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SAFE PRACTICES in Patient Care

Helping to promote a culture of safety

Enteral nutrition is a vital therapy for patients unable to take in adequate food and fluid via the oral route. According to 2009 National Center for Health statistics HCUP data, more than 245,000 acute-care hospital discharges were coded for patients receiving enteral nutrition therapy. With all of these patients who have enteral feeding tubes, proper protocols and care are critical to keep tubes patent and allow for adequate nutritional intake and optimal fluid balance. Dr. Guenter has convened a panel of nutritional experts to discuss the best fluid management practices in tube-fed patients.

The Health Care Financing Administration listed dehydration among the 10 most frequent diagnoses in Medicare patients requiring hospitalization. Tube-fed patients are especially at risk for dehydration because water is administered by prescription, which depends on the prescribers' and caregivers' knowledge and degree of monitoring. In her article, Ms. Lord discusses the ongoing need for water flushes to fully hydrate tube-fed patients and maintain the patency of their tubes for uninterrupted nutrition support.

Maintaining Hydration and Tube Patency in Enteral Tube Feedings

Linda M Lord, NP, MS, CNSN

Ongoing water flushes are necessary to fully hydrate tube-fed patients and maintain the patency of their tubes for uninterrupted nutrition support. If tube-feeding formulas are not delivered at the volume that meets total calorie and protein needs, malnutrition will occur in weeks to months. Of greater importance, if the water volume does not meet total fluid needs, dehydration can occur within days. Water is the body's most essential nutrient. All body cells, including brain cells, require hydration to function properly—transporting nutrients, eliminating waste, and regulating body temperature. Therefore, nutritional assessments should always include estimated fluid requirements in addition to the estimation of caloric and protein needs. Clogged tubes interfere with tube feeding and water delivery, placing patients at risk for malnutrition and dehydration. It is important for the clinician to be aware of fluid requirements and to ensure they are being met. Measures must be taken to prevent tube clogging, with declogging methods at hand to avoid feeding delays and tube replacements.

Dehydration

Definition and Causes of Dehydration

Dehydration is defined as the excessive loss of body fluid or water. In general, dehydration can be caused by losing too much water, not taking in enough water or fluids, or both; and it may be accompanied by sodium imbalance. Dehydration may be caused by insufficient water intake (orally or via tube), fever, diarrhea, vomiting, burns, significant blood volume loss, undiagnosed chronic illnesses (e.g., diabetes, kidney disease), and hyponatremia (sodium loss greater than water loss, such as with cystic fibrosis or overuse of diuretics).

> Dehydration causes both morbidity and mortality. Dehydrated patients are at risk for pressure ulcers, constipation, urinary tract infections, respiratory infections, medication toxicities, and falls.

Dehydration has a generic diagnosis code (ICD-9-CM) of 276.51; however, the term "dehydration" has been used interchangeably with hypovolemia or volume depletion (276.50), which is defined as decreased intravascular, interstitial, and/or intracellular fluid—water loss alone without change in sodium. Other diagnosis codes exist for forms of dehydration related to electrolyte imbalances. Statistics vary on

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Panel Discussion: *Fluid Management in Enteral Feeding.*

Moderator: Peggi Guenter, PhD, RN, CNSN

Panelists: Carol McGinnis, RN, MS, CNSN
Susan L. Brantley, MS, RD, CNSD, LDN
Elizabeth Pash, MS, RD, LD
Linda Lord, NP, CNSN

Enteral nutrition is a vital therapy for patients unable to take in adequate food and fluid via the oral route. According to 2009 National Center for Health statistics HCUP data, more than 245,000 acute-care hospital discharges were coded for patients receiving enteral nutrition therapy. With all of these patients who have enteral feeding tubes, proper protocols and care are critical to keep tubes patent and allow for adequate nutritional intake and optimal fluid balance.

Enteral tube occlusion is a frequent problem associated with tube feeding. What is the incidence of enteral tube occlusion, and could you describe its impact on the patient's ability to receive adequate nutrition and hydration?

McGinnis: Studies of tube occlusion, or clogging, can be difficult to interpret, as many variables may be involved. When these variables are not clearly identified and controlled, the results may be difficult to generalize to other settings. Some of these variables include tube material and size, length and termination, flushing techniques, various formulas, as well as specific medications and administration techniques. One of the many advantages of having a nurse specialist available in an institution or the community is that she or he can assist with feeding tube issues, identify trends, and suggest or implement means to prevent problems such as feeding tube occlusion. Medication delivery is the most common factor related to tube clogging. When proper administration techniques are followed, the incidence of clogging can be minimal.

The most obvious adverse effect related to tube clogging is the inability to administer medication, fluid and nutrition until the occlusion is cleared, or the tube is replaced and placement is verified. This may involve several hours or even a day or two for tubes that are challenging to replace, such as gastrojejunostomy tubes. Transportation to a radiology department or another facility can slow the process. Fluid may temporarily need to be administered via another route, such as an IV. Potential adverse effects to patients may include dehydration, medication delay, and diminished nutrient intake. Additionally, time spent trying to unclog and replace a tube taxes valuable healthcare resources.

Brantley: Tube occlusion is probably the most frequent mechanical complication encountered with enteral nutrition support, occurring in 9% to 20% of tube-fed patients.[1] As Carol [McGinnis] noted, nutrient delivery is severely compromised by clogged feeding tubes. Although most feeding pumps have occlusion alarms, several minutes may pass before the clog is detected. Attempts to unclog feeding tubes can result in a significant feeding delay, as nurses must frequently instill water and wait for the clog to "dissolve" before reattempting to flush the tube.[2]

Pash: The incidence of occlusion occurs especially in patients receiving enteral feeding via a short-term feeding device (i.e., a small-bore feeding tube). As mentioned, an occlusion severely impacts both the patient's nutrient and hydration delivery. Once an occlusion occurs, enteral formula is unable to be delivered. Multiple remedies are often tried, such as warm water flushes, and even the use of manufactured kits to declog the tube; but they are not always successful. Such attempts take time. On the average it may take 15-30 minutes to declog a tube. When attempts fail, plans for replacement must be made. Some delays are significant enough that the patient goes into calorie deficit, due to the loss of nutrient infusion. Such delays have a detrimental effect on the patient's nutrition and hydration status, increasing the risks of delayed wound healing as well as prolonged intubation and length of stay.

Adequate water flushing can prevent tube clogging. In addition, water provides adequate hydration to maintain skin integrity and prevent formation of decubitus ulcers. The Centers for Medicare and Medicaid Services (CMS) will not cover the additional costs to treat a decubitus ulcer that develops during a hospital stay, because it can be prevented by providing adequate nutrition, hydration, and nursing care. Often, private insurance companies will follow suit with CMS. Non-payment of those costs will significantly decrease reimbursement to hospitals, so they are quite willing to adopt multidisciplinary strategies to prevent this from occurring at their facilities.

Lord: The incidence of tube clogging varies with the feeding tube type and composition, tube tip location (gastric vs. small bowel), flushing agents and methods, formula composition and infusion rates, residual check techniques and medication administration techniques. Tubes that are longer with smaller Fr sizes, such as nasally placed and jejunal tubes, have a higher risk of clogging compared to shorter tubes with larger Fr sizes, such as gastrostomy tubes. Silicone tubes can clog more readily than polyurethane tubes. Acidic solutions can coagulate formula proteins and form clogs. So, tubes with more than one exit hole and tubes that have their tips located in the stomach clog more readily than those in the small bowel, especially if one does not flush before and after gastric residual checks. Acidic solutions used for tube flushing, such as sodas and juices, promote clogging. Medications can interact with formulas or each other, forming clogs. Slow tube-feeding infusion rates and formulas that contain fiber or have a high viscosity are prone to cause tube clogging. Medications that are not in liquid form or are not fully dissolved in water can create clogs that are difficult to dissolve.

Incorrect nursing practices can contribute to enteral tube occlusion. Please outline the causes of enteral tube occlusion and strategies for prevention.

McGinnis: As Linda [Lord] noted, a primary cause of tube occlusion is related to medication administration. Knowledge level and technique may vary among caregivers and may not be consistent with best-practice recommendations.[3] It is difficult to know which medications can be administered together without clogging a tube, so one of the most helpful recommendations in preventing tube occlusion is to flush the tube before and after administering each medication; not to mix any medications to be given via feeding tube. An adequate volume, enough to separate each medication, should be used. A.S.P.E.N. Enteral Nutrition Practice Recommendations say to use a minimum 15-mL flush,[4] and more should be used when possible. Often, the planned water bolus used for hydration can be used for medication administration.

The liquid form of medication is usually the preferred form for administration via feeding tube, with few exceptions, such as iron, which can be quite viscous. Diluting viscous liquid medications can help reduce tube clogging and also help enhance delivery of the medication to the distal end of the tube. Diluting hyperosmolar medications such as acetaminophen elixir or others such as liquid potassium chloride, which is also very hypertonic,[5] can help prevent clogs and reduce the potential for hyperosmolar diarrhea.

Another reason for tube clogging may be lack of flushing after an infusion of feeding is stopped. If the tube isn't flushed, the feeding product may dwell and thicken in the tube. Some feeding products may be too viscous for the size of the tube, so check feeding product recommendations. Additionally, a kink or knot in the tube may be mistaken for tube clogging, which should also be considered in ruling out causes of tube occlusion.

Sometimes one may see routine administration of agents such as cola, cranberry juice, enzyme solutions, etc.—at times in large amounts per day—in attempts to reduce tube occlusion. Research says that water flushes are the most effective in preventing tube occlusion.[6,7]

Brantley: As mentioned, the most common cause of tube occlusion is medication administration. This can be a result of giving too many medications at one time or inadequate flushing before and after medication administration. Solutions to these issues are administering medications one at a time and flushing the tube before and after each administration. Inadequate flushing may also contribute to clogging of feeding tubes. It probably requires at least 30 mL of water or saline (if indicated) to adequately flush tubes in adult patients. Another nursing practice that can lead to clogging is the practice of gastric residual volume (GRV) measurement. Adequate flushing with 30mL of water can be effective in preventing this complication.[4]

Pash: Inadequate water flushing throughout the day, particularly before and after medication administration and before and after tube feeding, does contribute to enteral tube occlusions. Preventive strategies start with proper nursing education and in-servicing. One should implement a flush protocol that emphasizes flushing tubes with 30 mL of water every 4 hours during continuous feeds, and before and after every bolus feeding. Flushing with 30 mL of water after checking gastric residual volumes may help decrease occlusions. Collectively, the development of and adherence to feeding, flushing, and medication administration protocols can significantly reduce the occurrence of enteral tube occlusions. In addition, the development of gastric residual checking policies in coordination with nursing and nutrition departments may be beneficial as well.

Causes for tube-feeding-related dehydration are multifactorial, and this complication can be prevented with proper fluid management. Please comment on the causes and strategies to prevent this phenomenon.

McGinnis: Perhaps the biggest reason for dehydration in patients receiving enteral tube feeding is oversight in ordering water via feeding tube. There may be a lack of knowledge regarding the amount of water necessary to maintain adequate hydration or failure to order the proper amount, especially as needs change due to increased fluid losses. Those caring for patients who rely on tube feeding must watch for the need to increase fluids and recognize the early signs and symptoms of dehydration. Misconceptions such as the idea that fluid should be reduced to curtail diarrhea need to be corrected. Fluid must be increased in response to what is lost in sweat, fistula output, stool, etc. Patients, families and even some clinicians sometimes assume that a 60-mL syringe of water is a large amount—when, in reality, it contains only the equivalent of 4 tablespoons of fluid. Comparisons to normal intake, such that taken in a glass of water, can be very helpful. Dialogues of this nature help patients and caregivers have a more realistic picture of what is needed and sometimes even enhance a sense of tolerance for the needed volume of fluid. Water administration should not just be viewed as a tube flush, but its administration should be hard-wired into the feeding regimen; for example, by putting a noticeable prompt on a tube-feeding order form.

Brantley: Tube-feeding-related dehydration is common in patients who have been placed on a concentrated enteral formula without careful monitoring. Such patients can become dehydrated over time as their condition improves. As medical conditions change, fluid requirements also change, and adjustments must be made accordingly. Dehydration can also result in elevated gastric residual volumes, possible delays in the patient's feeding, or even delays in surgical procedures. So enteral feeding protocols should include instructions for when to restart enteral feedings after specific procedures. Inadequate blood glucose control can also result in dehydration over time.[1,4]

Pash: Dehydration is also commonly related to lack of adequate flushing or a flushing schedule. Often, no water flush orders accompanies the tube feed order. Strategies to prevent dehydration should include protocols and order sets that contain water-flushing orders. This is especially important with ICU patients, because dehydration often occurs when tube feeding is interrupted repeatedly due to tests, procedures, tube occlusions and dislodgements.

Lord: Clinicians who are knowledgeable about nutrition should perform the calculations for water requirements for tube-fed patients. Requirements vary according to age, disease states, and route of fluid loss; and nutrition support services can help with that. The prescriber needs to be familiar with the percentage of water in the various tube-feeding formulas prior to ordering the additional volume. The initial fluid requirement calculations are only gross estimates, and patients need to be continuously monitored for adjustments.

As Carol [McGinnis] noted, patients, families, and caregivers need be educated on the multiple signs and symptoms of dehydration and how to prevent and treat it. For example, they need to replace fluid when a tube-feeding is omitted. They need to increase fluid intake with diaphoresis (associated with fever or warmer environments); increased urine outputs (as occurs with hyperglycemia); and increased outputs from diarrhea, ostomies, fistulas, or drainage tubes. Some of those outputs need to be measured if they fluctuate in volume. If a patient is fluid-overloaded, a larger urine output is desired; but, at some point, even diuretics can lead to dehydration. When the fluids needed via the tube cannot be administered, they need to know when to call the provider.

Patients receiving enteral nutrition in both in acute and long-term care settings are at risk for dehydration even when the feeding tube is patent. Please review the incidence, impact and costs of tube-feeding-related dehydration in these facilities.

McGinnis: Dehydration is a concern of many nursing home residents, whether they take nutrition orally or via feeding tube or both. The natural thirst mechanism is reduced with aging, and this is often accompanied by reduced fluid intake. Additionally, fluid may be self-restricted to reduce incidents of incontinence. Pneumonia, urinary tract infections and constipation are prevalent in the elderly and lead to further adverse effects, as well as discomfort and increased health care expenses, especially when hospitalization is involved. Adequate fluid intake is important in clearing secretions, maintaining adequate urine output, and helping to prevent constipation. In general, weakness, fatigue and feeling out of sorts may not be recognized as being related to dehydration in the elderly, who may already be experiencing some weakness and fatigue. The tube-fed client may not recognize e thirst and hunger and may be dependent on the caregiver to address his or her needs and see that they are being met.

> Automatic flush pumps provide a set flush volume at a set interval, as opposed to the nurse spending time at the bedside accessing the enteral system and manipulating the tube.
>
> - McGinnis -

Brantley: In acute care, dehydration can result from excessive fluid loss via the GI tract (NG suction, fistulas, diarrhea) and through diuretic therapy. This can be averted by monitoring of intake/output and providing fluids by an intravenous route as indicated. A concentrated enteral formula can also contribute to dehydration, as previously mentioned.[8] Potentially this complication can delay transfer to a less acute floor or facility and increase length of stay. The elderly are especially susceptible to dehydration through the use of inappropriate enteral formulas with high solute loads for extended periods, leading to azotemia, hypernatremia, and dehydration. These conditions can lead to re-admission to acute care facilities and potential death if not treated immediately.[9]

Pash: At least 30% of enteral patients develop dehydration due to frequent enteral interruptions, especially in the acute care setting. When a patient is made NPO or a tube feeding is held and that is their only source of nutrition and hydration, dehydration can occur quickly, especially if other IV fluids are not infusing or ordered. Patient and facility costs can increase because of the potential risk of developing malnutrition, pressure ulcers, and electrolyte abnormalities due to feeding regimen interruptions and lack of or decreased water flushing. All of the above could result in an increased length of stay and increased cost of care. It is estimated that $1.14 billion dollars could be saved from avaoidable hospitalization due to dehydration. [13]

Enteral nutrition tube flushing can be done manually by the nurse or via an automatic flush pump. What are the advantages and disadvantages of each on their ability to maintain hydration and prevent tube occlusion?

McGinnis: Automatic flush pumps provide a set flush volume at a set interval, as opposed to the nurse spending time at the bedside accessing the enteral system and manipulating the tube. Manual flushing allows the clinician to detect early signs of sluggishness before fluid flow is reduced and intervene accordingly. Manual flushing also reduces tube clogging when the water bolus is used liberally in flushing with medication administration. A disadvantage of manual flushing is that entries into the enteral system increase the risk for microbial contamination and the potential for tubing misconnection.

Brantley: Advantages of automatic flushes include the lack of need to disconnect and reconnect avoiding the risk of an enteral misconnection, consistent delivery of a specified volume of free water to prevent dehydration in at-risk populations, and fewer incidences of tube occlusion.[10] Disadvantages include the possibility of overhydration of at-risk patients. Also, larger bore tubes may require a higher volume of flush than smaller bore tubes. An advantage of manual flushes is that larger amounts of free water can be infused quickly, resulting in improved fluid delivery. Disadvantages of manual flushes include increased nursing time, increased risk of enteral misconnections with a need to disconnect for flushing, and the risk of enteral tube damage if too small a syringe is used in flushing procedure. A smaller syringe exerts a higher pressure on the enteral tube walls than does a larger syringe. Finally, the volume and timing of flushing may be inconsistent,[11,12] so having a flushing protocol with prescribed volumes at designated intervals would benefit the patient.

Can you predict the impact of these two methods of flushing on nursing time and cite any associated literature to back up this prediction?

McGinnis: Flushing done via syringe can be time consuming. For example, if 2 cups of water are to be administered via 60-mL syringe into a gastrostomy tube, one must draw water into the syringe and administer it 8 times. Manual flushing can take up to 10 minutes per flush or approximately 60 minutes per day. This is not only tedious but also tiring for busy hands. It takes a little less time if the fluid is poured into the barrel of the syringe, which can be used like a funnel to administer the fluid. It takes even less nursing time to administer water via a gravity feeding bag. Gravity feeding bags may be used when preparing a patient to administer his or her own "bolus" or meal-type feedings. It is practical to demonstrate administration of feeding, then fluid via a gravity bag on a meal-by-meal basis, especially for the homebound patient. An automatic flush pump is a time-saving device for nurses in inpatient and critical care settings, but such a pump may be less desirable for ambulatory patients who could be free of the pump with bolus feedings and fluid administration. As in most situations, the cost-benefit ratio must be closely examined on an individual basis to see which system benefits the patient the most.

Brantley: Having recently changed to a closed system with automatic flushing, the nurses I have interviewed prefer the pumps with the automatic flush feature. On average, they estimate saving 30-minutes per shift with the automatic flush. This would equate to about 548 nursing hours per patient per year. They state they are using the flush feature for medication administration as there is a "flush now" option on the pumps.

Summary

Enteral nutrition and adequate hydration may decrease morbidity associated with undernutrition and dehydration in patients unable to take adequate oral nutrition. Safe-practice protocols are essential to minimize complications including tube clogging and to ensure that the tube-fed patient to receives adequate nutrition and hydration. Enteral tube flushing should be part of a tube-feeding protocol that provides optimal hydration and prevents tube clogging. Automatic flush pumps can shorten nursing care needed for flushing by providing a set flush volume at a set interval. Additionally, automatic flush pumps eliminate the need to disconnect and reconnect enteral tubes, avoiding the risk of a misconnection and ensuring safer patient care.

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the incidence and prevalence of dehydration, as well as determining whether it is a principal or concomitant diagnosis.

Dehydration Incidence, Prevalence, Morbidity and Mortality

A paucity of data exists regarding overall incidence and prevalence of dehydration. The Health Care Financing Administration listed dehydration among the 10 most frequent diagnoses in Medicare patients requiring hospitalization in 1991.[1] In data analyzed from the 1991 Medicare Provider Analysis and Review of hospitalized Medicare patients (age 65 and older), 6.7% were admitted with an ICD-9-CM code of 276.50, including 1.4% with dehydration as the principal diagnosis.[1] An observational study of a tertiary teaching hospital's geriatric and rehabilitation unit showed that 16.3% of patients admitted were rated as mildly dehydrated.[2] Bennett et al. reported chronic dehydration in 48% of older adults who visited the emergency department.[3] Since 2001, annual hospitalizations for dehydration have reportedly exceeded one-half million per year.[4]

Patients can present with dehydration or it may also develop during hospitalization. A three-year investigation of hospitalized veterans reported that 3.5% developed dehydration during their hospital stay.[5] A comparison of the admission characteristics for those patients versus other inpatients revealed that those who became clinically dehydrated had greater weakness, less independence, more frequent NPO status, higher probability of receiving hyperosmotic laxatives and IV fluids, and an overall lower BMI. Additional admission characteristics identified for patients who developed volume depletion dehydration (276.50) included difficulties with bowel movements (diarrhea or constipation), altered urinary frequency (increased or decreased), edema, the need for eating assistance, vomiting, receiving stool softeners, and elevated blood chemistries—specifically, BUN, creatinine and glucose levels. Overall mortality rates at 30 days and 6 months post discharge were significantly higher—about double—for those patients who developed dehydration during their hospital stay compared to those who did not: 13.8% vs. 6.0% and

29.3% vs. 14.7%, respectively.

Dehydration causes both morbidity and mortality. Dehydrated patients are at risk for pressure ulcers, constipation, urinary tract infections, respiratory infections, medication toxicities, and falls. One analysis of nursing home residents who became dehydrated showed a 43% increased risk of developing pressure ulcers.[6] If dehydration is allowed to progress, patients can become delirious, develop renal failure and succumb to coma and death. The mortality rate of Medicare patients 65 years and older with volume depletion (276.5) listed as their principal diagnosis was 17.4% within 30 days after hospitalization and 48% within one year of hospitalization.[1]

Cost of Dehydration

Based on the data from the 1996 National Hospital Discharge Survey and the National Center for Health Statistics, Kayser-Jones et al. estimated the cost for hospitalizations with a principal diagnosis of dehydration at $1.36 billion.[7] A retrospective analysis of the 1999 national database of hospital charges provided by the Healthcare Cost and Utilization Project (HCUP) NIS estimated the potential cost savings of avoidable hospitalizations for dehydration in the elderly population to be $1.4 billion.[8] Additional costs also can be incurred for treating clinical conditions that result from dehydration—including fractures from falls, pressure ulcers, urinary and respiratory infections and medication toxicities. The 2002 price tag for treating pressure ulcers in the United States was $1.3 billion.[6]

Dehydration Risk in the Tube-fed Patient

Tube-fed patients are at risk for dehydration because water is administered by prescription, which depends on the prescribers' and caregivers' knowledge and degree of monitoring.

One investigation by Leibovitz et al. reported that 18% of elderly tube-fed patients in a long-term care facility had ≥ 4 dehydration markers.[9] That patient population is particularly at risk for dehydration because of body composition changes. Their decreased lean-body mass results in lower total body water and less water reserve. In addition, the elderly may have reduced kidney function, altered sense of thirst, diminished cognition, dysphagia, dysgeusia, hyposmia, chronic disease, limitations in function, impairment of hormonal modulators of sodium and water balance (lowered aldosterone secretion, vasopressin release and renin activity), and adverse drug reactions that can lead to dehydration.[8,10] Tube-fed patients with similar characteristics are also at higher risk for dehydration. Because water is dispensed via prescription for tube-fed patients, it is important to understand what constitutes adequate hydration, the best way to deliver it, and how to keep feeding tubes patent so that nutrition and hydration are not jeopardized.

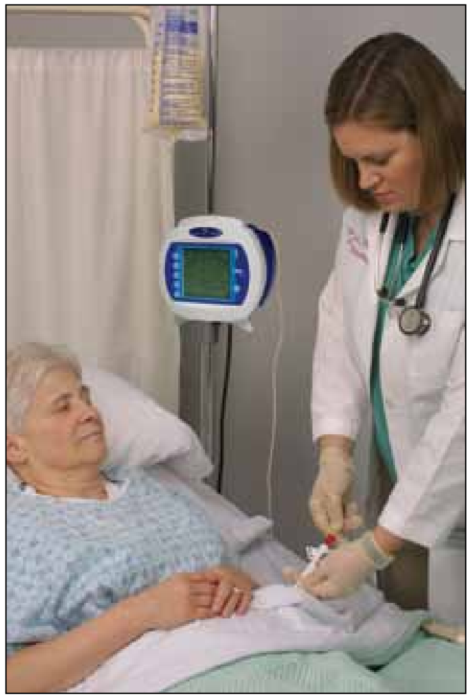

Figure 1. Kangaroo ePump® (Covidien, mansfield MA)

Tube Feeding/Fluid Delivery Methods

There are several different ways to deliver fluids to patients. Choices depend on whether a feeding is intermittent or continuous drip, and on institution policy and patient preference (if in the home setting). Water flushes are usually given after tube-feeding delivery or periodically during continuous-drip feedings to clear tubing of the feeding formula; similarly, flushes are given before and after medication delivery.

Syringe method

The simplest method to deliver water is to use a large (60-mL) syringe, either drawing up the water into the syringe and instilling it into the tube; or removing the plunger of the syringe, attaching it to the tube, and holding it up to allow the water to free-flow in by gravity. Manufacturers of feeding tubes have added a Y-port feature for medication delivery and water flushes, to obviate the need to disconnect tubing during continuous feeding schedules. This feature may decrease formula contamination and save nursing time.[11]

Enteral feeding bag

Enteral feeding bags are manufactured specifically for tube-feeding delivery and are suspended on an IV pole. Water can be poured into the bag and infused into the tube either by free flow, roller-clamp flow adjustment, or enteral pump delivery. To minimize bacterial contamination, these bags need to be discarded after 24 hours.[12]

Automatic flush bags & pumps

Automatic flush bags are separate items manufactured as part of an enteral pump delivery system and are suspended on an IV pole.[13] The bag is filled with water and hangs along side of the feeding bag. The pump is programmed to deliver water flushes periodically (See Figure 1). Some pumps deliver small, regulated water flushes to prevent tube clogging. Other pumps can be adjusted to deliver a patient's fluid requirements in addition to preventing tube clogging. Automatic flush pumps are proven to be more effective than manual flushing for patients requiring continuous enteral feeding, and several clinical trials have found less tube clogging with the automatic flush pump compared to manual flushing. Automatic flush systems are designed to prevent tube clogging and can provide up to hourly water flushes to help meet daily fluid requirements. The four automatic flush pumps currently on the market are the Kangaroo™ ePump® enteral feeding pump and Kangaroo™ Joey™ enteral feeding pump (Covidien; Mansfield, MA), Dual Flo (Nestle), and the Flexiflo® Quantum Pump (Ross Laboratories, Columbus, OH).[14]

Even though flush bags add cost and require two delivery bags, they may actually be more cost-effective. Automatic flush bags (pumps) save nursing time, prevent a missed water flush (lowering tube clogging and patient dehydration risk), likely decrease contamination risk because of less manipulation of the enteral delivery system, and decrease disturbances to patients who may require rest.

Allowing dehydration

In terminally ill patients who are unable to consume adequate fluids or tolerate the full fluid requirement with tube feeding administration, treatment beyond the gentle offering of beverages, water flushes, and good oral care should be carefully reviewed. Fluid options should be individually crafted, considering the potential risks and benefits of fluid replacement, risks of dehydration and the patients' and families' wishes. Some untoward effects of enteral fluid administration in the terminally ill are pulmonary congestion and gastrointestinal intolerance, such as nausea, emesis, cramping and diarrhea. Many individuals at the end of life do not experience hunger or thirst.

Tube Clogging

Causes of Tube Clogging

Feeding tubes can clog due to many reasons; eight are described in the following paragraphs. The risk for clogging varies with the type of the feeding tube, the material from which it is made, the tube tip location (gastric vs. small bowel), flushing agents and methods, formula composition, infusion rates, as well as techniques for making residual checks and administering medication.

Longer feeding tubes with smaller Fr sizes, such as nasogastric or jejunal tubes, have a higher risk of clogging compared to shorter tubes with larger Fr sizes, such as gastrostomy tubes.

Silicone tubes have been shown to clog more readily than polyurethane tubes.[15,16]

Acids denature and coagulate formula proteins, forming clogs.[17,18] Therefore, tubes with tips placed in the highly acidic environment of the stomach may clog more readily than those positioned in the more neutral pH environment of the small bowel.19 Tubes with more than one exit hole clog more readily, possibly due to increased contact of the feeding formula with gastric acid.[18] The technique of pulling gastric juices into small-bore feeding tubes for gastric residual volume (GRV) checks has been shown to increase clogging even when a 10-mL water flush is provided before and after.[20] Patients receiving medications that buffer or block gastric acid may not have the added tube clogging risk during GRV checks.

Acidic solutions used for tube flushing, such as various sodas and juices, promote clogging.[15,21,22]

Slow feeding infusion rates and highly viscous formulas are prone to cause tube clogging. Nutritional formulas are suspensions, and some particles—including soy protein, calcium caseinate, fiber, and sodium—will settle out if left static.

> Automatic flush pumps are proven to be more effective than manual flushing for patients requiring continuous enteral feeding, and several clinical trials have found less tube clogging with the automatic flush pump compared to manual flushing.

Medications can interact with formula or each other and form clogs.

In addition, medications that are not in liquid form or are not fully dissolved in water can create clogs that are difficult to dissolve.

Finally, significant contamination of the formula (bacterial counts of 107 cfu/mL) can cause clogging.[12]

Incidence of Tube Clogging

The incidence of tube clogging is hard to pin down, given the myriad variables associated with feeding tubes themselves, as well as the formulas and medications delivered via those tubes and their administration protocols. For example, an early investigation of hospitalized patients who utilized 8-Fr, nasally-inserted polyurethane gastric feeding tubes (76 cm) with multiple exit ports noted a clogging rate of only 2.6%.[23] But, in another investigation of 8-Fr feeding tubes with multiple exit holes, tubes clogged in 35% of the patients—with 3x the incidence of clogs in gastric tubes as compared to small-bowel tubes.[24] In addition, almost half of the patients who received crushed medications through their tubes experienced clogging.

Pancorbo-Hidalgo reported a 12.5% incidence of clogging of 10–12-Fr feeding tubes with a protocol that required a 30-mL water flush after formula and medication delivery.[25] No difference was reported in clogging rates between gastric and small-bowel tubes, and the clogging rate for patients who received crushed medications versus those who did not was statistically insignificant.

A study of 8-Fr small-bowel feeding tubes with multiple exit holes reported an overall clogging rate of 24%, with no statistical difference among the three tube lengths (105, 125, 145 cm) used.[26] Medications were delivered in 42% of the tubes, but only one of these tubes clogged (5% clogging rate).

In a study that compared protocols of using a 50-mL water flush every 4 hours versus the same water flush followed by a 5-mL suspension of pancreatic enzymes as a lock for long-term (gastrostomy, jejunostomy) and short-term (nasally placed) feeding tubes, the incidence of clogging was 23.5% in the water protocol group, compared to 2.6% in the pancreatic enzymes group.[27] The numbers in each group were too small to determine clogging rates according to tube types. There was no difference in clogging rates between gastric and small-bowel tubes or tubes used for crushed medications.

In summary, the literature identifies tube clogging as a significant problem that requires the attention of those caring for tube-fed patients. No single risk factor stands out as the most frequent cause for tube clogging; therefore, all risk factors need to be addressed to minimize clogging.

Risks and costs associated with clogs

The impact of a clogged tube on a patient's ability to receive adequate nutrition and hydration depends on the length of time it takes to resolve the clog or replace the feeding tube. Tube feedings and water flushes are usually resumed at the same infusion rate after the problem is solved, and many times no attempt is made to compensate for the fluid volume lost. The temporary lack of nutrition may not be clinically significant if it is resolved within hours or if the patient can consume small amounts of food and liquid. However, patients can quickly develop dehydration if daily fluid needs are not met, and medication delivery can also be delayed. Malnutrition can occur if tube clogging occurs repeatedly.

Moreover, if a tube cannot be declogged, a new tube must be inserted. This carries considerable risks, the most serious being malposition (e.g., lung placement with potential pneumothorax, esophageal perforation, intracranial malplacement). In an investigation of all small-bore feeding tubes placed during 2005 at a major tertiary referral hospital, respiratory tree misplacement occurred in 3.2% of patients.[28] A total of 1.2% patients had a pneumothorax, and 0.5% died. Patient discomfort and the additional radiographic procedures needed to confirm tube position also cannot be discounted. This same investigation found that, on average, 1.5 radiographic films per tube and 3.7 per patient were required for every feeding tube placement, showing that it was not uncommon to have to reposition a feeding tube.

Replacement of a feeding tube increases patient and hospital costs. Costs include the material cost of the new tube, labor costs of the bedside nurse for tube replacement, and the cost of the radiographic film needed to confirm placement. A representative estimate by the author is $30 (feeding tube) + $21 (30 minutes /average ICU nurse annual salary of $65,000 + 33% overhead) + $40 (radiographic film) = $91. These costs may vary by institution. Costs are higher for the replacement of a jejunal tube, as it requires transport to radiology and fluoroscopic confirmation of tube placement.

Preventative Strategies for Maintaining Tube Patency

For enteral feeding tube flushes, no solution has been found to be superior to water in its effectiveness, accessibility and cost.[29] In the hospital setting, sterile water is recommended, as nosocomial infections have resulted from contaminated tap water supply given to critically ill, immunocompromised patients.[30-36] In the home setting, either tap water or bottled water is generally used for water flushes.

Formula contamination must be minimized to prevent clog formation from formula coagulation. Adult liquid formulas are available in closed-system containers, bottles, Brik Paks or cans that have undergone heat sterilization during processing. It is recommended that the water be administered as separate flushes instead of being added directly to the tube feeding formula. This will decrease the risk of contaminating the formula. Cans should be wiped down with isopropyl alcohol and allowed to air dry prior to use.[37]

Automatic water flush pumps aid this process by providing periodic flushes as frequently as every 1–2 hours.

Powdered formulas do not require sterilization during manufacturing, so they may be contaminated. To minimize further contamination, trained individuals with good hand hygiene and aseptic technique should reconstitute the formulas in a clean environment, using sterile water.[38-40] Manufacturer-recommended formula hang times must be followed to prevent bacterial growth.

The hubs of feeding tubes have been shown to harbor enteric bacteria that appear to have migrated from GRV and tube patency checks and further contaminated the extraluminal portion of enteral delivery sets.[41] Thus, it is important to wash hands and don clean gloves when handling enteral delivery sets and administering enteral feedings. The same practice applies when moving from a "dirty procedure" (GRV checks) to a "clean procedure" (tube-feeding administration).

According to the 2009 Enteral Nutrition Practice Recommendations published by the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N), feeding tubes in adult patients should be flushed with 30 mL water every 4 hours during continuous feeding, before and after intermittent feedings, and after residual volume checks.[37] Automatic water flush pumps aid this process by providing periodic flushes as frequently as every 1–2 hours. In addition, the A.S.P.E.N. recommendations advise that sterile water be used before and after each individual medication administration.

If formula infusion rates are slow, a pump should be used, and pump occlusion alarms should receive prompt attention. Fiber formulas should be shaken vigorously for 5 seconds to disperse any settled fiber back into the suspension. Bulk-forming agents or thick syrups should be avoided.

Medications may be delivered via feeding tubes but should be converted to liquid form when possible to avoid tube clogging. If a liquid form is not available, some medications can be crushed to a fine powder with enough water added to dissolve them. A mortar and pestle or a tablet-crushing syringe called the PillCrusher™ (Peak Medical; Kingston, Tasmania) can facilitate this process. The PillCrusher syringe can crush the tablet (with its corrugated plunger), draw up water and instill the diluted medication—all from one syringe. Other devices on the market are made to crush, grind or pulverize tablets. NOTE: Sustained-release, enteric-coated or microencapsulated medications should not be crushed and administered through feeding tubes because this alters the medication's bioavailability.

Before any medication is delivered through a feeding tube, the clinician must note the location of the tube tip in the GI tract to be sure that it is the appropriate site for drug action and absorption. Medications should not be mixed together nor allowed to mix with the tube-feeding formula, or a clog may form. In addition, mixing medications together or with formula can negate the therapeutic effect of the medications.

Tube Declogging Techniques

When an occlusion alarm sounds on an enteral pump or if a tube is found to be clogged when attempting a flush and the tube is not kinked, the declogging process should begin. The longer a clogged tube is allowed to remain untreated, the more difficult it is to resolve the clog.[42] It may be prudent to even begin the declogging process as soon as a tube becomes sluggish. The tube declogging process would also be expedited if it was established as a nursing policy rather than a physician order.

Warm-water flush

Initially a flush syringe should be attached to the tube and the plunger pulled back to attempt to dislodge and aspirate the clog and as much fluid as possible. Then the flush syringe should be filled with warm water and reattached to the tube to attempt a flush. If resistance is met, the plunger may be moved back and forth gently to help loosen the clog then left in place to allow the warm water to penetrate the clog. Water alone may be effective in dislodging a clog.[43] Milking the tube with the fingers from the insertion site outward has also been advocated.[44] If resistance continues, a declogging solution using activated pancreatic enzymes may be tried using the same technique. When a clog is dislodged, it should be aspirated and discarded, followed by a warm-water flush.

In one study, water was able to clear 27% of occluded small-bore feeding tubes.[19] In the remaining tubes, activated pancreatic enzyme was effective 72% of the time in relieving the obstruction. In the clogged tubes that remained, the majority had clogs due to tablet impaction, food particles, tube knotting, or a 24-hour formula clog that necessitated tube removal. Of note, Marcuard's investigation used a Drum cartridge catheter (Abbott Laboratories; North Chicago, IL) inserted into the feeding tube to gain closer proximity to the site of occlusion.

Pancreatic enzyme declogging solution

Until recently, a mixture of dissolved pancreatic enzyme, Viokase (Axcan Pharma; Birmingham, AL) and sodium bicarbonate activator was advocated as an inexpensive, declogging solution.[24] However, Viokase, the only non-enteric coated pancreatic enzyme, was recently removed from the market.[45] Instead, an enteric-coated pancreatic enzyme can be used, which requires a waiting period for the enzyme to dissolve.[43]

Procedure for tube declogging using warm water, followed by a declogging solution

1. With a 30–60 mL irrigation syringe, aspirate as much liquid as possible from the feeding tube and discard the fluid.
2. Instill 5–10 mL of warm water with that same syringe under manual pressure for 1 minute, using a back-and-forth motion to help dislodge the clog.
3. Clamp the tube for 5–15 minutes.
4. Try to aspirate and flush with warm water.
5. If tube remains clogged, repeat the above procedure with the following solution:
6. Dissolve 1 crushed non-enteric coated sodium bicarbonate tablet (650 mg) or 1/4 tsp baking soda in 10 mL water.
7. Open one pancrelipase (Creon) 12,000-unit capsule and empty granules into the water/bicarbonate mix and allow to dissolve (10–15 minutes).
8. Instill solution into feeding tube and clamp for 30–60 minutes.
9. Try to aspirate and flush with warm water.
10. If tube remains clogged, repeat once.
11. If tube remains clogged, notify provider to replace tube.

Manufactured declogging kit

A declogging kit called the Clog-Zapper™ (Corpak Medsystems; Wheeling, IL) contains a syringe preloaded with a powder of papain, cellulose and amylase enzymes, which can break down protein, fiber and starch clogs, respectively. The powder is activated by pulling water into the syringe. An elongated hollow catheter is attached to the syringe so that the declogging solution is delivered in closer proximity to the clog and left clamped for 30–60 minutes. After the dwell, the tube is unclamped and a flush is attempted. If the tube is still clogged, this may be repeated with the remaining solution in the syringe. This procedure was used in patients with 10–12-Fr nasogastric or jejunostomy tubes, 84–109 cm in length, receiving polymeric tube feedings (no tube-delivered medications).[46] Fifteen of 17 tubes were successfully declogged on the first try; the remaining two were declogged on the second try, obviating the need for any tube reinsertions. The average declog time was 29.4 minutes. Even though this kit is more costly than mixing your own solution, it saves nursing time, is less messy, and may be more successful at declogging because the clog can be worked on more quickly.

Manufactured mechanical declogging devices for larger tubes

Several declogging devices contain either a plastic corkscrew tip or cleaning brush with a hub that allows for injection of cleaning solution. Such devices can be inserted into gastrostomy or jejunostomy tubes to mechanically dislodge clogs by using a twisting motion. They come in various Fr sizes, need to be premeasured so they do not exceed tube length, and should only be used by experienced clinicians, to avoid tube perforation and mucosal damage. They are not designed for small-bore feeding tubes. (Declogger®: Bionix Medical Technologies, Toledo, OH; Bard PEG Cleaning Brush: Bard Interventional Products, Billerica, MA).

In the 1997 Sriram study already mentioned, a prophylactic lock of pancreatic enzymes instilled in between intermittent feedings greatly decreased the occlusion rate.[27] However, a recent *in vitro* investigation revealed internal surface damage to polyurethane feeding tubes after 7 days of continuous contact with a pancreatic enzyme/sodium bicarbonate solution.[47] If sludge buildup becomes an ongoing issue, it may be prudent to instill a declogging solution for 30 minutes weekly to clear the internal lumen, but a declogging solution should not be a continuous indwell.

How to Assess Dehydration

The mechanics of maintaining feeding-tube patency and declogging tubes are fairly straightforward. Assessing a patient for dehydration is not. However, it is an important clinical skill that must be honed, especially if you care for patients on tube feedings.

Clinical Assessment of Dehydration

No single, widely accepted standard or laboratory method exists for clinical dehydration assessment.[2,48] Clinicians must look for multiple signs and symptoms of dehydration. Early signs include dry mouth and eyes, and dark urine with a strong odor. Clinical findings may reveal

- Hypotension
- A drop in systolic blood pressure of 20 mm Hg or more on standing
- A rapid pulse rate

Blood and urine tests typically reveal the following:

- Elevated blood urea nitrogen (BUN), plasma osmolality and hematocrit levels
- BUN rises disproportionately to creatinine; a normal BUN:creatinine ratio is 20:1.
- Serum sodium may be high, low or normal, depending on the etiology of dehydration.
- Elevated urine specific gravity (SG > 1.028), paired with low urine output (Typical SG measurements are 1.010 to 1.025.) If quantitative measurement is not feasible, urine color, using a standardized color reference chart is comparable to urine specific gravity and osmolality results.[49,50] Tube-fed

home-care patients can aim for urine that is pale yellow or straw colored.

Additional symptoms may include

- Thirst
- Light-headedness (especially when standing)
- Headache
- Fatigue
- Loss of appetite
- Flushed skin
- Heat intolerance

One study identified tongue dryness as a simple, quick, reliable, cost-effective way to identify dehydration risk in the elderly.[51] However, use of diuretics and anticholinergics can cause dryness of the oral mucosa in the absence of dehydration. In contrast, moist mucus membranes without tongue furrows are reportedly the strongest physical sign against dehydration.[52] Evidence of advanced dehydration includes dysphagia, clumsiness, poor skin turgor (more than 2 seconds at the sternum), sunken eyes with dim vision, painful urination, muscle cramps, and/or delirium.

Intake and Output Assessment

In hospitalized patients at risk for dehydration, daily weighing and strict intake and output measurements are useful for tracking fluid status. The minimum urine output required to remove waste is 700 mL per day or 30 mL per hour. Urine output > 1 mL/kg/hour is a useful guideline for adequate urine output in adults, with the typical range being 0.5–2.0 mL/kg/hour or 40–140 mL per hour.[53] When comparing daily weight changes to intake and output totals, it is useful to know that 1 L of fluid difference equates to a 1-kg weight change; or, similarly, a difference of 2 cups of fluid equates to a 1-lb weight change.

In the euvolemic patient, the beginnings of dehydration can be detected when total fluid output exceeds total fluid intake by more than 800 to 1000 mL daily (insensible losses), with concurrent weight loss. Insensible fluid losses are those that are not usually measurable; under normal circumstances, they mostly come from the lungs, with about 200 mL contributed from stool. Total fluid output must include diarrhea, paracentesis losses, drains, and nasogastric, fistula and ostomy output measurements. If a fluid-overloaded patient is being diuresed, then higher outputs with concurrent weight loss are expected, even with fluid restriction. In this scenario, the clinician needs to track the point at which the patient becomes euvolemic (loss of edema) and begin to provide adequate fluids to prevent dehydration.

Dehydration prevention

The AHRQ (Agency for Healthcare Research and Quality) tracks quality measures in health care systems and identifies conditions that are "potentially avoidable hospitalizations." Among them are dehydration, which AHRQ considers an acute, but preventable and reversible condition, given the right patient care. Indeed, in 2007, dehydration was listed as one of 16 PQIs (prevention quality indicators).

Clinicians need to monitor closely and provide early intervention for those at risk for dehydration, including the elderly, very young children, patients with serious comorbidities, and all patients fed by tube. Most tube-fed patients, except those who can drink some fluids or those who require strict fluid restriction, need more water than what is provided with liquid enteral formulas, which are approximately 67–87% water (161–208 mL water per 8-oz. can) and 13–33% solids (macro- and micro-nutrients). The more calorically dense formulas have less water volume. A formula's water content is not usually reported on its label but can be obtained from written manufacturer's materials.

After accounting for the water in the formula, the patient's remaining fluid needs are usually provided with water flushes unless the patient can consume some oral fluids. Water flushes are usually administered during or after feedings and around medication delivery. Patients with renal failure, cardiac insufficiency or pulmonary diseases may require fluid restriction; while those with diarrhea, large draining wounds, excessive diaphoresis, constant drooling, paracentesis losses, drains or high nasogastric, fistula and ostomy outputs require additional replacement fluids. Lactation also requires replacement fluid. Measuring these outputs would give useful information for replacement, although this is not always possible. Fluid loss from wounds may be measured by weighing dressings before and after placement. Excessive diaphoresis or fluid loss from wounds that soak bed linens to the point where they require changing is usually equal to at least 1 liter of fluid.[53] Significant amounts of electrolytes, minerals or proteins may be lost with some of these outputs and require replacement, along with water. Once a plan for tube feeding and water flushes is initiated, the patient needs continuous monitoring for clinical response to be sure that adequate fluid status is being maintained.

With more care shifting from the hospital to the home, patients and their significant others need to be educated on how to maintain adequate orally or tube-administered fluids at all times and how to increase fluid intake in cases of fever (increase fluid intake by 12% per 1°C above 37.8°C),[54] diarrhea, hyperglycemia, warm environments and missed feedings. They also need to be educated on the signs and symptoms of dehydration so they can treat it early. Occasionally, the administration of total fluid needs via the GI tract is not possible due to unremitting emesis or the need to replace high nasogastric, fistula, ostomy, drainage tube or diarrheal losses. In these instances, a clinician may need to initiate intravenous fluid therapy.

Fluid Calculations

The percentage of body weight that is water varies proportionally with lean body mass. (Water is contained in lean body mass, not fat.) As an individual gains fat, the % body weight that is water decreases. Also, as lean body mass decreases with age, the % of water body weight also decreases. Body weight is an important factor in calculating an adult's fluid requirements, and several equations can be used for that purpose. A simplistic equation is 1 mL water per Kcal required, but this can underestimate fluid needs.[7,55] See articles by Kayser-Jones[7], Chidester,[55] Holliday,[56] and Whitmere,[57] for more accurate calculation methods.

Conclusion

Delivery of manual- or automatic-pump water flushes at set intervals during or after feedings and around medication delivery offer the best method for keeping feeding tubes patent. The prevention of clogged tubes is key; but when clogging occurs, appropriate action needs to be taken quickly to prevent the clog from worsening and potentially disrupting patient delivery of needed nutrition, fluids and medications. Hydration status in tube-fed patients can usually be maintained without hospitalization, if monitored appropriately and on an ongoing basis. If hydration status is neglected, it can become life threatening. When a patient is hospitalized with dehydration, this should be considered a marker for an increased risk of death within the following year. It takes vigilant, educated clinicians and caregivers to ensure that tube-fed individuals are receiving adequate fluid and care is taken to maintain tube patency.

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2. List the strategies to keep feeding tubes patent and the methods that have been shown to successfully declog tubes.
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7. The fee has been waived through an educational grant from Covidien. Nursing Care Division.
8. Answer forms must be postmarked by Aug.15, 2013 (Nurses) Sept. 30, 2014 (Dietitians).
9. Faculty disclosure: No conflicts were disclosed.
10. No off-label products were mentioned in this program.

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We welcome opinions and subscription requests from our readers. Please direct your correspondence to:
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1. Which of the following statements is true regarding dehydration?

a. Sodium losses are always greater than water losses resulting in hyponatremia
b. Water losses are always greater than sodium losses resulting in hypernatremia
c. Water is lost without any changes in serum sodium
d. Water is lost and serum sodium can be normal, elevated, or low

2. Why are tube fed patients at risk for dehydration?

a. The fluid administered via the tube is a prescribed order and requires careful monitoring of knowledgeable caregivers
b. Tube feeding formulas provide patients' total fluid needs so when formulas are held, dehydration occurs
c. Tube fed patients lose their sense of thirst when tube feedings are initiated
d. Tube fed patients' body compositions are altered and total body water decreases

3. An investigation of hospitalized veterans reported the following admission characteristics for those patients that ended up dehydrated during their hospital stay:

a. Weakness, less independent, lower BMI, receiving hyperosmotic laxatives
b. Obese, hypertension, elevated blood sugar and edematous
c. Anorexia, middle aged, alcoholism, disabled, low income
d. Independent, feeds self, alert and oriented, normal bowel movements and urination

4. In this same investigation, what was the risk of death at 30 days and 6 months post discharge for the patients who developed dehydration during their hospital stay compared to those who did not?

a. No difference
b. About 25% higher
c. About 100% higher
d. About 50% higher

5. Which of the following is a clinical sign of dehydration?

a. Hunger
b. Pale yellow urine
c. Lightheadednesss
d. Shivering

6. Which of the following is a lab value change indicating dehydration?

a. Elevated blood urea nitrogen
b. Elevated blood glucose
c. Low urine specific gravity
d. Low serum osmolality

7. When obtaining daily weights to help determine a patient's fluid status, each kilogram weight change equals

a. 1 pound of fluid
b. 1 liter of fluid
c. 2 cups of fluid
d. 2 liters of fluid

8. Which of the following would be an appropriate daily fluid requirement for a healthy 75 year old patient weighing 70 kg?

a. 2100 – 2250 mL
b. 1200 – 1350 mL
c. 1600 – 1750 mL
d. 2500 -2650 mL

9. Feeding tubes have been shown to clog more frequently when the feeding formula is exposed to

a. activated pancreatic enzymes
b. warm water
c. a pH neutral environment
d. an acid environment

10. What is the most serious risk of a feeding tube insertion?

a. Malposition
b. Radiation exposure
c. Infection
d. Clog formation

What is the highest degree you have earned (circle one) ? 1. Diploma 2. Associate 3. Bachelor's 4. Master's 5. Doctorate

Indicate to what degree did this program meet the objectives: Using 1 = stongly disagree to 6 = strongly agree rating scale, please circle the number that best reflects the extent of your agreement to each statement.

At the end of the session the participant will be able to:

	Strongly Disagree					Strongly Agree
1. Describe fluid requirements for tube fed patients and identify those at risk for dehydration	1	2	3	4	5	6
2. List the strategies for keep feeding tubes patent and the methods that have been shown to successfully declog tubes.	1	2	3	4	5	6
3. Discuss the role of automated flush pumps on nursing time and patient safety	1	2	3	4	5	6

Name & Credentials ______________________
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Mark your answers with an X in the box identifying the correct answer(s).

	A	B	C	D		A	B	C	D
1	☐	☐	☐	☐	9	☐	☐	☐	☐
2	☐	☐	☐	☐	10	☐	☐	☐	☐
3	☐	☐	☐	☐	11	☐	☐	☐	☐
4	☐	☐	☐	☐	12	☐	☐	☐	☐
5	☐	☐	☐	☐	13	☐	☐	☐	☐
6	☐	☐	☐	☐	14	☐	☐	☐	☐
7	☐	☐	☐	☐	15	☐	☐	☐	☐
8	☐	☐	☐	☐	16	☐	☐	☐	☐

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