis among children.) Electrolyte replacement products found in the grocery store's baby section are just as useful for adults who have diarrhea or flu.

People often question when to seek medical care for symptoms of dehydration. Advise them to act sooner rather than later for the vulnerable: young children, older adults, and people who are underweight.

Medical care for adults is appropriate for these situations:

- Moderate diarrhea for five days or more.
- Severe diarrhea with or without fever or vomiting.
- Vomiting that continues for over 12 hours.
- Inability to hold fluids down.
- Disorientation, marked irritability, or unusual sleepiness.¹

Medical care for children is appropriate for these situations:

- Signs & symptoms of dehydration as described in this course.
- Fever over 103° F.
- Vomiting and/or diarrhea that lasts for more than 24 hours, contains blood, or is consistently green.^{15; 19}

Patients taking bowel preparations the night before a colonoscopy are at risk for dehydration and electrolyte imbalance. There are two choices of products but both can cause nausea and vomiting. Sodium phosphate solutions have a higher risk of fluid and electrolyte imbalance because they draw water into the bowel to stimulate peristalsis. Electrolyte lavage solutions are less likely to shift balance. They work by cleansing the bowel. Advise patients to call the doctor if they start vomiting. Tell them how much clear liquid to drink and to stop intake two hours before receiving the pre-procedure anesthesia.¹³

Fluid Overload

Prevention includes not only avoiding overload but careful monitoring during the treatment for overload. Fluid imbalances can swing both ways.

Patients on hemodialysis are at risk for overload and so monitoring of weight is a key assessment. Weight gain more than 4% is a sign of overload. Dietary salt restriction is often advised.¹⁶

Patients treated for third-spacing may experience fluid overload during the reabsorption phase. Monitor them carefully.⁹

Patients taking diuretics are at risk for hypokalemia and may need potassium supplements or a switch to a potassium-sparing diuretic. Symptoms of hypokalemia to watch for are: disorientation, muscular weakness and dysrhythmia.

Refeeding syndrome manifests within 12 to 72 hours after treatment is started and continues for two to seven days.¹⁴ Monitor patients during this time by checking electrolyte levels, blood pressure, pulse, intake and output, and weight. Electrolyte imbalances can cause a variety of signs and symptoms involving cardiac, neurological, respiratory, and gastrointestinal systems. A weight gain over 0.5 pound/day or 3.3 pounds/week is most likely from fluid retention. The best prevention of this syndrome is to start nutritional supplementation slowly, especially with carbohydrates.

Conclusion

This course on hydration basics is applicable to the entire patient population. It is especially useful for nursing of the expanding group of vulnerable older people making up the bulk of patients in healthcare facilities. With the prevalent use of intravenous therapy used in the hospital setting, almost all patients require monitoring of their fluid status. Fluid imbalances can swing either way: toward dehydration or toward overhydration.

This course explains that assessment of fluid status is done through a variety of clinical and laboratory measures. It emphasizes the dynamic nature of fluid regulation and explains how normal feedback mechanisms may take days to complete, are limited in scope, and may be dysfunctional or blocked in the presence of chronic disease states.

The course explores the commonly employed options for restoring fluid balance. It also notes the precautions needed in administering treatments. Some cases of fluid imbalance are inadvertently the consequence of medical treatment, procedural preparations, medications, transfusions, or overzealous or too rapid administration of intravenous fluids or nutrition.

Lastly, the course offers information suitable for patient education. Patients often ask when to seek medical care for dehydration and what measures are effective for home care. Nurses completing this course are prepared to offer advice.

References

1. Mayo Foundation for Medical Education and Research. (2007). Dehydration. Available online @ <http://www.mayoclinic.com>.
2. Johnson, J. (2008). *Fluids and electrolytes demystified*. New York: McGraw-Hill Companies.

3. Stevens, W. (2008). Fluid balance and resuscitation. *Nursing 2008 Critical Care*, 3(2): 12-21
4. Rosenthal, K. (2006). Intravenous fluids: the why and wherefores. *Nursing 2006*, 36(7): 26-27.
5. Woodrow, P. (2003). Assessing fluid balance in older people: fluid replacement. *Nursing Older People*, 14(10): 29-30.
6. Cheever, K. (2008). *I.V. therapy demystified*. New York: McGraw-Hill Companies.
7. Bryant, H. (2007). Dehydration in older people: assessment and management. *Emergency Nurse*, 15(4): 22-26.
8. Hankins, J. (2007). The role of albumin in fluid balance. *Nursing 2007*, 37(12): 14-15.
9. Holcomb, S. (2008). Third-spacing: when body fluid shifts. *Nursing 2008*, 38(7): 50-54.
10. Merck & Company. (2008) Chapter 18: water and electrolyte balance. *The Merck Manual of Health & Aging*.
11. Faes, M.; Spigt, M. & Olde Rikkert, M. (2007). Dehydration in geriatrics. *Geriatrics Aging*, 10(9): 590-596. Available online @ <http://www.medscape.com>
12. Larson, K. (2003). Fluid balance in the elderly: assessment and intervention- important role in community health and homecare nursing. *Geriatric Nursing*, 24(5): 306-309.
13. Dykes, C. & Cash, B. (2008). Key safety issues of bowel preparations for colonoscopy and importance of adequate hydration. *Gastroenterology Nursing*, 31(1): 30-35.
14. Yantis, M. & Velander, R. (2008). How to recognize and respond to refeeding syndrome. *Nursing 2008*, 38(5): 34-39.
15. Ferry, Jr., R. (2007). Dehydration in children. Available online @ <http://www.emedicinehealth.com>.
16. Pace, R. (2007). Fluid management in patients on hemodialysis. *Nephrology Nursing Journal*, 34(5): 557-559.
17. Pham, T. (2007) Hyponatremia. *WebMD*. Available online @ <http://www.emedicine.com>.

18. Armstrong, L. (2007). Assessing hydration status: the elusive gold standard. *Journal of the American College of Nutrition*, 26(5): 575S-584S.
19. D'Alessandro, D. & D'Alessandro, M. (2002). Dehydration. Available online @ <http://www.virtualpediatrichospital.org>.
20. Pagana, K. & Pagana, T. (2005). *Mosby's diagnostic and laboratory test reference*. St. Louis, Missouri: Elsevier Mosby. Pagana, K. & Pagana, T. (2005)
21. Mayhew, M. (2002). What should I know about using hypodermoclysis in geriatric patients? *Medscape Nurses*. Available online @ <http://www.medscape.com>.
22. Remington, R. & Hultman, T. (2007). Hypodermoclysis to treat dehydration: a review of the evidence. *Journal of the American Geriatrics Society*, 55(12): 2051-205.

Appendix A

Travel with Infants and Young Children

Diarrhea and associated gastrointestinal illness are among the most common travel-related problems affecting children (1). Young children and infants are at high risk for diarrhea and other food- and waterborne illnesses because of limited pre-existing immunity and behavioral factors such as frequent hand-to-mouth contact. Infants and children with diarrhea can become dehydrated more quickly than adults.

PREVENTION

Causes of Travelers' Diarrhea (TD) in children are similar to those in adults (see Chapter 4). For young infants, breastfeeding is the best way to reduce the risk of foodborne and waterborne illness. Travelers should use only purified water for drinking, preparing ice cubes, brushing teeth, and mixing infant formula and foods. Scrupulous attention should be paid to handwashing and cleaning pacifiers, teething rings, and toys that fall to the floor or are handled by others. When proper handwashing facilities are not available, an alcohol-based hand sanitizer can be used as a disinfecting agent. However, alcohol does not remove organic material; visibly soiled hands should be washed with soap and water.

Travelers should ensure that dairy products are pasteurized. Fresh fruits and vegetables must be adequately cooked or washed well and peeled without recontamination. Bringing finger foods or snacks (self-prepared or from home) will reduce the temptation to try potentially risky foods between meals. Meat, fish and eggs should always be well cooked and eaten just after they have been prepared. Travelers should avoid food from street vendors.

MANAGEMENT OF DIARRHEA IN INFANTS AND YOUNG CHILDREN

Adults traveling with children should be counseled about the signs and symptoms of dehydration and the proper use of World Health Organization oral rehydration solutions (ORS). Immediate medical attention is required for an infant or young child with diarrhea who has signs of moderate to severe dehydration (Table 8-1), bloody diarrhea, fever higher than 38.5° C (101.5° F), or persistent vomiting. ORS should be provided to the infant by bottle or spoon while medical attention is being obtained.

Assessment and Treatment of Dehydration

The greatest risk to the infant with diarrhea and vomiting is dehydration. Fever or increased ambient temperature increases fluid losses and speeds dehydration. Parents should be advised that dehydration is best prevented and treated by use of ORS, in addition to the infant's usual food (Table 4-20). Rice and other cereal-based ORS, in which complex carbohydrates are substituted for glucose, are also available and may be more acceptable to young children. Adults traveling with children should be counseled that sports drinks, which are designed to replace water and electrolytes lost through sweat, do not contain the same proportions of electrolytes as the solution recommended by WHO for rehydration during diarrheal illness.

ORS packets are available at stores or pharmacies in almost all developing countries. [See information below regarding ORS availability in the United States.] ORS is prepared by adding one packet to boiled or treated water. Travelers should be advised to check packet instructions carefully to ensure that the salts are added to the correct volume of water. ORS solution should be consumed or discarded within 12 hours if held at room temperature or 24 hours if kept refrigerated. A dehydrated child will drink ORS avidly; travelers should be advised to give it to the child as long as the dehydration persists. An infant or child who vomits the ORS will usually keep it down if it is offered by spoon in frequent small sips.

Children weighing less than 10 kilograms who have mild to moderate dehydration should be administered 60-120 mL ORS for each diarrheal stool or vomiting episode. Children who weigh 10 kg or more should receive 120-240 mL ORS for each diarrheal stool or vomiting episode. Severe dehydration is a medical emergency that usually requires administration of fluids by IV or intraosseous routes.

Breastfed infants should continue nursing on demand. Formula-fed infants should continue their usual formula during rehydration. They should receive a volume that is sufficient to satisfy energy and nutrient requirements. Lactose-free or lactose-reduced formulas are usually unnecessary. Diluting formula may slow resolution of diarrhea and is not recommended. Older infants and children receiving semisolid or solid foods should continue to receive their usual diet during the illness. Recommended foods include starches, cereals, yogurt, fruits, and vegetables. Foods that are high in simple sugars, such as soft drinks, undiluted apple juice, gelatins, and presweetened cereals, can exacerbate diarrhea by osmotic effects and should be avoided. In addition, foods high in fat may not be tolerated because of their tendency to delay gastric emptying. The practice of withholding food for 24 hours or more is inappropriate. Early feeding can decrease changes in intestinal permeability caused by infection, reduce illness duration and improve nutritional outcome. Highly specific diets (e.g., the BRAT [bananas, rice, applesauce, and toast] diet) have been commonly recommended; however, similar to juice-centered and clear fluid diets, such severely restrictive diets used for prolonged periods of time can result in malnutrition and should be avoided (2).

The use of antimotility agents (e.g., loperamide, lomotil) in children younger than 2 years of age is not recommended. Because overdoses of these types of drugs can be fatal, they should be used with extreme caution in children. Side effects of these drugs in adults include opiate-induced ileus, drowsiness, and nausea. Lomotil has been associated with fatal overdoses and other severe complications, including coma and respiratory depression. Antinausea medications, such as promethazine and prochlorperazine, are not routinely recommended. They are contraindicated for use in children less than 2 years of age. Fatal respiratory depression in children has been reported with use of promethazine. Children with an acute illness, including gastroenteritis and dehydration, are more susceptible to neuromuscular reactions, especially dystonias, associated with prochlorperazine, than adults. The extrapyramidal side effects associated with these medications can be confused with symptoms of other undiagnosed primary diseases associated with vomiting, such as Reye syndrome. These medications should not be routinely prescribed as empiric treatment for children with possible TD. Adults traveling with children should be fully counseled about the indications, dosage, frequency and possible side effects if these medications are prescribed.

Few data are available regarding empiric administration of antibiotics for TD in children. Furthermore, the antimicrobial options for empiric treatment in children are limited.

Source: Travelers' Health: Yellow Book
CDC Health Information for International Travel 2008

Appendix B

Managing Acute Gastroenteritis Among Children

BOX 2. Seven principles of appropriate treatment for children with diarrhea and dehydration

1. Oral rehydration solutions (ORS) should be used for rehydration.
2. Oral rehydration should be performed rapidly (i.e., within 3–4 hours).
3. For rapid realimentation, an age-appropriate, unrestricted diet is recommended as soon as dehydration is corrected.
4. For breastfed infants, nursing should be continued.
5. If formula-fed, diluted formula is not recommended, and special formula usually is not necessary.
6. Additional ORS should be administered for ongoing losses through diarrhea.
7. No unnecessary laboratory tests or medications should be administered.

Source: Adapted from Sandhu BK. Practical guidelines for the management of gastroenteritis in children. *J Pediatr Gastroenterol Nutr* 2001;33(Suppl 2):S36–9.

Table 3

TABLE 3. Composition of commercial oral rehydration solutions (ORS) and commonly consumed beverages

Solution	Carbohydrate (gm/L)	Sodium (mmol/L)	Potassium (mmol/L)	Chloride (mmol/L)	Base* (mmol/L)	Osmolarity (mOsm/L)
ORS						
World Health Organization (WHO) (2002)	13.5	75	20	65	30	245
WHO (1975)	20	90	20	80	30	311
European Society of Paediatric Gastroenterology, Hepatology and Nutrition	16	60	20	60	30	240
Enfalyte [†]	30	50	25	45	34	200
Pedialyte [§]	25	45	20	35	30	250
Rehydralyte [¶]	25	75	20	65	30	305
CeraLyte ^{**}	40	50–90	20	NA ^{††}	30	220
Commonly used beverages (not appropriate for diarrhea treatment)						
Apple juice ^{§§}	120	0.4	44	45	N/A	730
Coca-Cola ^{¶¶} Classic	112	1.6	N/A	N/A	13.4	650

* Actual or potential bicarbonate (e.g., lactate, citrate, or acetate).

[†] Mead-Johnson Laboratories, Princeton, New Jersey. Additional information is available at <http://www.meadjohnson.com/products/cons-infant/enfalyte.html>.

[§] Ross Laboratories (Abbott Laboratories), Columbus, Ohio. Data regarding Flavored and Freezer Pop Pedialyte are identical. Additional information is available at <http://www.pedialyte.com>.

[¶] Ross Laboratories (Abbott Laboratories), Columbus, Ohio. Additional information is available at http://rpdcon40.ross.com/pn/PediatricProducts.NSF/web_Ross.com_XML_PediatricNutrition/96A5745B1183947385256A80007546E5?OpenDocument.

^{**} Cera Products, L.L.C., Jessup, Maryland. Additional information is available at <http://www.ceralyte.com/index.htm>.

^{††} Not applicable.

^{§§} Meeting U.S. Department of Agriculture minimum requirements.

^{¶¶} Coca-Cola Corporation, Atlanta, Georgia. Figures do not include electrolytes that might be present in local water used for bottling. Base = phosphate.

Source: MMWR, November 21, 2003/52(RR-16);1-16

The information presented in this course is intended solely for the use of healthcare professionals taking this course, for credit, from NurseCe4Less.com.

The information is designed to assist healthcare professionals, including nurses, in addressing issues associated with healthcare.

The information provided in this course is general in nature, and is not designed to address any specific situation. This publication in no way absolves facilities of their responsibility for the appropriate orientation of healthcare professionals.

Hospitals or other organizations using this publication as a part of their own orientation processes should review the contents of this publication to ensure accuracy and compliance before using this publication.

Hospitals and facilities that use this publication agree to defend and indemnify, and shall hold NurseCe4Less.com, including its parent(s), subsidiaries, affiliates, officers/directors, and employees from liability resulting from the use of this publication.

The contents of this publication may not be reproduced without written permission from NurseCe4Less.com.