Hydration Management

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Grading Scheme

This guideline was developed from a systematic review and synthesis of current evidence on hydration management for residents in long-term care facilities. The research findings and other evidence, such as guidelines and standards from professional organizations, case reports and expert opinion were critiqued, analyzed and used as supporting evidence.

The practice recommendations are assigned an evidence grade based upon the type and strength of evidence from research and other literature.

Scheme for Grading the Strength & Consistency of Evidence in the Guideline

A1	=	Evidence from well-designed meta-analysis or well-done systematic review with results that consistently support a specific action (e.g., assessment, intervention, or treatment)
A2	=	Evidence from one or more randomized controlled trials with consistent result
B1	=	Evidence from high quality Evidence-Based practice guideline
B2	=	Evidence from one or more quasi experimental studies with consistent results
C1	=	Evidence from observational studies with consistent results (e.g., correlational, descriptive studies, qualitative)
C2	=	Inconsistent evidence from observational studies or controlled trials
D	=	Evidence from expert opinion, multiple case reports, or national consensus reports

Purpose

The purpose of this evidence-based protocol is to help health care providers in all settings determine adequate oral fluid intake for elders and to use strategies that will improve and maintain hydration. The need for implementation of the protocol is supported by a prevalence of inadequate intake of residents of long term care facilities that has ranged from 50 to 68% (Chidester & Spangler, 1997; Holben, Hassell, Williams, & Helle, 1999; Gaspar, 2011; Marra et al., 2016). Use of this protocol will help prevent dehydration and associated conditions, such as acute confusion/delirium (Foreman, 1989; Mentes, Culp, Maas, & Rantz, 1999; O'Keefe & Lavan, 1996; Seymour, Henschke, Cape, & Campbell, 1980), adverse drug reactions (Doucet, 2002), infections (Beaujean et al., 1997; Masotti et al., 2000), and increased mortality in general (El-Sharkawy et al., 2015) and specifically associated with bladder cancer, coronary heart disease, and stroke (Chan, Knutsen, Blix, Lee, & Fraser, 2002; Kelly et al., 2004; Michaud et al., 1999; Rasouli, Kiasari, & Arab, 2008; Wakefield, Mentes, Holman, & Culp, 2009; Warren et al., 1994). It is important to address hospitalization and rehospialization of older adults. Dehydration has been associated with longer hospital stays for rehabilitation (Mukand, Cai, Zielinski, Danish, & Berman, 2003), readmission to the hospital (Gordon, An, Hayward, & Williams, 1998) and excess cost of hospitalization (Frangeskou, Lopez-Valcarel, & Serra-Maiem, 2015; Xiao, Barber & Campbell, 2004). Hospitalization costs are even higher when dehydration is a comorbid condition during an older adult's hospitalization (Frangeskou et al., 2015; Mentes & Aronow, 2016). Even in healthy community dwelling elders, physical performance and cognitive processing is affected by mild dehydration (Ainslie et al., 2002). The focus of this protocol is to prevent dehydration through careful assessment, identification of elders at risk for hydration problems, and implementation of individualized nursing interventions based on a risk profile. This guideline does not include interventions for acute/emergent rehydration of elderly individuals.

Overview

Water is an essential component of body composition. Intricate cellular functions, such as gene expression, protein synthesis, and uptake & metabolism of nutrients are affected by hydration status. Organ systems, specifically the cardiovascular and renal systems, are particularly vulnerable to fluctuating levels of hydration (Mentes et al., 1998).

Fluid is found in different compartments in the body. Two basic compartments are the intracellular, or within cell water and extracellular, or water outside of the cells. The extracellular compartment can be further broken down into the interstitial compartment or the water between cells and the intravascular compartment, or fluid in the blood vessels. Of course, when one thinks about where water can be found in the body, it is realized that water serves as a solvent for many essential elements of the body, such as the electrolytes sodium, potassium, and others. Fluid with these elements moves between the compartments in an orchestrated manner--guided by electrochemical forces that are exerted by electrolytes, by large molecules such as glucose, or by the colloidal osmotic pressure of proteins contained in the blood. Cellular factors, such as cell permeability and transport of elements/nutrients across this membrane, also contribute to the pattern of fluid distribution in the body. Therefore, hydration problems rarely involve body water alone, but rather are a water and electrolyte problem (Mentes & Buckwalter, 1997; Mentes, et al., 1998).

Older individuals are at increased risk for hydration problems for a variety of reasons. First, as an individual ages, his/her total body water decreases from 50-70% to 40-50% of body weight. For example, a female weighing 60Kg (132 pounds) at age 35 with 55% or 33 Kg of body weight as water, would have significantly less body weight as water at age 75, assuming that she weighed the same and that only 45% or 27Kg was water (Metheny, 2000). Second, older individuals tend to lose muscle cells, which increases the proportion of fat cells to muscle cells. Fat cells are known to contain less water than muscle cells which decreases overall intracellular fluids (Bossingham, Carnell, & Campbell, 2005; Metheny, 2000). Third, the risk of hydration problems is further increased with another age-related change involving the hormonally regulated thirst mechanism. Although not completely understood, elderly individuals do not experience thirst as intensely as younger individuals do in response to dehydrating conditions (Farrell Zamarripa, Shade et al., 2008; Kenny & Chiu, 2001; Mack et al., 1994; Miescher & Fortney, 1989; Phillips et al., 1984; Phillips, Bretherton, Johnson, & Gray, 1991). Therefore, a major hydration management mechanism is impaired with age. Finally, a myriad of other clinical factors that are more likely to occur as one ages, but are not a direct effect of aging, also contribute to increased risk. These include renal dysfunction/decline, cardiovascular disease, diabetes, multiple medical problems, malnutrition, and medication usage, to name a few.

In concluding this overview, it should be emphasized that this protocol aims to prevent hydration problems by outlining mechanisms for the provision of the appropriate amount of a variety of fluids to keep the aging body in an optimal state of hydration.

Definition of Hydration Management

Hydration management is the promotion of adequate fluid balance that prevents complications resulting from abnormal or undesired fluid levels (See Fluid Management nursing intervention Appendix C).

Definitions of Associated Terms

Terms associated with dehydration are categorized in various ways according to:

i. Sodium concentration (hypernatremic dehydration)
ii. Tonicity or active osmoles of the fluid (hypertonic dehydration)
iii. The fluid compartment affected (intracellular dehydration)

For the purposes of this document, tonicity will be used to categorize the hydration problem. (Weinberg & Minaker, 1995).

Hypotonic Dehydration (*also known as Extracellular Fluid Volume Depletion)* is depletion in both sodium and water with greater losses of sodium than water, resulting in extracellular fluid loss (Leaf, 1984; Mange et al., 1997; Silver, 1990). Causes of hypotonic dehydration include overuse of diuretics, chronic salt wasting renal disease, and decreased intake of both salt and water. Circulation is affected in hypotonic dehydration (Leaf, 1984; Silver, 1990).

Isotonic Dehydration (*also known as Isotonic Fluid Volume Depletion)* is a balanced depletion of water and sodium causing extracellular fluid loss. Causes of isotonic dehydration include vomiting, diarrhea, and the osmotic diuresis of glucose.

Hypertonic Dehydration *(also known as Intracellular Dehydration, Hypernatremic Dehydration)* is depletion in total body water content due to pathologic fluid losses, diminished water intake, or a combination of both (Gross et al., 1992). It results in hypernatremia in the extracellular fluid compartment, which draws water from the intracellular fluids. The water loss is shared by all body fluid compartments, and relatively little reduction in extracellular fluids occurs. Thus, circulation is not compromised unless the loss is large (Leaf, 1984; Mange et al., 1997).

Individuals at Risk for Inadequate Hydration Levels

Risk Factor	References	Overall Evidence Grade
Age Related Physiologic Changes		
Altered thirst perception in older men	Farrell et al., 2008; Mack et al., 1994; Miescher & Fortney, 1989; Phillips et al., 1991; Phillips et al., 1984; Vivanti, Harvey, & Ash, 2010	B
Reduced total body water (TBW) as a portion of body weight related to body composition changes, i.e. higher proportion of fat to muscle	Bossingham et al., 2005; Lavisso-Mourey, Johnson, & Stolley, 1988	C1
Impaired renal conservation of water	Lindeman, Tobin, & Shock, 1985; Rowe, Shock, & DeFronzo, 1976	C1
Decreased effectiveness of vasopressin	Faull, Holmes & Baylis, 1993; O'Neill, Duggan, & Davies, 1997; Phillips, Johnston, & Gray, 1993	B2
Increased prevalence of multiple chronic diseases	Hooper, Bunn, Jimoh, & Fairweather-Tait, 2013; Morgan, Masterson, Falman, Topp, & Boardley, 2003	C1
Poor tolerance for hot weather	Josseran et al., 2009	C1
Factors Identified among Long-term Care Residents		
Individual Characteristics		
Age 85 years of age or older/70 years of age or older	Gaspar, 1999; Lavisso-Mourey, Johnson, & Stolley, 1988; Marra et al., 2016; Murray, Doeltgen, Miller, & Scholten, 2015	C1
Female	Bennett, Thomas, Riegel, 2004; Gaspar, 1988; Lavisso-Mourey, Johnson, & Stolley, 1988; Mentes & IVANRC, 2000; Murray et al., 2015; Stookey, Piper & Cohen, 2005	C1

Continued on next page

Risk Factor	References	Overall Evidence Grade
Individual Characteristics (con't)		
Dependence in ADLs	Marra et al., 2016; Murray et al., 2015	C1
Functionally semi-dependent (e.g., those individuals who are cognitively unaware of their needs yet have mobility, and those who are physically unable to meet their needs but who can express them)	Gaspar, 1988	C1
Functionally more independent	Gaspar, 1999; Mentes & Culp, 2003	C1
Semi-dependent with eating (needing prompting or some assistance but not completely dependent)	Gaspar, 1999	C1
Refuses to drink (e.g., those who are capable of safely consuming liquids but who do not because they worry about incontinence issues [Fears of Incontinence] or because they say that they have never consumed many fluids [Sippers])	Gaspar, 1988; Mentes, 2006	C1
Impaired cognitive ability/Alzheimer's Disease or other dementias	Albert, Nakra, Groseberg, & Caminal, 1989, 1993; Hooper, Bunn, Downing et al., 2016, Marra et al. 2016; Oates & Price, 2017	B2
4 or more chronic conditions	Lavisso-Mourey, Johnson, & Stolley, 1988	C1
> 4 medications	Lavisso-Mourey, Johnson, & Stolley, 1988	C1
Fever	Pals et al., 1995; Weinberg, et al., 1994	C1
Depression and loneliness associated with decreased fluid intake as identified by Nursing Home (NH) Staff	Mentes, Chang, & Morris, 2006	C1
Not experiencing Pain	Rodrigues et al., 2015; Vivanti et al., 2010	C1

Risk Factor	References	Overall Evidence Grade
Ingestion Factors		
Use of thickened liquids	Marra et al., 2016	C1
Use of Oral Nutritional Supplements	Marra et al., 2016	C1
Semi-dependent with eating (needing prompting or some assistance but not completely dependent)	Gaspar, 1999	C1
Refuses to drink (e.g., those who are capable of safely consuming liquids but who do not because they worry about incontinence issues [Fears of Incontinence] or because they say that they have never consumed many fluids [Sippers])	Gaspar, 1988; Mentes, 2006	C1
Few fluid/food ingestion opportunities/missing drinks between meals	Gaspar, 1988, 1999; Hooper, Bunn, Downing et al., 2016	C1
Lack of concern about being well hydrated	Rodrigues et al. 2015; Vivanti et al., 2010	C1
Inadequate nutrient intake	Gaspar, 1999; Hooper, Bunn, Downing, et al., 2016; Marra et al., 2016	C1
Inadequate staff and professional supervision	Himmelstein, Jones, & Woolhandler, 1983; Kayser-Jones, Schell, Porter, Barbaccia, & Shaw, 1999;	C1
Family or caregivers not spending time with patient/not being supportive associated with decreased fluid intake as identified by NH Staff	Mentes et al., 2006	C1

Minimum Data Set for Long-Term Care Settings

MDS 3.0 Comprehensive Assessment for Hydration Issues: Dehydration/Fluid Maintenance

✓	Symptoms of Dehydration	Supporting Documentation *(Basis/reason for checking the item, including the location, date, and source (if applicable) of that information)*
____	Dizziness on sitting or standing	
____	Confusion or change in mental status (delirium) (C1600)	
____	Lethargy	
____	Recent decrease in urine volume or more concentrated urine than usual	
____	Decreased skin turgor, dry mucous membranes	
____	Newly present constipation (H0600), fecal impaction	
____	Fever (J1550A)	
____	Functional decline	
____	Increased risk for falls (J1700)	
____	Fluid and electrolyte disturbance	
✓	Abnormal Laboratory Values *(from clinical record)*	Supporting Documentation
____	Hemoglobin	
____	Hematocrit	
____	Potassium chloride	
____	Sodium	
____	Albumin	
____	Blood urea nitrogen	
____	Urine specific gravity	

Centers for Medicare & Medicaid Services (2016). Long Term Care Facility Resident Assessment Instrument 3.0 Manual Version 1.14. Washington DC: Department of Health & Human Services.

✓	Cognitive, Communication, and Mental Status *(issues that can interfere with intake)*	Supporting Documentation *(Basis/reason for checking the item, including the location, date, and source (if applicable) of that information)*
____	Depression (I5800, D0300, D0600) or anxiety (I5700)	
____	Behavioral disturbance that interferes with intake (E0200 and from clinical record)	
	Recent change in mental status (C1600)	
____	Alzheimer's or other dementia that interferes with eating due to short attention span, resisting assistance, slow eating/drinking, etc. (I4200, I4800)	
____	Difficulty making self-understood (B0700)	
____	Difficulty understanding others (B0800)	
✓	Diseases and Conditions *(that predispose to limitations in maintaining normal fluid balance)*	Supporting Documentation
____	Infection (I1700 – I2500)	
____	Fever (J1550A)	
____	Diabetes (I2900)	
____	Congestive heart failure (I0600)	
____	Swallow problem (K0100)	
____	Renal disease (I1500)	
____	Weight loss (K0300)	
____	Weight gain (K0310)	
____	New cerebrovascular accident (from record)	
____	Unstable acute or chronic condition (from record)	
____	Nausea or vomiting (J1550B)	
____	Diarrhea (from record)	
____	Excessive sweating (from record)	

✓	Diseases and Conditions *(that predispose to limitations in maintaining normal fluid balance)*	Supporting Documentation *(Basis/reason for checking the item, including the location, date, and source (if applicable) of that information)*
____	Recent decline in activities of daily living, including body control or hand control problems, inability to sit up, etc. (observation, interview, clinical record)	
____	Parkinson's or other neurological disease that requires unusually long time to eat (I4200 – I5500)	
____	Abdominal pain, with or without diarrhea, nausea, or vomiting (from record)	
____	Newly taking a diuretic or recent increase in diuretic dose (N0400G) (medication records)	
____	Takes excessive doses of a laxative (from interview, record)	
____	Hot weather (increases risk for elderly in absence of increased fluid intake)	
✓	Oral Intake *(from observation and clinical record)*	Supporting Documentation
____	Recent change in oral intake	
____	Skips meals or consumes less than 25 percent of meals	
____	Fluid restriction	
____	Newly prescribed diet	
____	Decreased perception of thirst	
____	Limited fluid-drinking opportunities	
____	Fluid intake limited to try to control incontinence	
____	Dependence on staff for fluid intake	
____	Excessive output compared to fluid intake	

Centers for Medicare & Medicaid Services (2016). Long Term Care Facility Resident Assessment Instrument 3.0 Manual Version 1.14. Washington DC: Department of Health & Human Services.

Dehydration and Risk of Hospitalization

El-Sharkawy et al. (2014) reported that 37% of older adults are dehydrated on admission to hospital and that 62% are dehydrated at 48 hours following hospitalization. Those dehydrated at the time of hospital admission were 6 times more likely to die in hospital than those who were euhydrated.

Risk Factor	References	Overall Evidence Grade
Age: Individuals 85-99 years of age are at 6 times higher risk for hospitalization due to dehydration than persons 65-69 years.	Warren et al., 1994	C1
Race: Blacks were 1.5-2 times more likely than whites to be hospitalized for dehydration. Blacks more likely to be diagnosed with dehydration vs. whites	Lancaster, Smiciklas-Wright, Heller, Ahern, & Jensen, 2003; Warren et al., 1994	C1
Gender: Within race, men were more likely than women to be hospitalized for dehydration except for white men 65-79 years of age.	Warren et al., 1994	C1
Setting: Those patients admitted to the hospital with hypernatremic dehydration were most frequently from nursing homes	Bennett, Thomas, & Riegel, 2004; Palevsky, Bhagrath, & Greenberg, 1996; Warren et al., 1994; Wolff, Stuckler & McKee, 2015	C1
Medications: thiazide diuretics/ Loop and thiazide diuretics	Lancaster et al., 2003; Wakefield, Mentes, Holman, & Culp, 2008	C1
Emergency Department contact: Females more than males and more likely to present with disorientation	Bennett et al., 2004	C1
Infections		
• Any Infection	Mentes & Aronow, 2016	C1
• Urinary tract infection (24.9%)	Warren et al., 1994	C1
Other associated medical Conditions	Warren et al., 1994	C1
• Respiratory illness (28.2%)		
• Gastroenteritis (10.4%)		
• Frailty (20.3%)		
• Cancer (15.7%)		
• Diabetes (12.0%)		
• Generalized weakness, paraplegia, or hemiplegia (50.6%)	Wakefield et al., 2008	C1
• Vomiting and/or diarrhea	Wakefield et al., 2008	C1

Special Issues in At Risk Elders

Chronically Mentally Ill Patients

Special consideration should be given to chronic mentally ill elders, (e.g., individuals with schizophrenia, bipolar disorder, obsessive-compulsive disorder), as they may be at risk for both over- and under- hydration. Their antipsychotic medications may blunt the thirst response and put older adults at increased risk in hot weather for dehydration and heat stroke (Batscha, 1997 *[Evidence Grade = D]*). In addition, even small increases in their antipsychotic medications may predispose older adults to neuroleptic malignant syndrome (NMS), of which hyperthermia and dehydration are prominent features (Bristow & Kohen, 1996; Jacobs, 1996; Sachdev, Mason, & Hadzi-Pavlovic, 1997 *[Evidence Grade = C1]*). Polyuria due to lithium treatment in community dwelling adults with bipolar disorder may also put them at risk for dehydration and death (Kinahan et al., 2015 *[Evidence Grade = C1]*). In addition, in individuals with persistent mental illness, risks for overhydration stem from a combination of the drying side effects of prescribed psychotropic medications and the individual's compulsive behaviors that result in excessive fluid intake (Cosgray, Davidhizar, Giger, & Kreisl, 1993 *[Evidence Grade = C1]*).

Stroke Patients

There is increasing evidence that dehydration may play an important part in contributing to early cerebral ischemia (Rodriguez et al., 2009 *[Evidence Grade = C1]*) and in the early recovery from stroke (Kelly et al., 2004 *[Evidence Grade = C1]*). In fact, Kelly et al. (2004) found that dehydration in stroke patients was hospital acquired and lead to poorer outcomes for recovering stroke patients. Dehydration, signified by increased serum osmolality, led to a 2.8 to 4.7-fold increase in the risk of hospitalized stroke patients acquiring a venous thromboembolism (VTE). Hospitalized patients recovering from stroke should be carefully and continuously monitored for dehydration. Another sequela of stroke is dysphagia, which can cause dehydration (Murray et al., 2015; Whelan, 2001 *[Evidence Grade = C1]*). This appears to be related not only to the dysphagia resulting from the stroke but also the poor palatability of the thickened fluids offered to patients to prevent aspiration (Lin, Lee, Hung, Chang, & Yang; 2014 *[Evidence Grade = C1]*; McGrail & Kelchner, 2015 *[Evidence Grade = B2]*).

Surgical Patients

Prolonged NPO status prior to elective surgery has been linked to increased risk of dehydration and adverse effects such as, thirst, hunger, irritability, headache, hypovolemia, and hypoglycemia in for surgical patients (Smith, Vallance, & Slater, 1997; Yogendran, Asokumar, Cheng, & Cheng, 1995 *[Evidence Grade = B2]*). Crenshaw and Winslow (2002) have found that despite the formulation of national guidelines developed by the American Society of Anesthesiologists Task Force on Preoperative Fasting *[Evidence Grade = C1]*, patients were still being instructed to fast too long prior to surgery (Crenshaw & Winslow, 2002 *[Evidence Grade = C1]*). In fact, patients may safely consume clear liquids up to 2 hours of elective surgery using general anesthesia, regional anesthesia or sedation-anesthesia (ASA, 2011)

End of Life Patients

Maintaining or withholding fluids at the end of life remains a controversial issue. Proponents suggest that dehydration in the terminally ill patient is not painful and lessens other noxious symptoms of terminal illness, such as excessive pulmonary secretions, nausea, edema, and pain (dehydration acts as a natural anesthetic) (Fainsinger & Bruera, 1997; *[Evidence Grade = D]*). Some suggest additional benefit from the decreased need to get up to use the restroom and receive bed pans or diaper changes, which could be difficult or painful for someone at the end of life (Mion, & O'Connell, 2003; *[Evidence Grade = D]*). Opponents to this position suggest that associated symptoms of dehydration, such as acute confusion/delirium are stressful and reduce the quality of life for the terminally ill elder (Bruera, Belzile, Watanabe, & Fainsinger, 1996 *[Evidence Grade = C1]*).

Most research that has been done with terminally ill cancer patients has examined discomforts of dehydration including thirst, dry mouth, and agitated delirium. However, research has not demonstrated a link between biochemical markers of dehydration and these various symptoms in terminally ill patients (Burge, 1993; Ellershaw, Sutliffe, & Saunders, 1995; Morita, Tei, Tsunoda, Inoue, & Chihara, 2001; *[Evidence Grade = C1]*). It is suggested that several confounding factors influence the uncomfortable dehydration-like symptoms that accompany the end of life. These include use and dosage of opiates, type and location of cancer, hyperosmolality, stomatitis, and oral breathing (Morita et al., 2001; *[Evidence Grade = C1]*). On the other hand, Bruera et al. (1996) has determined that small amounts of fluids delivered subcutaneously via hypodermoclysis plus opioid rotation was effective in decreasing delirium and antipsychotic use and did not cause edema in terminally ill patients *[Evidence Grade = C1]*.

Bruera et al. (2005) also found in a 2 day long pilot study that parenteral hydration in terminally ill cancer patients lead to statistically significant decreases in hallucination, myoclonus, fatigue, and sedation, but in a larger clinical trial, no benefit to parenteral hydration was found for cancer patients in a hospice setting (Bruera et al., 2012; *[Evidence grade=A2]*). Research also suggests that artificial hydration does not prolong life (Bruera et al., 2005; Meier, Ahronheim, Morris, Baskin-Lyons, & Morrison, 2001; Mitchell, Kiely, & Lipsitz, 1997; *[Evidence Grade = B2]*); Bruera et al., 2012; *[Evidence grade=A2]*).

Therefore it is recommended that maintaining or withholding fluids at the end of life be an individual decision that should be based on the etiology of illness, use of medications, presence of delirium and family and patient preferences (Fainsinger & Bruera, 1997; Morita et al., 2001; Schmidlin, 2008; *[Evidence Grade = C1]* and Bruera et al., 2012; *[Evidence grade=A2]*). Schmidlin (2008) and Bruera et al., (2012) recommend early discussions with patients and family on their wishes as well as educating patients on the current knowledge about artificial hydration so that proper, patient-centered care will be provided.

Assessment Criteria

The following screening criteria indicate patients who are likely to benefit the most from use of this protocol:

- All individuals >85 years of age
- Older adults needing services provided by long term care facilities
- Individuals with recent weight loss ≥5% of body weight
- Individuals with feeding/eating/swallowing difficulties
- Individuals with a diagnosis of dementia
- Individuals with congestive heart failure, diabetes and/or renal failure
- Individuals experiencing increased water loss due to diarrhea, vomiting or fever

Essential Areas for Assessment of Hydration Status in Older Adults

(See Appendix A.1 for an example of an assessment form that can be used)

Several areas are essential to assess with regard to the hydration status of older adults. These include a health history, physical assessment, laboratory tests, functional assessment, and individual fluid intake behaviors. A combination of approaches with consideration of the individual's baseline needs to be considered (Armstrong, Kavouras, Walsh, & Roberts, 2016)

Health History

Health history may be obtained through interview or by reviewing the patient's record. It should include: (Lavisso-Mourey et al., 1988; Mentes & Wang 2010; *[Evidence Grade = C1]*).

- Specific disease states: dementia, diabetes, congestive heart failure, chronic renal disease, malnutrition, and psychiatric disorders such as depression, schizophrenia, and bipolar disorder.
- Presence of co-morbidities: > 4 chronic health conditions
- Prescription drugs: number and types
- Past history of: dehydration, overhydration, repeated infection, fatigue

Physical Assessments

Components of physical assessments that are essential to include are*:*

- Vital signs including axillary skin temperature
    - Axillary skin temperature increases of 1 degree C there was a 3.67-fold risk of being classified into the at-risk of dehydration range (serum osmolality levels between 292 and 300 mOsm/kg) (Okuyama & Nishida, 2016 *[Evidence Grade = C1]*).
- Height-Weight
- BMI (Body Mass Index) which can be calculated from height and weight with following formula: weight in kg. divided by height in m^2. BMI <21 or >27 puts an individual at risk (Nutrition Screening Literature, 1992 *[Evidence Grade = D]*). Recent evidence suggests that a lower BMI confers risk (Vivanti, Harvey, Ash, & Battistutta, 2008;

Wakefield et al., 2008, 2009 *[Evidence Grade = C1]*).

- Review of Systems or Head to Toe Assessment--Make sure to include an assessment of the oral cavity, upper body strength and speech (Gross et al., 1992 *[Evidence Grade = C1]*.
- Additional signs of hydration status and the relative strength of each in assessing dehydration are in Table 1.

TABLE 1: RELATIVE STRENGTH OF DIFFERENT SIGNS OF DEHYDRATION IN ELDERS

Parameter	Physical Sign	Supporting Reference	Strength of Indicator
Vital signs	Rapid pulse[1]	[1]Gross et al., 1992, Chassagne, Druesne, Capet, Menard, & Bercoff, 2006	++
	Orthostatic hypotension[2]	[2]Chassagne et al., 2006; Vivanti et al., 2008	+/-
	Low systolic blood pressure[3]	[3]Fortes, et al. 2015	+++
	Axillary temperature[4]	[4]Okuyama & Nishida, 2016	++
Weight	Acute increase		+++
	Acute decrease		+++
Oral mucous membranes	Dry, pale ↓ saliva	Gross et al., 1992, Vivanti et al., 2008 Chassagne et al., 2006	+++
Tongue	Longitudinal furrows	Gross et al., 1992	+++
	Dry	Gross et al., 1992, Vivanti et al., 2010	+++
Sternal Skin Turgor	Decreased	Chassagne et al., 2006; Vivanti et al., 2008	+/-
Eyes	Sunken	Gross et al., 1992	++
Axillary sweat	Decreased	Eaton, Bannister, Mulley, & Connolly, 1994; Kinoshita et al.,2013	+
Speech	Difficulties	Gross et al., 1992	+++
Confusion	Acute onset	Gross et al., 1992	++
Upper body control	Muscle weakness	Gross et al., 1992	++++
Key:	- No Relationship + Little Relationship ++ Some Relationship +++ Moderate Relationship ++++ Strong Relationship		*[Evidence Grade = C1]*

Laboratory Tests

Many laboratory tests can be helpful in assessing hydration status in older adults (See Table 2). It should be noted that the blood tests are better predictors of actual dehydration. Urine tests are better at predicting impending dehydration and identifying those patients at risk for developing dehydration. For both blood and urine tests it is important to obtain a baseline value for comparison and evaluation of significant changes (Armstrong et al., 1994, Armstrong, Herrera Soto, Hacker, Kavouras, & Maresh, 1998 *[Evidence Grade = B2]*; Metheny, 2000; Neelon, personal communication, 1998. *[Evidence Grade = D]*; Mentes, Wakefield, & Culp, 2006; Wakefield, Mentes, Diggelmann, & Culp, 2002) *[Evidence Grade = C1]. It is important to note that urine collected in the afternoon (1600-2000) has been found to best reflect hydration status as measured by urine osmolality among younger adults (Perrier et al., 2013). Time of urine collection has not been tested among older adults but worthy of consideration.*

Saliva analysis for osmolality has been explored and appears promising although no normative values have been established (Fortes et al 2015; Woods & Mentes, 2011; Oliver, Laing, Wilson, Bilzon, & Walsh, 2008; Walsh et al., 2004) *[Evidence Grade = B2]. Among hospitalized adults over the age of 78 years Fortes et al. (2015) found sensitivity and specificity of salivary osmolality with water loss dehydration as 70% and 68% respectively. Salivary osmolality demonstrated 78% sensitivity and 72% specificity for water and solute dehydration.*

Bioelectrical Impedance Analysis has been used to estimate total body water in research studies (Culp et al., 2004 *[Evidence Grade = C1]*). *In a recent Cochrane review for diagnostic accuracy a single measure of bioelectrical impedance with resistance at 50 hx was found to be diagnostic of impending dehydration in two studies and equivocal in two studies (Hooper, Abdelhamid, Attreed et al., 2015)*

TABLE 2: APPROXIMATE RANGES OF LABORATORY TESTS FOR HYDRATION STATUS

Value Ranges for:	Normal	Impending Dehydration	Dehydration
BUN/Creatinine ratio	20-24		> 25
Hematocrit	male 42-52% female 35-47%		> normal > normal
Serum osmolality	<295 mmol/kg	295-300 mmol/Kg	> 300 mmol/kg
Serum sodium	135-145 mEq/L		> 150 mEq/L
Urine osmolality	500-700 mOsm/kg	700-1050 mOsm/kg	> 1050 mOsm/kg
Urine specific gravity	1.005-1.019	1.020-1.029	> 1.029
Urine color	Pale to medium yellow	Dark yellow	Greenish brown
Amount of urine		800-1200 cc/day	< 800 cc/day

When serum osmolality is not available but other routine laboratory tests are accessible the equation that can be used to best reflect serum osmolality is:

$$\text{Osmolarity} = 1.86 \times (Na^{+}+K^{+}) + 1.15 \times \text{glucose} + \text{urea} + 14 \text{ (all measured in mmol/L)}$$

(Hooper, Abdelhamid, & Ali et al., 2015)

Functional Assessments

Cognitive impairments, functional dependence and depression have all been identified as risk factors for dehydration in the elderly (Miller, Perry, & Morley, 1998), therefore the following assessments are recommended:

- Cognitive screening (one of the following): Mini Mental State Exam (MMSE), Short Orientation Memory Test, Short Portable Mental Status Test (SPMSQ), MDS Cognitive Performance Scale, Saint Louis University Mental Status Examination (SLUMS)
- ADLs (one of the following): Katz ADLs, Functional Independence Measure (FIM), ADL section from Resident Assessment Instrument of MDS, Barthel Index
- Mood (one of the following): Geriatric Depression Scale (GDS), Beck Depression Scale,

Cornell Scale for Depression in Dementia

Individual Fluid Intake Behaviors

It is important to assess the individual's usual fluid intake pattern through direct observation, or by interviewing the older adult or a family member who is familiar with the individual's daily pattern. Questions to consider:

- Do they consume most of their fluids during meals?
- At what time of the day do they consume the most fluids?
- What is the actual amount of fluid intake?
- What types of fluids are preferred?

Research has demonstrated that community dwelling older adults consume a greater variety and larger amounts of fluids. The mean amount for community dwelling older adults was 2100 cc/ day (Adams, 1988; de Castro, 1992; *[Evidence Grade = C1]*), but older community dwelling adults >85 years drink significantly less water than young-old adults aged 65-75 and only 19% of the oldest old participants meet their daily adequate intake (AI) (Zizza, Ellison, & Wernette, 2009; Popkin, 2010; *[Evidence Grade = C1]*). The mean amount of fluid consumed in the LTC setting was 1100-1500 cc/day (Adams, 1988, Armstrong-Esther, Browne, Armstrong-Esther, & Sander, 1997; Chidester & Spangler, 1997; Colling, Owen, McDreedy, 1994; O'Neill et al., 1997; *[Evidence Grade = C1]*).

Assess any problematic behaviors associated with fluid intake. These include choking, drooling, spilling, visual impairment, inability to hold a cup independently, or resistance to drinking due to fear of incontinence (Mentes, 2006; Mentes & Wang, 2010; *[Evidence Grade = C1]*).

Description of Intervention

The hydration management intervention is an individualized daily plan to promote adequate hydration based on risk factor identification that is based on a comprehensive assessment. The intervention is divided into three phases:

1. Risk Identification
2. Hydration Management
3. Evaluation

1. RISK IDENTIFICATION

Dehydration Risk Appraisal Checklist

Based on the assessment data, a risk appraisal for hydration problems is completed using the Dehydration Risk Appraisal Checklist (Appendix A.2) revised by Mentes and& Wang (2010) *[Evidence Grade = C1]*. The more of the following risk indicators that are present, the greater the likelihood of dehydration:

Specifically, history of dehydration and difficulty swallowing were risk factors for dehydration (Mentes & Wang, 2010; *[Evidence Grade = C1]*).

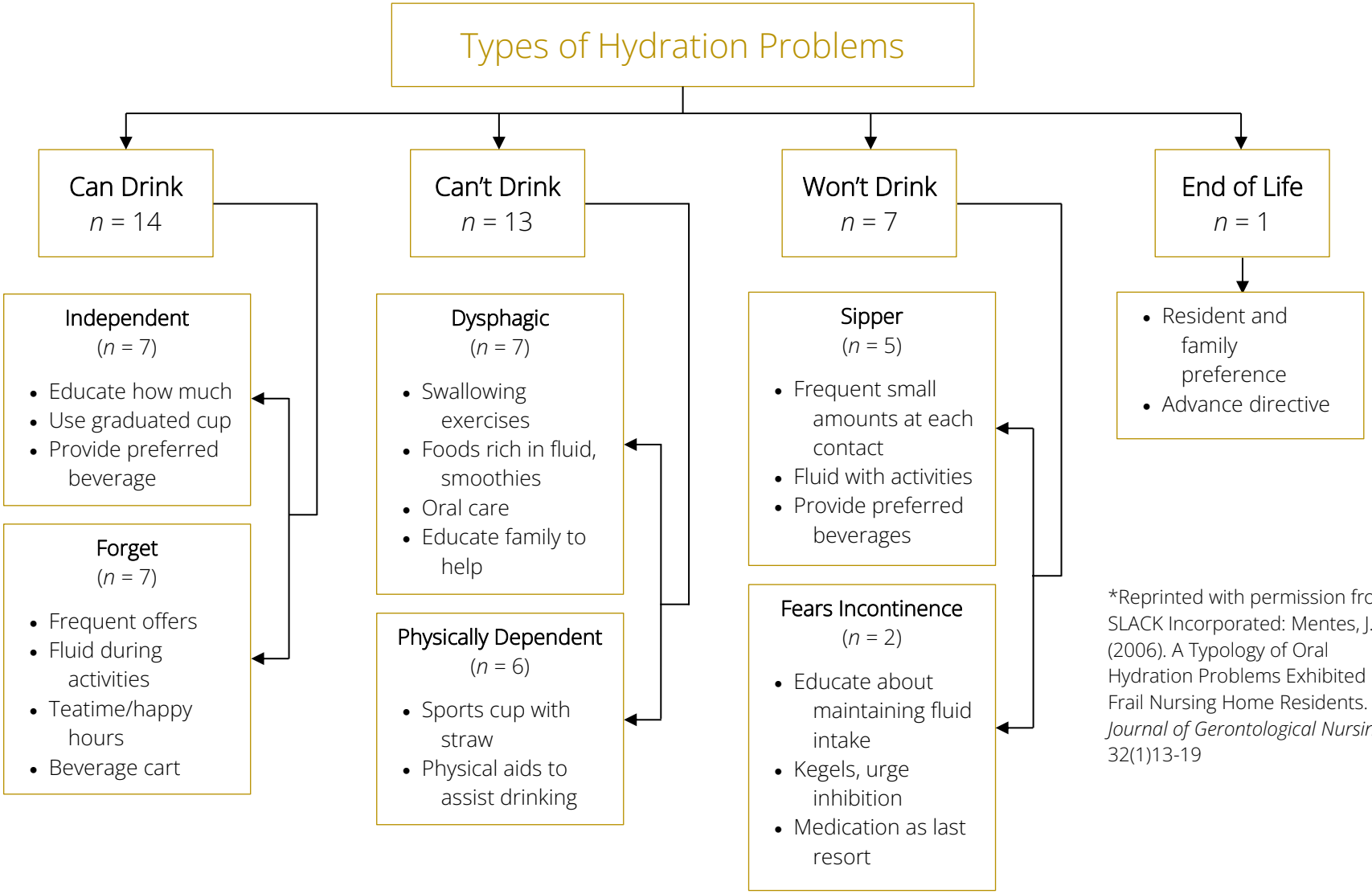
Types of Dehydration

Another way to conceptualize risk for dehydration is to classify oral hydration habits. Mentes (2006) identified different strategies to prevent dehydration in nursing home residents based upon drinking habits in a direct observational study of 35 patients *[Evidence Grade = C1]*. The "Can Drink" group had a 14% risk of dehydration (2 of 14) and included independent persons and those who forget to drink. The "Can't Drink" group had a 38% risk (5 of 13) and included patients with swallowing limitations and those who were physically dependent. The "Won't Drink" group had a 50% risk (4 of 7) and included those who liked to sip and those who refused drink because they feared the embarrassment of incontinence. Only one person comprised the "End of Life" group. Further discussion of end of life hydration issues were previously discussed. More than a third of all persons (31%) developed dehydration, demonstrating the increased risk for all nursing home residents regardless of drinking habits. Figure 1 details the different strategic measures suggested by Mentes (2006) according to the residents' drinking habits *[Evidence Grade = C1]*. The tailored guide can be helpful in maximizing hydration for each individual patient.

The Drinks Diary

This instrument is a self-recording tool to capture fluid intake (Jimoh, Bunn, & Hooper, 2015). It has been used successfully among care home residents who have cognitive ability and physical ability to complete the form. Amounts recorded were correlated with researcher direct observation (Jimoh, Bunn, & Hooper, 2015). A copy of the Drinks Diary and the instructions for use follow and are included in the Appendix A.6. The website for the instrument is: http://www.uea.ac.uk/medicine/research/research-evidence-studies/drinks-diary

FIGURE 1: TYPES OF HYDRATION PROBLEMS



*Reprinted with permission from SLACK Incorporated: Mentes, J.C. (2006). A Typology of Oral Hydration Problems Exhibited by Frail Nursing Home Residents. *Journal of Gerontological Nursing,* 32(1)13-19

2. Hydration Management

Managing fluid intake for optimal fluid balance consists of:

1. Acute management of oral intake
2. Ongoing management of oral intake.

Acute Management of Oral Intake

Any resident who develops a fever, vomiting, diarrhea or a non-febrile infection should be closely monitored by implementing intake and output records and provision of additional fluids as tolerated (Weinberg, Pals, Levesque et al, 1994; *[Evidence Grade = C1]*). Individuals who are required to be NPO for diagnostic tests should be given special consideration to shorten the time that they must be NPO and should be provided with adequate amounts of fluids and food when they have completed their tests. For many procedures a 2-hour fluid fast is recommended (American Society of Anesthesiologists, 2011; *[Evidence Grade = B1]*).

Any resident who develops unexplained weight gain, pedal edema, neck vein distension or shortness of breath should be closely monitored for overhydration. Fluids should be temporarily restricted, and the resident's primary care provider will be notified

Ongoing Management of Oral Intake

Ongoing management of oral intake consists of the following five components:

1. Calculate a daily fluid goal

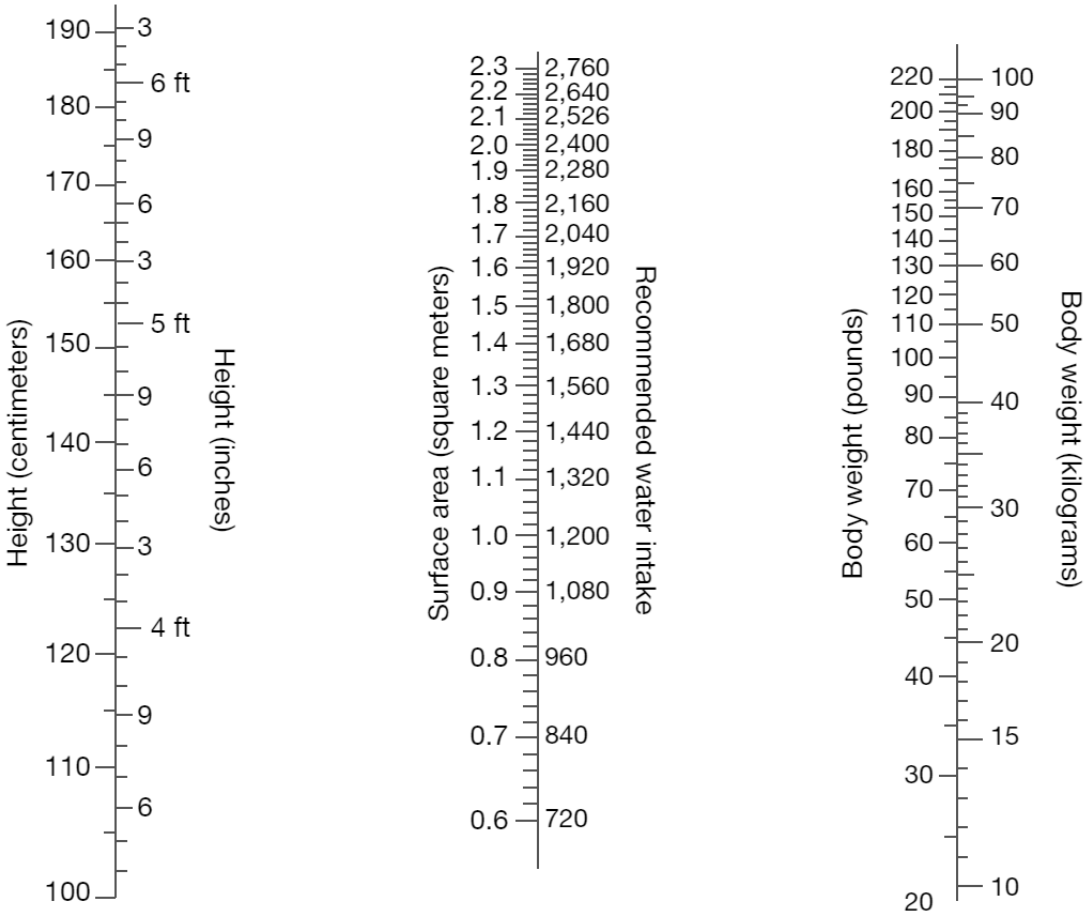
   All residents need to have an individualized fluid goal determined by a documented standard for daily fluid intake. There is evidence that the standard suggested by Skipper, (1993) of 100mL/kg for first 10kg of weight, 50 ml/kg for next 10kg, and 15mL for remaining kg or 75% of 1600 ml per m^2 of body surface/day is preferred (Gaspar, 1999; 2011; *[Evidence Grade = C1]*).

EXAMPLES
70kg (154 lb.) resident would have a fluid goal of 2250mL/day.
60kg (132 lb.) resident would have a fluid goal of 2100mL/day.
50kg (110 lb.) resident would have a fluid goal of 1950mL/day.

The standard, 75% of 1600 ml per m^2 of body surface/day, is based on the recommendation established by Butler and Talbot (1948) for adults in general, with consideration of the loss of total body water of an older adults, decreased renal function, and lower physical activity.

A nomogram has been developed to enhance calculation of the recommendation (Gaspar, 2011). A copy of the nomogram follows (Figure 2) and is included in the Appendix A.3. Directions for use are at the bottom of the nomogram.

FIGURE 2: NOMOGRAM TO DETERMINE RECOMMENDED WATER INTAKE OF NURSING HOME RESIDENTS



Developed by Phyllis Meyer Gaspar, Ph.D., RN. The nomogram for estimating recommended water intake for nursing home residents is based on height and weight. To determine recommended water intake find height on left-hand scale and weight on right-hand scale. Connect these two points with straight edge. Read the recommended water intake from the center scale. Estimate to the closest number. (Based on the surface area nomogram of Wilmore).

2. Compare resident's current intake to the amount calculated from applying the standard.

3. Based on at-risk status and the comparison of intake with calculated recommendation results implement intervention strategies. Strategies supported in the literature are provided in the table that follows. A combination of interventions may be needed to assist the older adult achieve optimum hydration (Hooper, 2016)

Interventions and Strategies	References	Overall Evidence Grade
PROVIDE FLUIDS CONSISTENTLY THROUGHOUT THE DAY	Ferry, 2005; Hodgkinson, Evans, & Wood, 2003; Simmons, Alessi, & Schnelle, 2001	A1
Specific Effective Strategies		
Plan fluid intake as follows: 75-80% delivered at meals, and 20-25% delivered during non-mealtimes such as medication times and planned nourishment times.	Zembrzuski, 1997	D
Offer a variety of fluids keeping in mind the individual's previous intake pattern	Bunn, Jimoh, Wilsher, & Hooper, 2015; Schnelle et al., 2010; Simmons, Alessi, & Schnelle, 2001; Zembrzuski, 1997	C1
Integrate fluid rounds mid-morning and late afternoon, where caregiver provides additional fluids	Spangler, Risley, & Bilyew, 1984	B2
Standardize fluid with medication administrations to a prescribed amount; e.g. 180mL (6oz.) per administration time.	Mentes & Culp, 2003	B2
Provide 2- 8 oz. glasses of fluid in AM and PM	Robinson & Rosher, 2002	B2
If taking thickened liquids encourage intake (as intake reported as lower than if taking thin liquids)	McGrail & Kelchner, 2012; McGrail & Kelchner, 2015	C1
Select between-meal snacks that will increase water intake	Marra et al., 2016	C1

Interventions and Strategies	References	Overall Evidence Grade
MAKE DRINKING OPPORTUNITY A PLEASURABLE AND SOCIAL EXPERIENCE	Abdelhamid et al., 2016; Godfrey, Cloete, Dymond, & Long, 2012	C1
Specific Effective Strategies		
"Happy Hours" in the afternoon, where residents can gather together for additional fluids and socialization	Mentes, Chang, & Morris, 2006; Munsson et al., 1990	C1
"Tea Time" in the afternoon, where residents come together for fluids, nourishment and socialization	Mueller & Boisen, 1989	D
Encourage resident to have meals in the dining room	Reed, Zimmerman, Sloane, Williams, & Boustani, 2005	C1
Create a non-institutional dining experience	Reed et al., 2005	C1
ENSURE UTENSILS ARE RESIDENT CENTERED		
Specific Effective Strategies		
Use of modified fluid containers based on resident's intake behaviors (e.g. ability to hold cup, to swallow)	Mueller & Boisen, 1989; Reedy, 1988	D
Use high contrast tableware during meals for residents with dementia	Dunne, Neargarder, Cipolloni, & Cronin-Golomb, 2004	D
Encourage on-going intake of fluids throughout the day	Bunn et al., 2015; Mentes, Chang, & Morris, 2006; Robinson & Rosher, 2002; Simmons, Alessi, & Schnelle, 2001	C1
Provide reminders/prompts to drink fluids	Bunn et al., 2015; Godfrey et al., 2012; Oates & Price, 2017	C1
Provide the appropriate level of assistance to enhance intake	Bunn et al., 2015; Godfrey et al., 2012; Marra et al., 2016	C1
Offer a variety of fluids with consideration for residents preference	Godfrey et al., 2012; Mentes, Chang, & Morris, 2006; Oates & Price, 2017; Robinson & Rosher, 2002; Schnelle et al., 2010; Simmons, Alessi, & Schnelle, 2001	C1
Increase toileting routine (in combination with other strategies)	Bunn et al. 2015; Schnelle et al., 2010; Spangler et al., 1984; Tanka et al., 2009; Zembrzuski, 2006	C1

Interventions and Strategies	References	Overall Evidence Grade
ENSURE UTENSILS ARE RESIDENT CENTERED		
Specific Effective Strategies	Bunn et al., 2015	
Provide staff with education on hydration management (in combination with other strategies)	Beattie, O'Reilly, Strange, Franklin, & Isenring, 2014; Zembrzuski, 2006	C1
Coordinate staff communication about hydration such as certified nursing assistant (CNA) handoff reports or documentation in nursing care plan.	Mentes, Chang, & Morris, 2006; Ullrich, & McCutcheon, 2008	C1
Provide a staffing ratio that allows the needs of the residents to be met	Reed et al., 2005	C1
Encourage family involvement and support	Mentes, Chang, & Morris, 2006	C1
Promote Self-Management of Hydration		C1
Individuals who are cognitively intact and physically capable can be taught to use the Drinks Diary to self-monitor their fluid intake. Assist to establish their fluid intake goal based on the calculated fluid recommendation.	Jimoh et al., 2014	C1
Individuals who are cognitively intact and visually capable can be taught how to note changes in their level of hydration through the use of a color chart (See Appendix A.4 for description), to compare to the color of their urine The chart is most accurate in individuals with better renal function.	Armstrong et al., 1994, 1998; Mentes, Wakefield & Culp, 2006	C1
Fluid Regulation and documentation Note: Frequency of documentation of fluid intake will vary from setting to setting and is dependent on an individual's condition.		
Document a complete intake recording including hydration habits	Mentes & IVANRC, 2000	D
Create fluid volume list of each utensil to accurately calculate fluid consumption	Burns, 1992; Hart & Adamek, 1984	C1

3. Evaluation

Adherence to the hydration management guideline can be monitored by (frequency of monitoring to be determined by setting):

	Indicator	Outcome approaches and/or values	Supporting References	Evidence Grade
Urine	Urine specific gravity checks, preferably an afternoon specimen	A value greater than or equal to 1.020 implies an undehydrated state and requires further monitoring	Armstrong et al., 1994, 1998; Hodgkinson et al., 2003; Wakefield et al., 2002; Mentes, Wakefield, & Culp, 2006; Mentes & Culp, 2003; Kavouras, 2002	A1 (with B2 and C1 support)
	Urine color chart monitoring, preferably a morning specimen	Comparison with baseline color	Armstrong et al., 1994, 1998; Wakefield et al., 2002	C1
	Note: A single measure of urine specific gravity or color was not found to accurately measure hydration status Hooper, Bunn, Abdelhamid, et al. (2016) , but serial measures of urine specific gravity or color in older adults with Cockcroft-Gault estimated creatinine clearance level of < 50 ml/min. can be helpful in understanding an individual's hydration status (Mentes, Wakefield, & Culp, 2006).			C1
Amount Ingested	24-hour intake recording (output recording may be added, however in settings where individuals are incontinent of urine, an intake recording should suffice) (See Appendix A.5).	Comparison with calculated daily fluid goal	Hodgkinson et al., 2003	A1
	Drinks Diary to document fluid intake in individuals who are cognitively intact and physically able.	Comparison with calculated daily fluid goal	Jimoh et al., 2014	C1
Laboratory Data	Serum Osmolality or Formula Calculated Osmolality	Comparison with category of euhydrated (<295 mmol/Kg), impending dehydration (295-300 mmol/Kg), dehydration (> 300 mmol/KG)	Thomas et al., 2008	C1

Deviations from the guideline should be discussed with the individual's primary nurse and updated plans to manage hydration status will be implemented.

Nursing Interventions Classificiations (NIC)

The Nursing Interventions Classification (NIC) is a comprehensive, standardized classification of interventions that nurses perform. The Classification includes the interventions that the nurse does on behalf of patients, both independent and collaborative interventions, both direct and indirect care. An Intervention is any treatment, based upon clinical judgment and knowledge that a nurse performs to enhance patient/client outcomes. NIC can be used in all settings (from acute care to ambulatory care and long-term care) (Bulechek et al., 2013).

Planning care and services using nursing standardized languages begins with assessment to generate accurate nursing diagnoses. For the *Hydration Management* guideline, nursing diagnoses that are particularly relevant are *Deficient Fluid Volume, Excess Fluid Volume, Risk For Deficient Fluid Volume, Risk For Imbalanced Fluid Volume, Readiness For Enhanced Fluid Balance, Risk For Electrolyte Imbalance, Impaired Swallowing, and Imbalanced Nutrition: Less Than Body Requirements* (NANDA International, 2012). Selected nursing interventions from the Nursing Interventions Classification (NIC) and outcomes from the Nursing Outcomes Classification (NOC) are listed to illustrate the process of clinical reasoning when caring for elders' regarding their hydration management needs. The interventions and outcomes below are intended to serve as examples, and not as an exhaustive list.

Major Interventions

These are the obvious interventions associated with the guideline. They were selected because they provide a good match with the focus of the guideline.

(4120) Fluid Management - promotion of fluid balance and prevention of complications resulting from abnormal or undesired fluid levels.

(2080) Fluid/Electrolyte Management - regulation and prevention of complications from altered fluid and/or electrolyte levels.

(4130) Fluid Monitoring - collection and analysis of patient data to regulate fluid balance.

(4170) Hypervolemia Management - reduction in extracellular and/or intracellular fluid volume and prevention of complications in a patient who is in fluid overload.

(4180) Hypovolemia Management - expansion of intravascular fluid volume in a patient who is volume depleted.

(2020) Electrolyte Monitoring - Collection and analysis of patient data to regulate electrolyte balance.

(1120) Nutrition Therapy - Administration of food and fluids to support metabolic process of a patient who is malnourished or at high risk for becoming malnourished.

(1160) Nutritional Monitoring - collection and analysis of patient data to prevent or minimize malnourishment.

Suggested Interventions

These will address the guideline but are selected less frequently than the priority interventions.

(4140) Fluid Resuscitation - administering prescribed intravenous fluids rapidly.

(2380) Medication Management - facilitation of safe and effective use of prescription and over the counter drugs.

(2395) Medication Reconciliation - comparison of the patient's home medications with the admission, transfer, and discharge orders to ensure accuracy and patient safety.

(4260) Shock Prevention - detecting and treating a patient at risk for impending shock.

(6680) Vital Signs Monitoring - collection and analysis of cardiovascular, respiratory, and body temperature data to determine and prevent complications.

(6610) Risk Identification - analysis of potential risk factors, determination of health risks, and prioritization of risk reduction strategies for an individual or group.

(2009) Electrolyte Management: Hyponatremia - promotion of sodium balance and prevention of complications resulting from serum sodium levels lower than desired.

(2004) Electrolyte Management: Hypernatremia - promotion of sodium balance and prevention of complications resulting from serum sodium levels higher than desired.

(1100) Nutrition Management - assisting with or providing a balanced dietary intake of foods and fluids.

Additional Optional Interventions

These interventions were chosen because they are associated with the guideline and may be selected in specific situations that allow the nurse to further tailor the plan of care.

(1056) Enteral Tube Feeding - delivering nutrients and water through a gastrointestinal tube.

(0460) Diarrhea Management - management and alleviation of diarrhea.

(0590) Urinary Elimination Management - maintenance of an optimum urinary elimination pattern.

(1570) Vomiting Management - prevention and alleviation of vomiting.

(1050) Feeding - providing nutritional intake for a patient who is unable to feed self.

(1860) Swallowing Therapy - facilitating swallowing and preventing complications of impaired swallowing.

(3740) Fever Treatment - management of a patient with hyperpyrexia caused by non-environmental factors.

(4250) Shock Management - facilitation of the delivery of oxygen and nutrients to systemic tissue with removal of cellular waste products in a patient with severely altered tissue perfusion.

Nursing Outcomes Classifications (NOC)

The Nursing Outcomes Classification (NOC) is a standardized classification of patient/client outcomes developed to evaluate the effects of nursing interventions. A nursing-sensitive patient outcome is "an individual, family, or community state, behavior or perception that is measured along a continuum in response to nursing intervention(s). Each outcome has an associated group of indicators that are used to determine patient status in relation to the outcome", (Moorhead et al., 2018, p. viii). A sample NOC outcome most relevant to this guideline Fluid Balance is included in Appendix D.

Suggested Outcomes

These outcomes are closely related to the guideline and may be useful in measuring effectiveness for individual patients:

(0601) Fluid Balance - water balance in the intracellular and extracellular compartments of the body.

(0602) Hydration - adequate water in the intracellular and extracellular compartments of the body.

(1008) Nutritional Status: Food and Fluid Intake - amount of food and fluid taken into the body over a 24-hour period.

(1005) Nutritional Status: Biochemical Measures - body fluid components and chemical indices of nutritional status.

(0603) Fluid Overload Severity - severity of excess fluids in the intracellular and extracellular compartments of the body.

(0504) Kidney Function - filtration of blood and elimination of metabolic waste products through the formation of urine.

(0600) Electrolyte and Acid/Base Balance - balance of electrolytes and non-electrolytes in the intracellular and extracellular compartments of the body.

Additional Associated Outcomes

These are other possible outcomes that may be useful:

(1010) Swallowing Status - safe passage of fluids and/or solids from the mouth to the stomach.

(1622) Compliance Behavior: prescribed Diet - Personal actions to follow food and fluid intake recommended by a health professional for a specific health condition.

(1902) Risk Control - personal actions to prevent, eliminate, or reduce modifiable health threats.

(2107) Nausea and Vomiting Severity - severity of nausea, retching, and vomiting symptoms.

(0501) Bowel Elimination - formation and evacuation of stool.

(1015) Gastrointestinal Function - extension to which foods (ingested or tube-fed) are moved from ingestion to excretion.

(1802) Knowledge: Diet - extent of understanding conveyed about recommended diet.

(0502) Urinary Elimination - collection and discharge of urine.

Guideline Implementation Process

Implementation of a practice guideline is a challenging step to achieving evidence-based practice. "The Iowa Model Revised: Evidenced-Based Practice to Promote Excellence in Health Care©" (Appendix E.1) is a valuable resource to organizations, nurse leaders, and individuals who are interested in implementing an EBP Guideline into practice. To assist readers in implementing this guideline we have included the Iowa Model© and a diagram that highlights a number EBP implementation strategies that can be used to implement this guideline into a practice setting. Details on the Iowa Model can be found in *Evidence-based Practice in Action: Comprehensive Strategies, Tools, and Tips from the University of Iowa Hospital and Clinics* (Cullen et al., 2018). Specific implementation tools can be found in Chapter 8: Implementation, including how to develop tools on how to develop Sound Bites, Journal Clubs, Posters, Education, Pocket Guides, Case Studies, Incentives, Checklists, Documentation, and Peer Influence. The "Implementation Strategy for Evidence-based Practice" in Appendix E.2 of this guideline includes a list of strategies the are explained in detail in the *Evidence-based Practice in Action: Comprehensive Strategies, Tools, and Tips from the University of Iowa Hospital and Clinics* (2018) textbook.

Evaluation of Process Outcomes

In order to evaluate the use of this protocol among patients at risk for hydration management problems both process factors and outcomes should be evaluated.

Process Factors

One process factor that can be assessed with a sample of nurses and/or physicians is knowledge about Hydration Management. The Hydration Management Knowledge Assessment Test (see Appendix F) should be assessed before and following the education of staff regarding use of this protocol.

The same sample of nurses and/or physicians for whom the Knowledge Assessment test was given should also be given the Process Evaluation Monitor (see Appendix G) approximately one month following his/her use of the protocol. The purpose of this monitor is to determine his/her understanding of the protocol and to assess the support for carrying out the protocol.

Outcome Factors

Outcomes of consistent application of a hydration management plan include:

Outcome	Supporting References	Evidence Grade
Maintenance of body hydration	Culp, Mentes, & Wakefield, 2003; Robinson & Rosher, 2002; Simmons, Alessi, & Schnelle, 2001	B2
Decreased infections, especially urinary tract infections	McConnell, 1984; Robinson & Rosher, 2002	B2
Improvement in urinary incontinence	Spangler et al., 1984	B2
Lowered urinary pH	Hart & Adamek, 1984	B2
Decreased constipation*	Robinson & Rosher, 2002; Sheehy & Hall, 1998	B2
Decreased acute confusion	Mentes & Culp, 2003; Mentes et al., 1999	B2

*See also McKay, Fravel, & Scanlon, 2009. *Management of Constipation.* In Deborah P. Scholenfelder (Series Ed.), *Series on Evidence-Based Practice for Older Adults.* Iowa City, IA: The University of Iowa College of Nursing John A. Hartford Foundation Center for Gerontological Nursing Excellence.

Fluid Balance outcomes from the Nursing Outcomes Classification (NOC) may be of further help in determining outcomes for a variety of care settings (Moorhead, Johnson, Maas, & Swanson, 2013).

In order to document the success of the Hydration Management plan that is devised for each patient, and based upon this protocol, please use or adapt the Risk Appraisal Checklist, urine specific gravity readings, Armstrong color chart, and Intake and Output Record described in Appendix A.5. These tools will allow continued individual patient audits to determine the adequacy of the outcomes based on the Hydration Management program. This assessment tool may be adapted for individual organizations or units, and additional outcomes may be added.

Appendix A

Assessment Tools

Appendix A contains tools to assess hydration status with a focus on those at-risk of inadequate hydration levels. The purpose of the tools and instructions for use accompany each tool or form. The tools in Appendix A are:

Appendix A.1: Hydration Assessment Process Form

Appendix A.2: Dehydration Risk Appraisal Checklist

Appendix A.3: Nomogram for Determining Recommended Water Intake of Nursing Home Residents

Appendix A.4: Armstrong Urine Color Chart

Appendix A.5: 24-Hour Intake and Output Record

Appendix A.6: Drinks Diary

Appendix A.1

Hydration Management Process Form

Purpose: The purpose of this assessment is to determine the risk for dehydration, presence of impending dehydration/dehydration, adequacy of intake based on individualized recommendation and identification of factors in determining management plan.

1. Review Patient/ Resident Health Record for Risk Factors for Dehydration using the *Dehydration Risk Appraisal Checklist* revised by Mentes & Wang (2010) *[Evidence Grade = C1]*.

2. Determine Presence of Indicators of Impending or Dehydration

Laboratory Indicator	Values	Date	Indicative of Impending Dehydration or Dehydration	Changes in Values Over Past 6 Months
Serum Sodium				
BUN/Creat				
Serum osmolality				
Hematocrit				
Hemoglobin				
K+				
Glucose				
Urea				

Note: When serum osmolality is not available but other routine laboratory tests are accessible the equation that can be used to best reflect serum osmolality is:

Osmolarity =1.86 x (Na^++K^+) + 1.15 x glucose + urea + 14 (all measured in mmol/L)

(Hooper, Abdelhamied, & Ali et al., 2015)

Vital Sign and Physical Exam Indicators	Indicator Present	Changes in Past Month
Orthostatic hypotension		
Increased pulse		
Increased temperature		
Decreased weight		
Dry oral mucous membranes		
Tongue furrowing		
Decreased sternal skin turgor		
Decreased axillary sweat		

3. Calculate Recommended Intake Using Nomogram (Appendix A.3)

Weight: _____ (lbs) Height: _____ (in)

Recommended Intake: _____

4. Complete 24-Hour Intake and Output Record (Appendix A.5)

5. Compare intake with recommended intake

% of Recommended _____

6. Establish Usual Intake Pattern based on 24 Hour Intake and Output Assessment along with Preferences

Intake Pattern			Fluid Preferences (Check all that apply)	
7 am - 12 noon	_____	Cc	_____ Water	_____ Colas
12:01 pm – 3 pm	_____	Cc	_____ Coffee/ tea	_____ Other soda/ pop
3:01 pm - 6 pm	_____	Cc	_____ Fruit juice	
6:01 pm - 9 pm	_____	Cc	_____ Beer/ wine	_____ Other
9:01 pm - 7 am	_____	Cc	_____ Milk	
Total:	_____	Cc		

7. Review Intake Behaviors from the 24 Hour Intake and Output Assessment (check all that apply)

_____ Requires assistance to drink

_____ Requires thickening agents in fluids

_____ Can drink with proper fluid utensils

_____ Drinks mostly caffeinated beverages

_____ Holds food/fluid in mouth

_____ Receives tube feeding

_____ Has difficulty swallowing/Chokes

_____ Can drink independently but forgets

_____ Poor eater (eats < 50% of food)

_____ Spills

_____ Drools

_____ NPO status

Appendix A.2

Dehydration Risk Appraisal Checklist

Instructions: The greater the number of characteristics present, the greater the risk for hydration problems. Please check all that apply.

_____ > 85 years

_____ Female

SIGNIFICANT HEALTH CONDITIONS

_____ MMSE score < 24 (or any cognitive scale rating indicative of cognitive impairment)

_____ Dementia diagnosis

_____ GDS score ≥ 6 (indicating depression)

_____ Semi-dependent in ADLs

_____ Repeated infections

_____ History of dehydration

_____ Urinary Incontinence

MEDICATIONS

_____ Laxatives

_____ Diuretics

_____ Psychotropics: Antipsychotics, Antidepressants, Anxiolytics

INTAKE BEHAVIORS

_____ BMI < 21 or > 27

_____ Requires assistance to drink

_____ Has difficulty swallowing/Chokes

_____ Can drink independently but forgets

_____ Poor eater

Low Risk ‹ RISK › High Risk

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

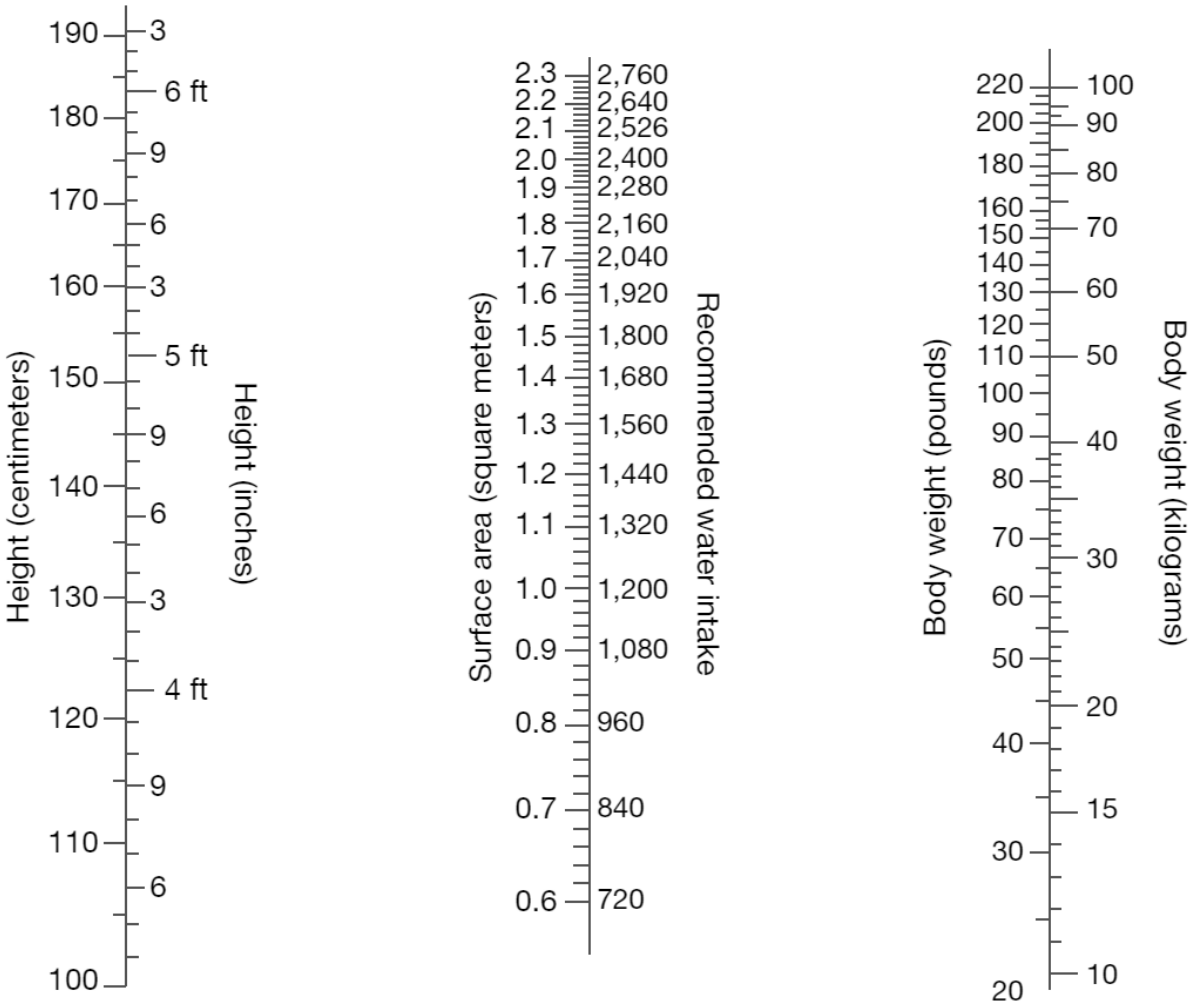
Source: Mentes & Wang, 2011

Appendix A.3

Nomogram to Determine Recommended Water Intake of Nursing Home Residents

Instructions: The nomogram for estimating recommended water intake for nursing home residents is based on height and weight. To determine recommended water intake:

1. Find height on left-hand scale
2. Find weight on right-hand scale
3. Connect these two points with straight edge
4. Read the recommended water intake from the center scale (estimate to the closest number).



Developed by Phyllis Meyer Gaspar, Ph.D., RN. (Based on the surface area nomogram of Wilmore).

Written 1998; Revised 2004; 2011; 2019

Appendix A.4

Armstrong Urine Color Chart

Introduction: The urine color chart is used to assess an older adults' hydration status, in conjunction with the Hydration Management Evidence-Based guideline.

- For older adults at risk for hydration problems, assess urine color weekly and with changes in health status.
- For all others, conduct urine color assessment on a monthly basis and with changes in health status.
- A color reading of > 4 in people ≥ 65 years of age puts them in the "at risk" range. Fluid intake should be monitored and additional fluids offered. Remember to offer fluids throughout the day rather than large quantities at one time.

INSTRUCTIONS

1. Have the older individual urinate into a urine collection device such as a hat or a clear cup (if able).

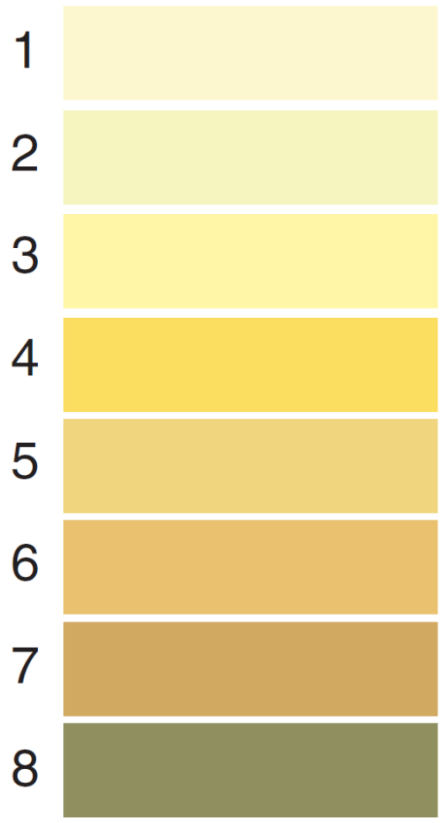
2. Evaluate urine color right after the individual has voided and under the same environmental conditions each time (ie., in a place with the same lighting).

3. Carefully compare urine to the color chart by holding the color chart next to the container of urine.

4. Document or report color to charge nurse.
If > 4, report to charge nurse immediately.

5. It may be helpful to designate certain team members to do this task on a regular basis and have them practice together to develop some agreement in assessing the urine color.

COLOR CHART



Reference: Mentes, J.C. (2000). Hydration Management: A long-term care nursing intervention to prevent acute confusion and other hydration-linked events. Unpublished PhD. thesis, University of Iowa, Iowa City, pages 96-98; or contact Dr. Janet Mentes, Assistant Professor UCLA School of Nursing, jmentes@sonnet.ucla.edu. The scientific evidence supporting the use of the Urine Color Chart in the assessment of hydration status in elite athletes may be found in the International Journal of Sports Nutrition, Volume 4, 1994, pages 265-279 and Volume 8, 1998, pages 345-355.

Appendix A.5

24-Hour Intake and Output Record

Patient/Resident ID: _____ Date: _____

Starting Specific Gravity: _____ Ending Specific Gravity: _____

Starting Urine Color: _____ Ending Urine Color: _____

Intake		Output	
11 pm - 7 am:			
11 pm - 7 am Total:		11 pm - 7 am Total:	
7 am - 3 pm:			
Breakfast:			
Lunch:			
Nourish:			
Medications:			
7 am - 3 pm Total:		7 am - 3 pm Total:	
3 pm - 11 pm:			
Dinner:			
Nourish:			
Medications:			
3 pm - 11 pm Total:		3 pm - 11 pm Total:	
Daily Total Intake:		Daily Total Output:	

Intake Behaviors (check all that apply). As you are observing and recording intake it is appropriate to also observe and record intake behaviors at the same time.

_____ Requires assistance to drink

_____ Requires thickening agents in fluids

_____ Can drink with proper fluid utensils

_____ Drinks mostly caffeinated beverages

_____ Holds food/fluid in mouth

_____ Receives tube feeding

_____ Has difficulty swallowing/Chokes

_____ Can drink independently but forgets

_____ Poor eater (eats < 50% of food)

_____ Spills

_____ Drools

_____ NPO status

Appendix A.6

Drinks Diary

Instructions: Working out how much a person has drunk in 24 hours (using a completed Drinks Diary):

1. Volume of cups, mugs, and glasses. For each type of glass, cup and mug used you will need to measure or estimate the volume. For example, to measure the volume of a teacup fill the teacup with water to the point it would be usually filled with tea or coffee (don't fill to the rim). Then pour the water into a measuring jug (the sort you use in the kitchen). Write down the volume (in ml).

Volumes	Type of Mug, Cup, or Glass Used				
	Teacup	Small mug	Big Mug	Small glass	Half pint glass
Your measured volume (ml)					
If you prefer to estimate the volume, use these (ml)	190	220	260	160	280

2. Amount drunk for each drink. We need to calculate how much was drunk of each drink. Write down the measured volumes of each cup or mug on the grey row below, and then multiply them to give the volume of each drink drunk.

Volumes	Type of Mug, Cup, or Glass Used				
	Teacup	Small mug	Big Mug	Small glass	Half pint glass
Measured volume (ml)					
Drank a little (volume x 0.25)					
Drank a half (volume x 0.5)					
Drank most (volume x 0.75)					
Drank all (volume)					

If you use the estimated volumes of each cup, mug and glass then the volumes to use for each amount drunk are on the table at the top below.

Volumes	Type of Mug, Cup, or Glass Used				
	Teacup	Small mug	Big Mug	Small glass	Half pint glass
Measured volume (ml)	190	220	260	160	280
Drank a little (volume x 0.25)	48	55	65	40	70
Drank a half (volume x 0.5)	95	110	130	80	140
Drank most (volume x 0.75)	143	165	195	120	210
Drank all (volume)	190	220	260	160	280

3. Adding up the volume. For each drink on the Drinks Diary look at the type of cup, mug or glass, and the amount drunk – and write the volume (from the table above) to the right of the Diary row. Add up the volumes of each individual drink through the day, to get the total drunk during the day.

4. Are they drinking enough? The European Food Safety Authority (EFSA)[1] recommends that adult men of all ages drink at least 2.0 litres (or 2000ml) each day, and that adult women of all ages drink at least 1.6 litres (or 1600ml) each day. US recommendations by the Institute of Medicine (IOM)[2] are 3.0 litres (or 3000ml) each day for adult men, and 2.2 (or 2200ml) each day for women.

5. How to drink more. Does this person need to drink a bit more to get to the recommendations? If so, then try these ideas:

    - Encourage at least one drink at every meal (and offer seconds)
    - Encourage a drink first thing in the morning, often when people are most thirsty
    - Always have drinks during the morning (between breakfast and lunch), during the afternoon (between lunch and evening meal), and during the evening
    - Drink a full drink with any medication, much more than just a sip
    - Try a different drink – have a fizzy lemonade, or Bovril with hot water, or ginger ale, or orange juice and lemonade, or a smoothie, or warm apple juice with cinnamon, or iced water
    - Present the drinks beautifully – use a favorite teacup, have a tray with a doily, teapot, milk jug, sugar, biscuits and teacup, use a pretty glass for fruit juice or a stemmed glass for orange juice and lemonade – or even a cocktail parasol!
    - Ask them what they like to drink most, and have the brand they like, how they like it
    - Make sure they are able to get to the toilet when they need to (as people often cut down on drinks deliberately so they don't have any accidents)
    - Work on this, and then use the Drinks Diary again to make sure it has worked.

---

[1] EFSA. Scientific Opinion on Dietary Reference Values for water. EFSA Journal 2010; 8(3):1459. See http://www.efsa.europa.eu/en/efsajournal/pub/1459.htm

[2] Institute of Medicine. Panel on Dietary Reference Intakes for Electrolytes and Water. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*. Washington DC, USA: National Academies Press, 2004.

Drinks Diary

Directions:

1. Start at 10pm, finish at 10pm the next day
2. Each time you drink (alone, with food or with pills):
    a. Write the name of the drink
    b. Mark (✓) the type of mug, cup, or glass used
    c. Mark (✓) the how much you drank

EXAMPLE

Below shows an example of the first row filled out by someone taking milk with pills at 10pm.

Time	What did you drink?	Type of mug, cup, or glass used					How much did you drink?			
		Teacup	Small Mug	Big Mug	Small glass	Half pint glass	Drank a little	Drank half	Drank most	Drank all
										
Evening after 10pm	*Milk with pills*				✓			✓		

Written 1998; Revised 2004; 2011; 2019

Name: _____ Date: _____

Time	What did you drink?	Type of mug, cup, or glass used					How much did you drink?			
		Teacup	Small Mug	Big Mug	Small glass	Half pint glass	Drank a little	Drank half	Drank most	Drank all
										
Evening after 10pm										
During the night										
Before Breakfast										
Breakfast										
_____										

Time	What did you drink?	Type of mug, cup, or glass used					How much did you drink?			
		Teacup	Small Mug	Big Mug	Small glass	Half pint glass	Drank a little	Drank half	Drank most	Drank all
										
During the morning										
Lunch										
_____										
During the afternoon										
Tea (evening meal)										

Written 1998; Revised 2004; 2011; 2019

Time	What did you drink?	Type of mug, cup, or glass used					How much did you drink?			
		Teacup	Small Mug	Big Mug	Small glass	Half pint glass	Drank a little	Drank half	Drank most	Drank all
_____										
During the evening										
STOP AT 10 PM										

Comments:

Appendix B

Comparison of Common Oral Fluids

Water	A good source of fluid, 50% of daily fluid requirements should be water.
Carbonated water (non-caloric)	A good replacement for soft drinks. Non-caloric varieties do not contain sugar or salt. Carbonation doesn't appear to be a problem (Wooten & Liebman, 1998)
Milk	Nutritious, but may thicken phlegm. Can cause constipation, bloating, and or gastric distress in persons who are lactose intolerant.
Yogurt drinks	Nutritious and better tolerated in lactose intolerant persons
Coffee/Tea	May increase fluid loss in certain individuals; however, in persons who are habituated to caffeine, there is preliminary evidence that its consumption does not adversely affect their fluid balance (Martof & Knox, 1997; Maughan & Griffin, 2003)
Green Tea	Contains reduced amounts of caffeine. Can be a good replacement for caffeinated tea.
Herbal tea	Usually contains no caffeine, but herbs do have medicinal effect. Use in moderation.
Colas	Not a good fluid choice: high caffeine/sugar content. Decaffeinated diet colas are better.
Alcohol	Use in moderation as diuretic effects may cause fluid losses. Alcohol-drug interactions are problematic in elders taking multiple medications.
Nonalcoholic beer/wine	For persons who have enjoyed a drink, nonalcoholic beer/wine may be a good replacement.
Soft drinks or Gelatin	High in sugar which may cause loss of fluids as kidneys try to dilute sugar.

Sports drinks	Contain an average 6% solution of simple carbohydrate plus small amounts of electrolytes. Probably not necessary unless involved in very strenuous exercise or as a recovery aid after exercise.
Soups	Broth-based may be best, cream based may cause gastric problems similar to milk. Watch for sodium content.
Fruit/vegetable juices	Watch % of juice content. "Juice drink" is mostly sugar water. 100% fruit/vegetable juice is nutritious and a good source of fluid. Use in moderation; causes diarrhea when overused.
Popsicles	Good choice during hot weather. Watch for sugar content; fruit juice popsicles are better.

Source: Clark, 1992; Kositzke, 1990

Appendix C

Nursing Interventions Classification (NIC)

Fluid Management – 4120

Definition: Promotion of fluid balance and prevention of complications resulting from abnormal or undesired fluid levels

Activities:

- Weigh daily and monitor trends
- Count or weigh diapers, as appropriate
- Maintain accurate intake and output record
- Insert urinary catheter, if appropriate
- Monitor hydration status (e.g., moist mucous membranes, adequacy of pulses, and orthostatic blood pressure), as appropriate
- Monitor laboratory results relevant to fluid retention (e.g., increased specific gravity, increased BUN, decreased hematocrit, and increased urine osmolality levels)
- Monitor hemodynamic status, including CVP, MAP, PAP, and PCWP, if available
- Monitor vital signs, as appropriate
- Monitor for indications of fluid overload/retention (e.g., crackles, elevated CVP or pulmonary capillary wedge pressure, edema, neck vein distention, and ascites), as appropriate
- Monitor patient's weight change before and after dialysis, if appropriate
- Assess location and extent of edema, if present
- Monitor food/fluid ingested and calculate daily caloric intake, as appropriate
- Administer IV therapy, as prescribed
- Monitor nutrition status
- Give fluids, as appropriate
- Administer prescribed diuretics, as appropriate
- Administer IV fluids at room temperature

- Promote oral intake (e.g., provide a drinking straw, offer fluids between meals, change ice water routinely, make freezer pops using child's favorite juice, cut gelatin into fun squares, use small medicine cups), as appropriate
- Instruct patient on nothing by mouth (NPO) status, as appropriate
- Administer prescribed nasogastric replacement based on output, as appropriate
- Distribute the fluid intake over 24 hours, as appropriate
- Encourage significant other to assist patient with feedings, as appropriate
- Offer snacks (e.g., frequent drinks and fresh fruits/fruit juice), as appropriate
- Restrict free water intake in the presence of dilutional hyponatremia with serum Na level below 130 mEq per liter
- Monitor patient's response to prescribed electrolyte therapy
- Consult physician, if signs and symptoms of fluid volume excess persist or worsen
- Arrange availability of blood products for transfusion, if necessary
- Prepare for administration of blood products (e.g., check blood with patient identification and prepare infusion setup), as appropriate
- Administer blood products (e.g., platelets and fresh frozen plasma), as appropriate

1st edition 1992; revised 2000

Background Reading:

American Association of Critical Care Nurses. (2006). *Core curriculum for critical care nursing* (6th ed.) [J. G. Alspach, Ed.]. Philadelphia: W. B. Saunders.

Baer, C. L. (1993). Fluid and electrolyte balance. In M. R. Kinney, D. R. Packa, & S. B. Dunbar (Eds.), *AACN's clinical reference for critical-care nursing* (pp. 173-208). St. Louis: Mosby.

Cullen, L. M. (1992). Interventions related to fluid and electrolyte balance. In G. M. Bulechek & J. C. McCloskey (Eds.), Symposium on nursing interventions. *Nursing Clinics of North America, 27*(2), 569-598.

Horne, M. & Swearingen, P. (1997). *Pocket guide to fluids and electrolytes* (3rd ed.). St. Louis: Mosby.

Kokko, J. & Tannen, R. (1990). *Fluids and electrolytes* (2nd ed.). Philadelphia: W. B. Saunders.

Wong, D. L. (1995). *Whaley and Wong's nursing care of infants and children* (5th ed.). St. Louis: Mosby.

Source: Bulechek, Butcher, Dochterman, & Wagner, 2013.

Appendix D

Nursing Outcomes Classification (NOC)

Fluid Balance – 0601

Definition: Severity of manifested apprehension, tension, or uneasiness arising from an unidentifiable source

Outcome Target Rating: Maintain at _____ Increase to _____

Outcome Overall Rating		Severe 1	Substantial 2	Moderate 3	Mild 4	None 5	NA
Indicators:							
060101	Blood pressure	1	2	3	4	5	NA
060122	Radial pulse rate	1	2	3	4	5	NA
060102	Mean arterial pressure	1	2	3	4	5	NA
060103	Central venous pressure	1	2	3	4	5	NA
060104	Pulmonary wedge pressure	1	2	3	4	5	NA
060105	Peripheral pulses	1	2	3	4	5	NA
060107	24-hour intake and output balance	1	2	3	4	5	NA
060109	Stable body weight	1	2	3	4	5	NA
060116	Skin turgor	1	2	3	4	5	NA
060117	Moist mucous membranes	1	2	3	4	5	NA
060118	Serum electrolytes	1	2	3	4	5	NA
060119	Hematocrit	1	2	3	4	5	NA
060120	Urine specific gravity	1	2	3	4	5	NA
060106	Orthostatic hypotension	1	2	3	4	5	NA
060108	Adventitious breath sounds	1	2	3	4	5	NA

Outcome Overall Rating	Severe 1	Substantial 2	Moderate 3	Mild 4	None 5	NA
Indicators:						
060110 Ascites	1	2	3	4	5	NA
060111 Neck vein distention	1	2	3	4	5	NA
060112 Peripheral edema	1	2	3	4	5	NA
060113 Soft, sunken eyeballs	1	2	3	4	5	NA
060114 Confusion	1	2	3	4	5	NA
060115 Thirst	1	2	3	4	5	NA
060123 Muscle cramps	1	2	3	4	5	NA
060124 Dizziness	1	2	3	4	5	NA

Source: Moorhead, Johnson, Maas, & Swanson, 2013

Appendix E

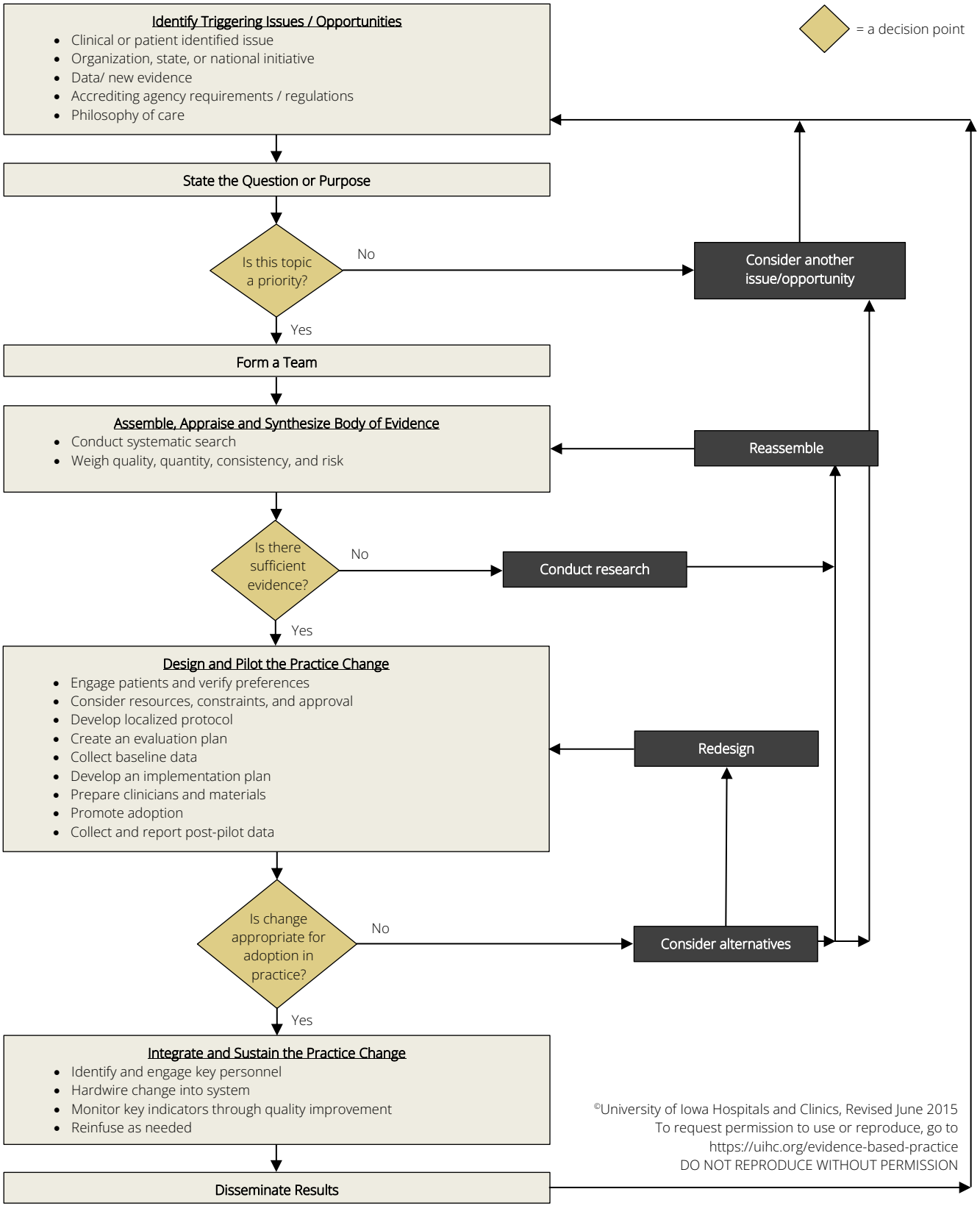
Guideline Implementation Process

Appendix E contains tools to assist in implementing this guideline into practice. These tools include:

- Appendix E.1: The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care©
- Appendix E.2: Implementation Strategies for Evidence-Based Practice

Appendix E.1

The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care©



Appendix E.2

Implementation Strategies for Evidence-Based Practice

	Create Awareness & Interest	Build Knowledge & Commitment	Promote Action & Adoption	Pursue Integration & Sustained Use
Connecting with Clinicians, Organizational Leaders and Key Stakeholders	• Highlight advantages* or anticipated impact* • Highlight compatibility* • Continuing education programs* • Sound bites* • Journal club* • Slogans & logos • Staff meetings • Unit newsletter • Unit inservices • Distribute key evidence • Posters and postings/ fliers • Mobile 'show on the road' • Announcements & broadcasts	• Education (e.g., live, virtual or computer-based)* • Pocket guides • Link practice change & power holder/stakeholder priorities* • Change agents (e.g., change champion*, core group*, opinion leader*, thought leader, etc.) • Educational outreach or academic detailing* • Integrate practice change with other EBP protocols* • Disseminate credible evidence with clear implications for practice* • Make impact observable* • Gap assessment/gap analysis* • Clinician input* • Local adaptation* & simplify* • Focus groups for planning change* • Match practice change with resources & equipment • Resource manual or materials (i.e., electronic or hard copy) • Case studies	• Educational • outreach/academic detailing* • Reminders or practice prompts* • Demonstrate workflow or decision algorithm • Resource materials and quick reference guides • Skill competence* • Give evaluation results to colleagues* • Incentives* • Try the practice change* • Multidisciplinary discussion & troubleshooting • "Elevator speech" • Data collection by clinicians • Report progress & updates • Change agents (e.g., change champion*, core group*, opinion leader*, thought leader, etc.) • Role model* • Troubleshooting at the point of care/ bedside • Provide recognition at the point of care*	• Celebrate local unit progress* • Individualize data feedback* • Public recognition* • Personalize the message to staff (e.g., reduces work, reduces infection exposure) based on actual improvement data • Share protocol revisions with clinician that are based on feedback from clinicians, patient or family • Peer influence • Update practice reminders
Building Organizational System Support	• Knowledge broker(s) • Senior executives' announcements • Publicize new equipment	• Teamwork* • Troubleshoot use/ application* • Benchmark data* • Inform organizational leaders* • Report within organizational infrastructure* • Action plan* • Report to senior leaders	• Audit key indicators* • Actionable and timely data feedback* • Non-punitive discussion of results* • Checklist* • Documentation* • Standing orders* • Patient reminders* • Patient decision aides* • Rounding by unit & organizational leadership* • Report into quality improvement program* • Report to senior leaders • Action plan* • Link to patient/ family needs & organizational priorities • Unit orientation • Individual performance evaluation	• Audit and feedback* • Report to senior leaders* • Report into quality improvement program* • Revise policy, procedure or protocol* • Competency metric for discontinuing training • Project responsibility in unit or organizational committee • Strategic plan* • Trend results* • Present in educational programs • Annual report • Financial incentives* • Individual performance evaluation

* = Implementation strategy is supported by at least some empirical evidence in healthcare

Source: Cullen et al., 2018

Appendix F

Hydration Management Knowledge Assessment Test

Instructions: The individual who will be managing the use and training of this protocol should be the only one who has access to this test key. Following proper training with regard to this protocol, each individual who will be using the Hydration Management practice protocol should be given an opportunity to take this test. Please do not use this test as part of the typical evaluation, but instead this test should be used as a learning tool only. Please have each person take this test without the key present, and once he/she is done, let them code how many questions they answered correctly and incorrectly. Guidance in determining why he/she answered as they did can also be part of the learning process.

Knowledge Assessment Test Key

1. D
2. A
3. A
4. B
5. D
6. A
7. C
8. A
9. B
10. B

Hydration Management
Knowledge Assessment Test

1. An assessment for problems with hydration should include all but one of the following:

   A. Weight
   B. vital signs
   C. measure of cognitive status
   D. hearing assessment

2. Risk factors for dehydration include all but one of the following:

   A. >65 years of age
   B. few ingestion times
   C. functionally semi-dependent
   D. diagnosis of Alzheimer's Disease

3. Overhydration is associated with:

   A. congestive heart failure
   B. urinary tract infection
   C. febrile conditions
   D. depression

4. Older adults experience no change in thirst perception.

   A. True
   B. False

5. A hydration management intervention should include all but one of the following:

   A. Risk appraisal
   B. acute management strategies
   C. evaluation
   D. routine blood evaluations

6. Assessment of an older adult's adherence to a hydration management intervention can be accomplished through regular measurement of urine specific gravity/color.

   A. True
   B. False

7. Medications that increase the risk of dehydration are:

   A. NSAIDS
   B. Antacids
   C. Antipsychotics
   D. Beta blockers

8. One recommended fluid standard for the elderly is based on the individual's weight.

   A. True
   B. False

9. Sequelae of dehydration include:

   A. myocardial infarction
   B. acute confusion
   C. brain hemorrhage
   D. depression

10. Adherence to a hydration management guideline may increase urinary incontinence.

    A. True
    B. False

Total Score: _____

Appendix G

Process Evaluation Monitor

Instructions: The purpose of this monitor is to evaluate perceived understanding and support of each nurse in carrying out the protocol.

Scoring: Once the nurses who are using the protocol complete this Process Evaluation Monitor, the individual in charge of implementing the protocol needs to review each form with the nurse. For the nine questions, please tally up the responses provided by adding up the numbers circled. For example, if Question 1 is answered '2' and Question 2 is answered '3' and Question 3 is answered '4' the nurse's score for those three questions (2+3+4) equals 9. The total score possible on this monitor is 36, while the lowest score possible is 9. Nurses who have higher scores on this monitor are indicating that they are well-equipped to implement the protocol and understand its use and purpose. On the other hand, nurses who have relatively low scores are in need of more education and support in the use of the protocol.

Process Evaluation Monitor

Directions: Please circle the number that best communicates your perception about your use of the hydration management protocol.

Your Perception	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I feel knowledgeable to carry out the hydration management protocol.	1	2	3	4
2. Implementing the hydration management protocol enhances the quality of patient care.	1	2	3	4
3. I feel supported in my efforts to implement the hydration management protocol.	1	2	3	4
4. I feel well prepared to carry out the protocol with the assistance of unit and facility resources.	1	2	3	4
5. I am able to identify patients at risk for dehydration/overhydration.	1	2	3	4
6. I am able to identify and carry out the essential activities of the hydration management intervention.	1	2	3	4
7. I had enough time to learn about the protocol before it was implemented.	1	2	3	4
8. We are managing dehydration/overhydration better with the use of the protocol.	1	2	3	4
9. The protocol enables me to meet hydration needs of most patients.	1	2	3	4

Appendix H

Hydration Management Outcomes Monitor

Instructions: For each patient receiving the Hydration Management protocol, please complete the chart on the following page. This chart should be completed at least weekly throughout the hydration management program for each patient. For each patient receiving the hydration management intervention, please keep a record of the changes observed in his or her patient records.

Place the appropriate key criteria next to the three separate outcomes for each patient assessment. A total of 8 boxes have been provided, which represent the first eight weeks.

EXAMPLE

Directions: Please place the appropriate key next to the outcomes for each assessment period.

Criteria Key: Y = Yes/met criteria N = No/criteria not met J = Justified Variation

(Justified Variation e.g. patient not included in the monitor; note ***why*** patient is not included)

WEEK:	1	2	3	4	5	6	7	8
Outcome 1: Patient Interview/ observation reveals that the patient is hydrated	N	N	N	Y	Y	Y	Y	Y

HYDRATION MANAGEMENT OUTCOMES MONITOR

Directions: Please place the appropriate key next to the outcomes for each assessment period.

Criteria Key: Y = Yes/met criteria N = No/criteria not met J = Justified Variation

(Justified Variation e.g. patient not included in the monitor; note ***why*** patient is not included)

WEEK:	1	2	3	4	5	6	7	8
Outcome 1: Patient Interview/ observation reveals that the patient is hydrated								
Outcome 2: Patient Record reveals that patient is meeting his/her daily fluid goal either through intake/output records or urine specific gravity/color readings.								
Outcome 3: Patient record reveals improvement in incontinence/infections/acute confusion in patients who previously exhibited these problems.								

Comments:

REFERENCES

Abdelhamid, A., Bunn, D., Copley, M., Cowap, V., Dickinson, A., Gray, L., ... & Poland, F. (2016). Effectiveness of interventions to directly support food and drink intake in people with dementia: systematic review and meta-analysis. *BMC geriatrics*, *16*(1), 26.

Adams, F. (1988). How much do elders drink? *Geriatric Nursing, 9*(4), 218-221.

Ainslie, P., Campbell, I., Frayn, K., Hymphreys, S., MacLaren, D., Reilly, T., & Westerterp, K. (2002). Energy balance, metabolism, hydration, and performance during strenuous hill walking: the effect of age. *Journal of Applied Physiology, 93,* 714-723.

Albert, S., Nakra, B., Grossberg, G., & Caminal E. (1993). Drinking behavior and vasopressin responses to hyperosmolality in Alzheimer's Disease, *International Psychogeriatrics, 6,* 79-86.

Albert, S., Nakra, B., Grossberg, G., & Caminal, E. (1989). Vasopressin response to dehydration in Alzheimer's Disease. *Journal of the American Geriatrics Society, 37,* 843-847.

American Society of Anesthesiologists (ASA). (2011). Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: An updated report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology, 114,* 495-511. Doi: 10.1097/ALN.0b013e3181fcbfd9.

Armstrong, L. E., & Armstrong, L. E. (2000). *Performing in extreme environments* (Vol. 1). Champaign, IL: Human kinetics.

Armstrong, L. Kavouras, S., Walsh, N., & Roberts, W. (2016). Diagnosing dehydration? Blend evidence with clinical observations. *Current Opinion in Clinical Nutrition and Metabolic Care 19*(6): 434-438.

Armstrong, L., Herrera Soto, J., Hacker, F., Kavouras, S., & Maresh, C. (1998). Urinary Indices during dehydration, exercise, and rehydration. *International Journal of Sport Nutrition, 8,* 345-355.

Armstrong, L., Maresh, C., Castellani, J., Bergeron, M., Kenefick, R., La Grasse, K., & Riebe, D. (1994). Urinary indices of hydration status. *International Journal of Sport Nutrition, 4,* 265-279.

Armstrong-Esther, C., Browne, K., Armstrong-Esther, D., & Sander, L. (1996). The institutionalized elderly: Dry to the bone! *International Journal of Nursing Studies, 33,* 619-628.

Batscha, C. (1997). Heat Stroke. Keeping your patients cool in the summer. *Journal of Psychosocial Nursing, 35*(7), 12-17.

Beattie, E., O'Reilly, M., Strange, E., Franklin, S., & Isenring, E. (2014). How much do residential aged care staff members know about the nutritional needs of residents? *International Journal of Older People Nursing, 9* (1): 54-64. Doi:10.1111/opn.1216

Beaujean, D., Blok, H., Vandenbroucke-Grauls, C., Weersink, A., Raymakers, J., & Verhoef, J. (1997). Surveillance of nosocomial infections in geriatric patients. *Journal of Hospital Infection. 36,* 275-284.

Bennett, J., Thomas, V., Riegel, B. (2004). Unrecognized chronic dehydration in older adults *Journal of Gerontological Nursing, 30* (11), 22-28.

Bossingham, M., Carnell, N., & Campbell, W. (2005). Water balance, hydration status, and fat-free mass hydration in younger and older adults. *American Journal of Clinical Nutrition, 81,* 1342-1350.

Bristow, M., & Kohen, D. (1996). Neuroleptic malignant syndrome. *British Journal of Hospital Medicine, 55,* 517-520.

Bruera, E., Belzile, M., Watanabe, S. & Fainsinger, R. L. (1996). Volume of hydration in terminal cancer patients. *Support Care Cancer, 4*(2), 147-50.

Bruera, E., Hui, D., Dalal, S., Torres-Vigil, I., Trumble, J. Roosth, J., ... &Tarleton, K. (2012). Parenteral hydration in patients with advanced cancer: A multi-center, double-blind, placebo-controlled randomized trial. *Journal of Clinical Oncology, 31,* 111-118. Doi 10.1200/JCO.2012.44.6518.

Bruera, E., Sala, R., Rico, M. A., Moyano, J., Centeno, C., Wille, J., & Palmer, L (2005). Effects of parenteral hydration in terminally ill cancer patients: A preliminary study. Journal of Clinical Oncology. 23(10):2366-2371.

Bulechek, G. M., Butcher, H. K., Dochterman, J. M., & Wagner, C. (2013). *Nursing interventions classification (NIC) 6: Nursing interventions classification (NIC).* St. Louis: Mosby Elsevier.

Bunn, D., Jimoh, F., Wilsher, S.H., & Hooper, L. (2015). Increasing fluid intake and reducing dehydration risk in older people living in long-term care: Asystematic review. *Journal of the American Medical Directors Assocaition,16,* 01-113. Doi: 10.1016/j.jamda.2014.10.016.

Burge, G. (1993). Dehydration symptoms of palliative care cancer patients, *Journal of Pain Symptom Management, 8,* 454-464.

Burns, D. (1992). Working up a thirst. *Nursing Times, 88*(62), 44-45.

Butler, A. M. & Talbot, N. B. (1948). Parental fluid therapy: estimation and provision of daily maintenance requirements. *New England Journal of Medicine, 231,* 585-590.

Centers for Medicare & Medicaid Services (2016). Long Term Care Facility Resident Assessment Instrument 3.0 Manual Version 1.14. Washington DC: Department of Health & Human Services. accessed August 4, 2017 at https://downloads.cms.gov/files/MDS-30-RAI-Manual-V114-October-2016.pdf

Chan, J., Knutsen, S., Blix, G., Lee, J., & Fraser, G. (2002). Water, other fluids, and fatal coronary heart disease. *American Journal of Epidemiology, 155,* 827-833.

Chassagne, P., Druesne, L., Capet, C., Menard, JF., & Bercoff, E. (2006). Clinical presentation of hypernatremia in elderly patients: A case control study. *Journal of the American Geriatrics Society, 54,* 1225-1230.

Chernoff, R. (1994). Meeting the nutritional needs of the elderly in the institutional setting. *Nutrition Review, 52*(4), 132-136.

Chidester, J., & Spangler, A. (1997). Fluid intake in the institutionalized elderly. *Journal of the American Dietetic Association, 97,* 23-28.

Clark, N. (1992). Fluid facts. What, when and how much to drink. *The Physician and Sports Medicine, 20,* (11), 33-36.

Colling, J., Owen, T. & McCreedy, M. (1994). Urine volumes and voiding patterns among incontinent nursing home residents. *Geriatric Nursing, 15*(4), 188-192.

Cosgray, R., Davidhizar, R., Giger, J., & Kreisl, R. (1993). A program for water-intoxicated patients at a state hospital. *Clinical Nurse Specialist, 7*(2), 55-61.

Crenshaw, J., & Winslow, E. (2002). Preoperative fasting: Old habits die hard, American *Journal of Nursing, 102*(5), 36-44.

Cullen, L., Hanrahan, K., Farrington, M., DeBerg, J., Tucker, S., & Kleiber, C. (2018). *Evidence-based practice in action: Comprehensive strategies, tools, and tips from the University of Iowa Hospitals and Clinics.* Indianapolis, IN: Sigma Theta Tau International.

Culp, K, Wakefield B.,Dyck, M., Cacchione, P, DeCrane, S., & Decker, S. (2004). Bioelectrical impedance analysis and other hydration parameters as risk factors for delirium in rural nursing home residents, *Journals of Gerontology Biological and Medical Science, 59,* 813-817.

Culp, K., Mentes, J., & Wakefield, B. (2003). Hydration and acute confusion in long-term care residents. *Western Journal of Nursing Research.25,* 251-266.

de Castro, J. (1992). Age-related changes in natural spontaneous fluid ingestion and thirst in humans. *Journal of Gerontology, 47,* 321-330.

Doucet, J., Jego, A., Noel, D., Geffroy, C. E., Capet, C., Coquard, A., ... & Bercoff, E. (2002). Preventable and non-preventable risk factors for adverse drug events related to hospital admissions in the elderly. *Clinical drug investigation*, *22*(6), 385-392.

Dunne, T., Neargarder, S., ipolloni, P., & Crpmom-Golomb, A. (2004). Visual contrast enhances food and liquid intake in advanced Alzheimer's disease. Clinical Nutrition, 23 (4), 533-538.

Eaton, D., Bannister, P., Mulley, G., & Connolly, M. (1994). Axillary sweat in clinical assessment of dehydration in ill elderly patients. *British Medical Journal, 308,* 1271.

Ellershaw, J., Sutcliffe, J., & Sanders, C. (1995). Dehydration and the dying patient, *Journal of Pain Symptom Management, 10,* 192-197.

El-Sharkawy, A. M., Watson, P., Neal, K. R., Ljungqvist, O., Maughan, R. J., Sahota, O., & Lobo, D. N. (2015). Hydration and outcome in older patients admitted to hospital (The HOOP prospective cohort study). *Age and ageing*, *44*(6), 943-947.

European Food Safety Authority (EFSA) Panel on Dietetic Products, Nutrition, and Allergies. (2010). Scientific Opinion on Dietary Reference Values for water. *EFSA Journal*, *8*(3):1459. http://www.efsa.europa.eu/en/efsajournal/pub/1459.htm

Fainsinger, R., & Bruera, E., (1997). When to treat dehydration in a terminally ill patient? *Support Care Cancer, 5,* 205-211.

Farrell, M. J., Zamarripa, F., Shade, R., Phillips, P. A., McKinley, M., Fox, P. T., ... & Egan, G. F. (2008). Effect of aging on regional cerebral blood flow responses associated with osmotic thirst and its satiation by water drinking: a PET study. *Proceedings of the National Academy of Sciences*, *105*(1), 382-387.

Faull, C., Holmes, C., & Baylis, P. (1993). Water balance in elderly people: Is there a deficiency of vasopressin? *Age and Aging, 22,* 114-120.

Ferry, M. (2005). Strategies for ensuring good hydration in the elderly. *Nutrition Reviews*, *63*(6 pt. 2), S22–S29.

Food and Nutrition Board (1989). *Recommended Dietary Allowances.* 10th Edition. Washington, DC: National Academy Press.

Foreman, M. (1989). Confusion in hospitalized elderly: Incidence, onset and associated factors. *Research in Nursing & Health, 12,* 21-29.

Fortes, M.B., Owen, J.A., Raymond-Barker, P., Bishop, C., Elghenzai, S., Oliver, S.J. & Walsh, N.P. (2015) Is this elderly patient dehydrated? Diagnostic accuracy of hydration assessment using physical signs, urine and saliva markers. *Journal of American Medical Directors Association, 16,*221-228. Doi:10.1016/j.jamda.2014.09.012.

Frangeskou, M., Lopez-Valcarel, B., & Serra-Majem, L. (2015). Dehydration in the elderly: A review focused on economic burden. *Journal of Nutrition Health and Aging, 19,* 619-627.

Gaspar, P. (1988). What determines how much patients drink? *Geriatric Nursing, 9*(4), 221-224.

Gaspar, P. (1999). Water intake of nursing home residents. *Journal of Gerontological Nursing, 25*(4), 22-29.

Gaspar, P.M. (2011). Comparison of four standards for determining adequate water intake of nursing home residents. *Research and Theory for Nursing Practice: An International Journal, 25* (1), 11-22, DOI:10.1891/0889-7182.25.1.11.

Godfrey, H., Cloete, J., Dymond, E., & Long, A. (2012) .An exploration of the hydration care of older people: a qualitative study. *International Journal of Nursing Studies, 49*(10): 1200-1211.

Gordon, J., An, L., Hayward, R., & Williams, B. (1998). Initial emergency department diagnosis and return visits: Risk versus perception. *Annals of emergency medicine, 32,* 569-573.

Gross, C. R., Lindquist, R. D., Woolley, A. C., Granieri, R., Allard, K., & Webster, B. (1992). Clinical indicators of dehydration severity in elderly patients. *The Journal of emergency medicine*, *10*(3), 267-274.

Gross, C., Lindquist, R., Anthony, W., Granieri, R., Allard, K., & Webster, B. (1992). Clinical indicators of dehydration severity in elderly patients. *The Journal of Emergency Medicine, 10,* 267-274.

Hart, M., & Adamek, C. (1984). Do increased fluids decrease urinary stone formation? *Geriatric Nursing, 5*(July/August), 245-248.

Hert, M., & Huseboe, J. (1998). Evidence-Based Protocol: Management of Constipation. In M. G. Titler (Series Ed.), *Series on Evidence-Based Practice for Older Adults.* Iowa City, IA: The University of Iowa College of Nursing Gerontological Nursing Interventions Research Center, Research Dissemination Core.

Himmelstein, D., Jones, A., & Woolhandler, S. (1983). Hypernatremic dehydration in nursing home patients: An indicator of neglect. *Journal of American Geriatrics Society, 31,* 466-471.

Hodgkinson, B., Evans, D., & Wood, J. (2003). Maintaining oral hydration in older adults: A systematic review. *International Journal of Nursing practice, 9* (3), S19-S28.

Holben, D. H., Hassell, J. T., Williams, J. L., & Helle, B. (1999). Fluid intake compared with established standards and symptoms of dehydration among elderly residents of a long-term-care facility. *Journal of the Academy of Nutrition and Dietetics*, *99*(11), 1447.

Hooper, L., Abdelhamid, A., Ali, A., Bunn, D. K., Jennings, A., John, W. G., ... & Walsh, N. P. (2015). Diagnostic accuracy of calculated serum osmolarity to predict dehydration in older people: adding value to pathology laboratory reports. *BMJ open*, *5*(10), e008846.

Hooper, L., Abdelhamid, A., Attreed, N. J., Campbell, W. W., Channell, A. M., Chassagne, P., ... & Gaspar, P. M. (2015). Clinical symptoms, signs and tests for identification of impending and current water-loss dehydration in older people. *Cochrane Database of Systematic Reviews*, (4).

Hooper, L., Bunn, D. K., Abdelhamid, A., Gillings, R., Jennings, A., Maas, K., ... & Potter, J. F. (2016). Water-loss (intracellular) dehydration assessed using urinary tests: how well do they work? Diagnostic accuracy in older people. *The American journal of clinical nutrition*, *104*(1), 121-131.

Hooper, L., Bunn, D. K., Downing, A., Jimoh, F. O., Groves, J., Free, C., ... & Shepstone, L. (2015). Which frail older people are dehydrated? The UK DRIE study. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *71*(10), 1341-1347.

Hooper, L., Bunn, D., Jimoh, F.O., Fairweather-Tait, S.J. (2013). Water-loss dehydration and aging. *Mechanisms of Aging and Development, 136-137,* 50-58. Doi. 10.1016/jmad.2013.11.009.

Institute of Medicine Panel on Dietary References for Electrolytes and Water, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food & Nutrition Board. (2005). *Dietary references intakes for water, potassium, sodium, chloride, and sulfate, pp. 73-185.* Retrieved Sept 30, 2009, from National Academies Press online: http://www.nap.edu/catalog/10925.html.

Institute of Medicine. Panel on Dietary Reference Intakes for Electrolytes and Water. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate.* Washington DC, USA: National Academies Press, 2004.

Jacobs, L. (1996). The neuroleptic malignant syndrome: Often an unrecognized geriatric problem. *Journal of the American Geriatrics Society, 44,* 474-475.

Jimoh, F.O., Bunn, D., & Hooper, L. (2015). Assessment of a self-reported drinks diary for the estimation of drinks intake by care home residents: Fluid intake study in the elderly (FISE). *The Journal of Nutrition, Health and Aging, 19(5):491-6*

Josseran, L., Caillere, N., Brun-Ney, D., Rottner, J., Filleul, L., Brucker, G., & Astagneau, P. (2009). Syndromic surveillance and heat wave morbidity: a pilot study based on emergency departments in France. *BMC Medical Informatics and Decision Making, 9* (14). Doi: 10.1186/1472-6947-9-14.

Kavouras, S. (2002). Assessing hydration status. *Current Opinion in Clinical Nutrition and Metabolic Care, 5,* 519-524.

Kayser-Jones, J., Schell, E., Porter, C., Barbaccia, J., & Shaw, H. (1999). Factors contributing to dehydration in nursing homes: Inadequate staffing and lack of professional supervision. *Journal of the American Geriatrics Society, 47,* 1187-1194.

Kelly, J., Hunt, BJ, Lewis, RR, Swaminathan, R., Moody, A., Seed, PT, & Rudd, A. (2004). Dehydration and venous thromboembolism after acute stroke, *QJ Medicine, 97*, 293-296.

Kenny, W. L., & Chui, P (2001). Influence of age on thirst and fluid intake, *Medicine & Science in Sports and Exercise, 33,* 1524-1532.

Kinahan, J. C., NiChorcorain, A., Cunningham, S., Freyne, A., Cooney, C., Barry, S., & Kelly, B. D. (2015). Risk factors for polyuria in a cross-section of community psychiatric lithium-treated patients. *Bipolar disorders*, *17*(1), 50-62.

Kinoshita, K., Hattori, K., Ota, Y., Kanai, T.,Shimizu, M., Kobayashi, H., & Tokuda, Y. (2013). The measurement of axillary moisture for the assessment of dehydration among older patients: a pilot study. *Experimental Gerontology, 48*(2): 255-258.

Kositzke, J. (1990). A question of balance. Dehydration in the elderly. *Journal of Gerontological Nursing 16* (5), 4-11.

Lancaster, K., Smiciklas-Wright, H., Heller, D., Ahern, F., & Jensen, G. (2003). Dehydration in Black and White older adults using diuretics. *Annals of Epidemiology, 13,* 525-529.

Lavisso-Mourey, R., Johnson, J., & Stolley, P. (1988). Risk factors for dehydration among elderly nursing home residents. *Journal of the American Geriatrics Society, 36,* 213-218.

Leaf, A. (1984). Dehydration in the elderly. *New England Journal of Medicine, 311,* 791-792.

Lin, L., Lee, J., Hung, Y., Chang, C., & Yang, J. (2014). BUN/creatinine ratio-based hydration for preventing stroke-in-evolution after acute ischemic stroke. *American Journal of Emergency Medicine, 32,* 709-712. Doi. 10.1016/j.ajem.2014.03.045.

Lindeman, R., Tobin, J., & Shock, N. (1985). Longitudinal studies on the rate of decline in renal function with age. *Journal of the American Geriatrics Society, 33,* 278-285.

Mack, G., Weseman, C., Langhans, G., Scherzer, H., Gillen, C., & Nadel, E. (1994). Body fluid balance in dehydrated healthy older men: thirst and renal osmoregulation. *Journal of Applied Physiology, 76*, 1615-1623.

Mange, K., Matsuura, D., Cizman, B., Soto, H., Ziyadeh, F., Goldfarb, S., & Neilson, E. (1997). Language guiding therapy: The case of dehydration versus volume depletion. *Annals of Internal Medicine, 127*, 848-853.

Marra, M. V., Simmons, S. F., Shotwell, M. S., Hudson, A., Hollingsworth, E. K., Long, E., ... & Silver, H. J. (2016). Elevated serum osmolality and total water deficit indicate impaired hydration status in residents of long-term care facilities regardless of low or high body mass index. *Journal of the Academy of Nutrition and Dietetics*, *116*(5), 828-836.

Martof, M., & Knox, D. (1997). The effect of xanthines on fluid balance. *Clinical Nursing Research, 6*, 186-196.

Masotti, L., Ceccarelli, E., Cappelli, R., Barabesi, L., Guerrini, M., & Forconi, S. (2000). Length of hospitalization in elderly patients with community acquired pneumonia. *Aging Clinical Experimental Research, 12*, 35-41.

Maughan, RJ & Griffin, J. (2003). Caffeine ingestion and fluid balance: a review. *Journal of Human Nutrition and Dietetics 16,* 411-420.

McConnell, J. (1984). Preventing urinary tract infections...nursing measures alone reduced UTI in a nursing home. *Geriatric Nursing -American Journal of Care for the Aging, 5*(8), 361-362.

McGrail, A., & Kelchner, L. (2012). Adequate oral fluid intake in hospitalized stroke patients: does viscosity matter? *Rehabilitation Nursing, 37*(5):252-7.

McGrail, A., & Kelchner, L. (2015). Barriers to oral fluid intake: Beyond thickened fluids. *Journal of Neuroscience Nursing, 47,* 58-63.

Meier, D. E, Ahronheim, J. C, Morris, J., Baskin-Lyons, S., & Morrison, S. R. (2001). High short-term mortality in hospitalized patients with advanced dementia: lack of benefit of tube feeding. *Archives of Internal Medicine*. *161*(4), 594–599.

Mentes, J & Aronow, H. (2016). Comparing older adults presenting with dehydration as a primary diagnosis versus a secondary diagnosis in the emergency department. *Journal of Aging Research & Clinical Practice, 5,*181-186. dx.doi.org/10.14283/jarcp.2016.118

Mentes, J. & Culp, K. (2003). Reducing hydration-linked events in nursing home residents, *Clinical Nursing Research*, *12, 210-225.*

Mentes, J. (2006). A typology of oral hydration problems exhibited by frail nursing home residents. *Journal of Gerontological Nursing, 32* (1), 13-21.

Mentes, J. C. (2001). *Hydration management: A long-term care nursing intervention to prevent acute confusion and other hydration-linked events* (Unpublished doctoral dissertation). University of Iowa, Iowa City, IA.

Mentes, J. C., & Iowa-Veterans Affairs Nursing Research Consortium (IVANRC). (2000). Hydration Management research-based protocol. *Journal of Gerontological Nursing, 26* (10), 6-15.

Mentes, J. C., Chang, B. L., & Morris, J. (2006). Keeping Nursing home residents hydrated. *Western Journal of Nursing Research, 28*(4), 392-406.

Mentes, J., & Buckwalter, K. (1997). Getting back to basics. Managing hydration to prevent acute confusion in frail elders. *Journal of Gerontological Nursing, 23*(10), 48-51.

Mentes, J., & Wang, J. (2011). Measuring risk for dehydration in nursing home residents. *Research in Gerontological Nursing.* May 31:1-9.

Mentes, J., Culp, K., Maas, M., & Rantz, M. (1999). Acute confusion indicators: Risk factors and prevalence. Using MDS data. *Research in Nursing & Health, 22,* 95-105.

Mentes, J., Culp, K., Wakefield, B., Gaspar, P., Rapp, C.G., Mobily, P., & Tripp-Reimer, T. (1998). Dehydration as a precipitating factor in the development of acute confusion in the frail elderly. *Facts, Research and Interventions in Geriatrics.* New York: Springer Publishing Company.

Mentes, J., Wakefield, B., & Culp, K. (2006). Use of a urine color chart to monitor hydration status in nursing home residents. *Biological Research for Nursing ,7,* 197-203.

Metheny, N. (2000). *Fluid and electrolyte balance. Nursing Considerations* (4rd Ed.). St. Louis, MO: Lippincott, Williams, & Wilkins.

Michaud, D., Spiegelman, D., Clinton, S., Rimm, E., Curhan, G., Willett, W., & Giovannucci, E. (1999). Fluid intake and the risk of bladder cancer in men. *The New England Journal of Medicine, 340,* 1390-1397.

Miescher, E., & Fortney, S. (1989). Responses to dehydration and rehydration during heat exposure in young and older men. *American Journal of Physiology, 257*(26), R1050-R1056.

Miller, D. K., Perry, H. M., & Morley, J. E. (1998). Relationship of dehydration and chronic renal insufficiency with function and cognitive status in older US blacks. *Hydration and Aging. Facts, Research, and Intervention in Geriatric Series*, 149-159.

Mion, L. C., & O'Connell, A. (2003). Parenteral hydration and nutrition in the geriatric patient: Clinical and ethical issues. *Journal of Infusion Nursing*. 26(3), 144-152

Mitchell, S. L, Kiely, D.K., & Lipsitz, L. A. (1997). The risk factors and impact on survival of feeding tube placement in nursing home residents with severe cognitive impairment. *Archives of Internal Medicine*. 157(3), 327–332.

Moorhead, S., Johnson, M., Maas, M., & Swanson, E. (2013). Nursing Outcomes Classification (NOC). (5th ed.). St. Louis, MO: Mosby Elsevier

Morgan, A., Masterson, M., Fahlman, M., Topp, R., & Boardley, D. (2003). Hydration status of community-dwelling seniors. *Aging Clinical and Experimental Research, 15*, 301-304.

Morita, T., Tei, Y., Tsunoda, J., Inoue, S., & Chihara, S. (2001). Determinants of the sensation of thirst in terminally ill cancer patients, *Support Care Center, 9,* 177-186.

Mueller, K., & Boisen, A. (1989). Keeping your patient's water level up. *RN, 52,* 65-6,

Mukand, J., Cai, C., Zielinski, A., Danish, M., & Berman, J. (2003). The effects of dehydration on rehabilitation outcomes of elderly orthopedic patients. *Archives of Physical Medicine Rehabilitation, 84,* 58-61.

Murray, J., Doeltgen, S.,Miller, M., &Scholten, I. (2015). A Descriptive Study of the Fluid Intake, Hydration, and Health Status of Rehabilitation Inpatients without Dysphagia Following Stroke. *Journal of Nutrition in Gerontology and Geriatics, 34*(3): 292-304.

Musson, N. D., Kincaid, J., Ryan, P., Glussman, B., Varone, L., Gamarra, N., ... & Silverman, M. (1990). Nature, nurture, nutrition: Interdisciplinary programs to address the prevention of malnutrition and dehydration. *Dysphagia*, *5*(2), 96-101.

Nutrition Screening Initiative (1992). Nutrition intervention manual for professionals caring for older Americans. Washington D.C.: Greer, Margolis, Mitchell, Grunwald & Associates, Inc.

O'Neill, P., Duggan, J., & Davies, I. (1997). Response to dehydration in elderly patients in long-term care. *Aging Clinical Experimental Research, 9,* 372-377.

Oates, L. & Price, C. (2017). Clinical assessments and care interventions to promote oral hydration amongst older patients: a narrative systematic review. *BioMed CentralNursing*, *16*: 4.

O'Keeffe, ST., & Lavan, JN. (1996). Predicting delirium in elderly patients: Development and validation of a risk-stratification model. *Age and Aging, 25,* 317-321.

Okuyama, M. & Nishida, M. (2016). The physical signs of impending dehydration among elderly people in nursing homes: The association with axillary skin temperature, humidity, intraoral moisture content, and salivary components. *Nihon Ronen Igakkai Zasshi 53*(4): 379-386.

Oliver, S., Laing, S., Wilson, S., Bilzon, J., & Walsh, N. (2008). Saliva indices track hypohydration during 48 h of fluid restriction or combines fluid and energy restriction. *Archives of Oral Biology, 53,* 975-980.

Omnibus Budget Reconciliation Act of 1987 and 1990. 6.2 CFR § 483.25.

Palevsky, P., Bhagrath, R., & Greenberg, A. (1996). Hypernatremia in hospitalized patients. *Annals of Internal Medicine, 124,* 127-203.

Pals, J., Weinberg, D., Beal, L., Levesque, P., Cunningham, T., & Minaker, K. (1995). Clinical triggers for detection of fever and dehydration: Implications for long-term care nursing. *Journal of Gerontological Nursing, 21*(4), 13-19.

Perrier, E., Demazières, A., Girard, N., Pross, N., Osbild, D., Metzger, D., ... & Klein, A. (2013). Circadian variation and responsiveness of hydration biomarkers to changes in daily water intake. *European journal of applied physiology*, *113*(8), 2143-2151.

Phillips, P., Bretherton, M., Johnston, C., & Gray, L. (1991). Reduced osmotic thirst in healthy elderly men. *American Journal of Physiology, 261,* R166-R171.

Phillips, P., Johnston, C., & Gray, I. (1993). Disturbed fluid and electrolyte homeostasis following dehydration in elderly people. *Age and Aging, 22*, 26-33.

Phillips, P., Rolls, B., Ledingham, J., Forsling, M., Morton, J., Crowe, M., & Wollner, L. (1984). Reduced thirst after water deprivation in healthy elderly men. *New England Journal of Medicine, 311,* 753-759.

Popkin, B. (2010). Patterns of beverage use across the lifecycle. *Physiology & Behavior, 100,* 4-9. Epub 2010 Jan 4.

Rasouli, M., Kiasari, A., & Arab, S. (2008). Indicators of dehydration and hemoconcentration are associated with the prevalence and severity of coronary artery disease. *Clinical and Experimental Pharmacology and Physiology, 35,* 889-894.

Reed, P., Zimmerman, S., Sloane, P., Williams, C., & Boustani, M. (2005).Characteristics associated with low food and fluid intake in long-term care residents with dementia. *Gerontologist, 45 Spec No 1*(1): 74-80.

Reedy, D. (1988). How can you prevent dehydration? *Geriatric Nursing, 9*(4), 224-226.

Robinson, S., & Rosher, R. (2002). Can a beverage cart help improve hydration? *Geriatric Nursing, 23,* 208-211.

Rodrieguez, G., Cordina, S., Vazquez, G., Suri, MF, Kirmani, J., Ezzeddine, M., & Queshi, A. (2009). The hydration influence on the risk of stroke (THIRST) study. *Neurocrit Care, 10,* 187-94.

Rodrigues, S., Silva, J., Severo, M., Inácio, C., Padrão, P., Lopes, C., ... & Moreira, P. (2015). Validation analysis of a geriatric dehydration screening tool in community-dwelling and institutionalized elderly people. *International journal of environmental research and public health*, *12*(3), 2700-2717.

Rowe, J., Shock, N., & DeFronzo, R. (1976). The influence of age on the renal response to water deprivation in man. *Nephron, 17,* 270-278.

Sachdev, P., Mason, C., & Hadzi-Pavlovic, D. (1997). Case control study of neuroleptic malignant syndrome. *American Journal of Psychiatry, 154*, 1156-1158.

Schmidlin, E. (2008). Artificial hydration: The role of the nurse in addressing patient and family needs. *International Journal of Palliative Nursing. 14*(10), 485-489.

Schnelle, J. F., Leung, F. W., Rao, S. S., Beuscher, L., Keeler, E., Clift, J. W., & Simmons, S. (2010). A controlled trial of an intervention to improve urinary and fecal incontinence and constipation. *Journal of the American Geriatrics Society*, *58*(8), 1504-1511.

Seymour, D., Henschke, P, Cape, R., & Campbell, A. (1980). Acute confusional states and dementia in the elderly: The role of dehydration/volume depletion, physical illness and age. *Age and Aging, 9,*137-146.

Sheehy, C. & Hall, G. (1998). Rethinking the obvious. A model for preventing constipation. *JGN, 24*(3), 38-44.

Silver, A. (1990). Aging and risks for dehydration. *Cleveland Clinic Journal of Medicine, 57,* 341-344.

Simmons, S., Alessi, C., & Schnelle, J. (2001). An intervention to increase fluid intake in nursing home residents: Prompting and preference compliance. *Journal of the American Geriatrics Society, 49,* 926-933.

Skipper, A. (1993). Monitoring and complications of enteral feeding. In: Skipper, A. (Ed) *Dietitian's handbook of enteral and parenteral nutrition.* Rockville, MD: Aspen Publishers.

Smith, A., Vallance, H., & Slater, R. (1997). Shorter preoperative fluid fasts reduce postoperative emesis, British Medical Journal, 314, 1486.

Spangler, P., Risley, T., Bilyew, D. (1984). The management of dehydration and incontinence in nonambulatory geriatric patients. *Journal of Applied Behavior Analysis, 17,* 397-401.

Stookey, JD., Pieper, C.F. & Cohen, H.J. (2005): Is the prevalence of dehydration among community-dwelling older adults really low? Informing current debate over the fluid recommendation for adults aged 70+years. *Public Health Nutrition 8*, 1275-85.

Tanaka, Y., Nagata, K., Tanaka, T., Kuwano, K., Endo, H., Otani, T., ... & Koyama, H. (2009). Can an individualized and comprehensive care strategy improve urinary incontinence (UI) among nursing home residents?. *Archives of gerontology and geriatrics*, *49*(2), 278-283.

Thomas, D. R., Cote, T. R., Lawhorne, L., Levenson, S. A., Rubenstein, L. Z., Smith, D. A., ... & Council, D. (2008). Understanding clinical dehydration and its treatment. *Journal of the American Medical Directors Association*, *9*(5), 292-301.

Ullrich, S., & McCutcheon, H. (2008). Nursing practice and oral fluid intake of older people with dementia. *Journal of Clinical Nursing, 17,* 2910-2919.

Vivanti, A., Harvey, K., & Ash, S. (2010). Developing a quick and practical screen to improve the identification of poor hydration in geriatric and rehabilitative care. *Archives of Gerontology and Geriatrics, 50* (2), 156-164. Epub 2009 Apr23.

Vivanti, A., Harvey, K., Ash, S, & Battistutta, D. (2008). Clinical assessment of dehydration in older people admitted to hospital. What are the strongest indicators? *Archives of Gerontology and Geriatrics, 47* (3), 340-355. Epub 2007 Nov 9.

Wakefield, B., Mentes, J., Diggelmann, L., & Culp, K. (2002). Monitoring hydration status in elderly veterans. *Western Journal of Nursing Research, 24,* 132-142.

Wakefield, B., Mentes, J., Holman, J., & Culp, K. (2008). Risk factors and outcomes associated with hospital admission for dehydration. *Rehabilitation Nursing, 33*(6), 233-241.

Wakefield, B., Mentes, J., Holman, J., & Culp, K. (2009). Postadmission dehydration: Risk factors, indicators, and outcomes. *Rehabilitation Nursing, 34*(5), 209-216.

Wallach, J. (2000). *Interpretation of diagnostic tests 7th Ed.* Philadelphia: Lippincott Williams & Wilkins.

Walsh, N., Laing, S., Oliver, S., Montague, J., Walter, R., & Bilzon, J. (2004). Saliva parameters as potential indices of hydration status during acute dehydration. *Medicine & Science in Sports & Exercise, 36,* 1535-1542.

Warren, J., Bacon, E., Harris, T., McBean, A., Foley, D., & Phillips, C. (1994). The burden and outcomes associated with dehydration among U.S. elderly, 1991. *American Journal of Public Health, 84,* 1265-1269.

Weinberg, A., Minaker, K., & The Council on Scientific Affairs, AMA. (1995). Dehydration. Evaluation and management in older adults. *Journal of the American Medical Association, 274,* 1562-1556.

Weinburg, A., Pals, J., Levesque, P., Beals, L., Cunningham, T., & Minaker, K. (1994). Dehydration and death during febrile episodes in the nursing home. *Journal of the American Geriatrics Society, 42,* 968-971.

Whelan, K. (2001). Inadequate fluid intakes in dysphagic acute stroke. *Clinical Nutrition, 20,* 423-428.

Wolff, A., Stuckler, D., &McKee, M. (2015)."Are patients admitted to hospitals from care homes dehydrated? A retrospective analysis of hypernatraemia and in-hospital mortality. *Journal of the Royal Society of Medicine, 108*(7): 259-265.

Woods, D. L. & Mentes, J. C. (2011). Spit: Saliva in nursing research, uses and methodological consideration. *Biological Research for Nursing*. 68.

Wooten, M., & Liebman, B. (1998). Ten steps to a healthy 1998. *Nutrition Action Health Letter, 25*, (1), 1, 6-9.

Xiao, H., Barber, J., & Campbell, ES. (2004). Economic burden of dehydration among hospitalized elderly patients. *American Journal of Health-System Pharmacists, 61,* 2534-2540.

Yogendran, S., Asokumar, B., Cheng, D., & Chung, F. (1995). A prospective randomized double-blinded study of the effect of intravenous fluid therapy on adverse outcomes on outpatient surgery, *Anesthesia & Analgesia, 80,* 682-686.

Zembrzuski, C. (1997). A three-dimensional approach to hydration of elders: Administration, clinical staff, and in-service education. *Geriatric Nursing, 18*(1), 20-26.

Zembrzuski, C. (2006). Oral fluid intake and the effect on postural blood pressure and falls in skilled nursing facility residents [dissertation]. New York University, p.176.

Zizza, CA., Ellison, KJ, & Wernette, CM. (2009). Total water intakes of community living middle-old and old-old. *Journal of Gerontology Biological Sciences, 64,* 481-486.

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