

NUTRITIONAL MANAGEMENT OF INDIVIDUALS WITH CHRONIC DISEASE
AND VULNERABLE POPULATIONS FOLLOWING A DISASTER

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII AT MĀNOA IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

MASTERS OF SCIENCE

IN

NUTRITIONAL SCIENCES

MAY 2016

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DEDICATION

*To my husband,
for his patience,
unfailing love, and
constant encouragement.*

ACKNOWLEDGEMENTS

There are so many people to thank for their guidance, support, time, and dedication. First, I would like to acknowledge and thank Dr. Corilee Watters, PhD, RD, who encouraged me to pursue my graduate degree and who has faithfully guided and supported me no matter what situation or obstacles arose over the years. Next, I would like to thank the members of my thesis committee, Dr. Donald Hayes, MD, MPH, and Dr. Rachael Novotny, PhD, RDN, who have given of their time and expertise to develop me professionally. I would also like to thank the Hawaii Department of Health and Matthew Turnure, MPH, for his statistical expertise and assistance with data analysis. Finally, I would like to thank Jennifer Graf Myles, MS, RDN from NIH and Blakeley Fitzpatrick, MPH, RDN, and Suzanne Wolcuff, RDN, from the FDA for their editorial comments. I am blessed to have the opportunity to collaborate with and learn from so many excellent individuals.

ABSTRACT

Chronic diseases and related conditions (CDRCs), such as diabetes, renal disease, and cardiovascular disease affect a large proportion of the population in developed nations. Following a large scale disaster, when food, water, and medical supplies are limited, CDRCs increase the risk of adverse health outcomes in displaced populations and require nutrition intervention. Other vulnerable populations, including the elderly, breastfeeding moms, and infants are also at high risk for adverse nutrition related health outcomes following a disaster. This thesis is comprised of two research studies, which examine: a) the prevalence of CDRCs in non-institutionalized U.S. adults, b) the effect of chronic disease status, mental or emotional health status, and disability status on disaster preparedness behaviors, and c) nutritional management of vulnerable populations include those with CDRCs. Preparation for disasters by both individuals and communities is an important part of critical infrastructure needed to be able to respond, and recover from disasters.

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CHAPTER 1: OVERVIEW OF RESEARCH

INTRODUCTION

In recent years the number and severity of extreme weather events have increased which contribute to an increased prevalence of natural disasters¹. Concomitantly, the rising rates of obesity have increased prevalence of chronic disease or non-communicable disease (NCD). Historically focus has been on communicable diseases following a disaster in developing countries and guidelines are limited for developed countries. This thesis is focused on disaster preparedness of vulnerable populations which include perinatal, elderly and adults with chronic diseases, and nutrition interventions for vulnerable populations.

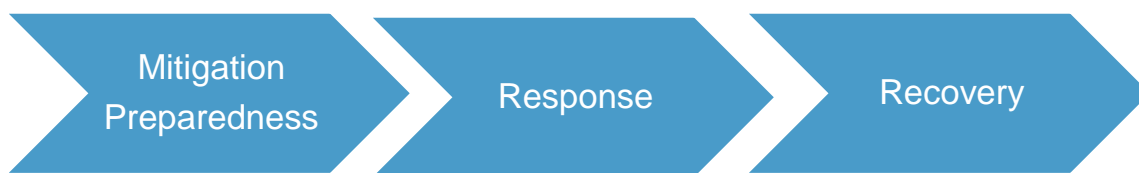
Definition of Disaster

Disasters are defined from a number of organizations and government agencies including the United Nations (UN), Federal Emergency Management Agency (*FEMA*) and U.S. Congress. The UN defines a disaster as a sudden event that causes serious disruption of the functioning of a community or a society causing widespread human, material, economic and/or environmental losses which exceed the ability of the affected community or society to cope using its own level of resource². FEMA defines disaster as an occurrence that has resulted in property damage, deaths, and/or injuries to a community³. The U.S. Congress uses the following definition of a major disaster as any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought) or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which, in the determination of the President, causes damage of

sufficient severity and magnitude to warrant major disaster assistance to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby⁴. Together these definitions designate disasters as adverse incidents that have a major impact on a population.

Phases of Disaster Management

FEMA designates disaster management into four phases which include mitigation, preparedness, response and recovery. Mitigation includes any activities that prevent or reduce the chance of an emergency happening, and/or reduce the damaging effects of unavoidable emergencies. Preparedness activities take place before an emergency occurs and include storage of disaster food and water supplies. Response activities take place during an emergency and include nutrition intervention during disasters. Recovery includes actions taken to return to a normal or an even safer situation following an emergency, and would include re-distribution of food and water resources.



This thesis focuses on Nutrition Preparedness and Nutrition Response during Disasters. In Chapter 4, suggestions for Disaster Mitigation and Recovery will be discussed.

Guidelines on Disaster Management

There are a number of prescriptive guidelines developed by accreditation and federal agencies that require organizations such as hospitals, childcare and home care facilities, and school and education institutions to develop Emergency Operations Plans.

The Centers for Medicare & Medicaid Services (CMS), a federal agency within the United States Department of Health and Human Services (HHS) that administers the Medicare program and works in partnership with state governments to administer Medicaid, has developed an Emergency Preparedness Checklist which indicates identification and maintenance of sufficient supplies and equipment to sustain operations and deliver care and services for 3-10 days, since previous recommendations of 72 hours may no longer be sufficient during some wide-scale disasters. CMS indicates this recommendation can be achieved by maintaining 72-hours of supplies on hand, and holding agreements with suppliers for the remaining days. These CMS guidelines apply to staff, patients and visitors and require the facilities to provide food, and water. Some guidelines, such as California Department of Public Health stipulate food must consider the special needs of patients/ clients including age (e.g. infants, pediatrics), and therapeutic diets (renal, diabetic, mechanically altered puree).

Individuals preparing for a disaster can find guidelines through their state Civil Defense and Emergency Management departments. FEMA has also issued a Family Emergency Planning Guide that guides families in creating a family disaster supply kit and developing a 4-step family preparedness plan⁵. The guide also provides information on considerations for functional needs and deciding whether to stay or leave during an evacuation. Although this guide does instruct individuals to prepare a three-day supply of non-perishable food for the entire family, with considerations for the family's special needs, there are no specific guidelines on the type or quantities of food that should be stocked.

RESEARCH QUESTIONS

There are two major research questions that this thesis will address:

1. Are individuals with nutrition related chronic disease and nutritionally vulnerable pediatric and elderly populations prepared for a disaster?
2. What nutrition interventions are available after a disaster to acutely treat individuals with nutrition related chronic disease and nutritionally vulnerable pediatric and elderly populations?

The questions will be studied using data from secondary analysis of population survey data, and from a systematic review of published literature and guidelines available.

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CHAPTER 2: Disaster Preparedness of individuals with chronic disease and vulnerable population

INTRODUCTION

Natural disasters and emergency situations lead to large-scale morbidity and mortality and affect a large number of healthcare practitioners and institutions worldwide. In 2013, 28 natural disasters killed a total of 252 people and affected 232,201 people in the United States alone [1]. Unlike low-income nations, whose main nutrition related concern following a major disaster is widespread malnutrition and infectious disease, disaster responders in developed countries face a large population of patients with a wide variety of chronic diseases and related conditions (CDRCs), such as diabetes, chronic renal disease, and cardiovascular disease [2].

Surveillance and survey data collected from evacuation centers housing displaced victims of Hurricane Katrina confirmed that individuals with CDRCs made up a large portion (up to 55%) of those affected by natural disasters in the United States, five of the top six conditions affecting evacuees were chronic diseases, and procurement of medication was the most important challenge for patients and providers [3-6]. Following a disaster, vulnerable populations, such as individuals with CDRCs, those experiencing mental distress, individuals with physical, mental, or emotional problems, households with children, and individuals over the age of 65, are at increased risk of adverse health outcomes due to slower response time, inability to take appropriate steps, and/or special needs that require additional supplies or modified preparedness items [7-12]. In addition, unfavorable situations caused by the disaster, such as exposure to extreme temperatures, lack of safe water, and lack of appropriate food can aggravate existing CDRCs.

Due to the potential for adverse effects and need for additional disaster response items, assessment of vulnerable populations' preparedness is essential to minimize the impact of a natural disaster on these populations. The objective of the present study was to examine the association of chronic disease status, mental or emotional health status, and disability status with disaster preparedness among Behavioral Risk Factor Surveillance System (BRFSS) survey respondents from 2006 through 2010. It is hypothesized that these vulnerable populations were less prepared than their healthier counterparts.

METHODS

Data was obtained from the BRFSS, an annual, random-digit-dialed telephone survey of the non-institutionalized U.S. civilian adult (aged ≥ 18) population on behaviors and experiences. BRFSS is supported by the Centers for Disease Control and Prevention (CDC) and carried out by state health departments. The questionnaire includes fixed and rotating core modules, optional modules, and state-added questions. The modules collect demographics and health information on disease status, health behaviors, preventive health practices, and healthcare access. Secondary data analysis was conducted on BRFSS data from 2006 to 2010 from all states which implemented the optional General Preparedness module in at least one of those years.

Six (6) household preparedness variables were included in the analysis as defined by the BRFSS questionnaire. Survey respondents were asked if their household had: 1) a 3-day supply of nonperishable food for everyone who lives in the house, 2) a 3-day supply of water for everyone who lives in the house [defined as 1 gallon per person per day], 3) a 3-day supply of prescription medication if applicable, 4) a written evacuation

plan, 5) a working radio with working batteries, 6) a working flashlight with working batteries.

Statistical Analysis

Univariate analysis was performed to describe the study population. Multivariate logistic regression models were conducted to investigate the likelihood of reporting all six (6) disaster preparedness behaviors among those with one or more chronic conditions, those with frequent mental distress, those limited in activities because of physical, mental, or emotional problems, households with children and individuals aged 65 or older. Chronic conditions were defined as diabetes (ever diagnosed), heart attack (ever), stroke (ever), and coronary heart disease (ever). Frequent mental distress was defined as fourteen (14) or more days in the past month of poor mental health. Limitation in activities was assessed with a single question that asked “Are you limited in any way in any activities because of physical, mental, or emotional problems?” Households with children were assessed by a single question that asked if there were any children in the household. Age and number of children were not assessed nor accounted for in the models. Statistical analysis was conducted using SAS, release 9.2. Adjusted prevalence ratios (APR) were calculated. Analyses were adjusted for age, sex, race, education, and marital status.

RESULTS

A total of 110,245 respondents completed the optional General Preparedness module during 2006 through 2010 in fourteen (14) states (Connecticut, Delaware, Georgia, Louisiana, Maryland, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New York, North Carolina, Pennsylvania, and Tennessee). Respondents were

primarily non-Hispanic white (76.3%); aged 35-54 (41.1%); married (61.2%); and had at least some college education (60.4%; Table 1). One-fifth (20%) reported a limitation in activities because of a physical, mental, or emotional problem; only 10.2% reported frequent mental distress; 14.4% reported having one or more chronic diseases; and 41.8% lived in a household with children (Table 2). Overall, 11.4% reported having all six preparedness items (Figure 1). Most respondents reported having a working flashlight with batteries (95%), a 3-day supply of medication for every household member that required medication (90.2%), a 3-day supply of food (83.5%), and a working radio with batteries (77.4%) (Figure 2). Just over half (53.6%) of the respondents reported having a 3-day supply of water, but only 20.3% reported having an evacuation plan.

Multivariate logistic regression showed that persons with at least one of four chronic diseases (diabetes, coronary heart disease, heart attack, stroke) were 14% more likely (APR=1.14; 1.04, 1.24) than those with no chronic disease to be prepared for a disaster (answered “yes” to all six items)(Table 3). People aged 65 or older were 46% more likely (APR=1.46; 1.26, 1.69) than those in the youngest age category, aged 18 to 34, to be prepared. Households with children were not significantly different in their likelihood to be prepared over households without children (APR=1.05; 0.96, 1.15). Those with frequent mental distress (14 or more days in the past month of poor mental health) were 19% less likely (APR=0.82; 0.72, 0.92) than those without frequent mental distress to be prepared. Finally, those limited because of physical, mental, or emotional problems were 14% less likely (APR=0.86; 0.79, 0.93) than those not limited to be prepared.

DISCUSSION

The original hypothesis that vulnerable populations are less prepared for disasters was both supported by some findings and refuted by others. While those with at least one chronic disease appear to be more prepared for a disaster than the general population, individuals with frequent mental stress and those limited in activity because of physical, mental, or emotional problems are less likely to be prepared. Unfortunately, this puts individuals who are already at risk for a poor disaster response due limited mental or functional capacity at even greater risk due to poor preparedness. This is in contrast to the finding by Bethel et al., who conducted a similar analysis on BRFSS data from six states from 2006-2008¹³. These authors only included four disaster preparedness items in their analysis and found that individuals with three or more chronic diseases are less likely to have the four items (3-day supply of water, 3-day supply of food, flashlight, and radio) than respondents without a chronic disease. Individuals with poor mental health and others with particular limitations may potentially benefit from education and outreach to help them prepare for a disaster and learn about ways to improve their response during an emergency situation.

Having children in the household was not a significant predictor of preparedness, indicating that they are about as prepared as the general population. Seniors (65 years or older) and persons with chronic diseases are more prepared than the general population; however, only 11.4% of the entire sample had all six disaster preparedness items.

This analysis focused on the prevalence of having all six disaster response items; however, there was a large variation in the prevalence of respondents reporting each individual disaster preparedness item, with 95% reporting having a working flashlight

with batteries, but only 20% reported having an evacuation plan. Further analysis into subgroup differences across the different preparedness items may reveal more useful associations that can be used to target specific preparedness items among vulnerable populations.

This study is limited by several factors. First, BRFSS data is self-reported and therefore may be subject to recall and reporting bias. The data is also cross-sectional; hence causal associations are not possible. Additionally, only four specific chronic conditions were examined (diabetes, coronary heart disease, heart attack, stroke). There are many additional diseases that may affect disaster preparedness and there could be other confounding variables that were not controlled for in data analysis. Also, since only one question on the presence of children in the household was asked, it was not possible to account for the age or number of children in the household. Finally, since indexes were used for preparedness and chronic disease, information about individual preparedness items or chronic conditions will require additional research.

Results from this study can help public health officials target vulnerable populations who are at risk for poor disaster preparedness. Future research should focus on why these groups differ in preparedness and how officials can facilitate behavior change in this area. A better understanding of the preparedness level of households with children is needed, and how the number and age of children may affect a household's disaster preparedness.

In addition, data from non-contiguous states, such as Alaska and Hawaii, needs to be collected and analyzed, as these states are more at risk for poor disaster response due to their isolated location. These states may also have a different prevalence

of chronic disease and related conditions than other states due to their native populations. Data from U.S. territories, such as Guam and Puerto Rico, should be included in future research if available.

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TABLES AND FIGURES

Table 2.1: Demographic Characteristics (n=110,1245)

	Estimate (%)	95% CI
Model primary predictors		
≥ 1 Chronic Disease	14.4	(14.0 - 14.7)
Frequent Mental Distress	10.2	(9.8 - 10.6)
Limited in Activities	20.0	(19.5 - 20.5)
Race		
White	76.3	(75.7 - 76.8)
Black	12.8	(12.4 - 13.2)
Hispanic	6.0	(5.6 - 6.4)
Other	4.9	(4.6 - 5.2)
Education		
≤ High School Graduate	39.6	(39.0 - 40.3)
Some College	25.1	(24.6 - 25.6)
College Graduate	35.3	(34.7 - 35.9)
Age		
18-34	26.7	(26.1 - 27.4)
35-54	41.1	(40.5 - 41.7)
55-64	14.6	(14.3 - 14.9)
65 and older	17.6	(17.3 - 18.0)
Sex		
Female	51.9	(51.2 - 52.5)
Male	48.1	(47.5 - 48.8)
Marital Status		
Married	61.2	(60.6 - 61.8)
Separated	17.6	(17.2 - 18.0)
Single	21.2	(20.6 - 21.8)
Children in household		
No	58.2	(57.6 - 58.8)
Yes	41.8	(41.2 - 42.4)

Note: 95% CI refers to 95% Confidence Intervals

Table 2.2: Bivariate associations of independent variables with reporting of all six preparedness behaviors

	Estimate (%)	95% CI
Model primary predictors		
≥ 1 Chronic Disease	14.7	(13.7 - 15.7)
Frequent Mental Distress	10.6	(9.4 - 11.9)
Limited in Activities	11.1	(10.4 - 11.9)
Race		
White	10.6	(10.2 - 11.0)
Black	14.5	(13.3 - 15.9)
Hispanic	13.1	(10.8 - 15.8)
Other	13.8	(11.8 - 16.2)
Education		
≤ High School Graduate	14.0	(13.4 - 14.8)
Some College	11.4	(10.7 - 12.2)
College Graduate	8.3	(7.8 - 8.9)
Age		
18-34	9.1	(8.2 - 10.1)
35-54	11.0	(10.3 - 11.6)
55-64	12.2	(11.5 - 13.0)
65 and older	14.4	(13.7 - 15.2)
Sex		
Female	10.9	(10.4 - 11.3)
Male	12.0	(11.4 - 12.7)
Marital Status		
Married	11.2	(10.7 - 11.7)
Separated	13.9	(13.0 - 14.7)
Single	9.8	(8.9 - 10.8)
Children in household		
No	11.9	(11.4 - 12.4)
Yes	10.7	(10.0 - 11.4)

Note: 95% CI refers to 95% Confidence Intervals

Table 2.3: Adjusted Prevalence Ratios

	Chronic disease		Mental distress		Mental, physical, emotional limitation	
	Adjusted PR	95% CI	Adjusted PR	95% CI	Adjusted PR	95% CI
Chronic disease	1.12	(1.03 - 1.22)				
Frequent mental distress			0.88	(0.78 - 1.00)		
Mental, physical, emotional limitations					0.86	(0.79 - 0.93)
Race						
White	ref		ref		ref	
Black	1.39	(1.25 - 1.53)	1.40	(1.26 - 1.54)	1.39	(1.26 - 1.54)
Hispanic	1.28	(1.05 - 1.56)	1.27	(1.04 - 1.55)	1.28	(1.05 - 1.56)
Other	1.43	(1.22 - 1.68)	1.42	(1.21 - 1.67)	1.43	(1.21 - 1.67)
Education						
≤ High School Graduate	1.63	(1.50 - 1.79)	1.64	(1.50 - 1.80)	1.66	(1.52 - 1.81)
Some College	1.37	(1.24 - 1.51)	1.37	(1.24 - 1.51)	1.39	(1.26 - 1.53)
College Graduate	ref		ref		ref	
Age						
18-34	ref		ref		ref	
35-54	1.21	(1.07 - 1.37)	1.22	(1.08 - 1.39)	1.25	(1.10 - 1.42)
55-64	1.36	(1.18 - 1.56)	1.38	(1.20 - 1.59)	1.44	(1.25 - 1.66)
65 and older	1.49	(1.29 - 1.73)	1.54	(1.34 - 1.78)	1.61	(1.40 - 1.85)
Sex						
Female	ref		ref		ref	
Male	1.14	(1.06 - 1.22)	1.15	(1.07 - 1.24)	1.15	(1.07 - 1.23)
Marital Status						
Married	ref		ref		ref	
Separated	1.08	(0.99 - 1.17)	1.10	(1.01 - 1.19)	1.09	(1.00 - 1.19)
Single	0.90	(0.79 - 1.01)	0.90	(0.80 - 1.02)	0.91	(0.80 - 1.02)
Children in Household						
No	ref		ref		ref	
Yes	1.05	(0.95 - 1.15)	1.05	(0.96 - 1.16)	1.04	(0.95 - 1.14)

Note: 95% CI refers to 95% Confidence Intervals

Figure 2.1: Prevalence (%) of reporting preparedness behaviors; BRFSS, 2006-2010

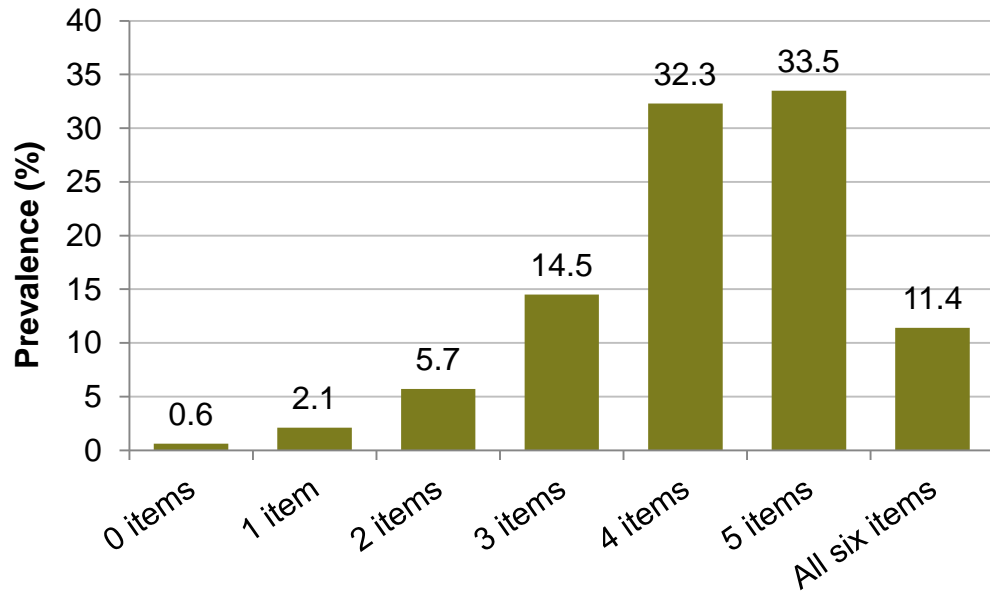
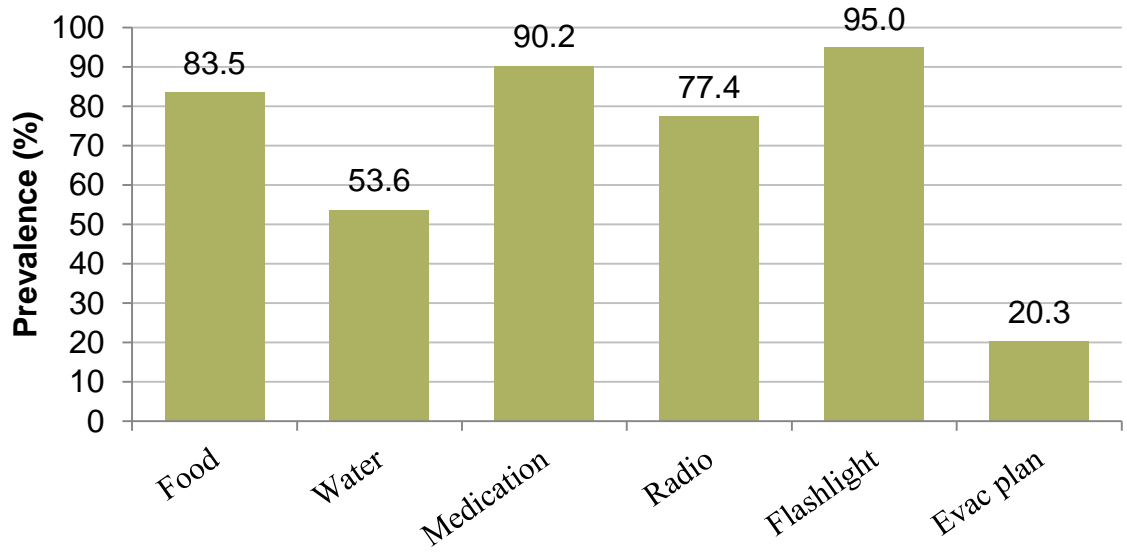


Figure 2.2: Prevalence (%) of reporting each preparedness behavior; BRFSS, 2006-2010



CHAPTER 3: Systematic Review on the Nutritional Management of Patients with Chronic Diseases and Vulnerable Populations During Natural Disasters

ABSTRACT

Background

During disasters, resources are scarce and access to traditional treatment for vulnerable populations and chronically ill may be limited. Dietitians play a key role in nutritional management of these patients while medications, therapeutic treatments, and traditional foods are unavailable. Limited guidance exists on nutritional management of disaster victims from well-nourished populations where chronic disease incidence is high. Likewise, although there are extensive disaster preparedness guidelines, information on interventions during disasters is lacking. This literature review sought to summarize the evidence on nutritional care of vulnerable populations to develop an evidence-based guidance paper to assist dietitians during disasters.

Methods and Findings

Articles were identified through an electronic search of MEDLINE and CINAHL. A hand search of key review article reference lists and health association websites was conducted. Medical Subject Headings (MeSH) were used to search MEDLINE and adapted for CINAHL. The MeSH search terms used were: ["Mass Casualty Incidents" OR "Disasters"] AND [diabetes OR nutrition OR renal dialysis OR elderly nutrition OR pediatric nutrition OR breastfeeding]. Searches were limited to English publications after 1990. Articles not related to nutrition, related only to chronic malnutrition, undernourished populations, or disaster preparedness, or without interventions or

conclusions affecting disaster victim treatment were excluded. Of the 444 articles found, 48 met inclusion criteria.

Conclusions

In resource limited periods, dietary management of patients with chronic disease and vulnerable populations, such as infants and the elderly, becomes paramount. Optimal intervention requires detailed guidelines for health care professionals. Infants and the elderly are at high risk for malnutrition and dehydration and require prompt, evidence-based intervention. Managing diabetic and renal patients requires careful meal planning and nutrient control, since disasters disrupt normal dialysis and insulin treatments. Disasters in developed countries affect a large number of chronic disease patients; timely nutrition intervention is needed.

INTRODUCTION

Natural disasters and emergency situations lead to large-scale morbidity and mortality and affect a large number of healthcare practitioners and institutions worldwide. In 2011, 332 natural disasters killed a total of 30,773 people and affected 244.7 million people in 101 countries [1]. During these emergency situations, medical and foodservice professionals face the challenge of providing acute life-saving care and nutrition to disaster victims in addition to continued support for patients who require ongoing treatments and specialized diets to manage preexisting conditions.

In 2011, seven of the 10 countries that had the highest disaster mortality were classified as high-income (Japan, United States) or upper-middle income (Brazil, China, Columbia, Thailand, Turkey) economies according to the World Bank income classification [1,2]. Healthcare providers and emergency responders in these high-income developed countries face a unique challenge. Unlike low-income nations whose main concern is widespread malnutrition and infectious disease, hospitals and care facilities in developed countries service a large population of patients with a wide variety of chronic diseases and related conditions (CDRCs), such as diabetes, chronic renal disease, and cardiovascular disease [3]. Furthermore, surveillance and survey data collected from disaster shelters housing displaced victims of Hurricane Katrina confirmed that individuals with CDRCs make up a large portion (up to 55%) of those affected by natural disasters in the United States [4,5]. Individuals suffering from CDRCs require specialized diets and medical interventions to prevent them from developing life-threatening physiological conditions.

Detailed resources exist for disaster preparation and treating and preventing malnutrition and infectious disease during disaster scenarios [6]. However, there is a lack of literature providing evidence-based guidance for healthcare and nutrition professionals on appropriate feeding methods for individuals with CDRCs when traditional treatments, such as dialysis and insulin, are not available. In recent years, several large-scale natural disasters in developed countries have provided new insight into the health and nutrition needs of disaster victims and the use of alternate foodservice and nutritional support protocols during emergency situations [7–19]. The development and publication of practical guidelines based on the lessons learned during these emergency situations may help other institutions implement these potentially life-saving practices during disasters. An evidence-based guidance paper for disaster nutrition intervention in developed countries was developed through identification and systematic review of published and grey literature on the subject.

MATERIALS AND METHODS

An integrative approach was used to systematically review the literature related to nutrition intervention after a disaster. Relevant articles were identified through an electronic search of Medline and CINAHL. A hand search of key review article reference lists and health association websites was also conducted.

Search Terms

The search terms were determined through a process of testing and refining with the assistance of the University of Hawaii at Manoa Science and Technology Reference Librarian. Medical Subject Headings (MeSH) were used to search Medline and adapted for CINAHL. Medline was chosen as it is the principal database used by biomedical and

health researchers conducting literature searches. CINAHL was also searched since it includes some non-scholarly publications that are not available on Medline, such as book chapters, dissertations, and conference papers, and the database uses descriptors that are based on MeSH. . The search terms used for the Pubmed search were (((("Mass Casualty Incidents"[Mesh]) OR "Disasters"[Mesh:noexp])) AND (diabetes OR nutrition OR renal dialysis OR elderly nutrition OR pediatric nutrition OR breastfeeding)). The search terms used for the CINAHL search were ((MH "Disasters") OR (MH "Mass Casualty Incidents") OR (MH "Natural Disasters")) AND (diabetes OR nutrition OR renal dialysis OR elderly nutrition OR pediatric nutrition OR breastfeeding). Although many other chronic conditions are found in developed countries, such as cancer, these conditions were chosen because they require specialized food or food related medication, which may be limited or not available following a large disaster.

Databases

A search of Medline and CINAHL was conducted in August 2012 and again in August 2014, at which time only one new relevant article was found. Because of the relative paucity of peer reviewed articles on the subject, both peer-reviewed journal articles and grey literature were included. This encompassed State and Federal government reports, reports and position statements by nongovernmental organizations, policy and procedure documents from healthcare facilities, and non-profit organizations/societies' clinical care guidelines from both U.S. and international sources.

Only English-language articles published prior to 1990 were included. Primary attention was given to studies that consider the care of chronic diseases, elderly patients, infants and pediatric patients in the context of a disaster. However, since the number of

high-quality studies and evidence based guidelines in this area is small, studies that address the care of these groups in other relevant contexts were included. Articles were excluded if they were not related to nutrition, related only to chronic malnutrition, undernourished populations, or disaster preparedness, or if they lacked interventions or conclusions affecting disaster victim treatment.

RESULTS

Four-hundred and forty-four articles were found. After exclusion, 49 articles relevant to the subject were evaluated for this review. Infant feeding (Table 1) was the topic with the largest number of relevant articles (n=16), followed by diabetes (n=11) (Table 2). Only three articles specifically relevant to chronic kidney disease or dialysis were found (Table 3). Nine articles were found dealing with nutrition related disease and health status of disaster victims in developed countries (Table 4). Two articles relating to nutritional assessment of disaster victims (Table 5) and three articles specific to foodservice during disasters (Table 6) were identified. Three articles related to tube feeding were found (Table 7). No articles were found that summarized the current recommendations for the six vulnerable populations that are the focus of this review.

Figure 3.1 - Systematic Review Flow Sheet

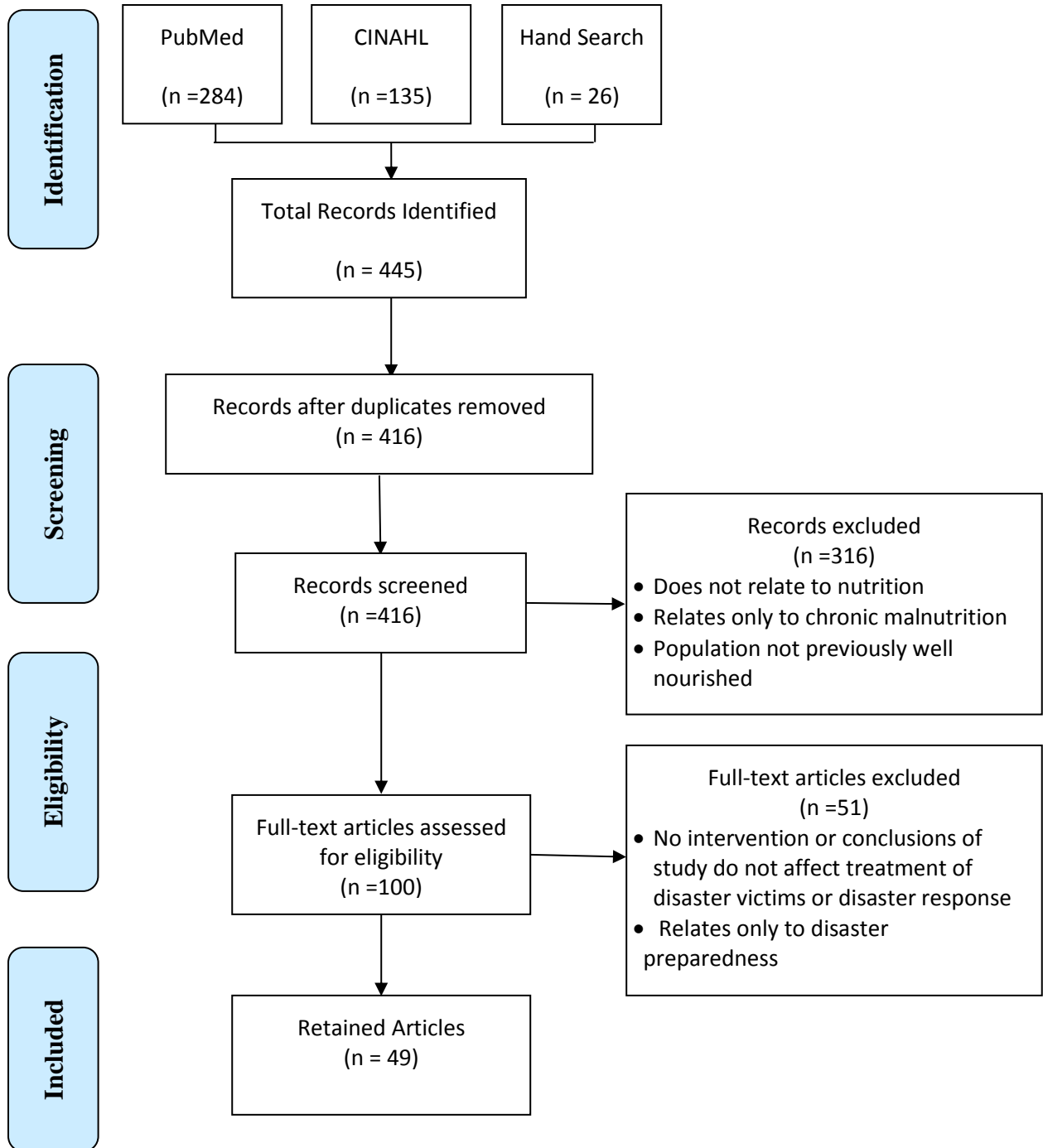


Table 3.1 – Papers Related to Infant Feeding Following a Disaster

Author (Year) Country	Study Design	Study Objectives	Population	Main Findings
Bengin (2010) China	Observational Letter to the Editor	Describe infant feeding situation after the 2008 earthquake in China's Sichuan Province	31 postpartum mothers in a certified Baby Friendly hospital	After an earthquake, breastfeeding patterns deviated from Baby Friendly Hospital Initiative practice, hospital staff demonstrated a misunderstanding of lactation and its importance in emergencies. There was no exclusive breastfeeding. Twenty-six (26) breastfed babies received infant formula
Barrett (2006) USA	Informational Summary	Bring awareness to infant feeding issues after disasters and highlight breastfeeding recommendations	Hurricane Katrina disaster victims	Breastfeeding rates are extremely low, many infants were left dehydrated and hungry, and knowledge about breastfeeding was low. Breastfeeding should be promoted as a vital emergency preparedness endeavor
Assefa (2012) Indonesia	Community- level survey	Assess magnitude of breast milk substitute distribution and its impact on infant feeding and diarrhea	Primary caregivers of surveyed children in earthquake affected districts of Indonesia	Seventy-five (75%) of households with infants aged 0-5 months received donated infant formula. 32% of 0-5 month-old infants consumed formula before the earthquake. One-week diarrhea incidence among those who received donated formula was higher than those who did not

Binns (2012) Australia	Literature review	Discuss ethical issues in infant feeding after disasters	Disaster victims from the 2006 Jogjakarta earthquake, the 2008 Wenchuan earthquake, and the 2009 north-east Japan earthquake and tsunami	There were strong associations between receipt of breastmilk substitutes and changes in feeding practices and incidence of diarrhea after disasters. Inappropriate, widespread distribution of infant formula in a postdisaster situation exacerbates these issues. The use of infant formula after disasters needs to be tightly controlled and used according to specific guidelines.
Callaghan (2007) USA	Case report	Use events of Hurricane Katrina to expose needs of pregnant women and infants during disasters	Pregnant women and infants in counties and parishes affected by Hurricane Katrina	An estimated 56,100 pregnant women and 74,900 infants were directly affected by the hurricane. Pregnant women and infants have unique health concerns and need special consideration when addressing issues with food and water, vaccinations, drug treatments, environmental exposure, and diarrhea and food-borne illness.
Bruce (1997) USA	Case report	Describe circumstances surrounding oral water intoxication in infants	Two African-American infants 55 and 56 days old	Feeding infants excessive amounts of solute-free water (amounts sufficient for a 7%-8% increase in total body water) can lead to hyponatremic seizures secondary to oral water intoxication
Cook (2010) UK	Educational Review Article	Discuss issues in infant feeding after a disaster to promote safe infant feeding and breastfeeding protection	Infants still feeding on breastmilk or breastmilk substitutes	Breastfeeding is the safest option for infant feeding after a disaster. Emergencies workers need to focus on providing breastfeeding and, if indicated, relactation support. Only when breastmilk is not available to breastfed infants should a substitute be given.

World Health Organization (1997)	Educational Guide	Provide information to mothers to support breastfeeding during emergencies	Infants requiring breastmilk or breastmilk substitutes for food. Especially those under 6 months.	Breastfeeding is the safest method of infant feeding during an emergency. Most women can breastfeed with the proper information and support. Infant formula should only be used with caution as a last resort.
Gribble (2005) Australia	Case report and review article	Discuss infant feeding in disasters in the context of the 2004 Indian Ocean tsunami	Breastfeeding mothers and relief staff affected by the 2004 Indian Ocean tsunami	After the tsunami, the indiscriminate and unorganized distribution of breastmilk substitutes undermined breastfeeding and created a dangerous infant feeding situation. Breastfeeding mothers should be supported; women who have weaned should be encouraged to relactate. Wet nursing is the first choice for orphaned babies. Infant formula should be tightly controlled and only used as a last resort.
O'Connor (2001) USA	Literature review and case report	Use case studies as educational tools for management of infant feeding during emergencies	4 hypothetical infants 2 to 18 months old	Breastfeeding provides the best protection from infant disease and death during a disaster. Five criteria must be met for infants to be safely fed a breast milk substitute (continuous supply, clean water, monetary support, safe storage, and appropriate cleaning method). Use of breast milk substitutes should be discouraged after a disaster.
The American Academy of Pediatrics (2007) USA	Policy/Guidance paper	Provide recommendations for infant feeding after a disaster.	Breast and formula-fed infants	Disasters create situations unfavorable for safe infant feeding. Breastfeeding must be supported; families should be kept together in safe havens that provide support. Breast milk substitutes should only be provided if breastfeeding, relactation, and donor milk are not possible.

International Lactation Consultant Association (2002)	Policy/Guidance paper	Address issues with infant feeding after a disaster	Infants and small children	Exclusive breastfeeding is the safest, and often the only reliable choice for infants and young children during adverse situations. Even after a stressful disaster, nearly every woman is physiologically able to feed her baby.
Horman (1998)	Review	Provide relevant information to healthcare workers caring for women and children who need relactation support	Mothers who have stopped breastfeeding but want to relactate	Measures essential to relactation are counseling for the mother, stimulation of the nipple and breast, and provision of temporary milk supplement for the infant without using a bottle. Provision of lactagogues if indicated and plenty of food, fluids, and rest are other measures that can improve success of relactation.
Muresan (2011) Romania	Case report	Use relactation case to provide recommendations for relactation	A healthy male term infant and his ill mother	Relactation is possible at 9 weeks postpartum if mother is strongly motivated. Short, frequent episodes of breastfeeding are the best technique to increase milk supply.
Gribble (2011) USA	Review	Identify consequences of infant feeding practices on infant health in emergencies	Breastfeeding mothers and infants	Provision of breastmilk substitutes after a disaster undermines breastfeeding and increases an infant's chance of morbidity and mortality. Distribution of breastmilk substitutes should be strictly controlled and breastfeeding mothers should be supported.
American Academy of Pediatrics Committee on Drugs (2001) USA	Review	Provide data concerning the excretion of drugs and environmental agents in human breastmilk	Breastfeeding mothers and infants	Most drugs prescribed to nursing mothers have no effect on milk supply or infant well-being. Radiation and some food and environmental agents can affect lactation and infant well-being.

Table 3.2 – Papers Related to Diabetes Care				
Author (Year) Country	Study Design	Study Objectives	Population	Main Findings
Yancy (2005)* USA	Intervention Trial	Improve glycemic control and reduce medicine through a low-carbohydrate, ketogenic diet	28 overweight outpatients with type 2 diabetes	Hemoglobin A1c decreased by 16% from baseline to week 16. Diabetes medications were discontinued in 7 participants, reduced in 10, and unchanged in 4.
Kamoi* (2006) Japan	Prospective, uncontrolled	Investigate changes in HbA1c levels	65 type 1 diabetic patients with insulin therapy	Mean HbA1c in all patients increased significantly ($P<0.01$) from $6.7\pm 0.9\%$ to $7.0\pm 1.0\%$ in the third month, peaked at the fifth month, and decreased at 12 months
Inui (1998) Japan	Prospective, controlled including a General Health Questionnaire (GHQ)	Examine effect of the Kobe, Japan earthquake on stress and glycemic control in diabetic patients	157 diabetic patients in Kobe and 277 diabetic patients in Osaka as a control	Glycemic control worsened in Kobe after the earthquake but not in Osaka. Increased HbA1c and GHQ scores were most prevalent in diabetic patients who experienced situations causing severe stress (house damage, relative killed, etc.)
Kirizuka (1997) Japan	Follow-up study	Investigate influences on glycemic control after a disaster	177 diabetic patients affected by the 1995 Great Hanshin-Awaji Earthquake	A significant temporary increase in mean HbA1c was found ($P<0.01$). Inappropriate diet had highest partial regression coefficient to raise mean HbA1c level. HbA1c levels gradually declined to pre-earthquake level 7 months after the earthquake.

Kamps (2010) USA	Controlled Prospective study	Examine contribution of fear of hypoglycemia, adherence to treatment regimen, and anxiety in predicting metabolic control in youth with type 1 diabetes	158 children with Type 1 diabetes and their caregivers	Fear of hypoglycemia is a risk factor for poor metabolic control in youth. Youth with a preexisting fear of hypoglycemia are at a particularly risk for high blood glucose levels and HbA1c after experiencing a major stressor such as a natural disaster.
Westman* (2008) USA	Randomized Trial	Determine if a diet lower in carbohydrate would lead to greater improvement in glycemic control in obese patients with type 2 diabetes	84 community volunteers with obesity and type 2 diabetes mellitus	Dietary modification improved glycemic control and reduced the need for medication. Lower carbohydrate diets led to greater improvements in glycemic control and more frequent medication reduction/elimination than low glycemic index diets.
Ng (2010) UK	Longitudinal study	Examine impact of extensive flooding in a UK city in 2007 on glycemic control of patients with diabetes mellitus	1743 patients with diabetes living in Hull and East Yorkshire, UK	Patients affected by the natural disaster had a rise in mean HbA1c. Those who were unaffected did not. Worsening of glycemic control was almost exclusively confined to patients taking insulin.
Cefalu (2006) USA	Observational Report	Provide recommendations for disaster preparedness and response for people with diabetes using experiences from Hurricane Katrina	Individuals affected by Hurricane Katrina	Thousands of people with diabetes were affected by Hurricane Katrina but shelters and emergency response teams were not prepared to care for their special needs. Lack of supplies, major changes in dietary intake, and stress led to significant disruption in glycemic control.

Hill (1916)* USA	Case report and treatment book	Provide details of the treatments for diabetes used at Massachusetts General Hospital before the discovery of insulin	Patients with diabetes mellitus being treated and Massachusetts General Hospital	Diabetes was controlled for a short time by using a three stage treatment. Stage 1-starvation until the patient's urine is free from glucose. Stage 2-gradually increasing fat, protein, and carbohydrate until glucose appears in the urine. Stage 3-holding the diet constant at a level just below where glucose appeared in the urine and testing for glucose twice a week.
Allen* (1919) USA	Monograph based on case reports	Provide details of the treatment used for diabetes at the Hospital of the Rockefeller Institute before the discovery of insulin	Seventy-six patients with diabetes being treated at the Hospital of the Rockefeller Institute	Diabetes was controlled for a short time through the use of a starvation diet until the urine is free of glucose. This is followed by a carbohydrate tolerance test in which carbohydrate is gradually reintroduced to the diet using green vegetables. Once a tolerance to carbohydrate is found, protein is increased to at least 1 g/kg body weight and fat is added slowly to maintain a desirable calorie level
Hui (2010)* UK	Review	Provide recommendations for people with diabetes who want to fast during Ramadan	Muslims with type 1 or type 2 diabetes	People with diabetes who fast are at an increased risk of adverse effects. Patients taking oral hypoglycemic agents and insulin should adjust their dosage and timing to match food intake. People with type 1 diabetes who fast during Ramadan need to decrease their insulin dose by 20%-30%.

*Papers not specifically related to disasters. These papers were included as proof-of-concept for using low-carbohydrate (ketogenic) diets to control blood glucose levels in the absence of insulin or oral hypoglycemic agents.

Table 3.3- Papers Related to Kidney Disease/Dialysis Following a Disaster

Author (Year) Country	Article Type/Study Design	Study Objectives	Population	Main Findings
Zoraster (2007) USA	Literature Review	Outline recommendations for disaster management of dialysis patients	Patients with end-stage kidney disease who require dialysis	Management of end-stage kidney failure without dialysis is a likely consequence of disasters. Strict fluid and dietary restrictions are needed. The diet should emphasize carbohydrates and aggressive use of cation-binding compound should be used in patients experiencing hyperkalemia
Rossi (2011) Australia	Case review	Outline response of dietetic team to the displacement of dialysis patients after Cyclone Yasi to propose a guide for future direction	71 hemodialysis patients from Cairns, Australia	Assembly of an emergency relief team including nephrologists, renal nurses, dietitians and psychologists helped to cover all patient needs. There is a need for readily available, consistent advice for menu planning for dialysis patients. Menus need to be low in protein, potassium, sodium, phosphate, and fluid and high in energy.
National Kidney Foundation (2010) USA	Patient Education	Provide guidance for dialysis patients for emergency preparedness and response	People with chronic kidney disease	Emergency response and preparedness needs to focus on medication and food supplies. If dialysis is not available, adhering to a strict diet limiting buildup of nitrogenous waste, sodium, potassium, phosphorous, and fluid is essential to preserve well-being.

Table 3.4 – Papers Related to Disease and Health Status of Disaster Victims

Author (Year) Country	Study Design	Study Objectives	Population	Main Findings
Greenough (2008) USA	2-stage 18-cluster sample survey	Determine prevalence of acute and chronic disease in displaced Hurricane Katrina disaster victims	499 evacuees in American Red Cross shelters in Louisiana 2 weeks after landfall of Hurricane Katrina	Fifty-six (56%) of evacuees arrived at the shelter with a chronic disease. Forty-eight (48%) of evacuees with a chronic disease lacked their usual medication. The most common chronic diseases were hypertension, hypercholesterolemia, diabetes, pulmonary disease, and psychiatric illness.
Sharma (2008) USA	Surveillance data questionnaire	Characterize the burden of visits for chronic disease and related conditions (CDRCs) after Hurricane Katrina	Patients at 29 emergency treatment facilities in and around New Orleans	Of 21,673 visits, 24.3% were for CDRCs. The proportion of visits for CDRCs increases with age. The most common illnesses were cardiovascular disease, chronic lower-respiratory disease, diabetes, and obstetric/gynecological conditions. People with CRDCs required hospitalization more often than those without CRDCs
Miller (2008) USA	Literature review with inclusion of personal experiences of author	Assess the burden of chronic renal failure, diabetes, and cardiovascular disease during disasters	Various populations affected by disasters worldwide	Disasters greatly affect chronic disease treatment and chronic disease exacerbations comprise a large disease burden during disasters. 22-40% of people living in regions affected by Katrina and Rita had at least 1 chronic disease. Chronic diseases accounted for 33% of visits after the hurricanes
Motoki (2010) Japan	Literature Review	Develop disaster pamphlets for people with chronic diseases	Disaster related literature, news-articles, and victim surveys from the Great Hanshin-Awaji Earthquake and Typhoon Tokage	During a disaster, people with chronic disease are unlikely to receive the same treatment or level of treatment for their illness as before the disaster. There is a need for people with chronic illnesses and their families to be able to cope with disasters independently and in resource limited situations

McKinney (2011) USA	Statistical analysis of mortality data	Quantification of the number of direct and indirect deaths resulting from Hurricanes Charley, Frances, Ivan, and Jeanne	Mortality data from counties directly impacted by the hurricanes, ordered to evacuate, or directly adjacent to the impact zone	Mortality was elevated up to 2 months following each storm. Trauma related deaths account for only 4% of total storm-related mortality. 34% of elevated mortality was heart related, 19% cancer-related, and 5% diabetes related
Aldrich (2008) USA	Literature Review	Highlight the special characteristics of older adults and provide recommendations for the disaster management of this population	Elderly adults living in the USA	About 80% of adults over 65 have at least 1 chronic health condition, 50% have at least 2. Disasters exacerbate existing chronic diseases. Special care should be taken during an emergency to provide older adults with medical, housing, and nutritional support.
Mori (2007) Japan	Semi-structured interviews	Identify the health needs of patients with chronic diseases during disasters	29 patients with rheumatism, diabetes, or chronic respiratory disease who were affected by the 1995 great Hanshin earthquake	Stress, lack of access to appropriate food and medication, and adverse environmental conditions exacerbated the pre-existing conditions of the patients. Access to medications was the primary concern. Patients with chronic diseases need to be targeted during a disaster to receive appropriate food, medication, and emotional support.
Rothman (2007) USA	Review	Outline the special needs of the elderly in the context of a large disaster	People age 60 and older	Impaired functional status and mobility, dementia and delirium, falls, dehydration, malnutrition, pressure ulcers, and issues with medication are common geriatric problems. These issues need to be rapidly assessed and treated to reduce mortality and suffering of elderly during disasters.

Grossbauer (2004)	Book excerpt	Provide guidelines for diet texture for dysphagia diets	Patients with dysphagia	The National Dysphagia Diet is the standard dietary treatment for swallowing difficulties. Determining the appropriate food texture (Regular, Advanced, Mechanically-Altered, or Pureed) and liquid consistency (Thin, Nectar, Honey, or Spoon/Pudding) is critical for patient well-being.
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Table 3.5 – Papers Related to Assessment of Nutrition Status After a Disaster				
Author (Year) Country	Study Design	Study Objectives	Population	Main Findings
Woodruff (2002) USA	Literature Review	Find solutions to difficulties in anthropometric assessment of adolescents during humanitarian emergencies	Adolescents in multiple populations worldwide	Weight-for-height can be used for prepubertal adolescents, body mass index for postpubertal. Age needs to be collected accurately. Ethnicity needs to be considered in school-age children and adolescents. Other information, such as health and food data should be included in assessment.
Magkos (2004) Greece	Survey	Assess nutritional risk of individuals in well-nourished societies after a major disaster	225 volunteers from two evacuee camps after the 1999 Athens earthquake	Nutritional risk in acute phase after disaster is low. Elderly face increased risk as situation is prolonged.

Table 3.6 – Papers Related to Food Service After a Disaster

Author (Year) Country	Article Type/Study Design	Objectives	Population	Main Findings
Center for Emergency Preparedness and Response (2007) Canada	Policy Statement	Provide guidelines for emergency food service during a disaster	Food service personnel, dietitians, and other professionals responsible for emergency food service response	Emergency food service should focus on food safety and hygiene and maintenance of an adequate, safe food and water supply throughout the emergency. Special care should be given to infants and young children
Everett (2004) USA	Case Report	Provide disaster response advice	Nursing homes, schools, and other care facilities in Florida affected by hurricanes in 2004	During a disaster the focus should be on safety and sanitation issues. Storing food by days instead of type may be more efficient. Adequate safe water is one of the main issues. Any container that can hold water (sinks, tilt skillets, pots, etc.) can be used to hold extra water if there is a possibility of losing access to a safe water supply.
RD Proves Value of Volunteers in Wake of Disaster (2012) USA	Case Report	Provide ideas for emergency foodservice response using the experiences of a volunteer RD during Hurricane Gustav	Evacuees at an emergency shelter in Louisiana	After a disaster, many evacuees in emergency shelters have medical needs requiring special diets. Baby food and pudding can be used for patients requiring a dysphagia diet. If meals cannot be prepared to meet dietary restrictions, patients may need to avoid portions of meals that are of concern.

Table 3.7 – Papers Related to Nutrition Support After a Disaster

Author (Year) Country	Article Type/Study Design	Study Objectives	Population	Main Findings
Seattle Children's Hospital (2010) USA	Patient and Family Education	Provide guidelines and recipes for the use of blenderized tube feeds	Children who require enteral nutrition	Blenderized tube feedings can be safely used if prepared and administered according to strict food safety guidelines. Formulas should include starches, fruits, vegetables, meat and protein, milk and calcium, and fats that can be blended into a smooth liquid.
Yatabe (2012) Japan	Controlled Emergency Trial	Analyze the outcome of an emergency reduction in tube feeding after a disaster	46 tube fed patients in Takada Welfare Hospital	Reducing enteral tube feedings by approximately 40% for 2 weeks did not result in any significant adverse effects. Reduction was not associated with liver or kidney dysfunction, anemia, worsening of pressure ulcers or formation of new ulcers.
Trento (2014) USA	Invited Review	Planning and preparing to continue nutrition support after a disaster	Individuals who require nutrition support.	Individuals who require nutrition support need additional preparedness supplies. Adults requiring special nutrition support formulas can use pediatric substitutes and hydrolyzed formulas as a temporary substitute under RD supervision. Gravity feeds can be used when pumps are not available.

DISCUSSION AND RECOMMENDATIONS

Infants and Pediatrics

Exclusive breastfeeding during disasters is the best choice to minimize infant morbidity and mortality [20,21]. However, the widespread distribution of infant formula during disasters makes it difficult to promote and sustain exclusive breastfeeding, especially when there is a lack of educational, emotional and environmental support [22,23]. Exclusive breastfeeding can be increased by taking steps to keep families together and create safe havens for pregnant and breastfeeding mothers that provide security, counseling, water, and food [24,25]. Breastfeeding mothers should receive the first supply of food and water during emergencies to ensure adequate hydration and support breast milk production [26]. It is important to assist new mothers to initiate breast feeding within 1 hour of birth and assure all mothers that human milk can contribute significant nutrition in the absence of safe complementary foods for the first year of life and beyond. Additionally, assessment of the infant's hydration and nutritional status supports breastfeeding continuation by assuring mothers that their children are receiving adequate nutrition through breast milk [25].

Mothers who have been exposed to environmental toxins or who are experiencing food or water-borne illness may be concerned about the safety of their breast milk [8]. In most cases, the benefits of breastfeeding outweigh the risks of exposure to contaminants, but contact with radioactive compounds and certain toxins may require temporary cessation of breastfeeding (Table 1) [27]. Mothers who must temporarily stop breastfeeding because of risk of contamination should express and discard their milk to ensure an adequate production of breast milk when breastfeeding is resumed.

Breastfeeding mothers experiencing diarrhea can safely continue to breastfeed but should increase their fluid consumption to prevent dehydration [8]. Diarrhea treatment with oral rehydration salts, Kaolin-pectin (Kaopectate) and loperamide (Imodium) is safe for breastfeeding moms. Antidiarrheal treatments containing bismuth subsalicylate compounds (Pepto-Bismol) are not recommended and should be used with extreme caution [27]

The use of infant formula during disasters is associated with an increased risk of infection, diarrheal disease, and mortality [21,28,29]. Several factors make the use of infant formula during disasters risky, including unsafe water, limited or no refrigeration, insufficient supplies, lack of support and instruction on the proper preparation of powdered and concentrated formula, and limited ability to sterilize feeding bottles and nipples [20,22,25]. In some cases, formula and bottles may not be available in shelter supplies. If bottle feeding is to be safely initiated during a disaster, 5 conditions must be met. 1) The formula must be available on a continuing basis. 2) Sanitary water must be available to mix with the powder or concentrate. 3) Adequate funds/assistance must be available to continue to supply the formula after disaster relief has ended. 4) Refrigeration or some other safe method of storage of the formula must be available to inhibit bacterial proliferation in the milk. 5) There must be a method to clean the feeding utensils to prevent bacterial contamination which can produce gastroenteritis in the infant [30].

Table 3.8 - Effects of Food, Environmental, and Radioactive Agents on Breastfeeding

Agent	Reported Sign or Symptom in Infant or Effect on Lactation
Aflatoxin	None
Aspartame	Caution if mother or infant has phenylketonuria
Bromide	Potential absorption and bromide transfer into milk which may cause rash, weakness, absence of cry with maternal intake of 5.4 g/d
Cadmium	None reported
Chlordane	None reported
Chocolate (theobromine)	Irritability or increased bowel activity if excess amounts (≥ 16 oz./d) consumed by mother
DDT, benzene hexachlorides, dieldrin, aldrin, hepatachlorepoide	None
Fava beans	Hemolysis in patient with G-6-PD deficiency
Fluorides	None
Hexachlorobenzene	Skin rash, diarrhea, vomiting, dark urine, neurotoxicity, death
Hexachlorophene	None; possible contamination of milk from nipple washing
Lead	Possible neurotoxicity
Mercury, methylmercury	May affect neurodevelopment
Methylmethacrylate	None
Monosodium glutamate	None
Polychlorinated biphenyls and polybrominated biphenyls	Lack of endurance, hypotonia, sullen, expressionless face
Silicone	Esophageal dysmotility

Tetrachloroethylene cleaning fluid (perchloroethylene)	Obstructive jaundice, dark urine
Vegetarian diet	Signs of B ₁₂ deficiency
Copper 64 (64Cu)	Radioactivity in milk present at 50 h
Gallium 67 (67Ga)	Radioactivity in milk present for 2 wk
Indium 111 (111In)	Very small amount present at 20 h
Iodine 123 (123I)	Radioactivity in milk present up to 36 h
Iodine 125 (125I)	Radioactivity in milk present for 12 d 42
Iodine 131 (131I)	Radioactivity in milk present 2–14 d, high dose may prolong excretion
Radioactive sodium	Radioactivity in milk present 96 h
Technetium 99m (99mTc)	Radioactivity in milk present 15 h to 3 d

*Adapted from *The Transfer of Drugs and Other Chemicals in Human Milk*

In the event that an infant is orphaned, or the mother is unable to breastfeed as a result of the disaster, it is important for dietitians to advocate for optimal feeding options, including the use of a wet-nurse or HIV-negative donor human milk if possible [20,30]. If human milk is unavailable, ready-to-feed infant formula should be used. Powdered or concentrated formula should be used only when sterile bottled or boiled water is available. Product labels should be carefully read for information on allergens, specific uses, and target age groups to ensure proper use. Whole fat cow's or goat's milk (in fluid, evaporated, or powdered form) should be the last resort and should only be used as short-term solutions as they do not provide complete infant nutrition and must be mixed with additional ingredients to be suitable for infants (Appendix A and B) [25,26]. Adult oral supplements (e.g. Boost®, Ensure®) should not be given to infants as they contain a

solute load too high for the infants developing kidneys. If no other option exists for providing nutrition, it is possible these drinks could provide temporary nutrition if they can be safely diluted to an osmolality around 200-300 mOsm/kg water.

Infants deprived of water and milk can become dehydrated rapidly. If breastfeeding or infant formula is not available in the first few hours, a small amount of boiled sugared water or juice may be given to the infant [26]. However, large amounts of solute-free water, such as bottled water, juice and tea, should not be given to infants under 1 year because of the risk of the infant developing life-threatening hyponatremia from oral water intoxication [31]. For infants who were fed with infant formula before the disaster, relactation should be considered first [20]. Providing relactation education and support may be more desirable than providing infant formula, since breastfeeding provides the best protection against infant morbidity and mortality during disasters [32]. Full relactation can be achieved in a few days to a few weeks, depending on a variety of factors [33] (See Appendix C for information on factors that affect relactation).

Stimulation of the nipple and breast is essential for relactation. The infant should be put to the mother's breast to suckle as often as the infant is willing [34]. The infant should suckle at least 10-15 minutes on each breast every 1-2 hours and at least 8-12 times every 24 hours [33]. An infant who is unwilling to suckle on an unproductive breast can be encouraged to suckle through the use of a breastfeeding supplementer, either proprietary or "home-made", designed to provide the infant with a steady flow of supplementary feed while they suckle the breast. If a proprietary supplementer or supplies to make a "home-made" supplementer are not available, the "drop and drip" method may be used [33,34] (Appendix D).

If the infant is still unwilling to suckle, stimulation of the breast by hand should be undertaken while continuing to provide plenty of skin-to-skin contact between the mother and infant. The infant should be offered the breast any time he or she shows interest, and the use of bottles and pacifiers should be avoided. Infants can be provided with supplementary formula by cup while the mother’s breastmilk supply is becoming established. It is essential to provide adequate nourishment while relactation is being attempted as a malnourished infant will not have the strength to suckle at the breast.

Infants should be provided with formula according to the optimal timing and amount for their age [26] (Table 2). Safe complementary foods can be given to infants over 6 months of age. Special attention should be given to allergies when feeding solid foods to infants and young children, as emergency foods may have hidden allergens and obtaining medical care for a severe reaction to a food allergen may be difficult during a disaster (Appendix E).

Table 3.9 - Nutritional Needs of Infant

Age	No. of Bottles	Qty. of Milk Per Feeding Bottle	Average Total Per Day
Newborn to 1 week	6-10	60-90 ml (2-3 oz.)	550 ml (20 oz.)
1 week to 1 month	6-8	90-120 ml (3-4 oz.)	700 ml (25 oz.)
1 to 3 months	5-6	120-180 ml (4-6 oz.)	850 ml (30 oz.)
3 to 5 months	4-5	180-210 ml (6-7 oz.)	850 ml (30 oz.)
6 to 12 months	3-4	210-240 ml (7-8 oz.)	700 ml (25 oz.)

Elderly

In a previously well-nourished population, the elderly are at highest nutrition risk after a disaster [14,17]. Elderly have an increased risk of mortality during disasters

because of a high prevalence of chronic diseases, age associated physical, psychological, and nutritional frailty, and special feeding requirements that may be difficult to meet during times of crisis. Extreme temperatures, difficult living conditions, and limited food and water have a much greater impact on the elderly, leading to rapid dehydration, acute malnutrition, and worsening of chronic conditions [35,36]. It is necessary to target disaster victims over the age of 60 to provide appropriate adequate food and water rations and monitor for signs of dehydration and acute or chronic malnutrition, which increase the risk of falls in elderly [35]. Elderly showing signs of dehydration or poor nutrition should be treated quickly and carefully monitored to reduce the risk of falls. Confusion in elderly who have not shown previous signs of cognitive difficulties can be a sign of dehydration.

Many elderly have difficulty eating under normal circumstances and problems may amplify after a disaster if access to properly fitting dentures or appropriate foods is lost [35]. Providing foods and beverages that limit aspiration and choking risk is vital to preventing deterioration of health in patients showing signs of eating difficulty or dysphagia [37]. Patients with dysphagia should be preferentially selected to receive oral supplements and should be the only patients who receive thickened supplements during emergencies, as emergency food supplies are not likely to be compliant with the patients required food consistency. This is especially important if the dysphagia patient is also suffering from a chronic disease, as finding or making appropriate food will be very difficult. If the hospital food service department lacks the ability to modify emergency food rations to be appropriate for a dysphagia meal plan, patients can be fed jarred baby food and puddings [38].

If using a blender to modify the consistency of foods, all equipment must be meticulously cleaned and sanitized to prevent bacterial contamination of the food. Appropriately thickened chicken, beef, or vegetable broth can be used as a gravy replacement to moisten the meals of dysphagia patients being fed texture appropriate foods. Information about foods that are appropriate for patients requiring thickened liquids should be provided to responders. Foods that melt, such as ice cream and gelatin, are considered thin liquids and cannot be safely fed to patients requiring dysphagia thickened liquids. Helping patients to maintain good oral hygiene reduces the risk of aspiration pneumonia [39], which can be devastating during a resource limited disaster situation.

Diabetes

Large scale disasters have a highly negative effect on glycemic control in diabetic patients. Severe stress, inappropriate diet, and limited access to insulin and oral hyperglycemic agents combine to cause a significant increase in mean HbA1c levels in diabetic patients after disasters [11,12,15,18,19,40]. Inappropriate diet has been found to be one of the highest risk factors for worsening of glycemic in these times [15], making patient education and careful menu planning for diabetic patients a top priority after a disaster.

During a disaster, patients may overeat during and between meals as a way to deal with stress or because of fear of supply shortages. As many emergency food rations contain primarily simple carbohydrates, overconsumption of these foods may aggravate the loss of glycemic control brought on by limited access to insulin and oral hyperglycemic agents. During disasters while pharmacological treatments are limited,

diabetic meal plans should focus on fat and protein, and contain only limited amounts of carbohydrates. Providing portion-controlled meals and limiting access to snacks while patients are in emergency shelters also helps to control blood sugar levels.

Diets so low in carbohydrates as to induce a state of ketosis, such as the ketogenic diet or the modified Atkins diet, have been shown to have a positive effect on blood sugar control in patients with type 2 diabetes even without the use of insulin or oral hyperglycemic agents [41,42]. In controlled settings, such as hospitals and nursing homes, it may be possible to follow a low carbohydrate, ketogenic meal plan to prevent type 2 diabetics from developing severe hyperglycemia and other complications when traditional insulin and pharmacological treatments are unavailable for an extended period of time. The most important requirement to maintain ketosis on these diets is to limit carbohydrate intake to 20-50 grams per day. The macronutrient distribution should be maintained at 65-75% of calories from fat, 25-30% from protein, and 5-10% from carbohydrate.

For patients with type 1 diabetes, continuation of insulin therapy is the only long term treatment. Following a disaster, insulin should be reserved preferentially for patients with type 1 diabetes to ensure a continuous supply. Before a patient with type 1 diabetes is given any food, it is important to determine the availability of insulin. If it is not possible to administer insulin to a patient with type 1 diabetes, they must not be fed carbohydrate rich foods. Before the discovery of insulin, treatment involving a 3-7 day fast followed by a slow progression to a very restricted diet low in carbohydrates and calories was used to prolong the life of individuals suffering from type 1 diabetes for weeks, months, and sometimes years [43,44]. If there is no way to obtain insulin for an

extended period of time, following a similar feeding plan may prevent life-threatening ketoacidosis and diabetic coma until insulin therapy can be resumed (Appendix F). However, as most of the patients treated with this method were children with type 1 diabetes, it is possible that the patients still exhibited some endogenous insulin secretion. Therefore, this method may be unsuccessful in patients who have been diagnosed with type 1 diabetes for several years. If insulin therapy will be unavailable for a few days only, adults and children with type 1 diabetes may be able to be sustained on a semi-fasting diet that contains only small amounts of clear broth, sugar-free juice and gelatin, black coffee or tea [44]. Alternatively, if insulin is available but limited, it may be possible to reduce the need for background insulin by 20%-30% by limiting food intake to smaller meals twice daily [45].

Renal Disease and Dialysis Patients

Patients with chronic kidney disease (CKD) or end-stage renal failure that require dialysis are very difficult to manage following a disaster. Loss of access to dialysis for even a few days can lead to life-threatening sodium, potassium, and fluid imbalances. Of particular concern is the high level of sodium found in most emergency foods. Meals-Ready-to-Eat (MREs) should never be given to patients with CKD, as a single meal exceeds the daily limit for protein, potassium, and sodium. Eating three MREs a day would put the patient's total daily sodium intake between 7-19 grams. Strict fluid limits should also be followed to prevent edema, shortness of breath, or heart failure. The National Kidney Foundation recommends that CKD patients consume about 40-50 grams protein, 1,500 mg sodium, 1,500 mg potassium, and less than 2 cups (16 oz.) of fluid a day until dialysis can be resumed [46](Appendix G). Sucking on hard, sour candies can

help to alleviate thirst without contributing excess fluid. Patients suffering from CKD and diabetes should follow these recommendations in addition to limiting their intake to 1,800 calories (Appendix H). It is important to remind patients that the strict meal plans provided to them are only temporary until dialysis capabilities resume and are absolutely necessary to prevent heart failure as a result of serum electrolyte imbalances. Even what patients consider to be small indulgences or deviations from their meal plan could have life threatening consequences because of limited medical support.

Cardiovascular Disease and Heart Failure

Heart associated deaths have been shown to contribute significantly to elevated mortality following a high impact disaster, accounting for up to 34% of all deaths attributable to the disaster [10]. Proper nutritional management of heart patients following a disaster is crucial as elevated emotional stress, limited access to medications, and exposure to physically taxing environments exacerbates preexisting conditions.

Patients with preexisting heart conditions, such as hypertension and congestive heart failure, should be provided with emergency foods that are low in sodium (<2 g per day) and should avoid the consumption of MREs if possible. Fluid intake should be moderated to prevent overload. Patients should be carefully monitored for signs of fluid overload and dehydration as post-disaster conditions (no air conditioning, increased physical movement) may alter their fluid needs. Hard candies can be used to relieve thirst without adding extra fluid.

Critically Ill and Nutrition Support

Critically ill patients who are receiving enteral nutrition may require modifications to their feeding protocol to provide the best nourishment during resource limited periods. Modifications should be made on a case by case basis. In addition to assessing the patient's condition, decision makers should take into account the hospital's enteral formula supply, expected delivery date and composition of soonest supply delivery, and availability of acceptable ingredients and facilities to safely prepare and administer blenderized formulas as substitutes to commercially prepared formulas.

The rate of tube feeding has been safely reduced in previously well-nourished elderly patients by up to 40% for two weeks without any significant adverse effects [7]. If the patient is not in a life-threatening medical or nutritional condition and adequate supplies are expected to be received in two weeks or less, a reduction in feeding rate to stretch supplies until deliveries can be made may be the best decision. If shortages are expected beyond two weeks, the patient has elevated nutritional needs or was previously malnourished, and there are resources available to safely produce alternative feeding formulas, preparing a blenderized tube-feed formula in the hospital may provide better nutritional outcomes than reducing feeding rate (Appendix I). Adult patients that require special formulas (such as soy based formula) due to allergies can be provided with hydrolyzed adult or infant formulas as available⁴⁷.

If enteral feeding pumps are unavailable or there is no power to the pumps, gravity drip feeding can be used to achieve a consistent feeding rate by adjusting the roller clamp of the giving set to deliver a specific number of formula drops per minute (Table 10). Bags can be hung on IV hooks or stands, any other sturdy object that is

higher than the patients head, or, if nothing else can be found, a nail driven into the wall. Because this method is not as precise as pump feeding and changes in the drip rate may occur, it is important that the drip rate be regularly check to ensure that the desired feeding rate is being achieved. Careful monitoring of tube feed patients is important to prevent aspiration or other complications. Patients should never be feed while lying flat. To reduce aspiration risk, the head of the bead should be maintained at no less than 30-45 degrees.

During an emergency when normal supply deliveries are interrupted, tube feeding administration sets can be exhausted more rapidly than expected. If supplies are depleted, it may not be possible to provide enteral feedings until more supplies are delivered. To extend supplies, enteral feeding bags and tubing used for intermittent feedings can be reused for two weeks by carefully following a simple cleaning procedure immediately after each feeding and after the last feeding of the day (Appendix J). Be sure to document the expiration date of the feeding bag and set. Feeding bags and tubing used for continuous feeding can be washed and reused, but should be discarded after 48 hours of use.

Table 3.10 - Approximate drip counts to achieve a desired feed rate

mls/hr	No. of drops/min
25	7
50	13
75	20
100	27
125	33
150	40
200	53

CONCLUSION

In resource limited periods, dietary management of chronic disease patients and vulnerable populations becomes paramount. Stress, limited access to traditional treatments, and emergency foods that are inappropriate for the chronically ill and other vulnerable individuals increase the risk of adverse effects in these populations.

Appropriate intervention requires specialized knowledge and detailed guidelines. Despite preparedness recommendations, many families lack resources during disasters, putting infants, elderly, and the chronically ill at high risk for malnutrition, dehydration, and serum imbalances. Infants are at increased risk of improper feeding practices, diarrhea, and mortality because of a lack of understanding of infant feeding guidelines during emergencies. Managing diabetic and renal patients requires careful meal planning and nutrient control, since disasters disrupt normal dialysis and insulin treatments. Disasters in developed countries affect a large number of chronic disease patients; timely nutrition intervention is needed.

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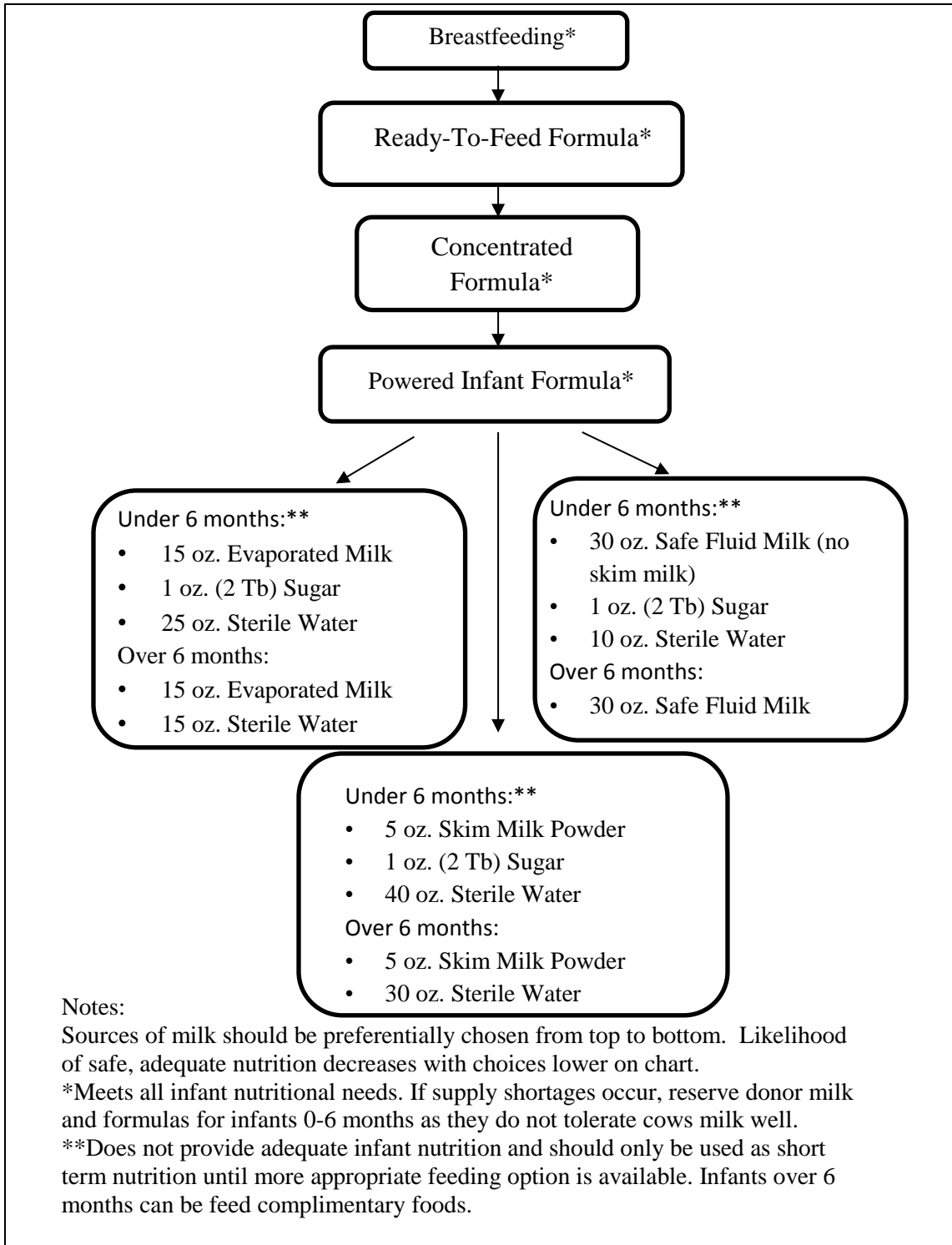
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APPENDICES

Appendix A

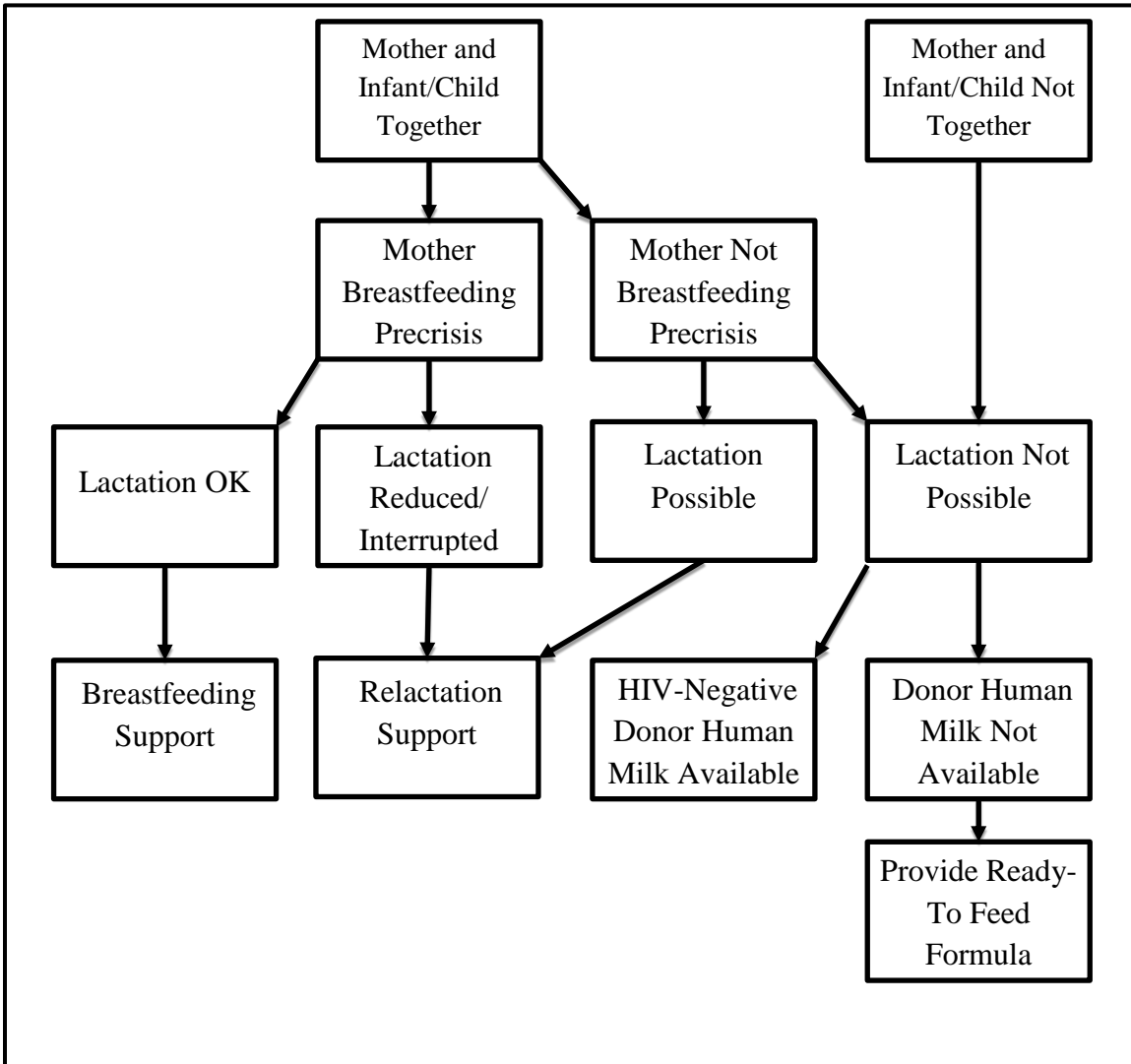
Figure 3.2 - Sources of Milk for Infants



Adapted from American Academy of Pediatrics *Infant Nutrition During a Disaster

Appendix B

Figure 3.3 - Decision Chart for Infant Feeding After a Disaster



Appendix C - Factors That Affect Relactation

Factors related to the infant.

The main requirement for relactation or induced lactation is that the infant should suckle.

This is affected by:

- The infant's willingness to suckle
- The infant's age
- The infant's breastfeeding gap (i.e. the time since the infant stopped breastfeeding)
- The infant's feeding experience during the gap
- Infant-related reasons for interrupting breastfeeding

Other factors of potential but unknown significance include:

- Gestational age (for low birth weight babies)
- Intake of complementary food (for older infants)

Factors related to the mother or foster mother:

The most important are:

- The woman's motivation
- Her lactation gap (the time since she stopped breastfeeding an infant)
- The condition of her breasts
- Her ability to interact responsively with her child
- Support from her family, community and health workers
- Her previous experience of lactation
- Her general health and nutrition

Appendix D- Breastfeeding Supplemter

Supplies needed

- Cup
- Fine nasogastric tube or other fine plastic tubing (gauge 8)
- Tape

Steps

1. Fill a cup with the amount of expressed breastmilk or appropriate breastmilk substitute that the infant needs for one feeding
2. Cut a small hole in the side of the tube near the end that will go into the infant's mouth (to help the flow of milk)
3. Place the end of the tube with the extra hole along the mother's nipple so the infant suckles the tube and breast at the same time. Tape the tube in place to prevent movement during feeding
4. Place the other end of the tube in the prepared cup of milk
5. The flow of milk should be controlled so that the infant suckles for about 30 minutes at each feed. This can be done by raising the cup to make the milk flow faster, or lowering the cup, tying a not in the tube, or pinching the tube with a paper-clip or other device to make the milk flow more slowly.
6. Clean and sterilize the tube of the supplemter and the cup by rinsing with hot water and soap, flushing with a sanitizing solution, and rinsing with clean water again immediately after use (use a syringe to dry solution/water through the tube). The tube should be flushed again with clean water before use and replaced every few days.

“Drop and drip” method

Supplies needed

- Dropper or cup

Steps

1. Prepare a dropper or cup with expressed breastmilk or an appropriate breastmilk substitute
2. Place the infant at the breast to suckle
3. While the infant is suckling, drip a small amount of milk directly onto the breast so it runs into the infant's mouth being careful not to spill into the infant's nose (this may require a second person) Note: This method does not work well after the infant develops a good attachment to the breast and is suckling well.

Appendix E - Food Allergy Considerations

The most common food allergens include milk, eggs, peanuts, tree nuts (e.g., walnuts, almonds, cashews, pistachios, and pecans), wheat, soy, fish, and shellfish.

Ingredient	Nutritional considerations
Milk	<ul style="list-style-type: none"> - Milk protein (casein) may be found in some canned tuna, in prepared meats as a binder - Substitute with rice or soy milk (if not also allergic to soy protein) - Calcium lactate and sodium lactate do not contain milk protein and do not need to be restricted
Egg	<ul style="list-style-type: none"> - Egg substitutes contain egg whites and are not suitable - Boxed, dry pastas are usually egg-free, exception of egg noodles
Peanuts	<ul style="list-style-type: none"> - African, Chinese, Indonesian, Mexican, Thai, and Vietnamese dishes often contain peanuts or are contaminated with peanuts during the preparation process - Sunflower seeds are often produced on equipment shared with peanuts
Tree nuts	<ul style="list-style-type: none"> - Peanut-allergic patients should avoid tree nuts as an extra precaution and vice versa - Tree nuts have been used in many foods, including barbecue sauce, cereals, crackers, and ice cream. - Water chestnuts and Nutmeg are safe for individuals with a tree nut allergy
Wheat	<ul style="list-style-type: none"> - The major grains that contain gluten are wheat, rye, oats, and barley. These grains and their by-products must be strictly avoided by people with celiac disease. - Corn tortilla chips and rice cakes can be safely used if there are no wheat ingredients listed on the label. - Read labels carefully. At least one brand of hot dogs and one brand of ice cream contain wheat. It is listed on the label.
Soy	<ul style="list-style-type: none"> - Soybeans and soy products are found in baked goods, canned tuna, cereals, crackers, infant formulas, sauces, and soups. - At least one brand of peanut butter lists soy on the label. - Most soy-allergic individuals may safely eat highly refined soybean oil (not cold pressed, expeller pressed, or extruded oil) and soy lecithin
Fish	<ul style="list-style-type: none"> - Caesar salad dressings, steak sauces and Worcestershire sauce often contain anchovies. - Surimi (imitation crabmeat) contains fish. - Carrageenan is not related to fish or shellfish and does not need to be avoided by those with food allergies.

*Information from the Food Allergy and Anaphylaxis Network at <http://www.foodallergy.org>

Appendix F- Sample ketogenic (Modified Atkins) meal plan for type 2 diabetics without access to medication

Meal	Item	Cho (g)	Fat (g)	Kcal(g)	Pro (g)
Breakfast	Coffee or tea	0	0	0	0
	Coffeemate - 1Tbs	2	1.0	20	0
	Whole powdered eggs- 4Tbs*	0.99	8.19	119	9.47
	Parmesan cheese - 2Tbs	0.41	2.86	43	3.85
	Butter - 2Tbs	0	23	204	0.24
	Canned Ham 2 oz.	0.15	10.7	136	9.1
Morning Snack	Peanut butter -2 Tbs (can be eaten with celery if available)	3.26	16.26	190	8.24
Lunch	Canned Tuna -6 oz.	0	1.39	197	43.39
	Regular mayonnaise -4T	1.74	43.8	396	0.5
	Canned green beans -1/2 Cup	2.95	0.29	20	.965
	Sugar-free drink	0	0	0	0
Afternoon Snack	Canned peaches or pears-1/4 cup	3.73	0.04	13	0.27
	Coffeemate -2 Tbs	4	2	40	0
Dinner	Canned chicken- 6oz	0	13.6	281	37.1
	Ital. Dressing -4 Tbs.	6.1	16.68	172	0.23
	Canned spinach or peas- 1/2 cup	3.9	.535	25	3.0
	Parmesan cheese -2Tbs	0.41	2.86	43	3.85
	Sugar-free drink	0	0	0	0
PM Snack	Sugar free gelatin ½ c	.83	0	9	1.38
Total		28.9 g 116kcal	143.2 1289kcal	1891kcal	121.51g 486kcal
Percent Kcal		6%	68%		26%

*Double serving of canned ham at breakfast if powdered eggs are not available.

Appendix G- Three day emergency meal plan for dialysis patients.

	Day 1	Day 2	Day 3*
Breakfast	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 1 tablespoon sugar • ½ cup pineapple*** 	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 1 tablespoon sugar • ½ cup peaches*** 	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 1 tablespoon sugar • ½ cup pears***
Morning Snack	<ul style="list-style-type: none"> • 5 vanilla wafers • ½ cup applesauce 	<ul style="list-style-type: none"> • 3 graham crackers • Honey or jelly as desired on crackers • 10 hard candies 	<ul style="list-style-type: none"> • 6 unsalted crackers • Honey or jelly as desired on crackers • 10 large marshmallows
Lunch	<ul style="list-style-type: none"> • 2 slices white bread • ¼ cup low-sodium tuna • 1 tablespoon margarine or mayonnaise • ½ cup pears** • Powered drink mix with ½ cup distilled water 	<ul style="list-style-type: none"> • 2 slices white bread • ¼ cup low-sodium tuna • 1 tablespoon margarine or mayonnaise • ½ cup fruit cocktail*** • Powered drink mix with ½ cup distilled water 	<ul style="list-style-type: none"> • 2 slices white bread • 2 tablespoon low-sodium peanut butter • 2 tablespoons jelly • ½ cup mandarin oranges*** • Powered drink mix with ½ cup distilled water
Afternoon Snack	<ul style="list-style-type: none"> • 6 unsalted crackers • Honey or jelly as desired on crackers • 10 sourballs 	<ul style="list-style-type: none"> • ½ cup canned applesauce • 10 large marshmallows 	<ul style="list-style-type: none"> • 3 graham crackers • Honey or jelly as desired on crackers • 10 mints
Dinner	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned low sodium carrots** • ½ cup cranberry juice 	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned low sodium peas*** • ½ cup cranberry juice 	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned low sodium green beans • ½ cup cranberry juice
Evening Snack	<ul style="list-style-type: none"> • 3 graham crackers • Honey or jelly as desired on crackers • 10 mints 	<ul style="list-style-type: none"> • 5 vanilla wafers • Honey or jelly as desired on wafers • 10 jelly beans 	<ul style="list-style-type: none"> • ½ cup applesauce • 10 sourballs

*Can be repeated until dialysis capabilities returned

**No Raisin Bran Cereal, instead use Cheerios

***All canned fruit and vegetables should be rinsed and drained of excess fluid

Appendix H- Three day* meal plan for chronic kidney disease and diabetes

	Day 1	Day 2	Day 3*
Breakfast	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 2 teaspoons artificial sweetener (optional) • ½ cup pineapple*** 	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 2 teaspoons artificial sweetener (optional) • ½ cup mandarin oranges*** 	<ul style="list-style-type: none"> • ½ cup milk (dry milk and ¼ c distilled water or ¼ cup evaporated milk and ¼ cup water) • ½ cup cereal** • 2 teaspoons artificial sweetener (optional) • ½ cup pears***
Morning Snack	<ul style="list-style-type: none"> • 5 vanilla wafers 	<ul style="list-style-type: none"> • ½ cup unsweetened apple sauce 	<ul style="list-style-type: none"> • 6 unsalted crackers • 1 tablespoon margarine spread on crackers
Lunch	<ul style="list-style-type: none"> • 2 slices white bread • ¼ cup low-sodium tuna • 1 tablespoon margarine or mayonnaise • ½ cup pears** • ½ cup sugar-free beverage 	<ul style="list-style-type: none"> • 2 slices white bread • 2 tablespoon low-sodium peanut butter • 2 tablespoons sugar-free jelly • ½ cup peaches*** • ½ cup sugar-free beverage 	<ul style="list-style-type: none"> • 2 slices white bread • ¼ cup low-sodium tuna • 1 tablespoon margarine or mayonnaise • ½ cup fruit cocktail*** • ½ cup sugar-free beverage
Afternoon Snack	<ul style="list-style-type: none"> • ½ cup canned unsweetened applesauce 	<ul style="list-style-type: none"> • 6 unsalted crackers • 1 tablespoon margarine spread on crackers 	<ul style="list-style-type: none"> • 3 graham crackers • 1 tablespoon low sodium peanut butter
Dinner	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned low sodium carrots** • ½ cup unsweetened apple juice 	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned low sodium peas*** • ½ cup cranberry juice 	<ul style="list-style-type: none"> • 2 slices white bread • ½ cup low-sodium chicken • 2 tablespoons margarine or mayonnaise • ½ cup canned green beans • ½ cup unsweetened apple juice
Evening Snack	<ul style="list-style-type: none"> • 3 graham crackers • 1 tablespoon peanut butter 	<ul style="list-style-type: none"> • 5 vanilla wafers • Honey or jelly as desired on wafer 	<ul style="list-style-type: none"> • ½ cup applesauce

*Can be repeated until dialysis capabilities returned

**No Raisin Bran Cereal

***All canned fruit and vegetables should be packed in unsweetened juice or water and rinsed and drained of excess fluid. Notes: Sugar-free hard candy (sour candy works well) can be sucked on throughout the day and after mealtimes to help subdue thirst without drinking extra fluid. Monitor blood sugar and follow protocol for insulin reactions. Best choices for treating low sugars are fluid-free items such as sugar, corn syrup, hard candy, instant glucose, and glucose tablets. If sugared soda or low-potassium juices are used, they must be counted toward the 2 cup daily limit.

Appendix I – Blenderized Nutrition Support Recipes

Blenderized tube feed recipe – Standard formula

Amount	Ingredient	Calories	Protein (g)
2 cups	Whole milk	300	16
½ cup	Non-fat dry milk powder	120	12
4 jars	Strained Meat	320	40
1 cup	Cooked cereal, strained	128	3.6
2 jars	Strained Vegetables (squash or carrot)	100	2
2 jars	Strained Fruit	140	.6
1 cup	Orange Juice, without pulp	120	0
5 Tbsp.	Oil	600	0
4 Tbsp.	Corn Syrup	240	0
170 cc	Distilled Water		
	TOTAL:	2068	74.2

Blenderized tube feed recipe – High protein modified baby food formula

Ingredient	amount
Baby meat	4 jars (or 9 oz. tender cooked meat)
Baby peas	2 jars (or 1 cup canned or cooked vegetables)
Baby peaches	2 jars (or 1 cup canned or cooked fruit)
Milk	3 cups (3/4 cup skim milk powder + 3 cups water)
Oil	1/4 cup + 1 teaspoon
Sugar	1/4 cup + 1 tablespoon + 2 teaspoons
Tomato Juice	1 cup
Vitamin Preparation	
Recipe contains: CHO: 184 g, Pro: 96 g, Fat: 78 g Calories; 1822	

Directions for making blenderized tube feeds

1. Always start with about 1 cup of liquid in the blender*
2. Add dry ingredients a little at a time until the blender is half full
3. Blend two minutes or until the mixture is very smooth
4. Pour through a clean strainer into a large container
5. Liquid vitamins can be added directly to strained blended mix and blended again for two minutes
6. Repeat in small batches to use all ingredients

*It is very important to use a blender that is well cleaned and sanitized. Poorly cleaned blenders can contain bacteria and produce unsafe blenderized formulas.

Appendix J - Procedure for washing enteral bags and tubing

Between feedings during the day

1. Rinse the feeding bag with cool water
2. Half fill the bag with warm water
3. Attach the feeding set to the feeding bag and shake the bag
4. Allow the water to run through the feeding set until the bag and set look clean
5. Detach the feeding set from the bag
6. Using one hand, hold the feeding set in the middle of the tube. Using your wrist, whirl one half of the feeding set in a circular motion to remove excess water. Repeat with other half. For safety be sure to stand clear of other people and objects.
7. Hang the feeding bag and set to air dry in an area where it will not be disturbed.
8. Prior to next use, flush the feeding set with running water

After the last feeding of the day

1. Rinse the feeding bag with cool water
2. Half fill the feeding bag with warm water
3. Add 1-2 drops of dish soap
4. Attach feeding set to feeding bag and shake bag until clean
5. Run the warm soapy water through the feeding set
6. Rinse the feeding bag and set, making sure all soap residue is washed away
7. Whirl feeding set using procedure from step 6 for cleaning between feedings
8. Hang set and bag to air dry

CHAPTER 4: CONCLUSION

RESEARCH SUMMARY

This thesis provides information pertaining to two research questions:

1. Are individuals with nutrition related chronic disease and nutritionally vulnerable pediatric and elderly populations prepared for a disaster?
2. What nutrition interventions are available after a disaster to acutely treat individuals with nutrition related chronic disease and nutritionally vulnerable pediatric and elderly populations?

Disaster Preparedness

Data analysis of the 2006-2010 BRFSS survey data indicates that while some vulnerable populations may be more prepared for a disaster than the general population, others, specifically those with frequent mental stress or mental, emotional, or physical limitations, tend to be less prepared. Households with children do not appear to differ significantly in their disaster preparedness from the general population, which itself is not well prepared with only 11.4% of the population surveyed by BRFSS reporting all disaster preparedness items.

Fortunately, individuals who report having at least one chronic disease and those 65 years or older may be more prepared than those who do not report dealing with a chronic disease and those who are younger (between the ages of 18-34 years old).

Nutrition Interventions

A systematic review of available literature revealed a surprising lack of high quality studies and published data related to nutrition intervention during resource limited periods. Although several papers and guidelines were found that provided resources for

dealing with one specific population or disease status, no paper was found that encompassed the breadth of conditions examined in this study.

Infants and Breastfeeding Mothers

Infant feeding recommendations following a disaster were consistent across the literature, with a focus on keeping mother and baby together to allow for continued breastfeeding whenever possible. Although many disaster relief workers are inclined to offer infant formula to all mothers with infants, the first choice should be fostering a safe environment and providing a private location to allow mothers to breastfeed. If breastfeeding is not an option due to other circumstances, ready-to-feed formula should be provided first, if available, due to the increased risk of diarrheal illness from contamination during the preparation of powdered infant formula. Infants and young children should also be given preference for receiving water and food, as they easily become dehydrated and malnourished.

Elderly

Similar to infants and young children, the geriatric population begins to feel the effects of limited food and water sooner than the younger adult population, and should be prioritized to receive food and water rations. Any available nutrition supplements following a disaster, such as Boost® and Ensure®, should be reserved for elderly individuals with poor dentition, swallowing difficulties, and poor appetites.

Diabetes

Conditions caused by a major disaster, such as emotional stress, inappropriate diet, and limited access to insulin and oral hyperglycemic agents combine to cause worsening of glycemic control in diabetic individuals following a disaster. Education and

Careful menu planning for diabetic patients is a top priority after a disaster. Although continuing insulin therapy is the only option for long-term survival in individuals with type 1 diabetes, in the absence of insulin, following a strict ketogenic meal plan may help to prolong survival and prevent life-threatening ketoacidosis until insulin becomes available. However, the majority of patients will have type 2 diabetes, and maintaining a consistent carbohydrate intake is the top priority¹.

Renal Disease

Individuals with chronic kidney disease requiring dialysis may be the most vulnerable population following a disaster, especially considering that most patients with kidney disease also have diabetes and/or cardiovascular disease. Limiting solute load and ensuring fluid intake matches urinary output to prevent fluid overload is required.

Nutrition Support

Experimental reports of tapering nutrition support to maximize formula administration until more formula is available have had positive results without any adverse outcomes². Adult patients that require special formulas (such as soy based formula) due to allergies can be provided with hydrolyzed adult or infant formulas as available. Feeds can be administered by gravity when electricity is not available for pumps. The rate of formula administration can be controlled by counting the number of drips per minute.

FUTURE RESEARCH

Due to an increase in the emphasis on fresh, local, and green foods, families are stocking fewer non-perishable items and are relying more heavily on foods that require refrigeration³. Although this movement supports healthy lifestyles, one unforeseen consequence is the increased vulnerability to disasters due to a decrease in the amount of shelf-stable foods in the households of the general population. Future research needs to focus more specifically on the amounts and types of foods that households are keeping on hand for disasters, since there has been a dramatic shift in the types of foods that individuals purchase on a daily basis. Finding a balance between fresh, local agriculture and shelf-stable foods is necessary to promote sustainability of the community before, during, and after a disaster.

On the opposite end of the spectrum is the increased popularity of all-in-one emergency food kits and meals-ready-to-eat (MREs). Although, these items are an easy way for the general population to prepare for a disaster situation, they can actually be potentially hazardous to individuals with special conditions, such as chronic kidney disease, congestive heart failure, or diabetes, due to their high sodium, carbohydrate, and protein content. Collaboration between dietitians, food scientists, and food industry companies is needed to develop emergency food kits that can meet the nutritional needs of individuals with chronic diseases without exacerbating their existing conditions.

The focus of this paper was on populations that are nutritionally vulnerable to disasters due to their health status; however, there are many other individuals that are nutritionally vulnerable following a disaster due to other circumstances, such as their location. This is the case in Hawaii, which is limited by space and proximity to outside

food and water. Because of its location, the City and County of Honolulu Department of Emergency Management (DEM) and the State Of Hawai'i Civil Defense (SCD) recommends Hawaii residents prepare for an emergency situation by keeping a seven day supply of food and water on hand, instead of the Centers for Medicaid requirement of a four day supply⁴. This is a potential problem, due to many Hawaii households containing multi-generational families with a wide variety of health needs and many individuals to plan for, but very limited space. Future work on disaster preparedness in Hawaii should assess the preparedness of the population and include ways to overcome the problem of increased supply needs in an area with limited storage capacity.

Finally, because of the far reaching effects of disaster preparedness and response, future discussions of community capacity building and food security should include disaster planning as an essential component⁵. Community capacity building encompasses the development of knowledge, skills, commitment, structures, systems and leadership to enable effective health promotion, and therefore must include effective disaster preparedness and response. Also, it may be necessary to redefine or expand the meaning of food security to include the ability to maintain access to safe, adequate food during a disaster. For some individuals, especially those living in areas with a high cost of living, maintaining food security for the present may be possible, but stocking supplies to maintain food security in the event of a disaster may not be feasible. Clearly, with increased trends in severe weather events, rising rates of obesity and associated chronic disease, and a shift in the way people are buying and storing food, effective nutrition intervention and care during a disaster is becoming increasingly more important and complex.

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