KNOWLEDGE REGARDING SEVERE ACUTE MALNUTRITION AND ITS TREATMENT AMONG MEDICAL OFFICERS IN THE XHARIEP DISTRICT, FREE STATE

by

Mandla Lackson Ramagoma

Bachelor of Science in Dietetics (UOVS)

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Dietetics and Human Nutrition
School of Agricultural, Earth and Environmental Sciences
College of Agriculture, Engineering and Science
University of KwaZulu-Natal
Pietermaritzburg
SOUTH AFRICA

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ABSTRACT

Introduction: Severe acute malnutrition (SAM) continues to be a major public concern in developing countries including South Africa (SA). A 2007 South African study showed that 14.6% of infants younger than one year died from malnutrition. The World Health Organization (WHO) Ten Step protocol for the management of severe malnutrition was developed to improve the inpatient treatment of SAM. Specific guidelines are required due to the serious physiological and metabolic changes that occur when children become malnourished. If the appropriate care is not in place for children with malnutrition, it can lead to diarrhoea, poor appetite, slow recovery and increased risk for mortality. In 2005, the South African Department of Health implemented the WHO Ten Step protocol in all district, regional and tertiary hospitals for all children less than five years of age, irrespective of clinical presentation. Medical officers (MOs) form the first line of treatment of SAM at South African provincial hospitals, as they are usually the first to see the patient on admission to hospital. Medical officers should therefore have sufficient knowledge about SAM in children and the WHO Ten Step protocol for the management of SAM. This would help to reduce the incidence of malnutrition-related complications and deaths in South African children.

Aim: The aim of this study was to assess the knowledge of MOs regarding SAM and its treatment in Xhariep District, Free State.

Objectives: i) To assess the knowledge of MOs regarding the WHO Ten Step protocol for the treatment of SAM ii) To determine the factors which influence the level of knowledge regarding the WHO Ten Step protocol for the treatment of SAM amongst MOs.

Methods: Fifteen MOs out of a possible twenty employed at Xhariep district in both the district's clinics and hospitals participated in this study by answering a questionnaire designed to assess knowledge on the WHO Ten Step protocol for the treatment of SAM. Eight of the MOs that answered the questionnaire were randomly selected to participate in a focus group discussion to determine the factors that influence the level of knowledge regarding the WHO Ten Step protocol for the treatment of SAM.

Results: The mean score for the knowledge questionnaire on the management of SAM in children was 74 ± 7.84 %, with none of the MOs scoring 100%. The MOs in this study had particularly poor knowledge regarding the definition of wasting according to the Road to Health Booklet, vitamin A supplementation dose according to age, the volume of feeding that

should be used for a child with malnutrition and without oedema and at which stage an infant with malnutrition and anaemia should be given iron supplements. The MOs scored 100% on the abbreviation for ReSoMal, whether a child with worsening oedema should be given diuretics or not, the need for investigation and counselling on human immunodeficiency virus (HIV) and tuberculosis (TB) prior to discharge and the need for referral to the dietitian for nutritional supplementation prescription and education prior to discharge. The focus group discussions revealed that the MOs felt that there was a need for more training on management of SAM at the undergraduate level as well as in-service training at the workplace. Even when in-service training was available, MOs were unable to attend due to lack of transport and high workload. Some MOs also suggested that the undergraduate university curriculum on the management of SAM should be standardised across all South African universities. The focus group discussions also revealed that the MOs found the management of a child with malnutrition in their district challenging, because most of these children remained at home until the development of complications, some of which are life threatening.

Conclusion: The MOs working in the Xhariep District, Free State did not have full knowledge of the WHO Ten Step malnutrition protocol. This suggests that there is a need for regular in-service training on the WHO Ten Step protocol for the treatment of SAM for MOs working in the Xhariep District. South African universities offering medical degrees should consider lengthening and standardising the undergraduate curriculum on the management of SAM in children.

PREFACE

This dissertation was written between January 2015-October 2016 using data collected from the Xhariep District, Free State under the supervision of Dr Kirthee Pillay.

Signed: _____ Date: _____

Mandla Lackson Ramagoma (Candidate)

As supervisor of the candidate, I agree to the submission of this dissertation.

Signed: _____ Date: _____

Dr Kirthee Pillay (Supervisor)

DECLARATION OF ORIGINALITY

I, Mandla Ramagoma, hereby declare that:

1. The entirety of the work contained in this dissertation is my original work, except where otherwise stated.

2. This dissertation, or any part of it, has not been submitted for any degree or examination at any other university.

3. Where other sources have been used they have not been copied and have been properly acknowledged.

4. This dissertation does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the relevant reference section.

Signed: _____ Date: _____

Mandla Lackson Ramagoma (Candidate)

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CHAPTER 1: INTRODUCTION, THE PROBLEM AND ITS SETTING

1.1 Importance of the study

Worldwide, malnutrition is recognised as one of the major contributors to childhood illness and death [Department of Health (DOH) 2014b]. The prevalence of childhood malnutrition is rising worldwide, especially in developing countries [United Nations Children's Fund (UNICEF) 1990]. Malnutrition can present as marasmus, kwashiorkor or marasmic kwashiorkor [World Health Organization (WHO) 2013; DOH 2012; Anderson 2016, p55]. This type of malnutrition results from a dietary deficiency of protein and energy (WHO 2013, p70; Manary & Sandige 2008). The current terminologies used to describe types of malnutrition are severe acute malnutrition (SAM) and moderate acute malnutrition (MAM). SAM arises as a consequence of a sudden period of food shortage and is associated with a loss of body fat and wasting of skeletal muscle. Many of those affected are already undernourished and are often susceptible to disease. Infants and young children are the most vulnerable as they have increased nutritional requirements for growth and development, have comparatively limited energy reserves and depend on others for care (Picot, Hartwell, Harris, Mendes, Clegg & Takeda 2012).

Malnutrition can lead to childhood mortality due to diarrhoea, pneumonia, severe infections, malaria and measles (Caulfield, de Onis, Blössner & Black 2004). According to the WHO (2013), more than 33% of childhood deaths worldwide resulted from malnutrition. In Africa, 25% of children under the age of five years were shown to be underweight and 10% were wasted (UNICEF 1990). Most of the causes of deaths in infants and toddlers in South Africa are associated with poor socio-economic conditions (Bradshaw, Bourne & Nannan 2003). In South Africa in 2007, 14.6% of infants younger than one year died as a result of malnutrition (Statistics South Africa 2009). A 2008 South African study found that 69% of deaths in children under five years of age were related to undernutrition and there was a case-fatality rate of 38% for severe malnutrition (Krug, Chunterpusat, France, Freirich, Jooste, Malek, Mulaudzi, Patrick, Pattinson, Stephen, Steinberg, Visser & Woods 2008).

Acute malnutrition in childhood is as much a medical problem as it is a social problem because it directly affects a broad range of issues: a country's mortality rates, educational prospects, productive employment and economic capacity. Malnutrition also happens to be one of the principal mechanisms behind the transmission of poverty and inequality from one generation to the next. These devastating consequences also carry a heavy economic cost as it is estimated

that in South Africa productivity losses alone exceed 10% of a person's lifetime income, and up to 3% of the country's gross domestic product (GDP) (Anthony 2013; UNICEF 2005).

The WHO Ten Step protocol for the management of severe malnutrition was developed to improve the inpatient management of SAM. Specialised guidelines are required as children with malnutrition undergo serious physiological and metabolic changes which affects the body and its functioning. Malnourished children do not respond to treatment in the same way as well-nourished children. Children who are malnourished are also more likely to die than children without malnutrition, further justifying the need for specialised guidelines. If children with malnutrition are not treated appropriately, it can lead to diarrhoea, poor appetite, slow recovery and increased risk for mortality (Ashworth, Khanum, Jackson & Schofield 2003). In 2005, the South African Department of Health implemented the WHO Ten Step protocol for the inpatient treatment of SAM in all district, regional and tertiary hospitals for all children less than five years of age, irrespective of clinical presentation (WHO & UNICEF 2009). This was done to reduce mortality from SAM (Burger 2010; WHO & UNICEF 2009; Ashworth *et al* 2003). The WHO Ten Step protocol for the inpatient management of severe malnutrition include:

Step 1: Managing hypoglycaemia

Step 2: Managing hypothermia

Step 3: Managing dehydration

Step 4: Correct electrolyte imbalance

Step 5: Treat infections

Step 6: Correct micronutrient deficiencies

Step 7: Prescribe stabilization feed

Step 8: Give transition feed for growth

Step 9: Provide, loving, care and stimulation

Step 10: Prepare for discharge and follow-up (WHO 1999).

Malnutrition in children is a major concern in the Free State province of South Africa with 11% of fatality cases reported, according to Maternal, Newborn, Child and Women's Health

(MNCWH) and nutrition data from 2014 (DOH 2014c). Fatality rates were highest in the Fezile Dabi District (26.2%), Thabo Mofutsanyane (18.2%) and Xhariep District (16.7%) in the Free State in 2014 (DOH 2014c). The Xhariep district is situated in the south western Free State. This district is composed of 21 small old towns namely: Bethulie, Edenburg, Fauresmith, Gariep Dam, Jacobsdal, Jagersfontein, Koffiefontein, Luckhoff, Oppermansgronde, Petrusburg, Philippolis, Reddersburg, Rouxville, Smithfield, Springfontein, Trompsburg, Waterkloof and Zastron (Xhariep District Municipality 2012). In 2011, the population size of Xhariep district was estimated to be at 146 259 (Statistics South Africa 2012). The district has 20 clinics and three hospitals. This part of the Free State is poorly developed and is susceptible to malnutrition. Most of the population from this area migrates to surrounding cities like Bloemfontein and Kimberley to search for employment. As a result, most grandmothers are left to care for children with little resources. Malnutrition in children is common in these areas. Most families depend on government grants and general farm work to survive. This results in poverty and food insecurity in these towns (DOH 2014c).

The Xhariep district has about 20 medical officers (MOs) who treat childhood malnutrition on a daily basis, both in private and public sectors. As part of the malnutrition management team, MOs should know how to correctly assess and treat a child with malnutrition (WHO 1999). Medical officers tend to neglect the nutrition-related aspects of malnutrition and focus on treating the complications of malnutrition (Moatlhodi 2014). It is especially important for MOs to be knowledgeable on how to treat malnutrition using the WHO Ten Step protocol in cases where there are no dietitians available to implement the protocol. The WHO Ten Step protocol should be used consistently by MOs and dietitians when treating malnutrition as this could help to reduce the malnutrition mortality and morbidity rate. MOs should have sufficient knowledge about childhood malnutrition and its treatment in order to ensure that all children with malnutrition are able to achieve optimal nutrition, and to lower the incidence of infectious disease and malnutrition-related deaths in infants and children (DOH 2014c).

Due to the lack of published studies in this area this study aimed to assess knowledge regarding severe acute malnutrition and its treatment among MOs in the Xhariep District, Free State. This study would offer important findings on the level of knowledge and gaps in knowledge that currently exist so that these could be improved through appropriate in-service training and updates. This could potentially help to improve the overall management of SAM in the Xhariep District and reduce the overall morbidity and mortality rates.

1.2 Aim of the study

The aim of this study was to assess the knowledge of MOs regarding severe acute malnutrition and its treatment in Xhariep District, Free State.

1.3 Research objectives

The objectives of this study were:

1.3.1 To assess the knowledge of MOs regarding the WHO Ten Step protocol for the treatment of malnutrition.

1.3.2 To determine the factors which influence the level of knowledge regarding the WHO Ten Step protocol for the treatment of malnutrition amongst MOs.

1.4 Hypotheses

The following hypotheses were tested in the study:

1.4.1 Medical officers have poor knowledge regarding the WHO Ten Step protocol for the treatment of malnutrition.

1.4.2 The factors which influence knowledge of the WHO Ten Step protocol for the treatment of malnutrition amongst MOs include low morale, inadequate university training, lack of supervision, a malfunctioning health system and inadequate in-service training.

1.5 Inclusion criteria

Only qualified MOs [with a valid Health Profession Council of South Africa (HPCSA) registration certificate and MP (medical practitioner) number] employed in the Xhariep district, were invited to participate in the study.

1.6 Assumptions

The following assumptions were made:

1.6.1 All the MOs understood English, which was the language, used to formulate the knowledge questionnaire and to conduct the focus group discussions.

1.6.2 The MOs answered the questionnaire honestly and without bias.

1.6.3 The MOs gave honest responses during the focus group discussions.

1.7 Definition of terms

Complementary foods: Foods that are given to infants above six months of age to supplement breastfeeding (WHO 2014).

Health Professions Council of South Africa (HPCSA): A statutory body, established in terms of the Health Professions Act No.56 of 1974 (HPCSA 2010).

Infant: A young baby aged between six months and one year (Rudolf, Lee & Levene 2011, p4).

Knowledge: Fact, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject (Anthony 2013).

Kwashiorkor: A clinically recognisable syndrome of severe malnutrition, which is characterised by severe loss of muscle and subcutaneous fat and weight less than 60% of the expected weight-for-age (Anderson 2016, p55).

Marasmus: A clinically recognisable syndrome of severe malnutrition. It is characterised by severe loss of muscle and subcutaneous fat and weight less than 60% of the expected weight-for-age (Anderson 2016, p55).

Medical officer: Health professionals who have obtained an MBChB or equivalent qualification and who are employed to render a clinical service. In South Africa all MOs must have a current registration with the HPCSA (HPCSA 2010).

Moderate acute malnutrition: Also known as wasting and is defined by weight-for-age/height indicator between -3 and -2 Z-scores (standard deviation) of the international standard or by a mid-upper arm circumference (MUAC) between 11cm and 12.5cm (WHO 2013).

Severe acute malnutrition: The presence of oedema of either feet or wasting [weight-for-age/length <-3SD or MUAC <11.5 cm] (WHO 2013).

1.8 Abbreviations

DOH	Department of Health
HFA	Height for age
IV	Intravenous
MAM	Moderate Acute Malnutrition
MNCWH	Maternal, Newborn, Child and Women's Health
MOs	Medical officers
MUAC	Mid-upper arm circumference
NFCS	National Food Consumption Survey
ReSoMal	Rehydration Solution for Malnutrition
RtHB	Road to health booklet
RUTFs	Ready-To-Use Therapeutic Foods
SAM	Severe Acute Malnutrition
UNICEF	United Nations Children's Fund
WFA	Weight for age
WFH	Weight for height
WHO	World Health Organization

1.9 Summary

Worldwide, malnutrition is recognised as one of the major contributors to childhood illness and death. The WHO Ten Step protocol for the management of severe malnutrition was developed to improve the inpatient treatment of SAM. The WHO Ten Step protocol for the inpatient treatment of SAM was implemented by the South African Department of Health in 2005 in order to reduce the mortality rate from SAM. Poverty and food insecurity is a major concern in the Free State province of South Africa and results in high rates of malnutrition amongst children. The Xhariep district has one of the highest child fatality rates in the Free

State. This district has about 20 MOs who treat childhood malnutrition on a daily basis in private and public sectors. Medical officers are usually one of the first health professionals to treat a child admitted to hospital with SAM. Therefore, it is important for MOs to be knowledgeable on how to treat malnutrition using the WHO Ten Step protocol, as management also influences overall prognosis and recovery. Due to the lack of published research in this area, this study aimed to assess the knowledge of MOs regarding severe acute malnutrition and its treatment in the Xhariep District, Free State.

1.10 Outline of dissertation

This dissertation consists of six chapters and is presented as follows:

Chapter 1: Introduction
Chapter 2: Literature review
Chapter 3: Methodology
Chapter 4: Results
Chapter 5: Discussion
Chapter 6: Conclusion and Recommendations

1.11 Referencing style

This dissertation has been referenced using the referencing style of the Department of Dietetics and Human Nutrition at the University of KwaZulu-Natal (UKZN).

CHAPTER 2: LITERATURE REVIEW

This chapter reviews literature on SAM in children with special focus on South Africa, WHO classification of SAM, causes of malnutrition as well as indicators, admission criteria and management of SAM. Finally, MOs knowledge regarding SAM in children and challenges preventing optimal management of SAM are also discussed.

2.1 Severe acute malnutrition in children, with special focus on South Africa

It is estimated that there are approximately 20 million children worldwide with SAM. In addition, malnutrition contributes to more than one third of childhood deaths worldwide (UNICEF 2009). Other causes of childhood deaths include neonatal (37%), acute respiratory infections (17%), diarrhoea (16%), other (13%), malaria (7%), measles (4%), injuries (4%) and Human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) (2%) (UNICEF 2009). Childhood mortality is high in South Africa (62 per 1000 live births) (UNICEF 2009). Of those who died in 2007, at least 33% had SAM and another 30% were underweight for age and over 50% were suspected or confirmed HIV positive. In addition, medical education and training in nutrition continue to be inadequate despite strong evidence that hospital malnutrition is highly prevalent and affects patient outcomes and costs of care. Over the last 10 years the management of SAM has improved and treatment programmes have been enhanced. Attention has been focused on children over 6 months of age whose treatment has been transformed through the development of Community Management of Acute Malnutrition (CMAM) and use of ready-to-use therapeutic foods (RUTFs). In contrast to this success, acute malnutrition among infants aged under 6 months old remains inpatient-based and has often been neglected in terms of directed research. This was recently highlighted by the Management of Acute Malnutrition in Infants (MAMI) project, a multiagency review of current evidence, policy, practice and programme outcomes for infants younger than 6 months with SAM (DOH 2012; Lutter, Daelmans, de Onis, Kothari, Ruel, Arimond, Deitchler, Blössner & Borghi 2011). A study conducted in South Africa in 2007 showed that 14.6% of infants younger than one year died because of malnutrition (Statistics South Africa 2009). Most of the causes of deaths in infants and toddlers in South Africa are associated with poor socio-economic conditions (Bradshaw *et al* 2003).

HIV infected malnourished children are either perinatally infected, underfed or both (Heinkens, Bunn, Amadi, Manary, Chagan, Berkley, Rollins, Kelly, Adamczick, Maitland & Tomkins

2008; Winter 1996). Infants of HIV infected mothers have a low weight gain in the first four months of life and a decrease in height is also observed (Winter 1996). Even uninfected children are affected because mothers and caregivers have chronic diseases and high mortality (Heinkens *et al* 2008; Winter 1996). Most of them live in south Asia and SSA [WHO, UNICEF and the Standing Committee on Nutrition (SCN) 2006]. Malnutrition can lead to childhood mortality due to diarrhoea, pneumonia, severe infections, malaria and measles (Caulfield *et al* 2004).

The major form of malnutrition observed in children in developing countries including South Africa is protein-energy malnutrition (PEM). Protein-energy malnutrition results from a lack of one or more macronutrients that are required by body tissue in order to sustain optimal function of the human body (Manary & Sandige 2008). It is caused by deficiencies in protein and glycaemic carbohydrates (Kathleen & Hammond 2016, p55). Malnutrition can manifest in different ways depending on the symptoms presented. The next section discusses the WHO classification of malnutrition.

2.2 WHO classification of severe acute malnutrition

Low weight-for-age (WFA) indicates underweight and acute malnutrition. Although, low weight-for-height (WFH) indicates wasting and severe and recent episodes of malnutrition, it cannot identify children with mild malnutrition. Low height-for-age (HFA) indicates stunting and chronic malnutrition. Underweight is clearly defined as a weight more than 2 standard deviations (or Z-scores) below the median expected WFA. This low weight could be due to stunting (low HFA) or wasting (low WFH). Severe wasting is seen when there is a WFH measurement of below -3 Z-score [WHO & UNICEF 2009; Ethiopia Federal Ministry of Health (EFMOH) 2007].

The standardised criteria for diagnosis of SAM are one or more of the following: WFH Z-score of below -3, presence of bilateral pitting pedal oedema of nutritional origin and MUAC of less than 11.5cm (WHO & UNICEF 2009; EFMOH 2007; WHO 1999). According to the National Centre for Health Statistics (NCHS) these new cut-off criteria are useful to identify children that were previously diagnosed with moderate malnutrition (WHO 1999). Syndromes of malnutrition are described as kwashiorkor or marasmus (Karaolis, Jackson, Ashworth, Sanders, Sogaula, McCoy, Chopra & Schofield 2007). Inadequate protein and energy intake leads to

marasmus (Kathleen & Hammond 2016, p55) which is defined as a clinically recognisable syndrome of severe malnutrition. It is characterised by severe loss of muscle and subcutaneous fat and the child weighs less than 60% of the expected WFA. Kwashiorkor is an illness that results when a mother's first child is weaned off protein-rich breast milk onto a food source which lacks protein (Kathleen & Hammond 2016, p55). This illness is caused by severe protein deficiency and hypoalbuminaemia. Kwashiorkor is also defined as a clinically recognisable syndrome of severe malnutrition characterised by peripheral oedema, skin changes and fine, pale, sparse hair. A new term called moderate acute malnutrition (MAM) is defined by moderate wasting (low WFH, Z-score between -2 and -3 SD) and MUAC between 11.5 and 12.4cm (DOH 2014b).

2.3 Causes of malnutrition

To ensure that all South Africans and their children can achieve optimal nutrition and to lower the incidence of infectious disease and malnutrition-related deaths in infants and children, it is important to understand the factors contributing to malnutrition (DOH 2014b). The UNICEF conceptual framework of child malnutrition (Figure 2.1) shows multiple levels for interventions that can reduce morbidity and mortality related to malnutrition. To prevent or treat malnutrition, the factors causing the condition need to be evaluated. The different causes of malnutrition are interlinked and include immediate causes, underlying causes and basic causes (UNICEF 2005). All factors function collectively and dependently (Williams 2005, p405).

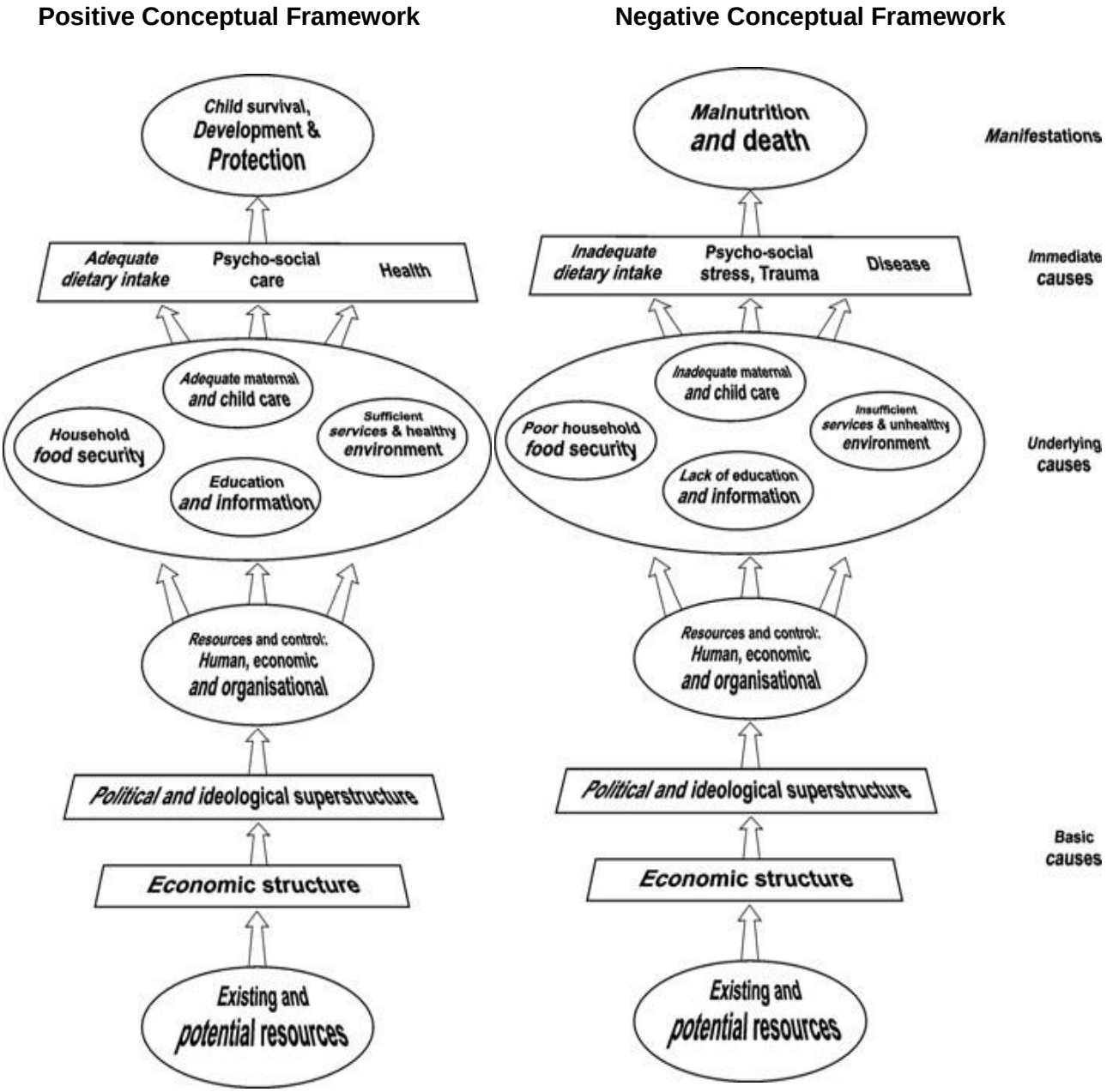

Figure 2.1 UNICEF conceptual framework on the causes of malnutrition (positive/negative) (UNICEF 1990)

2.3.1 Immediate causes of malnutrition

UNICEF (1990) classifies the immediate causes of childhood malnutrition as an insufficient diet as well as stress, trauma, disease (severe or frequent infections) and poor psychosocial care. Insufficient dietary intake may refer to poor breastfeeding practices, early weaning,

delayed introduction of complementary foods and inadequate protein in the diet. The insufficient intake can also be related to neglect and abuse (Williams 2005, p405; UNICEF 2005). Other factors that influence food intake include health status, food taboos, growth and personal choice related to diet (Vorster, Hautvast & Gibney 2002, p6).

2.3.2 Underlying causes of malnutrition

The underlying causes of malnutrition include household food insecurity, inadequate care of children and women, low education levels and information, insufficient health services and an unhealthy environment (lack of sanitation and safe water) (Müller & Krawinkel 2005; UNICEF 1990; Jones 1998). In order to improve malnutrition there should be specific emphasis on social norms, gender equity and maternal access to education (WHO & UNICEF 2009).

2.3.3 Basic causes of malnutrition

The basic causes, also called national or root causes of malnutrition include poor availability and control of resources (political, social, ideological and economic), environmental degradation, poor agriculture, war, political instability, urbanisation, population growth and size, distribution, conflicts, trade agreements, natural disasters, and religious and cultural factors (Torún 2006, p883; UNICEF 2005; Vorster *et al* 2002, p8; Torún & Chew 1994, p952). In addition, landlessness and migrant labour are also considered basic causes of malnutrition (Grantham-McGregor 1984, p105). Other basic causes include market failures due to economic decline, conflict and political upheavals that can lead to a reduction in food yields and price increases (Mason, Bailes, Mason, Yambi, Jonsson, Hudspeth, Hailey, Kendle, Brunet & Martel 2005). Food loss after a harvest can also occur when storage conditions are poor and food is inadequately distributed (Torún 2006, p883; Torún & Chew 1994, p952). An association between PEM and poor housing conditions was found in Ethiopia (Getaneh, Assefa & Tadesse 1998), Kenya (Ayaya, Esamai, Rotich & Olwambula (2004) and Kampala (Owor, Tumwine & Kikafunda 2000).

The economic position of the household was also found to impact on the risk of a child being stunted and underweight (Zere & McIntyre 2003). In poor families there is a higher chance of children being stunted and underweight (UNICEF 2005; Zere & McIntyre 2003; Grantham-McGregor 1984, p105). The fathers' occupation was found to be the best indicator of income. An association was found between PEM and the father being a labourer (Saito, Korzenik, Jekel & Bhattacharji 1997), having a low income job (Rikimaru, Yartey, Taniguchi, Kennedy &

Nkrumah 1998; Jeyaseelan & Lakshman 1997) having no land, no livestock such as cattle (Owor *et al* 2000; Ayaya *et al* 2004), no maize or beans and owning only a small piece of land (Ayaya *et al* 2004). Iqbal, Yasmin & Kabir (1999) found a significant association between low household income, parental illiteracy and small family size (less than six members). A close to significant association between room density and the prevalence of malnutrition was also found (Iqbal *et al* 1999).

2.4 Indicators of malnutrition

Nutritional indicators of malnutrition include anthropometry, biochemical and clinical assessment. Anthropometric indicators include mid-upper arm circumference (MUAC), height and weight, while biochemical indicators include blood glucose, infection markers, liver function tests, urea and electrolytes, full blood count and input and output report. The next section further discusses the nutritional indicators of malnutrition and clinical criteria for admitting a child with malnutrition.

2.4.1 Mid-upper arm circumference

The WHO and UNICEF have recommended the use of the MUAC as an independent indicator of severe wasting and SAM. MUAC is a useful indicator within community settings or during emergencies when measuring the weight and height of children may be problematic. MUAC is easy and cost-effective to measure and does not require a chart for interpretation of results. It has been shown to perform as well as measures of weight for height (WFH) in identifying children with SAM. Children from 6 months to 5 years of age are considered to have SAM if they have a MUAC of less than 11.5 cm (WHO 2013; Picot *et al* 2012; EFMOH 2007; WHO 1999).

In order to achieve early identification of children with SAM in the community, skilled community health workers and community members should measure the MUAC of infants and children who are between 6-59 months of age and examine them for bilateral pitting oedema. Infants and children who are between 6-59 months of age and have a MUAC of less than 11.5 cm, or have any degree of bilateral oedema, should be instantly referred for full evaluation at a treatment centre for the management of severe acute malnutrition (WHO 2013; Picot *et al* 2012; WHO 1999). The WHO (2013) recommends that the anthropometric indicators used to confirm SAM should also be used to assess whether a child has reached nutritional recovery.

For example, if MUAC is used to identify that a child has SAM, then MUAC should be used to assess and confirm nutritional recovery (WHO 2013).

2.4.2 Biochemical indicators

Biochemical values assist with understanding the patient's biochemical status as part of investigation and follow-up in order to achieve optimal clinical outcomes. Baseline values for the first five days of admitting a child with SAM include glucose, urea and electrolytes, magnesium, phosphorus, calcium, liver function test and albumin. Hypoglycaemia is defined by blood glucose of less than 3 mmol/l. Because hypoglycaemia due to malnutrition is prevalent in children with SAM, blood glucose readings should be investigated and monitored daily. Dehydration occurs when there is too little fluid without shock and eventually causes electrolyte imbalance. Electrolyte imbalance occurs when there is too little potassium and magnesium and too much sodium, and is usually present in patients with SAM. This is usually caused by persistent diarrhoea and vomiting (DOH 2014b; WHO 1999). Liver function tests are used to indicate inflammation and damage to the liver and overall functioning. Albumin which is an important indicator of nutritional status is an indispensable drug-binding protein in the blood. Low serum album levels are often the result of insufficient protein intake and poor nutrition and can result in oedema. The half-life of albumin is 21 days; therefore, albumin reflects the nutritional status for the past 21 days or 3 weeks (Anderson 2016, p872).

2.5 Admission criteria for children aged 6-59 months with severe acute malnutrition

According to Kerac, Trehan, Weisz, Agapova & Manary (2012); Picot *et al* (2012) and EFMOH (2007) the admission criteria for a child with SAM aged 6-59 months of age include:

a.) A WFH of less than -3 Z-score using the World Health Organization Child Growth Standards (WHO-GS). According to the guidelines MUAC is not recommended for infants less than 6 months of age. For infants who are less than 6 months of age, the WHO currently recommends the use of similar weight for height threshold guidelines compared with the WHO child growth standards for that age group. The presence of clinical signs of bilateral oedema of nutritional origin is also included. Low HFA reflects reduced skeletal growth as a result of recurrent long-standing undernutrition and WFA reflects both short and long term nutritional deficiencies. Underweight infants have a WFA below the -2 line and stunted infants have a HFA below the -2 line (Manary

& Sandige 2008). A WFA below the -3 line indicates SAM (DOH 2014b; Manary & Sandige 2008).

b.) Although phrased slightly differently in various protocols, the clinical criteria can be summarised as follows:
- Mother produces inadequate breast milk.
- The infant is too weak or unable to suckle well (independent of weight/height).
- The infant is not gaining weight or is losing weight at home.

Only two protocols offer guidance on how to assess breastfeeding, regardless of the emphasis on effective breastfeeding. Only one cited a formal breastfeeding assessment tool but did not specify a threshold score for admission. Three guidelines also cited "visible wasting" as an independent admission criterion (Kerac *et al* 2012; Picot *et al* 2012; EFMOH 2007).

2.6 Management of severe acute malnutrition in children

It is common for the development of SAM to occur rapidly, and is observed commonly in emergency situations. This is especially so if children already have mild or moderate undernutrition. Early identification and treatment is needed, but the urgency of the situation may not always be recognised. Failure to recognise SAM in a child may result in management that reduces the likelihood of survival. In the 1990s, one in four severely malnourished children died during treatment in developing countries. Mortality rates varied from 5% to 50% between centres. This variation was mainly due to differences in treatment practices. The centres where mortality was low followed a basic set of principles that implemented treatment in stages and addressed clinical problems in an ordered manner. In order to improve identification and treatment of SAM, the WHO introduced a guide in 1999 that provided a Ten Step ordered approach through three phases (Jones & Berkley 2014; WHO 1999). The guideline takes into account the serious physiological and metabolic changes that occur in severely malnourished children. This means that they have to be fed, rehydrated and managed differently from well-nourished children. If intensive feeding is started too soon i.e. before metabolic and electrolyte imbalances are corrected (refeeding syndrome), the child may deteriorate and die (DOH 2014b; DOH 2013; EFMOH 2007; Collins, Dent, Binns, Bahwere, Sadler & Hallam 2006).

Refeeding syndrome can be defined as the occurrence of severe fluid and electrolyte shifts (especially but not exclusively, of phosphate) with metabolic complications in malnourished patients receiving enteral, parenteral or oral feeds. Refeeding syndrome can also be defined as a decrease in phosphate to levels below 0.65mmol/l (DOH 2014b; Macdonald, Page, Brown & Bryden 2013; Mascolo, Trent, Colwell & Mehler 2012; Boateng, Sriram, Meguid & Crook 2010; Khan, Ahmed, Khan & MacFie 2010). The WHO (1999) guidelines have been developed in further WHO publications for the management and inpatient treatment of children with malnutrition.

2.6.1 Execution of the WHO Ten Step protocol for the management of severe acute malnutrition

The WHO Ten Step approach to the management of SAM is presented in Figure 2.2.

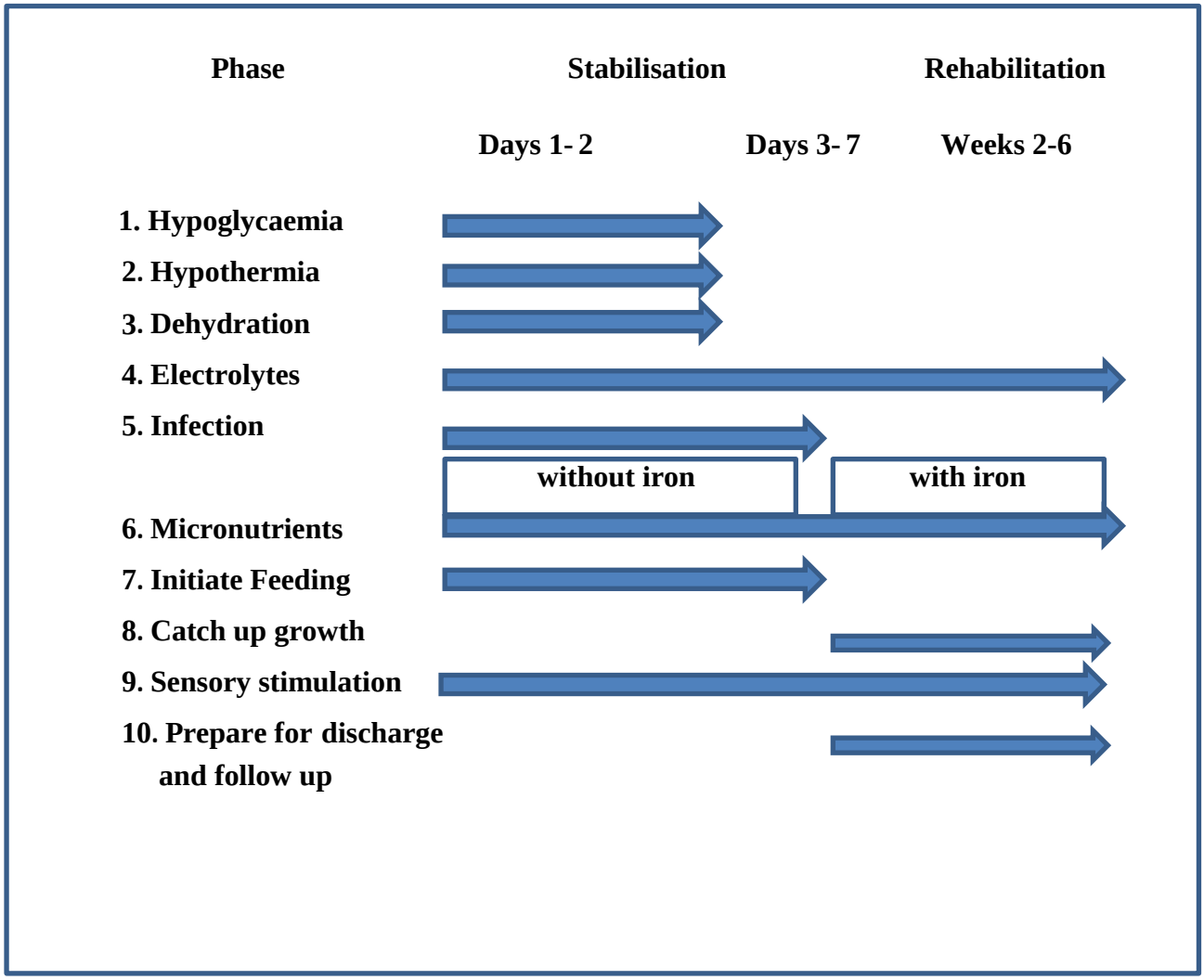

Figure 2.2: Schematic representation of the WHO Ten Step management protocol for severe acute malnutrition (WHO 1999)

There are three phases in treatment: stabilisation, rehabilitation and follow-up. In the first phase of initial treatment, the focus is on stabilising the child's condition by careful refeeding and identifying and treating any life-threatening problems (steps 1-7). This first phase usually takes place in a hospital or residential care facility and in most cases will last from 2 to 7 days, by which point the child's appetite should have improved. Formula 75 (also known as F75) is the starter formula used during initial management of malnutrition, beginning as soon as possible and continuing for 2-7 days until the child is stabilised. However, Formula 100 (also known as F100) is used for catch-up growth and forms part of the rehabilitation phase. Older children can start to receive solid food during this phase. The use of RUTFs is not discussed in the guidelines and only local foods are mentioned. At the same time, play interventions to stimulate the child's emotional and physical development are implemented. This can include different types of play with children, individually and in small groups (DOH 2014b; Jones & Berkley 2014; Play Therapy Africa 2009; EFMOH 2007; Collins *et al* 2006; WHO 1999).

At this time the child's caregiver should also receive training so that he or she understands the causes of undernutrition and to how to prevent a recurrence. Caregivers should also know how to treat or obtain treatment for common ailments such as diarrhoea and intestinal parasites (DOH 2014a; DOH 2014b; DOH 2013; Jones & Berkley 2014; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 1: Managing hypoglycaemia

Hypoglycaemia occurs when the blood glucose level is below 3 mmol/l. Blood transports glucose to the entire body for energy and cells cannot function properly without glucose. In addition, glucose is very important for brain functioning. If the brain does not get enough glucose: the child becomes drowsy, lethargic and limp and cannot be awakened and may lose consciousness. To prevent hypoglycaemia malnourished children should be fed every 3 hours, day and night, and it should start immediately (DOH 2014a; DOH 2014b; DOH 2013; Jones & Berkley 2014; EFMOH 2007; Collins *et al* 2006; WHO 1999). The following are the three danger signs of hypoglycaemia and the actions that should be taken:

- If the child is conscious, 50 millilitres (ml) of 10% glucose solution should be given immediately.
- If 10% glucose solution is not available 50 ml of F75 or 50 ml of sugar solution should be given orally.

- If the child is unconscious, glucose should be given intravenously (5 ml/kg sterile glucose solution). If this cannot be done quickly, 50 ml of 10% glucose solution should be given by naso-gastric tube.
- If only 50% sterile glucose solution is available, one part 50% glucose should be diluted with four parts sterile water and given to the child by naso-gastric tube (DOH 2014b; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 2: Manage hypothermia

According to DOH (2014b), DOH (2013), Jones & Berkley (2014), EFMOH (2007), WHO (1999) and Collins *et al* (2006) hypothermia occurs when axillary temperature is below 35.5˚ C or if rectal temperature is below 35˚C. If the child is hypothermic, it is likely that the child also has hypoglycaemia and severe infection. 'Active re-warming' e.g. 'kangaroo care' must be provided promptly. To prevent hypothermia, malnourished children should be kept warm day and night (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 3: Prevent and treat dehydration

Dehydration commonly results from reduced fluid intake, severe diarrhoea and vomiting. Diarrhoea causes about 30-50% of deaths in developing countries. The risk of death due to persistent diarrhoea is related to a lack of breastfeeding, systemic infections, malnutrition and young age (Ochoa, Salazar-Lindo & Cleary 2004). Persistent diarrhoea is caused indirectly and directly by poor nutrition, poverty, poor hygiene, environmental contamination, inappropriate feeding practices and early weaning. Persistent diarrhoea is mainly an infection-induced illness and is usually the result of continued gram-negative infections, unresolved infections, secondary malabsorption, gastroenteritis syndrome (Heinkens *et al* 2008; Ochoa *et al* 2004), zinc deficiency and changes in intestinal flora (Heinkens *et al* 2008). Mucus damage is associated with acute gastro and post-enteritis syndrome. The villi become short, the number and height of microvilli decrease, enterocyte borders are blunted, the glycocalyx is lost, and crypt hyperplasia follows (Heinkens *et al* 2008).

As mentioned previously dehydration is challenging to diagnose in malnourished children due to the clinical symptoms being similar to that of malnutrition i.e. loss of skin elasticity, dry mouth, absent tears and sunken eyes (Heinkens *et al* 2008).

Treatment of dehydration is as follows:

- A child with malnutrition should be rehydrated more slowly than a normal child.
- A child with malnutrition should be given Rehydration Solution for Malnutrition (ReSoMal) 20ml/kg every hour for 4 hours (i.e. 5 ml/kg every 15 min for 4 hours) using small, frequent sips.
- Oral rehydration should be given for more than 12 hours.

(DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999)

Full-strength, standard WHO low-osmolarity oral rehydration solution (75 mmol/L of sodium) should not be used for oral or nasogastric rehydration in children with SAM who present with dehydration. A child admitted with malnutrition and dehydration should be given either ReSoMal or half-strength standard WHO low-osmolarity oral rehydration solution with additional potassium and glucose, except if the child has cholera or profuse watery diarrhoea. A solution can be made by dissolving one sachet of standard WHO low-osmolarity oral rehydration solution in 2 L water (instead of 1 L). Then, 1 level scoop of commercially available combined minerals and vitamins mix or 40 ml of mineral mix solution and 50 g of sugar should be added. Sachets that are designed to make 500 ml of standard WHO low-osmolarity oral rehydration solution are available in some countries. In this situation, dilution can be modified to add 1 L of water (WHO 2013).

Signs of over-hydration in a child are: increasing pulse rate of up to 25 beats per minute, increase in respiration of up to 5 breaths per minute, increasing oedema and swollen eyelids. It is important to record the pulse of a child with SAM as well as respiration rate every 30 minutes for the first 2 hours after admission and thereafter every 1 hour. A lower pulse and respiration rates are signs of progress for a child with SAM and an increased pulse and respiration rates are signs of over-hydration. The rehydration solution should be stopped if the child is over-hydrated. One of the signs of over-hydration improvement is increased urine frequency. Stool/vomiting frequency determines how much ORS should be given. If a malnourished child is in shock: one should not give fluids via the intravenous (IV) route for more than 2 hours. ORS is favourably indicated if more fluids are needed. During shock or when the child cannot take fluids orally, IV fluids should be given at a slower rate than usual and the child should be checked every 5-10 minutes for signs of over hydration such as

increased pulse and respiration rates (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 4: Correct electrolyte imbalance

Electrolytes are substances with an electrical charge and include potassium, magnesium and sodium. Potassium and magnesium are usually found inside cells while sodium is usually found outside. This is important for maintaining fluid balance and the proper functioning of cells. The body loses potassium and magnesium in severe malnutrition because malnutrition damages the cells thus increasing the loss of electrolytes out of cells and through the urine. The tiny pumps in the cell wall that keep sodium out of the cell and potassium in, work much slower to save energy. When tissues are broken down to provide energy, the potassium and magnesium inside the cells are lost. Electrolytes are also lost in the stool during diarrhoea and deficiencies of electrolytes are worsened by poor food intake. The kidneys do not work properly and thus cannot excrete excess sodium, so children get "too salty" (develop hypernatraemia) (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

All severely malnourished children usually develop deficiencies of potassium and magnesium, with too much sodium. Diuretics should not be given to children with malnutrition, because it increases loss of potassium thus making the electrolyte imbalance worse. Electrolyte imbalance leads to: fluid retention (oedema), increased risk of heart failure, weakened heart (risk of heart failure), apathy, weakness and poor appetite. It is important to correct electrolyte imbalance in a child in order to prevent death from heart failure, restore normal metabolic processes in the cell, correct oedema, restore appetite and provide the building blocks for new cells (tissue synthesis). Extra potassium and magnesium should be given daily in order to correct electrolyte imbalances. In addition, low sodium fluids should be used for intravenous (IV) and oral rehydration (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 5: Prevent and treat infection

All malnourished children require antibiotics as infections are common in malnourished children. However, signs are often absent because of a poorly functioning immune system

that cannot respond in the usual way when a child is malnourished. Even very serious infections like septicaemia can easily be missed. It is not advisable to wait for a laboratory diagnosis before starting, because the child may die in the meanwhile. There is possibility of hidden infections if the child has hypoglycaemia and hypothermia (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Infection-related mortality can be prevented. The correct amount of broad spectrum antibiotics should be given to all malnourished children timeously. It is very important to complete the antibiotic course in order to prevent resistance or treatment failure. It is vitally important for children with malnutrition to be treated for skin lesions (dermatosis) so that they do not become infected. Cross infections can be prevented by giving the measles vaccine if the child is less than 6 months old and not immunised. Mothers should also be taught how to prevent cross-infection through good hygiene (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

A study done by Bachou, Tylleskar, Downing & Tumwine (2006) in Mulago Hospital, Kampala, Uganda found a high prevalence of infections (26%) and bacteraemia (18%) in a group of 315 malnourished children. Because nutrition and HIV are closely linked, weight loss and wasting are problems associated with inadequate intake due to anorexia, malabsorption, digestion, metabolic irregularities, and increased loss of nutrients through vomiting and decreased absorption. In addition, catabolic processes, abnormal energy utilisation, increased requirements, uncontrolled opportunistic infections and/or a lack of physical activity are also involved in weight loss and wasting (Torún 2006, p43, p883; Winter 1996, p1008; Torún & Chew 1994, p952).

Step 6: Correct micronutrient deficiencies

Micronutrients are vitamins and minerals required by the body in small amounts. Malnourished children are deficient in micronutrients because of poor dietary intake, poor appetite, and the loss of some micronutrients during diarrhoea and increased demand and utilisation of micronutrients during infections. Some signs of micronutrient deficiency include: dry conjunctiva, frothy white patches on the surface of the eye (Bitot's spot), cloudy eye, corneal ulceration (vitamin A deficiency), oedema, diarrhoea (zinc and folic acid deficiency), cracked and peeling skin (zinc, multiple micronutrient deficiency), hair changes (multiple micronutrient deficiencies), pallor (iron and folic acid deficiencies), cracks at the corners of the mouth, red

painful tongue (B vitamin deficiencies) and poor appetite (zinc and multiple micronutrient deficiencies). Extra micronutrients should be given during treatment for the following reasons (Kathleen & Hammond 2016, p55; WHO 1999):

- Prevent night blindness (on day one give vitamin A of 50 000 IU for less than six months of age; 100 000 IU for 12 months; 200 000 IU for less than five years).
- Repair leaky cells and correct oedema.
- Repair the damaged gastrointestinal tract (GIT) and stop diarrhoea (especially zinc and folic acid).
- Get cells to function properly again.
- Repair the damaged immune system.
- Restore appetite (especially zinc).
- Provide building blocks for new cells (tissue synthesis).

Iron should not be given initially during the stabilisation phase because iron makes existing infections worse and damages cell membranes. Iron can be started when the child has had time for the antibiotics to work on the pathogens and when micronutrient deficiencies are at least partially corrected. Iron can be given during the rehabilitation phase and when the oedema has cleared (DOH 2014b; DOH 2013; Iannotti, Trehan & Manary 2013; Jones & Berkley 2014; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Correction of micronutrient deficiencies can be done by giving vitamin A on day one of treatment according to age. Zinc, copper and folic acid can be given daily (2.5 mg i.e. ½ a tablet) as well as multivitamin syrup (5 ml) (DOH 2014b; DOH 2013; Iannotti *et al* 2013; Jones & Berkley 2014; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 7: Start cautious feeding

Malnourished children need to be fed differently to normal children because they have experienced weight loss and any further weight loss could be harmful. The gastrointestinal tract (GIT) of a malnourished child is damaged and cannot tolerate large amounts of food at one time. The liver is also damaged and cannot cope with excess protein, so small frequent feeds are indicated to avoid overloading the GIT. Carefully prescribed volumes are indicated to avoid excessive fluid intake. The heart of a child with SAM is usually smaller and weaker and cannot tolerate excess fluid and the kidneys are unable to remove excess fluid or sodium.

Low sodium and high sugar formulas are indicated (DOH 2014b; Jones & Berkley 2014; DOH 2013; EFMOH 2007; Collins *et al* 2006; WHO 1999).

Step 8: Catch up growth (rehabilitation phase)

Signs that indicate readiness for rehabilitation is hunger and clearing of most or all the oedema. Breastfeeding should be promoted and protected at all times. A starter feed can be given according to prescribed times but breastmilk should be offered in between and on demand. If a child vomits then the child should be given lower volume feeds after 10 minutes. If vomiting persists, the feeding rate should be reduced. If the child has persistent vomiting, a nasogastric tube should be considered. Using Formula 100, catch-up growth requires: 100 ml/kg/day if there is oedema and 130 ml/kg/day if there is no oedema. Intake should be controlled for the first three days on catch-up feeding when transition feeding has started. This transition aims to prevent sudden death from heart failure and should be increased slowly as tolerated. A lack of weight gain in the child may be due to the following reasons: not fed catch up formula, catch-up formula is incorrectly prepared (wrong recipe, inaccurate dietary scales, careless preparation, oil volumes not measured correctly), too few feeds, feeds not increased, feeds spill onto clothing, missed infection (not receiving antibiotics), food-borne illness, uncaring staff/caregivers, not receiving potassium or micronutrients and poor growth monitoring (DOH 2014b; DOH 2013; EFMOH 2007; WHO 1999).

Step 9: Provide loving care and play

The quality of psychosocial care is often determined by the interaction between mother and child. Severe malnutrition impairs mental development leading to behavioural problems when they are older, poor school performance as well as poor job prospects. Children with malnutrition need loving care, play and stimulation and should be referred to the occupational therapist or physiotherapist. Loving interactions and play improve mental development and thus future quality of life. Talking, storytelling, hugging, having a safe and attractive environment and encouraging independence may have a protective effect on the nutritional status of the child with SAM. Independence gives the child the ability to obtain food and health care later in life (Carvalhaes & Benicio 2006). It is important for parents to strengthen their psychosocial care and support skills as part of the intervention programme for malnourished children as the effects of hunger and food insecurity are closely linked to psychosocial stress. Parents should be involved as far as possible with care and should be taught the importance of play and stimulation. Mothers should play with their children in a happy manner and praise

them in order to build confidence. Playing with a child should include affordable, clean, safe and strong toys as well as discarded household items (Play Therapy Africa 2009; UNICEF 2005).

Table 2.1 shows the aspects of child development that should be promoted.

Table 2.1: Aspects of child development that should be promoted (DOH 2014b; DOH 2013; WHO 1999).

Aspect	**Example**
Cognitive development	Acquire knowledge (match items, size, colour, shape).
Motor development	Use muscles (splash water, shake rattle, hit drum).
Language development	Learn words through listening and imitating (animals, parts of body, colours and sing songs).
Exploratory	Find out about things (roll a ball, look in the mirror, blow bubbles).
Social development	Show love, interest in what others are doing, pleasure, affection.

These aspects of child development should be promoted to increase the chances of survival of the child, even when the child is given enough food. Children that survive these circumstances will have long-term mental and cognitive disabilities and could be stunted with poor growth (Play Therapy Africa 2009). Psychosocial care is also linked to better care practices in terms of eating and health. A study done in Mexico showed that there was an association between a mother that was not responding to her child, a poor environment and severity of malnutrition in the child. Mothers of malnourished children were more apathetic and dependent and showed more personal and family problems, immaturity and isolation with low self-esteem and feelings of inadequacy (Carvalhaes & Benicio 2006). Maternal behaviours are directly linked to the psychosocial care of the child. Children from low-income households have a high risk of malnutrition if the psychosocial environment is lacking. The risk is also lower in households with a low-income and good psychosocial care, which shows that good psychosocial care can

almost protect the child against their poor socio-economic conditions (Carvalhaes & Benicio 2006).

Ogunba (2008) conducted a study on psychosocial care and complementary feeding of children less than two years of age in Nigeria. About 77% of the mothers in the study cared for their own children, while 23.1% used caregivers. Complementary feeding started from one month of age. The study found that 58.7% of mothers motivated their children to eat, 76.4% of mothers sat with their children while they ate, 5.3% of mothers talked to their children and 23.6% of the mothers forced their children to eat. About 76.2% of children had their own bowls to eat from. The study showed that the psychology and culture of people strongly influenced the care and feeding of children (Ogunba 2008). Feeding times are ideal for strengthening the psychosocial bond. This is especially important in times of crises when children need to be resilient and mentally healthy to survive. Parents and caregivers are sometimes unavailable or unable to give psychosocial care because of their own illnesses (Play Therapy Africa 2009).

Malnourished children that received psychosocial stimulation showed an almost 50% quicker weight gain than those without stimulation. Children showed a 65% improvement in attention, irritability, lethargy and intolerance (Play Therapy Africa 2009). Studies done by Play Therapy Africa (2009) showed reduced mortality rates from 28.6% to 20.6%, increased speed of recovery, earlier discharge from hospital and prevention of emotional, development and intellectual loss or damage (Play Therapy Africa 2009).

Childcare practices also include protecting the children's food and drinks from contamination to reduce the risk of infections. A caregiver's unwashed hands can cause infections such as diarrhoea (Abate, Kogi-Makau & Muroki 2001). In a study by Ayaya *et al* (2004) in Eldoret, Kenya, the social risk factors for PEM included being a single mother and a young mother aged 15-25 years (Ayaya *et al* 2004). Other social problems included child abuse and maternal deprivation (Torún 2006, p882; Torún & Chew 199 4, p951). Clean water is also important for health. The South African Census of 2011 showed that most households had access to piped water (84.5%) in their homes, in the yard or somewhere in the area. Nationally, 13.6% had no toilets and just more than 50% had regular refuse removal (Census 2011-Census in brief 2012).

Step 10: Preparation for discharge and follow-up

HIV and tuberculosis (TB) should be investigated in order to find and manage the primary contributing factors of malnutrition. Half of the children that present with severe malnutrition are HIV infected (Golden & Golden 2000, p524). The need for malnourished HIV infected children to be treated in facilities increases by the day (Heinkens *et al* 2008). Evidence from sub-Saharan countries shows that HIV infected children can recover their nutritional status when given the correct treatment for SAM without antiretroviral (ARVS), however, their recovery is slower than that of uninfected children (WHO & UNICEF 2009; Collins *et al* 2006). Nutrition education should be given in lay language that is easy to understand. There are three ways in which school education and knowledge can influence the child's health and nutritional status: (1) formal education leads directly to a higher knowledge of mothers (2) literacy acquired in school ensures that mothers are more capable of identifying health problems in children (3) mothers who have attended school are more aware of modern diseases and where to obtain help and information from (Christiaensen & Alderman 2001).

Even though nutrition knowledge is not gained in the classroom, the school education that mothers receive can help with caring for children and the household. Both female and male education can have a positive effect on the child's nutritional status. Knowledge can lead to a higher household income and better nutritional status when the education is linked with strategies to improve both. Maternal nutrition knowledge is more important when the child falls within the high-risk group of younger than three years (Christiaensen & Alderman 2001), as there is an association between low maternal literacy and poor nutritional status in children between 3-23 months of age (WHO & UNICEF 2009). Now that malnutrition in children has been reviewed, the next section of the literature review discusses MOs knowledge regarding SAM in children.

A mother/caregiver should prepare for a continuous recovery process at home in order to prevent re-admission of a child with SAM. A child is ready for discharge when the child has completed antibiotic treatment, has no oedema and has a good appetite, shows good weight gain and has had potassium and mineral mix for at least two weeks. The child should be smiling and playful and the Road to Health Booklet (RtHB) should be filled in with up-to-date immunisations. Danger signs which make discharge questionable include: child not eating, has fever, convulsions, cough with fast breathing or chest in drawing, very frequent watery or

bloody stools, diarrhoea for more than 14 days and oedema (DOH 2014b; DOH 2013; EFMOH 2007; WHO 1999). A mother is considered ready to take her child home when she knows what to feed, how much and how often, knows how to keep her child healthy through good personal hygiene, knows when to take her child for growth monitoring, vitamin A supplementation and deworming and immunisations. She should also know the danger signs indicating when to take the child back to the hospital/clinic, and how to improve mental development through play and loving interactions (DOH 2014b; DOH 2013; Kerac *et al* 2012; EFMOH 2007; WHO 1999).

A child with SAM needs to be assessed by a social worker to determine if the child has social issues. Ignorance is directly associated with poor infant and child rearing practices, misconceptions about food, inadequate feeding during illness (especially infectious diseases and diarrhoea), improper food distribution among family members, poor maternal care (James, Ferro-Luzzi, Sette & Mascie-Taylor 1999) and high birth rates. Therefore, mothers should be taught how to feed their children using available resources and be advised on household food security sources (Torún & Chew 1994, p951).

2.6.2 Role of follow-up in children with severe acute malnutrition

The literature emphasises that continuous evaluation and follow-up of a child with SAM is vital to reduce case-fatality rates, complication rates and co-morbidities which provide a measure of the effectiveness of the hospital (Anthony 2013). A child with SAM and without medical complications is expected to recover faster and be discharged sooner than a child with SAM and with complications. A child with SAM should be discharged via a dietitian for management on the outpatient therapeutic programme (OTP). OTP is an integrated public health innovation for treating SAM without medical complications in children 6 to 59 months of age as outpatients within their communities using RTUFs. The aim of the OTP is to reduce case fatality rates. Before discharging a child from inpatient care, therapeutic targets must be met and suitable follow-up date/s should be set. Follow-up helps to prevent re-admission of the child with SAM and a child defaulting from treatment/OTP (DOH 2014b; WHO 2013; EFMOH 2007; WHO 1999).

2.7 Medical officers' knowledge regarding severe acute malnutrition in children

When reviewing the literature, very few published South African studies assessing MOs knowledge regarding SAM and its treatment could be found. This suggests that this is an area that requires further research and investigation. There is also a limited number of studies on the knowledge of clinical health staff worldwide (Abdollahi, Houshiarrad, Abtahi, Esmaeli, Pouraram, Khoshfetrat, Shakori & Keshel 2013). However, studies conducted outside of South African have shown that there is generally poor knowledge on malnutrition among health care workers. Abdollahi *et al* (2013) aimed to determine the nutrition knowledge of doctors, nurses and nutritionists in some teaching hospitals in Tehran. None of the MOs answered all the questions correctly and a score of 100% was not recorded. Physicians achieved a mean accuracy score of 79% with a range of 57-95%. This study found that clinical staff in these teaching hospitals did not have adequate nutrition knowledge to meet the demands of their work. A lack of appropriate nutritional care has been linked to a lack of nutritional knowledge among clinical staff (Abdollahi *et al* 2013). A study by Tafese & Shele (2015) used a self-administered multiple choice questionnaire to assess the knowledge, attitude and practice of 355 health care workers in Ethiopia. This study did not report on the knowledge of the general practitioners/physicians separately. Generally, it was found that the majority of health professionals who participated in this study had poor knowledge about the appropriate management of malnutrition in children. One of the possible reasons for this was that only a few health care workers were trained on malnutrition. Inadequate undergraduate training in nutrition was cited as one of the reasons for poor knowledge and the authors also recommended that in-service training and continuing education be implemented to improve knowledge on the management of childhood malnutrition (Tafese & Shele 2015).

Medical doctors are regarded as being amongst the most dependable and main sources of facts on diet and nutrition. However, regardless of the need for physician-directed nutrition care and the trust the public places in physicians, many physicians do not regularly evaluate or address nutrition-related topics. Medical students regularly report insufficient education on nutrition during undergraduate studies at medical school, and practicing physicians report less confidence in discussing nutrition matters with their clients (Karaolis *et al* 2007; Krebs & Hambidge 2007). Karaolis *et al* (2007) observed poor knowledge on malnutrition in the study, where two years after providing in-service training, high doctor turnover resulted in inexperienced doctors being responsible for treating severe malnutrition without adequate training.

Between 2000-2001, 50% of deaths in two South African hospitals among severely malnourished children were due to MOs incompetence and 28% was due to nursing errors. These deaths were caused by weaknesses in the health system, where MOs and nurses had inappropriate training and inadequate supervision with a lack of support systems for staff (Karaolis *et al* 2007). In addition, a study done by Anthony (2013) showed that there was poor clinical management of children with SAM admitted to Helderberg Hospital and Eerste River Hospital in the Western Cape by MOs. Anthony (2013) also found that not all MOs at all hospitals implemented the WHO Ten Step protocol for the stabilisation phase adequately with regards to monitoring, preventing and treating hypoglycaemia, hypothermia, fluid imbalance, electrolyte disturbances and micronutrient deficiencies or infections. The outcomes support the findings by Ashworth (2004) who stated that staff were unfamiliar with best practice, which resulted in inappropriate treatment regimens such as incorrect rehydration procedures, missed infections and the failure to recognise vulnerability to hypoglycaemia and hypothermia. The concern is that if basic clinical practice is lacking at the initial evaluation of the patient, misclassification or missed diagnoses are more likely to occur and impact negatively on adherence to the WHO Ten Step protocol for managing SAM (Anthony 2013). The next section of the literature review discusses challenges preventing optimal management of SAM.

2.8 Challenges preventing optimal management of severe acute malnutrition

2.8.1 Overcrowding and understaffing

Overcrowding of patients at casualties, theatres, outpatient and other medical services sections increases the workload for MOs. In addition, MOs are forced to work long hours because of a shortage of staff (Anthony 2013; Karaolis *et al* 2007).

2.8.2 High turnover

At Mary Theresa and Sipetu hospitals in the Eastern Cape Province, South Africa, MOs turnover was considerable. Medical officers were overstretched and in some cases one was responsible for all inpatients, outpatients and emergencies (Karaolis *et al* 2007).

2.8.3 Inadequate nutrition content in undergraduate training

Inadequate training of doctors has been cited as a constraint to optimal management of severe malnutrition. The WHO malnutrition guidelines should be included in paediatric text books and in undergraduate medical curriculum, especially in Africa and Asia. These guidelines should be implemented in all teaching hospitals in order for doctors in training to learn through

supervised practice (Karaolis *et al* 2007). A study conducted by Barron (2006) to investigate the barriers associated with doctors' referral to dietitians in Gauteng, found that 21% of the doctors believed that the total time spent on nutrition during their period of undergraduate studies was less than one week. Approximately 91% of the doctors who participated in the study agreed that nutrition education is essential during undergraduate medical training. The majority (97%) of the respondents believed that the nutrition covered at medical school as part of the undergraduate training did not adequately prepare them for giving nutrition advice to patients. Those doctors who had a nutrition component in their medical training referred patients to dietitians more often than those who did not (Barron 2006). In a study done at Sipetu hospital, it was found that MOs did not prescribe potassium and made errors when calculating doses for children with malnutrition. Medical officers did not always follow the age-specific doses for vitamin A, and over half of the children received an incorrect dose (Krug *et al* 2008; Karaolis *et al* 2007). In a study done by Krebs & Hambidge (2007), there was not enough time for students to be educated on nutrition materials that were developed for them. District hospitals should provide the necessary training on malnutrition to all health care staff (Krug *et al* 2008).

2.8.4 Lack of in-service training

A systematic review by Sunguya, Poudel, Mlunde, Urassa, Yasouka & Jimba (2013) found that in-service nutrition training improved health workers' nutrition knowledge, counselling skills, competence and management of child undernutrition. In-service nutrition training is important due to inadequate nutrition training in the undergraduate medical curriculum. In-service training can take various forms such as compulsory continuous medical education (CME), nutrition seminars, workshops or non-compulsory continuing professional education (CPD) (Sunguya *et al* 2013). A lack of in-service training can lead to a poor prognosis for any condition. Specifically, training on SAM is not routinely offered or conducted for MOs in South African hospitals. This may lead to outdated management of SAM and thus poor clinical outcomes (Karaolis *et al* 2007).

2.8.5 Low morale

According to Karaolis *et al* (2007), fatigue and emotional burnout amongst MOs has been found to lead to family discord, depression, and even suicidal thoughts. Medical officers identified low reimbursement, loss of autonomy, bureaucratic red tape, patient overload, and loss of respect as the top five factors contributing to low morale. Medical officers generally felt

that it was not their role to take decisions concerning feeding. They rarely checked to see if a child was fed appropriately because they were unaware of the central role that feeding plays in a child's recovery (Krug *et al* 2008).

2.8.6 Role of supervision

Inadequate support and supervision of inexperienced doctors has also been cited as one of the constraints to optimal management of severe malnutrition (Karaolis *et al* 2007). Supervising a MO similar to the way in which an intern or community service medical officer is supervised, may help to assign responsibilities and prevent complications in a patient. The intern training provider regularly evaluates and reviews the intern training program and terms to ensure standards are maintained. Its processes check program content, quality of teaching and supervision, assessment and trainees' progress. Supervisors contribute to monitoring and to program development. Their feedback is sought, analysed and used as part of the monitoring process. Interns have mechanisms for providing confidential feedback about their training and education experiences in the program overall, and in individual terms. The intern training program acts on feedback and modifies the program as necessary to improve the experience for interns, supervisors and health care facility managers (Krug *et al* 2008; Karaolis *et al* 2007; Oyelami & Ogunlesi 2007). A similar programme should be implemented for MOs.

2.8.7 Incorrect prescriptions and unclear orders by medical officers

Inexperienced MOs can have a negative impact on patient prognosis. In a study done at Mary Theresa and Sipetu hospitals in the Eastern Cape Province, South Africa, MOs with little training in severe malnutrition prescribed antibiotics with gram-negative cover less frequently than trained MOs (15% versus 46%) (Krug *et al* 2008). This was accompanied by a dramatic rise in deaths due to sepsis. In both hospitals, some night staff administered antibiotics several hours before they were due, but signed as though they had given them on time. The reasons were inadequate ordering by ward staff and distribution problems from the central medical stores. Drugs were sometimes wrongly reported as being out of stock by pharmacy staff that was unaware of their alternative names. Some MOs only saw children after completing their ward rounds, usually in the afternoon. Some were then sent for an x-ray examination and had to queue for the doctor again before being admitted. Medical officer's orders were found to be unclear, nurses rarely recorded having given it, and pulse and respiration rates were never monitored (Krug *et al* 2008; Karaolis *et al* 2007).

2.9 Conclusion

SAM is a major contributor to childhood morbidity and mortality worldwide and in South Africa. In 2005 the South African Department of Health implemented the WHO Ten Step malnutrition protocol for the inpatient treatment of SAM in all district, regional and tertiary hospitals for all children less than 5 years of age. The WHO Ten Step malnutrition protocol should be used consistently by MOs and dietitians when treating malnutrition as this could help to reduce the malnutrition mortality and morbidity rate. Medical officers form part of the malnutrition management team and are often the first to treat the child admitted with SAM. It is therefore essential for them to know how to correctly assess and treat a child with malnutrition, using the WHO Ten Step malnutrition protocol. The literature also emphasises how important it is to assess MOs knowledge regarding SAM and its treatment to reduce child mortality and increase child survival as part of Millennium Development Goals. Few published South African studies on MOs knowledge regarding SAM and its treatment could be found. Therefore, this study aimed to assess the knowledge of MOs regarding SAM and its treatment in Xhariep District, Free State, which is known to have a high rate of childhood malnutrition.

CHAPTER 3: METHODOLOGY

Chapter 3 describes the background information on the study site, study design, materials and methods, the pilot study, data quality control, reduction of bias, statistical analysis and ethical considerations.

3.1 Background information on the study site

Xhariep district is situated in the south western Free State and covers an area of approximately 34 249 km^2. According to the South African Census 2011, the Xhariep district population is 126 130 with 50.8% women and 49.2% men. There are approximately 38 811 households in this district (South African Health and Demographic Survey 2016). This district is composed of 21 small old towns namely: Bethulie, Edenburg, Fauresmith, Gariep Dam, Jacobsdal, Jagersfontein, Koffiefontein, Luckhoff, Oppermansgronde, Petrusburg, Philippolis, Reddersburg, Rouxville, Smithfield, Springfontein, Trompsburg, Waterkloof and Zastron. The district has 20 clinics and three hospitals. This part of the Free State is poorly developed and is susceptible to malnutrition. Most of the population from this area migrates to surrounding cities like Bloemfontein and Kimberly to search for work. As a result, many grandmothers are left to care for children with little resources. Malnutrition in children is common in these areas. Most families depend on government grants and general farm work to survive. This results in poverty and food insecurity in these towns (DOH 2014c).

Medical officers employed at the Xhariep district hospitals based in four various local municipalities namely: Letsemeng, Kopanong (Diamant hospital), Naledi and Mohokare (Stoffel Coetzee Hospital and Embekweni Hospital) (Figure 3.1) in the Free State province, were invited to participate in the study. All the MOs who work at these hospitals also work at the clinics and one community health care centre (CHC) in this district. The paediatric out-patient department at the clinics are the first point of consultation for paediatric patients and the patient is referred for admission at the hospital, if needed.

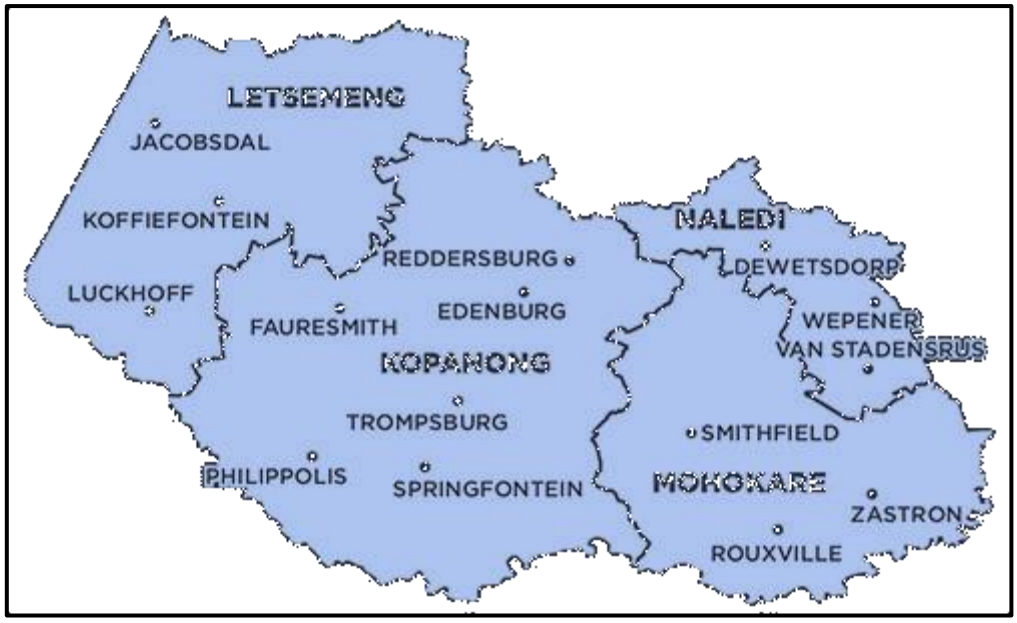

Figure 3.1: Map of the Xhariep District area, southern Free State

3.2 Type of study

This study was a cross-sectional survey, which involves the collection of data on a cross-section of the population at one point in time. It is often used to assess the prevalence of acute or chronic conditions, or to answer questions about the causes of disease or the results of an intervention (Olsen & St. George 2004).

3.3 Study population and sample selection

The study population consisted of MOs working in the Xhariep district, Free State. A Medical officer is a health professional who holds an MBChB or equivalent qualification and is employed to render a clinical service (HPCSA 2010). In South Africa, MOs must be registered with the HPCSA as a medical practitioner (HPCSA 2010). At the time of the study there were 20 MOs working in Xhariep district in both the district's clinics and hospitals (Moatlhodi 2014).

3.4 Pilot study

A pilot study was conducted prior to the main study. The purpose of the pilot study was to detect and correct any methodological problems related to the completion of the questionnaire and the focus group discussions. Eight MOs from Dr JS Moroka district hospital, Motheo district, Free State were invited to participate in the pilot study. Those who participated in the pilot study did not participate in the main study as the main study was conducted in a different area. After completing the questionnaires, the MOs participated in the focus group discussions. The outcome of the pilot study was that some of the questions in the questionnaire needed to be rephrased to reduce ambiguity and improve understanding of the questions. No other problems were encountered when the pilot study was conducted.

3.5 Study materials and methods

3.5.1 Questionnaire

A questionnaire (Appendix A) was formulated to assess the knowledge of MOs regarding SAM and its treatment in the Xhariep District, Free State using the WHO Ten Step protocol for the management of SAM. The questionnaire was developed in English, as it was common to all the MOs. In addition, English is a medium for instruction globally, thus allowing foreigners to communicate. All the medical curriculums at the different universities are taught in English. The questionnaire comprised four sections namely: demographics, university curriculum, work environment and knowledge on childhood malnutrition. The section on demographics obtained information on age, gender, race, type of medical degree obtained, duration of studies, time taken to complete degree and university attended. The section on university curriculum covered questions relating to childhood malnutrition in the undergraduate degree, specifically exploring whether or not it was covered, in which year of study, whether it was a module on its own or a section in a module, assessments and the time devoted to this section. Work environment covered questions with regards to training on SAM at the work place. The last section of the questionnaire consisted of multiple choice questions and assessed knowledge on childhood malnutrition and its treatment based on the WHO Ten Step protocol.

3.5.1.1 Validation of questionnaire

Before use, the questionnaire was validated by an expert panel consisting of academics from the University of the Free State. These included Dr Utter Hallbauer (Senior Lecturer/Senior Specialist: Paediatrics and Child Health), Dr Sarah Jane (Senior Lecturer/Senior Specialist:

Paediatrics and Child Health), Dr Jeannette Kriel (Senior Lecturer/Principal Specialist: Paediatrics and Child Health) and Prof Corinna Walsh (Associate Professor: Nutrition and Dietetics). The comments and suggestions received from the expert panel were used to improve the questionnaire.

3.5.2 Focus group discussion

A focus group discussion was conducted to determine MOs perceptions towards the management of SAM and factors influencing knowledge of SAM. All questions asked in the focus group discussion (Appendix B) were formulated in advance and validated by an expert panel (as mentioned in 3.5.1.1) from the University of the Free State.

3.6 Data collection

3.6.1 Questionnaires

Data collection was conducted at Diamant Hospital, Jagersfontein, in southern Free State. This hospital is at the centre of the Xhariep District and was a convenient meeting point for all the MOs. The District Manager communicated with the Chief Executive Managers and Local Area Managers of the district to ensure that the MOs were available to participate in this study. Data collection was conducted over two consecutive working days and each data collection session lasted one-hour long. On the day of data collection, the researcher explained the study and invited the MOs to participate in the study. All those who agreed to participate were given a consent form to sign (Appendix C) and a self-administered questionnaire (Appendix A). After giving written consent, the MOs answered the questionnaire, which took about 30 minutes to complete. Fifteen MOs out of a possible twenty answered the questionnaire, which aimed to assess knowledge regarding SAM and its treatment. Five MOs did not participate in the study as three had resigned, one position was still vacant and another was not at work on the day of the study, due to illness.

3.6.2 Focus group discussion

After completing the questionnaires, eight MOs were randomly selected to participate in a focus group discussion. The focus group discussion was conducted in English and was facilitated by a clinical psychologist, trained in the process of conducting a focus group discussion. According to Greenbaum (2000, p2) and Merton, Fiske & Kendall (1990, p137), the optimal size of a focus group is between seven to twelve individuals. The focus group discussions was recorded using a digital voice recorder. A scribe took notes of the discussion during the session.

3.7 Data quality control

Data was entered by the researcher and cross-checked by an assistant to eliminate errors in data entry.

3.8 Reduction of bias

Various steps were taken to reduce bias. The researcher and a trained research assistant were present during the entire data collection process to minimise bias. Medical officers were not allowed to discuss the questionnaire with each other and share their answers while answering the questionnaire. There were no breaks during the data collection to prevent MOs from discussing and sharing answers. Medical officers were not allowed to refer to any source documents including textbooks and course notes to look up answers to questions. Mobile phones and other electronic devices such as laptops were switched off and inaccessible during the data collection process to prevent MOs from using the internet to answer the questionnaire. The room in which the MOs answered the questionnaire did not have any information charts or posters on the walls to assist the MOs. Lastly; bias was also reduced by using validated questionnaires and a trained facilitator for the focus group discussions.

3.9 Statistical analysis

Data from the questionnaires were captured electronically in Microsoft Excel by the researcher. Data was analysed statistically using Statistical Analysis System (SAS) Version 9.2. For each participant a test score was calculated by tallying the score of the 20 multiple choice questions. This test score was converted to a percentage to simplify interpretation. Descriptive statistics namely frequencies and percentages for categorical data and means and standard deviations for numerical data were calculated. Due to the small sample size the statistical analysis of the data was limited.

3.10 Ethical considerations

Ethical approval was obtained from the University of KwaZulu-Natal, Humanities and Social Science Ethics Committee (HSS/0479/015M) (Appendix D). The Xhariep District Ethics Committee together with the Free State Department of Health issued a supporting letter for the research to be conducted (Appendix E).

CHAPTER 4: RESULTS

Chapter 4 presents and describes the results of the study.

4.1 Demographic characteristics of the sample

The demographic characteristics of the sample are presented in Table 4.1.

Table 4.1: Demographic characteristics of the sample

Variables	**n (%) ***
Age (years)	
20-35	7 (47)
≥ 35	8 (53)
Gender	
Male	10 (67)
Female	5 (33)
Race	
Black African	8 (53)
White	2 (13)
Indian	1 (7)
Coloured	3 (20)
Other (Zimbabwean)	1 (7)
Nationality	
South African	14 (93%)
Other (Zimbabwean)	1 (7%)

*Total sample (n= 15)

More males (n=10; 67%) participated in the study than females (n=5; 33%). The majority of the sample were Black African (n= 8; 53%) followed by Coloured (n=4; 20%), White (n= 2; 13%) and Indian (n= 1; 7%). Forty-seven percent (n=7) were between 20-35 years old while 53% (n=8) were older than 35 years of age.

4.2 Background on university attended

Background information on university attended, degree obtained and duration of studies is presented in Table 4.2.

Table 4.2: Background on university attended, degree and duration of studies

	n (%)
Medical degree obtained	
MBChB (Bachelor of Medicine and Bachelor of Surgery)	14 (93)
MBBS (Bachelor of Medicine and Bachelor of Surgery)	1 (7)
Duration of undergraduate curriculum	
5 years	6 (40)
6 years	7 (47)
7 years	2 (13)
Time taken to complete medical degree	
5 years	6 (40)
6 years	6 (40)
7 years	2 (13)
8 years	0
More than 8 years	1 (7)
University attended	
University of Cape Town (UCT)	3 (20)
University of the Free State (UOFS)	4 (27)
University of KwaZulu-Natal (UKZN)	1 (7)
Sefako Makgatho Health Sciences University (MEDUNSA)	3 (20)
University of the Witwatersrand (Wits)	2 (13)
Stellenbosch University	1 (7)
Other (University of Zimbabwe)	1 (7)
Country where degree was obtained	
South Africa	14 (93)
Other (Zimbabwe)	1 (7)

*Total sample (n=15)

The majority of the sample (all South Africans) had graduated with the MBChB degree (n=14; 93%). One participant had obtained the MBBS degree from the University of Zimbabwe. Forty percent (n=6) of the MOs had enrolled in a five-year undergraduate medical programme while 47% (n=7) and 13% (n=2) had enrolled in a six and seven year undergraduate medical programme respectively. Eighty percent (n=12) of the sample took between 5-6 years to complete their degrees while one participant took more than eight years to complete the degree. The University of the Free State, the University of Cape Town and Sefako Makgatho Health Sciences University (MEDUNSA) were the most commonly attended universities. All the MOs attended South African universities except one who attended the University of Zimbabwe.

4.3 University curriculum

Results on the university curriculum on childhood malnutrition is presented in Table 4.3.

Table 4.3: University curriculum on childhood malnutrition

	n (%)
Childhood malnutrition covered in undergraduate medical curriculum	
Yes	15 (100)
No	0
Childhood malnutrition covered as a:	
Module	0
Section in a module	15 (100)
Assessed on childhood malnutrition during undergraduate studies?	
Yes	15 (100)
No	0
Adequate time devoted to the childhood malnutrition section	
Yes	7 (47)
No	4 (27)
Not sure	4 (27)
More time should have been spent on this section?	
Yes	4 (27)
No	0
Time was adequate	11 (73)

*Total sample (n=15)

All of the MOs covered childhood malnutrition in the undergraduate curriculum and all had covered it as a section in a module. In addition, all of the MOs were assessed on childhood malnutrition in their undergraduate studies. Forty-seven percent (n=7) of the MOs felt that the time devoted to the childhood malnutrition section was adequate while 27% (n=4) felt that the time spent was inadequate. Twenty-seven percent (n=4) of the MOs felt that the more time should have been devoted to the childhood malnutrition section in the undergraduate university curriculum.

Table 4.4 shows whether or not MOs were exposed to training on SAM at the various work places in the Xhariep District.

Table 4.4: Exposure to training and protocol on severe acute malnutrition

	n (%)
After being employed have you ever attended in-service or out-service training/s on SAM?	
Yes	6 (40)
No	9 (60)
Is SAM protocol displayed in the paediatric ward or consultation room?	
Yes	14 (93%)
No	1 (7%)

*Total sample (n=15)

Forty percent (n=6) of the MOs received training on SAM. However, the training had been conducted more than five years before this study was conducted. The majority of the MOs (n=14; 93%) reported that SAM protocol was displayed in the paediatric ward or consultation room.

4.4 Knowledge on the management of severe acute malnutrition

The number of correct responses to the questions on the management of SAM is shown in Table 4.5. The correct answers are given in bold font.

Table 4.5: Number of correct responses to questions on the management of severe acute malnutrition

Questions	Answered correctly (%)
1. What are the four main causes of death in children with malnutrition? I. Hypoglycemia, hypothermia, Dehydration, electrolyte imbalance II. **Hypoglycemia, infections, dehydration, heart failure**	8 (53)
2. How is wasting defined in the Road to Health Booklet? **I. Low weight for height** II. Low weight for age	6 (40)
3. What is the standardized criterion for the diagnosis of Severe Acute Malnutrition (SAM) using mid-upper arm circumference (MUAC)? I. 10.5 cm **II. 11.5 cm and less** III. 12.5 cm IV. 13.5 cm and less	11 (73)
4. What does the abbreviation ReSoMal stand for? I. Rehydration Solution for Metabolic complications II. Rehydration Solution for the Dehydrated **III. Rehydration Solution for Malnutrition**	(15) 100
5. What is the formula for calculating ReSoMal for a child with dehydration? **I. 20ml/kg** II. 40ml/kg III. 100ml/kg IV. 130ml/kg	8 (53)
6. Which is the preferred method of giving fluids/feeds to a child with malnutrition? I. Intra-Vascular II. Nasogastric feeding tube **III. Oral**	10 (67)

Table 4.5 (continued): Number of correct responses to questions on the management of severe acute malnutrition

Questions	Answered correctly (%)
7. Should a child with worsening oedema be given diuretics? I. Yes **II. No**	15 (100)
8. What should be given to a child who develops or has worsening oedema? **I. Potassium** II. Sodium III. Phosphorus	11 (73)
9. Starting from day one, antibiotics should be given to _____ of the children with SAM. I. Some **II. All** III. None	13 (87)
10. Should an appropriate dosage for age of vitamin A be given as a boost for a child with SAM? **I. Yes** II. No	14 (93)
11. The vitamin A dosage booster for a child with SAM less than 6 months of age is ___. I. 200 000 IU II. 100 000 IU **III. 50 000 IU**	9 (60)
12. The vitamin A dosage booster for a child with SAM about 6-11 months of age is_____. I. 200 000 IU **II. 100 000 IU** III. 50 000 IU	7 (47)

Table 4.5 (continued): Number of correct responses to questions on the management of severe acute malnutrition

Questions	Answered correctly (%)
13. The vitamin A dosage booster for a child with SAM between 12-59 months of age is ___. **I. 200 000 IU** II. 100 000 IU III. 50 000 IU	8 (53)
14. Which volume of feeding should be used for a child with malnutrition and without oedema? I. 20ml/kg/day II. 100ml/kg/day **III. 130ml/kg/day**	4 (27)
15. Which volume of feeding should be used for a child with malnutrition and with oedema (3+)? I. 20ml/kg/day **II. 100ml/kg/day** III. 130ml/kg/day	13 (87)
16. In the case of an infant with malnutrition and anaemia when should iron supplements be given? I. At the initial phase **II. At the stabilisation phase** III. At the beginning of the transition phase IV. At the discharge phase	5 (33)
17. For loving, care and stimulation the child can be referred to the ___. I. Social worker **II. Occupational therapist** III. Professional nurse IV. Pharmacist	8 (53)
18. In order to obtain information on family background and socio-economic status a _____ should be consulted. I. Psychologist II. Occupational therapist **III. Social worker** IV. Pharmacist	13 (87)

Table 4.5 (continued): Number of correct responses to questions on the management of severe acute malnutrition

Questions	Answered correctly (%)
19. Prior to discharge it may be necessary to investigate and counsel on ____. I. Hypertension and diabetes mellitus **II. HIV and TB**	15 (100)
20. Prior to discharge the child should be referred to the ____ for nutritional supplementation prescription and education. I. Pharmacist **II. Dietitian**	15 (100)
21. All of the following are discharge criteria for a child with SAM, except ____. I. Good appetite II. Infection resolved III. Oedema resolved **IV. The height for age is on the 0-line target** V. Consecutive weight gain for 5 days (target weight-for-height reaches -1SD)	4 (93)

Knowledge scores calculated as the number of correct answers out of a total of 21 questions and expressed as a percentage are presented in Table 4.6.

Table 4.6: Knowledge scores on the management of severe acute malnutrition

	n	Mean (SD)	Lowest	Highest
Knowledge score (out of 21)	15	14.80 (1.57)	12.00	18.00
Knowledge score as a percentage (%)	15	74.00 (7.84)	60.00	90.00

Only four out of the 21 questions (19%) were answered correctly by 100% of the MOs. Only 40% of the MOs (n=6) knew the correct definition of wasting according to the Road to Health Booklet while only 47% (n=7) knew the correct vitamin A supplement booster dosage for a child with SAM (6-11 months of age). The questions on which volume of feeding should be used for a child with malnutrition and without oedema was the most poorly answered with only 27% (n=4) answering correctly. Only 33% (n=5) MOs knew the correct time to give iron

supplements in the case of an infant with malnutrition and anaemia. Seventeen out of the 21 questions (81%) were answered correctly by more than 50% of the MOs. Nine out of the 21 questions (43%) were answered correctly by more than 80% of the MOs.

4.5 Focus group discussion

The results of the focus group discussions are presented in Table 4.7.

Table 4.7 Medical officer's perceptions towards management of SAM and factors influencing knowledge of SAM

Question	Theme	Concept	Quotes	Discussion
Experience on managing a child with SAM	Sharing experiencing	Experience on the management of child with SAM	"I have managed lot of children with SAM and it is really heart-breaking to see how complicated a child with SAM can be, the cause being poor nutrition at home and child neglect."	All MOs have managed a child with SAM and they are aware of the role of nutrition in the management of SAM.
Description of how to manage a child with SAM	Medical officers' knowledge regarding SAM	Experience of Medical officer managing a child with SAM	"When managing child with SAM, you first deal with emergencies such as hypoglycaemia, electrolyte imbalance, dehydration and hypothermia." "Managing a child with malnutrition in this district is quite tricky, because most of these children stay at home and sick neglected until they develop complications, of which some are non-reversible leading to death of a child."	The majority of MOs treat electrolyte imbalance, hypothermia, hypoglycaemia and dehydration with intravenous fluids even if oral intake is preferable and indicated. Medical officers often miss Step 8 of the WHO Ten Step malnutrition protocol. i.e. referral to occupational therapist and referral to social worker. These increases social problems and thus affects development in these patients.
Difference between MAM and SAM	Medical officers knowledge regarding SAM	Medical officers knowledge regarding SAM	"MAM stands for moderate acute malnutrition where by the child is underweight and on Road-to-Health Booklet (RtHB) the weight is on the -2 line Z-scores, while SAM stands for severe acute malnutrition, whereby a child is severely wasted with a MUAC of 11,5 cm or less or weight on -3 z score line or less."	Medical officers knew the difference between MAM and SAM according to weight using the RtHB and MUAC cut-off values.

Table 4.7(continued): Medical officer's perceptions towards management of SAM and factors influencing knowledge of SAM

Question	Theme	Concept	Quotes	Discussion
Adequacy of in-service training on childhood malnutrition at the work place	Medical officers exposure regarding SAM at work place	Efficacy of in-service training	"In-service training is very rare in this district." "Some of the training we cannot attend due to lack of transport or high workload at work."	There is lack of training regarding SAM in the district. Reduced availability of transport and high workload prevents the MOs from attending training sessions on the management of SAM in children.
Adequacy of University curriculum on childhood malnutrition	Medical officers exposure regarding SAM at Universities	Efficacy of University curriculum	"I personally feel that MEDUNSA (Sefako Makgatho Health Sciences University) could do more in terms of strengthening their university curriculum." "At UOFS we had enough exposure on malnutrition doing tests, oral exams, examination, practical and assignments."	Some universities provide sufficient content on childhood malnutrition while others do not. Implementing a standardised and uniform module content on childhood malnutrition at all medical universities could help to improve the knowledge of MOs. This would result in them being better equipped to deal with children presenting with SAM.

4.6 Summary of results

The mean score for the knowledge questionnaire on the management of SAM in children was 74% with none of the MOs achieving a score of 100%. Only 19% of questions were answered correctly by all MOs. Questions that were poorly answered were: the definition of wasting according to the Road to Health Booklet, vitamin A supplementation dosage according to age, the volume of feeding that should be used for a child with malnutrition and without oedema and at which stage an infant with malnutrition and anaemia should be given iron supplements. Medical officers felt that there was a need for more undergraduate training on the management of SAM as well as in-service training at the workplace. Some MOs also suggested that the undergraduate curriculum on the management of SAM in children should be standardised across all South African universities.

CHAPTER 5: DISCUSSION

This chapter discusses the findings of this study.

5.1 Demographic characteristics of the sample

Fifteen MOs from Xhariep district, Free State participated in this study. More males (n=10; 67%) participated in the study than females (n=5; 33%). In South Africa, the latest available statistics on medical school enrolments show that females make up 56.2% of overall enrolments which has increased from 49.7% in 1999 [South African Demographic and Health Survey (SADHS) 2016]. In South Africa, the proportion of women graduating from medical school has increased from 46.6% to 55.1% between 1999-2007. In the USA, women make up more than 50% of medical students and 25% of practising doctors (DOH 2014d). In this regard South Africa is in line with global trends. In this study the majority of the sample were African (n= 9; 53%) followed by Coloured (n=3; 20%), White (n= 2; 13%) and Indian (n=1; 7%). This is generally in line with the racial profile of the Free State which is 86.9% African, 9.9 % White, 3.0 % Coloured and 0.1 % Indian (SADHS 2016). The mean age of the sample was 37.5 years which is lower than the mean age of MOs including specialists in South Africa, which is 55 years of age in both public and private health sectors (SADHS 2003). The younger mean age of this sample could be because many of the MOs were relatively new graduates who had recently completed community service. Medical officers of a younger age do not have as much experience as older colleagues which could possibly lead to inappropriate or incorrect treatment, especially in cases where they are no senior medical staff to consult with.

5.2 Background on university attended

Ninety-three percent (n=14) of the MOs obtained the MBChB (Bachelor of Medicine and Bachelor of Surgery degree, while one participant received the MBBS (Bachelor of Medicine and Bachelor of Surgery), which was from a University outside South Africa. In South Africa the Universities of Pretoria (UP), Cape Town (UCT), Free State (UFS), Stellenbosch, KwaZulu-Natal (UKZN), Walter Sisulu University and MEDUNSA (now Sefako Makgatho Health Sciences University) all offer the MBChB medical degree while the University of the Witwatersrand offers the MBBCh degree. Although the abbreviations differ these are all undergraduate degrees in medicine and surgery.

5.3 University curriculum

All MOs reported that childhood malnutrition was covered in their undergraduate medical curriculum and that it was covered as a section in a module and not as a module on its own. This suggests that the volume of theory covered on childhood malnutrition was not enough to justify it being a module on its own. All MOs were assessed on childhood malnutrition during their undergraduate studies. Some of the MOs (27%; n=4) felt that the time devoted to the section on childhood malnutrition was inadequate and that more time should have been devoted to this section. This suggests that these MOs may be less prepared to treat children with malnutrition. Given the fact that some MOs felt that the time devoted to the section on childhood malnutrition during undergraduate training was inadequate suggests that there is a greater need for MOs to receive in-service training at the work place on the management of SAM in children. Medical training has generally been known to lack adequate and updated nutrition training (Adams, Lindell, Kohlmeier & Zeisel 2006; Pearson, Stone, Grundy, McBride, van Horn, Tobin & The NAA Collaborative Group 2001; Zimmerman & Kretchmer 1993). Thus, health workers graduating from teaching institutions have lacked adequate nutritional knowledge (Mowe, Bosaeus, Rasmussen, Kondrup, Unosson, Rothenberg, Irtun & the Scandinavian Nutrition Group 2008; Kgaphola, Wodarski & Garrison 1997). This suggests that these health workers may be less equipped to treat nutrition-related conditions and this may impact negatively on the overall management and outcome of these patients.

5.4 Exposure to training and protocol on severe acute malnutrition at the hospital/clinic

Forty percent (n=6) of the MOs received training on SAM at the work place while 60% (n=9) did not. In addition, this training had been conducted more than five years before this study was conducted. This suggests that training on the management of childhood malnutrition may be outdated. It also shows that MOs are not attending regular in-service training on the treatment of childhood malnutrition which is highly prevalent in this area of the Free State. This may also contribute to poor and/or non-standardised management of this condition by MOs. The results are in support of the findings by Anthony (2013) as well as Lenders, Deen, Bistrian, Edwards, Seidner, McMahon, Kohlmeier & Krebs (2014) who indicated that health care professionals are unaware of the best practice with regards to management of SAM. This results in inappropriate management such as incorrect rehydration procedures, missed infections and the failure to be aware of vulnerability to hypoglycaemia and hypothermia. The majority of the MOs (93%; n=14) reported that SAM protocol was displayed in the paediatric

ward or consultation room. This implies that the MOs could refer to the protocol on display to confirm that they are following the correct protocol. A study done by Lenders *et al* (2014) found that medical education and training in malnutrition continues to be inadequate despite strong evidence that childhood malnutrition is highly prevalent and affects patient outcomes and healthcare costs. A review by Sunguya *et al* (2013) found that health worker's knowledge on management of undernutrition improved when they received in-service nutrition training and recommend that health workers should be exposed to in-service nutrition training as it improves their knowledge.

5.5 Knowledge on management of severe acute malnutrition

5.5.1 Overall score

In this study the mean overall knowledge score was 74% (SD ±7.84) and individual scores ranged between 60-90%. Although a mean score of 74% could be regarded as good, one would have expected a higher mean overall score as the information tested in the knowledge questionnaire could be regarded as basic knowledge that is essential for the management of SAM. No single individual scored 100% which is in keeping with findings by Abdollahi *et al* (2013) who also did not record an accuracy score of 100% amongst health workers. Although there are no similar South African studies available to compare these scores they are in keeping with the results from Abdollahi *et al* (2013) who found that physicians had a mean knowledge score of 74%. On the other hand, the study by Tafese & Shele (2015) did not report an overall knowledge score but did conclude that health workers had poor knowledge about management of malnutrition in children. According to the WHO (1999) insufficient knowledge amongst healthcare personnel can lead to an incorrect diagnosis being made which could lead to poor clinical outcomes in the patient.

5.5.2 Questions answered correctly by less than 50% of the sample

In this study, only 40% of the MOs knew how wasting is defined in the RtHB. According to the RtHB a low weight for height indicates wasting. Severe wasting is seen when the weight for height measurement is below the -3 Z-score [WHO & UNICEF 2009; EFMOH 2007]. When wasting is unnoticed in a child, it is unlikely to be treated correctly, leading to poor prognosis (Picot *et al* 2012).

According to the findings of this study, there was a lack of knowledge regarding the correct vitamin A supplementation dosage for age, amongst MOs. Only 47% (n=7) of the MOs knew that the correct vitamin A booster dosage for a child with SAM between 6-11 months of age is 100 000 international units (IU). The WHO currently recommends that for inpatient care of children with SAM, vitamin A supplements should be given on day one of admission, unless there is clear evidence that vitamin A supplementation was received in the previous month. Dosing guidelines are as follows: 200 000 international units (IU) for children over 12 months of age, 100 000 IU for children 6-12 months, and 50 000 IU for children below 6 months. If clinical signs of vitamin A deficiency are present, then another age specific, large dosage is administered on day two and again, on day 14. If a child with malnutrition is incorrectly given a high dosage of vitamin A supplementation vitamin A toxicity could result. Acute vitamin A toxicity could result in visual disturbances, bone pain and skin changes. This could lead to poor prognosis and possibly death (Anthony 2013; WHO 1999). Giving a dosage of vitamin A that is too low according to age leaves the child with SAM vulnerable to infection and unable to fight common childhood diseases (WHO 1999).

Vitamin A deficiency is a well-established risk factor for measles-related mortality (UNICEF 2009). According to UNICEF (2009) treating children with high dosage vitamin A supplements during the course of a measles episode can reduce measles-related deaths and severe acute malnutrition by about 66 % and is therefore the standard of care for managing the disease. Low stores of vitamin A also increases the risk of a measles episode which can escalate measles-related deaths and complications by about 66 % and the correct vitamin A dosage is therefore the standard of care for managing the disease (WHO & UNICEF 2007). In South Africa, improving the vitamin A status of deficient children through supplementation has been found to improve resistance to disease and reduce mortality rates by approximately 23% (DOH 2014b).

In this study, there seemed to be uncertainty regarding which volume of feeding should be used for a child with malnutrition and without oedema. Only 27% (n=4) knew that the correct volume of feeding for a child with malnutrition and without oedema is 130 ml/kg/day. Giving 20ml/kg or 100ml/kg would actually under hydrate the child. Under hydration would delay correcting the hydration status of the child, thereby prolonging length of stay and increasing health care costs unnecessarily (WHO 1999). With severe malnutrition the “therapeutic window” is narrow, so that even dehydrated children can quickly go from having a depleted circulation to over-hydration with fluid overload and cardiac failure. The preferred route of

feeding a patient is oral unless there are medical reasons that contraindicate it. In SAM (both marasmus and, to a greater extent, kwashiorkor) there is a particular renal problem that makes the child sensitive to sodium overload (WHO 1999). The standard protocol for the well-nourished dehydrated child should not be used. A supply of modified ORS or ReSoMal should not be freely available for the caregivers to give to their children, whenever they have a loose stool. Although common practice, it is very dangerous for these children as it could lead to heart failure, as well as failure to correct oedema and re-feeding oedema. If there is no dehydration, diarrhoea is often treated with rehydration fluids to "prevent" the onset of dehydration. This again could lead to over-hydration and heart failure (WHO 2008).

A study by Lenders *et al* (2014) conducted in the United States of America found that thirteen deaths in children under 5 years of age were attributed to poor fluid management. To prevent such deaths, doctors should review fluid management daily for all children with diarrhoea and give clear instructions about rehydration (Lenders *et al* 2014; Karaolis *et al* 2007). Doctors should reinforce the importance of nurses monitoring pulse and respiration rates to prevent fluid overload during rehydration (Lenders *et al* 2014; Karaolis *et al* 2007). If wall charts are available in the emergency room this could remind staff of the special procedures for the treatment of shock (Lenders *et al* 2014; Karaolis *et al* 2007).

The question on when a child with malnutrition and anaemia should be given iron supplements was also poorly answered. Only 33% (n=5) of the MOs correctly knew that iron supplements should be given to a child with SAM at the stabilisation phase. If iron supplementation is given at the initiation phase it increases the risk of infection. Therefore, iron supplementation should be given at the stabilisation phase. At the stabilisation phase appetite would have improved and most micronutrient deficiencies would have been resolved (Picot *et al* 2012).

5.5.3 Questions answered correctly by between 50-60% of the sample

Only 53% (n=8) of MOs knew that the four main causes of death in children with malnutrition are hypoglycaemia, infections, dehydration and heart failure. If the MOs are not aware of all the possible causes of death, it would be a challenge to treat the causes, thereby providing inadequate treatment (WHO 2008). It is essential that MOs are aware of the four main causes of death as this would draw greater attention to these symptoms when treating the children with SAM. Although the main responsibility for preventing hypoglycaemia and hypothermia lies with nurses, doctors could play a role if their understanding was improved by ensuring that key

practices are followed (Lenders *et al* 2014; Karaolis *et al* 2007). Doctors should initiate audit and feedback meetings with nurses and managers (Lenders *et al* 2014; Karaolis *et al* 2007).

There was also uncertainty regarding the formula for calculating the amount of ReSoMal to use in a child with dehydration. Only 53% (n= 5) of the MOs knew that the formula of 20 ml/kg should be used. Not knowing the correct formula could result in electrolyte imbalance, heart failure and consequent death (WHO 1999).

The vitamin A supplementation booster dosage for a child with SAM less than 6 months of age and for a child with SAM between 12-59 months of age was not well known amongst the MOs, with only 60% (n= 9) and 53% (n=5) of the sample answering correctly, respectively. This again highlights the MO's poor knowledge of the vitamin A supplementation protocol. Although the MOs had poor knowledge of the vitamin A supplementation dosage, they did know that vitamin A supplementation should be given as a boost for a child with SAM (93% answered correctly). This suggests that they understood the link between vitamin A supplementation and its benefits in treating malnutrition in children. It is also likely that the poor knowledge on the vitamin A supplementation dosage could be due to the fact that it is generally the nursing staff who administer the vitamin A supplementation. Poor knowledge of the correct vitamin A supplementation dosage according to age may lead to acute vitamin A toxicity in the case of a high dose, or worsening of malnutrition-related complications with a low dose.

Knowledge of the referral system in this study was unsatisfactory. Only 53% (n=8) of the MOs knew that for loving, care and stimulation the child should be referred to the occupational therapist. On the other hand, 47% (n=7) answered that the child should be referred to the social worker. This greatly affects the clinical outcome of the patient. Occupational therapists plan a stimulation programme for the child and play therapy is indispensable to malnourished children. The mother-baby-bond should be in place early in life for better cognitive, emotional and social development later in life (Play Therapy Africa 2009). Evidence shows that quality of care is linked to nutritional status. The quality of psychosocial care is often determined by the interaction between mother and child. A protective effect on nutritional status is seen by talking to the child, storytelling, hugging the child, having a safe and attractive environment and encouraging independence. Independence gives the child the ability to obtain food and health care later in life (Carvalhaes & Benicio 2006). Malnourished children that received psychosocial stimulation showed an almost 50% quicker weight gain than those without

stimulation (Play Therapy Africa 2009). Studies done by Play Therapy Africa (2009) showed reduced mortality rates from 28.6% to 20.6%, improved rate of recovery, earlier discharge from hospital and prevention of emotional, development and intellectual loss or damage (Play Therapy Africa 2009). A multidisciplinary ward round consisting of an occupational therapist, social worker, MO and pharmacist should be conducted regularly to increase awareness of other health services a child with severe acute malnutrition requires.

5.5.4 Questions answered correctly by 61-99 % of the sample

Surprisingly, in this study 87% (n=13) of the MOs reported that antibiotics should not be given to all children with SAM. Protocol for the in-patient management of children with SAM in South Africa states that all children with SAM should receive antibiotics from day one. If the child is severely ill (apathetic, lethargic) or has complications (hypoglycaemia, hypothermia, raw skin/fissures, meningitis, respiratory tract or urinary tract infection) the prescriber should give IV/Intramuscular (IM) Ceftriaxone 100mg/kg/day for seven days. If the child has medical complications but not seriously ill, the prescriber should give IV/IM Ampicillin: 50mg/kg IM/IV 6-hourly for seven days and Gentamicin: 7.5mg/kg IM/IV once daily for seven days (DOH 2014a). Childhood deaths in the Eastern Cape due to malnutrition often occur due to sepsis not treated with antibiotics and dehydration that is managed incorrectly leading to over hydration. This can be prevented by giving training to clinic staff, outpatient staff and community health workers who can also assist with follow-ups (Karaolis *et al* 2007; Ashworth, Chopra, McCoy, Sanders, Jackson, Karaolis, Sogaula & Schofield 2004). In addition, only 73% (n=11) of the MOs reported that potassium should be given to a child who has SAM. Potassium corrects electrolyte imbalance and improves oedema (DOH 2014a). If the child is on the stabilising feed with added minerals and vitamins (CMV) they will receive the necessary potassium, magnesium, copper and zinc within their feeds daily, or the prescriber should give daily: extra potassium (4mmol/kg/day body weight) and magnesium (0.4-0.6mmol/kg/day). For potassium, the prescriber should give Oral Mist Pot Chloride (MPC) solution: MPC 1ml/kg 8 hourly (1ml=1mmol K+) (DOH 2014a). Strict adherence to the guidelines for antibiotics, potassium and magnesium could prevent most deaths and could be achieved through training, standing orders and support and supervision of inexperienced doctors (Lenders *et al* 2014; Karaolis *et al* 2007).

Only 73 % (n=11) of the MOs knew that the standardised criterion for the diagnosis of SAM using MUAC is 11cm and less. In a study by Anthony (2013), only 52% of patients had height

measured and no patients had a MUAC measurement taken. MUAC provides a good indicator of nutritional status and can be used to diagnose malnutrition, especially when weight is not available. MUAC gives an estimation of muscle mass. Arm muscle area provides a good indication of the lean body mass and skeletal protein reserves. It is important in growing children and may help to diagnose possible protein-energy malnutrition as a result of poverty, chronic illness, stress, eating disorders or multiple surgeries (WHO 2013; Picot *et al* 2012; EFMOH 2007; WHO 1999). Sixty-seven percent (n=10) of the MOs knew that the preferred method of giving fluids/feeds to a child with malnutrition is the oral route. Use of the oral route has been shown to attenuate the catabolic response and preserve immunologic function in malnourished children. The oral route decreases the risk of hyperglycaemia compared to the parenteral method of feeding (Anderson 2016, p870).

5.5.5 Questions answered correctly by the entire sample

The questions for which there was a score of 100% was: the abbreviation for ReSoMal, whether a child with worsening oedema should be given diuretics or not, the need for investigation and counselling on HIV and TB prior to discharge and the need for referral to the dietitian for nutritional supplementation prescription and education prior to discharge. This can be regarded as basic information and a score of 100% would have been expected. One would have expected a 100% correct answers for a greater number of questions, especially those which impact more critically on outcome.

5.6 Factors influencing the level of knowledge regarding the WHO Ten Step protocol for the treatment of malnutrition amongst medical officers

One of the main issues highlighted by the MOs was the lack of in-service training regarding SAM. Although training was available in some cases, the MOs were unable to attend due to lack of transport and high workload. This is an important issue that needs to be addressed. One way to overcome the transport issue is to install Inter-Active Communication and Management (iCAM) at all the institutions in the district so that no travelling is required in order to attend training sessions. Medical officers also need to be relieved of the burden of work to allow them to attend the training sessions. This requires support from senior medical staff and management at the hospitals where the MOs work. In-service nutrition training is critical in improving health worker's nutrition knowledge, nutrition counselling skills and malnutrition management skills. It also has the potential to make the health workers more confident and competent in their ability to manage nutrition-related cases (Sunguya *et al* 2013).

Some MOs also reported that their undergraduate university curriculum did not adequately cover child malnutrition. This is in keeping with the findings of Barron (2006), where 97% of doctors reported that the nutrition education provided at medical school did not adequately prepare them for giving nutrition advice to patients. Although 91% of the doctors believed that nutrition was an essential component of the undergraduate medical degree, 21% stated that the total time spent on nutrition during their undergraduate studies was less than one week. Doctors who studied nutrition as part of their undergraduate degree referred patients to dietitians more often (Barron 2006).

Some MOs suggested that a standardised and uniform content on child malnutrition should be implemented at all universities offering undergraduate medical training. This is also important as it suggests that some MOs, depending on which university they attended, may be inadequately prepared to manage a child with SAM. Karaolis *et al* (2007) also suggested that the paediatric community should take on the responsibility of ensuring that the WHO malnutrition guidelines are included in paediatric texts and medical curriculum. The undergraduate medical curriculum at South African universities should adequately cover childhood malnutrition as well as the WHO Ten Step protocol and it should be done in a standardised and consistent manner to ensure that all medical graduates are adequately prepared to manage SAM. New medical graduates should receive support and supervision from senior doctors, especially when working in rural hospitals.

CHAPTER 6

The aim of this study was to assess the knowledge of MOs regarding severe acute malnutrition and its treatment in Xhariep District, Free State. In this chapter the study conclusions and recommendations are presented.

6.1 Conclusions

The findings of this study showed that the WHO Ten step protocol for the inpatient treatment of SAM was not fully understood by MOs working in the Xhariep District, Free State. Specifically, the MOs had poor knowledge regarding the definition of wasting according to the RtHB, vitamin A supplementation dosage according to age, the volume of feeding that should be used for a child with malnutrition and without oedema and at which stage an infant with malnutrition and anaemia should be given iron supplements. Lack of knowledge regarding the referral system was also evident, as some of the MOs did not know that a multidisciplinary team composed of the MO, occupational therapist, social worker and dietitian, should see a child with SAM.

This study has shown that the undergraduate training offered to medical students on the management of SAM may be inadequate at some universities in South Africa. MOs suggested that the undergraduate curriculum on the management of SAM should be standardised across South African universities offering medical degrees in terms of the nutrition content and assessment. There was also a lack of in-service training on the management of SAM at the work place. These findings suggest that MOs, especially those with less experience are in need of support to manage cases of SAM. This support can take the form of in-service training and adequate supervision from senior medical staff.

6.2. Study limitations

6.2.1 This study was conducted in Jagersfontein, in the Xhariep District, Free State. This limits inferring the study findings for MOs who work outside Jagersfontein.

6.2.2 Fifteen MOs out of a possible 20 participated in the study. The findings of this study should be interpreted with caution due to the small sample size. In general, it is challenging to recruit doctors to participate in research. This is mainly due to their taxing work schedules and them being in high demand. Their time is very valuable and is unlikely to be spent on lengthy surveys or

interviews. Although the sample size was small, the findings of this study offers important baseline data in an area that has not been well researched.

6.2.3 Due to the small sample size statistical analysis of data was limited.

6.3 Recommendations

6.3.1 The Provincial Nutrition Directorate should readily disseminate guidelines on the management of malnutrition to all hospitals and this should form part of orientation for new medical staff in both private and public health sectors.

6.3.2 There should be annual province-wide refresher training courses on childhood malnutrition for all health care professionals including MOs.

6.3.3 In-service training (formal and informal) should be in place and available in hospitals to all the health care professionals including the MOs to improve knowledge on childhood malnutrition.

6.3.4 Malnutrition charts should be posted in all consultation rooms where MOs work from so that the charts can be consulted if needed. Inter-Active Communication and Management (iCAM) should be installed at all the institutions in the district so that no one has to travel long distances to attend training sessions. This should be done in a way that allows for MOs to be tested and monitored after every session.

6.4 Implications for further research

6.4.1 Studies should be conducted to determine practices and management of severe acute malnutrition in other Free State hospitals.

6.4.2 Similar studies should be conducted in other provinces in order to assess the MO’s knowledge regarding the management of SAM.

6.4.3 A larger sample size should be obtained for future studies and MOs should be encouraged to participate in such studies. As mentioned previously this may present a challenge given the difficulty in recruiting doctors to participate in research.

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APPENDIX A QUESTIONNAIRE IN ENGLISH

Knowledge regarding Severe Acute Malnutrition and its treatment among medical officers in Xhariep district, Free State

Kindly answer this questionnaire honestly. You may clarify with the researcher if any question is unclear to you.

This questionnaire is completely confidential and anonymous.

Please **fill in** details where required or mark with an **X** where relevant.

SECTION A: DEMOGRAPHICS

1. Date of birth (dd/mm/yy)

☐☐ ☐☐ ☐☐

2. Gender

1. Male ☐ 2. Female ☐

3. Race

1. Black ☐ 2. White ☐

3. Indian ☐ 4. Coloured ☐

5. Other ☐

4. What medical qualification do you hold?

1. MBChB ☐

2. Other (specify) ☐

5. How many years was your undergraduate medical curriculum?

1. Five years ☐
2. Six years ☐
3. Seven years ☐
4. Other (please specify below)

☐

6. How many years did you take to complete your medical degree?

1. Five years ☐
2. Six years ☐
3. Seven years ☐
4. Eight years ☐
5. More than eight years ☐
6. Other (please specify)

☐

7. At which University did you complete your degree?

1. University of Cape Town ☐
2. University of Pretoria ☐
3. University of the Free State ☐
4. Walter Sisulu University ☐
5. University of KwaZulu-Natal ☐
6. University of Witwatersrand ☐
7. University of Medical South Africa (Medunsa) ☐
8. Stellenbosch University ☐
9. Other (please specify): ☐

☐

8. Where did you complete your undergraduate medical degree?

1. South Africa ☐

If not in South Africa, please list the country where you completed your studies:

☐

SECTION B: UNIVERSITY CURRICULUM

9. Was childhood malnutrition covered in your undergraduate medical curriculum?

1. Yes ☐ 2. No ☐

10. If yes, to question 9, in which year of study was it covered?
(You can cross more than one block)

1. First ☐ 2.Second ☐ 3.Third ☐ 4. Fourth ☐ 5. Fifth ☐

6. Sixth ☐ 7. Seventh ☐

11. If yes to question 9, was it a module on its own or a section within a module?

1. Module on its own ☐ 2. Section in a module ☐

12. Were you assessed on childhood malnutrition during your undergraduate studies?

1. Yes ☐ 2. No ☐

13. If yes to question 12, how were you assessed? You can mark more than one answer

1. Tests ☐ 2. Examinations ☐ 3. Oral examinations ☐

4. Assignments ☐

5. Other ☐

14. Do you feel that the time devoted to the childhood malnutrition section was adequate?

1. Yes ☐ 2. No ☐ 3. Not sure ☐

15. Would you have preferred to spend more time on this section?

1. Yes ☐ 2. No ☐ 3. Time was adequate ☐

SECTION C: WORK ENVIRONMENT

16. After being employed have you ever attended in-service or out-service training/s on Severe Acute Malnutrition?

1. Yes ☐ 2. No ☐

17. If yes to question 16, where was the training held?

1. In the hospital ☐ 2. Outside the hospital ☐

18. If yes to question 16, what was the duration of the training?

1. Less than 1 hour ☐ 2. Less than 5 hours ☐ 3. 5-8 hours ☐

4. More than 8 hours ☐

19. If yes to question 16, when was the training held?

1. This year ☐ 2. 1-3 years ago ☐ 3. 3-5 years ago ☐

4. 5-10 years ago ☐ 5. More than 10 years ago ☐

20. Is Severe Acute Malnutrition protocol displayed in the paediatric ward or consultation room?

1. Yes ☐ 2. No ☐

SECTION D: KNOWLEDGE ON CHILDHOOD MALNUTRITION

21. What are the four main causes of death in children with malnutrition?

(Choose one answer)

1. Hypoglycemia, Hypothermia, Dehydration, Electrolyte imbalance ☐

2. Hypoglycemia, infections, dehydration, Heart failure ☐

22. How is wasting defined in the Road to Health Booklet?

1. Low weight for height ☐ 2. Low weight for age ☐

23. What is the standardized criterion for the diagnosis of Severe Acute Malnutrition (SAM) using mid-upper arm circumference (MUAC)?

1. 10.5 cm ☐
2. 11.5 cm and less ☐
3. 12.5 cm ☐
4. 13.5 cm and less ☐

24. What does the abbreviation ReSoMal stand for?

1. Rehydration Solution for Metabolic complications ☐
2. Rehydration Solution for the Dehydrated ☐
3. Rehydration Solution for Malnutrition ☐

25. What is the formula for calculating ReSoMal for a child with dehydration?

1. 20ml/kg ☐
2. 40ml/kg ☐
3. 100ml/kg ☐
4. 130ml/kg ☐

26. Which is the preferred method of giving fluids/feeds to a child with malnutrition?

1. Intra-Vascular ☐
2. Nasogastric feeding tube ☐
3. Oral ☐

27. Should a child with worsening oedema be given diuretics?

1. Yes ☐ 2. No ☐

28. What should be given to a child who develops or has worsening oedema:

1. Potassium ☐ 2. Sodium ☐

3. Phosphorus ☐

29. Starting from day one, antibiotics should be given to _____ of the children with SAM:

1. Some ☐ 2. 2. All ☐ 3. None ☐

30. Should an appropriate dosage for age of vitamin A be given as a boost for a child with SAM?

1. Yes ☐ 2. No ☐

31. The vitamin A dosage booster for a child with SAM less than 6 months of age is:

1. 200 000 IU ☐ 2. 100 000 IU ☐ 3. 50 000 IU

32. The vitamin A dosage booster for a child with SAM about 6-11 months of age is:

1. 200 000 IU ☐ 2. 100 000 IU ☐ 3. 50 000 IU

33. The vitamin A dosage booster for a child with SAM between 12-59 months of age is:

1. 200 000 IU ☐ 2. 100 000 IU ☐ 3. 50 000 IU

34. Which volume of feeding should be used for a child with malnutrition and without oedema?

1. 20ml/kg ☐ 2. 100ml/kg ☐ 3. 130ml/kg ☐

35. Which volume of feeding should be used for a child with malnutrition and with oedema (3+)?

1. 20ml/kg ☐ 2. 100ml/kg ☐ 3. 130ml/kg ☐

36. In the case of an infant with malnutrition and anaemia when should iron supplements be given?

1. At the initial phase ☐ 2. At the stabilisation phase ☐

3. At the beginning of the transition phase ☐ 4. At the discharge phase ☐

37. For loving, care and stimulation the child can be referred to the ___:

1. Social worker ☐ 2. Occupational therapist ☐

3. Professional nurse ☐ 4. Pharmacist ☐

38. In order to obtain information on family background and socio-economic status the ___ should be consulted.

1. Psychologist ☐ 2. Occupational therapist ☐
3. Social worker ☐ 3. Pharmacist ☐

39. Prior to discharge it may be necessary to investigate and counsel on:

1. Hypertension and diabetes mellitus ☐ 2. HIV and TB ☐

40. Prior to discharge the child should be referred to the ____for nutritional supplementation prescription and education:

1. Pharmacist ☐ 2. Dietician ☐

41. All of the following are discharge criteria for a child with SAM, except____.

1. Good appetite ☐ 2. Infection resolved ☐
3. Oedema resolved ☐ 4. The height for age is on the 0-line target ☐
5. Consecutive weight gain for 5 days (target weight-for-height reaches WHZ ~-1SD) ☐

APPENDIX B FOCUS GROUP DISCUSSIONS QUESTIONS IN ENGLISH

Focus group discussion (SAM):

1. Have you ever managed a child with severe acute malnutrition (SAM)? Please share your experience.

2. Is it the first time you manage a child with SAM? Please describe how you manage the child from assessment to management?

3. Is there a difference between a child with SAM and a child with Moderate Acute Malnutrition (MAM)? Please share your knowledge.

4. Do you feel that you have had adequate training from the Department of Health or continuous education training on managing a child with severe acute malnutrition? Please share your opinion.

5. Do you feel that you have learned enough about childhood malnutrition during tertiary education? Please share your opinion.

APPENDIX C CONSENT FORM FOR MEDICAL OFFICERS

PARTICIPANT INFORMATION AND INFORMED CONSENT

My name is Mandla Lackson Ramagoma and I am a part-time M.Sc (Diet) student from the University of KwaZulu-Natal. I am conducting a research project to assess the knowledge of Medical Officers regarding severe acute malnutrition and its treatment in Xhariep district. Study MOs will be required to answer a questionnaire and participate in a group discussion. Contact details for the researcher are as follows 076 061 3820 or RamagomaML@fshealth.go.za.

For further information regarding the study, you may contact Dr Kirthee Pillay, who is the project supervisor. Contact details: 033-2605674 or pillayk@ukzn.ac.za. The Human and Social Sciences Ethics Research Office can be contacted on 033-2604557 or mohunp@ukzn.ac.za.

All the data collected from this study will remain confidential and will only be used for the purpose of this research project. All MOs will remain anonymous. Participation in this study is completely voluntary. All MOs may leave the study at any time they wish, without any negative consequences. There are no potential benefits from participating in this study. No MOs will receive any payments or financial reimbursements for participating in this research project. Audio recordings from the focus group discussions will be used for the purpose of this study and will be stored appropriately. All data will be destroyed when it is no longer needed.

Declaration:

I _____ (full name and surname) hereby confirm that the questionnaire has been clearly explained to me and I understand the purpose of this research project and how the information will be collected. I consent to participating in the research project.

I understand that participation is voluntary and I can leave the study if I desire.

_____ _____

Signature **Date**

APPENDIX D ETHICS APPROVAL LETTER FROM UKZN

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

15 May 2015

Mr Mandla Lackson Ramagoma 21504338
School of Agriculture, Earth and Environmental Sciences
Pietermaritzburg Campus

Dear Mr Ramagoma

Protocol reference number: HSS/0479/015M
Project title: Knowledge regarding Severe Acute Malnutrition and its treatment among medical officers in Xhariep district, Free State

Full Approval – Expedited Application

In response to your application received on 12 May 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Dr Kirthee Pillay
Cc Academic Leader Research: Professor Onisimo Mutunga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

APPENDIX E APPROVAL LETTER FROM DEPARTMENT OF HEALTH

health
Department of Health
FREE STATE PROVINCE

24 August 2015

Mr. ML Ramagoma
School of Agriculture, Earth and Environmental Science
University of KZN
Pietermaritzburg Campus

Dear Mr. ML Ramagoma

Subject: Knowledge regarding severe acute malnutrition and its treatment among medical officers in Xhariep district, Free State.

- Permission is hereby granted for the above – mentioned research on the following conditions:
- Participation in the study must be voluntary.
- A written consent by each participants must be obtained.
- Serious adverse events to be reported and/or termination of the study.
- Ascertain that your data collection exercise neither interferes with the day to day running of the Xhariep District Municipality Offices nor the performance of duties by the respondents or health care workers.
- Confidentiality of information will be ensured and no names will be used.
- Research results and a complete report should be made available to the Free State Department of Health on completion of the study (a hard copy plus a soft copy).
- Progress report must be presented not later than one year after approval of the project to the Ethics Committee of the University of the Kwazulu Natal and to Free State Department of Health.
- Any amendments, extension or other modifications to the protocol or investigators must be submitted to the Ethics Committee of the University of the Kwazulu Natal and to Free State Department of Health.
- Conditions stated in your Ethical Approval letter should be adhered to and a final copy of the Ethics Clearance Certificate should be submitted to khusemj@fshealth.gov.za or sebeelats@fshealth.gov.za before you commence with the study
- No financial liability will be placed on the Free State Department of Health
- Please discuss your study with the institution managers/CEOs on commencement for logistical arrangements
- Department of Health to be fully indemnified from any harm that participants and staff experiences in the study
- Researchers will be required to enter in to a formal agreement with the Free State department of health regulating and formalizing the research relationship (document will follow)
- You are encouraged to present your study findings/results at the Free State Provincial health research day
- Future research will only be granted permission if correct procedures are followed see http://nhrd.hst.org.za

Trust you find the above in order.

Kind Regards

Dr D Motau
HEAD: HEALTH
Date: 2/9/2015

Head : Health
PO Box 227, Bloemfotein, 9300
4th Floor, Executive Suite, Bophelo House, cnr Maitland and, Harvey Road, Bloemfotein
Tel: (051) 408 1646 Fax: (051) 408 1556 e-mail:khusemj@fshealth.gov.za@fshealth.gov.za/chikobvup@fshealth.gov.za