1.0 Background

1.1 Millennium Development Goals (MDGs)
In September 2000, world leaders joined together to endorse the United Nations Millennium Declaration, committing to meet global targets, entitled the ‘Millennium Development Goals’ by 2015. While all of the MDGs relate to the subject of this thesis, goals one (end poverty and hunger), four (reduce child mortality) and six (combat HIV) are particularly relevant. (See table one)

Table 1: Millennium Development Goals (UN, 2000)

<table>
<thead>
<tr>
<th>Millennium Development Goal</th>
<th>Targets</th>
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<tbody>
<tr>
<td>1. End poverty and hunger</td>
<td>Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day. Achieve full and productive employment and decent work for all, including women and young people. Halve, between 1990 and 2015, the proportion of people who suffer from hunger.</td>
</tr>
<tr>
<td>2. Universal primary education</td>
<td>Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.</td>
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<tr>
<td>3. Gender Equality</td>
<td>Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015.</td>
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<tr>
<td>4. Reduce child mortality</td>
<td>Reduce by two thirds, between 1990 and 2015, the under-five mortality rate.</td>
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<tr>
<td>5. Improve maternal health</td>
<td>Reduce by three quarters the maternal mortality ratio. Achieve universal access to reproductive health.</td>
</tr>
<tr>
<td>6. Combat HIV, Malaria and other diseases</td>
<td>Have halted by 2015 and begun to reverse the spread of HIV/AIDS. Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.</td>
</tr>
<tr>
<td>7. Ensure environmental sustainability</td>
<td>Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation. By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.</td>
</tr>
<tr>
<td>8. Develop a global partnership for development</td>
<td>Address the special needs of least developed countries, landlocked countries and small island developing states. Develop further an open, rule-based, predictable, non-discriminatory trading system. Deal comprehensively with developing countries’ debt. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries. In cooperation with the private sector, make available benefits of new technologies, especially information and communications.</td>
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</table>

In 2008 the United Nations produced a report entitled ‘the Millennium Development Goals Report’ showing slow progress toward achieving the MDGs. Under-five
mortality in sub-Saharan Africa is at least twice as high as in any other region of the world, and the report concluded that at the current rate of decline meeting the MDG target of reducing child mortality by two thirds is impossible. Malawi’s under-five mortality has declined from two hundred and twenty one per one thousand in 1990 to one hundred and twenty in 2006 (UNICEF, 2008b). While this reduction marks strong progress, Malawi is still in the top 20% of the world’s countries for child mortality. High incidence of early death has lead to rapidly declining life expectancy at birth in southern Africa. As shown in figure one, this is a reversal of earlier gains that had been made in reducing child mortality and increasing life expectancy (UNAIDS, 2008).

Figure 1: Life expectancy

Source (UNAIDS, 2008)

The MDG report, along with other global reports of progress in the fight against HIV, reported that the incidence of HIV was declining both globally and in sub-Saharan Africa (UN, 2008; UNAIDS, 2007, 2008). These results must however, be put into context. Decreasing incidence and prevalence figures may in part relate to changes in the way that data are collected and analysed; earlier estimates may have been higher than what has been borne out by increased saturation of HIV testing; finally in some countries HIV prevalence may be declining because of an increased proportion of people progressing to AIDS and finally to death.
Other important trends are highlighted; including the increased proportion of People Living with HIV (PLHIV) who are female. In sub-Saharan Africa approximately sixty per cent of PLHIV are women (UN, 2008). Finally the increasing number of PLHIV who have access to antiretroviral therapy (ART) was mentioned; increasing from twenty-one per cent in 2006 to thirty per cent in 2007 in sub-Saharan Africa (UN, 2008). While this figure demonstrates that demand still far outstrips supply, the rate of progress is encouraging. Unfortunately the proportion of HIV-infected children receiving ART is likely to still be much lower in sub-Saharan Africa because of problems with diagnosis of HIV and availability of ART.

The World Food Summit of 1996 defined food security as existing “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). Many factors can affect vulnerability to food insecurity, including gender, disease, age, poverty, landlessness and conflict. The global burden of food insecurity, malnutrition and hunger is formidable. According to the FAO Report of Food Insecurity, 2008, worldwide 848 million people suffered from chronic hunger in 2003–05. This number is slightly higher than the 842 million people who were undernourished in 1990–92. The World Food Programme (WFP) World Hunger Map highlights areas of high prevalence of underweight in orange and red (see figure two).
The 2008 MDG report, along with the FAO 2008, State of Food insecurity in the World highlighted increasing food prices as an ongoing threat to food security, and world hunger. Although the global prevalence of underweight has decreased from thirty-three per cent in 1990 to twenty-six per cent in 2006; this still translates to over one hundred and forty million underweight children (UN, 2008). Some countries have made dramatic progress in reducing child underweight. East Asia, notably China has halved its proportion of underweight children between 1990 and 2006 (UN, 2008). This is likely to be related to economic prosperity and the one child policy, rather than nutrition programmes. Other regions however have made significant reductions (see figure 3). In southern Africa the progress in reducing child underweight is slow, moving from thirty-two per cent in 1990 to twenty-eight per cent in 2006 (UN, 2008).

Figure 2: World Food Programme World Hunger Map 2006 (WFP, 2006)
Percentage of underweight children <5.

Figure 3: Regional child malnutrition 1990 and 2005
Source (UN, 2008).

Figure 4 shows that the proportion of underweight children under-five in Eastern and Southern Africa remained almost static between 1990 and 2004. The dotted lines show the dramatic decline in underweight that would need to be achieved to reach the MDG 2015 target.
1.2 Causes of malnutrition
The causes of malnutrition are broad and multi-factorial. Perhaps the most obvious cause of malnutrition is lack of food, due to food insecurity. While many children and adults do become malnourished each year because of food insecurity, particularly related to disasters like drought or conflict (FAO, 2008), many more also become malnourished because of infection. In the early 1950s the relationship between nutrition and infection was virtually unknown (Scrimshaw, 2007). Scrimshaw and colleagues began to explore the reciprocal relationship between malnutrition and infection, particularly through observations of infections in children with oedematous malnutrition (Scrimshaw, 2003, 2007; Scrimshaw, Taylor, & Gordon, 1959, 1969). This was an extremely important discovery as it helped to establish both the essential role of maintaining good nutrition in fighting infection, and also the importance not only providing adequate nutrition but also treating infections in order to respond to malnutrition. The UNICEF Causes of Malnutrition Conceptual Framework name food insecurity and infection as the immediate causes of malnutrition (figure 5).
While the immediate causes of malnutrition are clear, the underlying and basic causes of malnutrition are equally important. Both moderate and severe acute malnutrition are treated using methods that are primarily reactive rather than preventative. This thesis will discuss the treatment of malnutrition in more detail later, but at this point it is valuable to consider the wider picture, and to recognise that simply treating the cases of malnutrition which are identified at facility or community level can never correct the problem of childhood malnutrition. Even when nutritional rehabilitation programmes include health education messages including information on improving care (for example nutrition education and breastfeeding promotion), improving household food security (through agricultural education) or improving the household environment (through hygiene promotion) this is still only reaching the immediate and top level underlying causes (see figure 5). The dramatic reductions in
childhood prevalence of underweight in China between 1990 and 2006 (UN, 2008) speak to the importance of the deeper underlying and basic causes of malnutrition including the poverty and the social, economic and political context, as these gains were achieved by addressing these factors and therefore reducing poverty and improving health overall. Richard Horton, the editor of the Lancet summed up the importance of thinking broadly when addressing malnutrition in his editorial to open the Lancet series on maternal and child under-nutrition.

“There is no magic technological bullet to solve the problem of under-nutrition. Long-term investments in the role of women as full and equal citizens—through education, economic, social, and political empowerment— will be the only way to deliver sustainable improvements in maternal and child nutrition, and in the health of women and children more generally.” (Horton, 2008)

Malnutrition is described as a contributing factor in over 50 per cent of child deaths in developing countries (Black, Morris, & Bryce, 2003; Black, et al., 2008; Caulfield, de Onis, Blossner, & Black, 2004; Rice, Sacco, Hyder, & Black, 2000). This translates into 5.7 – 6.4 million child deaths related to malnutrition each year (Jackson, Ashworth, & Khanum, 2006). This estimate includes deaths related to both moderate and severe acute malnutrition. Moderate acute malnutrition actually contributes to more of these deaths than severe acute malnutrition, however, this is because moderate acute malnutrition is more common, affecting a larger number of children. A much larger proportion of children with severe acute malnutrition die, than those with moderate acute malnutrition (Jackson, et al., 2006). The specific importance of SAM has not been adequately recognised (Collins, et al., 2006a). Severe acute malnutrition is estimated to contribute to 1.7 million child deaths per year using the UNICEF global database (Collins, et al., 2006b; Pelletier, 1994). This estimate does not, however include oedema. As oedema is very common in southern Africa (Schofield & Ashworth, 1996), particularly in Malawi the underestimation of the prevalence and impact of SAM is likely to be large.

In many developing countries children with SAM comprise a large proportion of paediatric hospital deaths (Jackson, et al., 2006). SAM is one of the most common reasons for paediatric admission to a health facility in Malawi (Collins, 2007) where,
in 2005, more than 20,000 children with SAM were admitted to inpatient NRUs for nutritional rehabilitation (UNICEF, 2006b). Due to limited access by malnourished children to these inpatient treatment facilities, this figure is likely to be an underestimate of the total number of children with SAM in the country.

1.3 Severe acute malnutrition
Severe acute malnutrition in children is weight-for-height of less than -3 z-scores and/or the presence of bilateral pitting oedema. In children aged between 6-59 months, a mid upper arm circumference of < 11 cm is also indicative of severe acute malnutrition (WHO, 1999, 2003b; WHO, UNSCN, 2007). This is the currently accepted definition of malnutrition by the Ministry of Health (MOH) Malawi (MOH Malawi, 2003), and was the definition in use in this programme of research.

Discrepancies in assessment of malnutrition in children can occur based on which definition of malnutrition is being used. Along with the WHO definition, other definitions including the Gomez Classification (Gomez, et al., 2000), Waterlow Classification (Gomez, et al., 2000; Waterlow, 1972, 1973) and the Wellcome Classification (McLaren, Pellett, & Read, 1967; McLaren & Read, 1972) have also been used in the malnutrition literature. The Gomez and Wellcome classifications are based on weight for age measurements, while the WHO and Waterlow definitions are based on weight for height. In this programme of research the WHO definitions were used (WHO, 1999, 2003b; WHO, UNSCN, 2007), in accordance with MOH Malawi current practice (MOH Malawi, 2003).

Another important issue impacting on the assessment of malnutrition is which growth standards are used to compare the children with. In 2006 WHO published ‘the WHO Growth Standards’ based on data collected in the WHO Multicentre Growth Reference Study of breastfed children from six countries. These growth standards are intended to replace the Centre for Disease Control’s National Centre for Health Statistics (NCHS) growth standards. The NCHS standards came under some global criticism as they were based on American children, many of whom were formula-fed. In this programme of research the NCHS standards were used. There are several implications of introducing the WHO growth standards to nutritional rehabilitation
programmes for children with severe acute malnutrition globally. First, this may require intensifying resources as one study found that eight times more children were identified as malnourished using the WHO standards compared with the NCHS standards. The change to WHO standards will, however also lead to reduced mortality among children with SAM receiving nutritional rehabilitation, as many of the cases will be less ‘severe’ (Isanaka, Villamor, Shepherd, & Grais, 2009).

1.3.1 Treatment of severe acute malnutrition

Traditional inpatient-focused nutritional rehabilitation was addressed by WHO using a “10 Steps” case management approach (Schofield & Ashworth, 1996). The ten steps include: treat/prevent hypoglycaemia, hypothermia and dehydration; correct imbalance of electrolytes; treat infection; correct deficiencies of micronutrients; start cautious feeding with specially prepared starter formula; rebuild wasted tissues with specially prepared catch up formula; provide stimulation, play and loving care; and prepare for follow-up after hospital discharge (WHO, 1999, 2003b). Guidelines were published in 1999 (WHO, 1999), updated in 2003 (WHO, 2003b), and supported by a programme of training courses for staff (WHO, 2003a). Inpatient nutritional rehabilitation is conducted using formula milks specially designed for the needs of children with SAM, including a low-osmolarity starter formula (F75) and a catch up high nutrient density formula (F100).

The second TFP strategy, internationally endorsed in 2007 and currently rolling out worldwide, is Community Management of Acute Malnutrition (CMAM - originally known as Community-based Therapeutic Care, CTC (Valid, 2006; WHO, UNSCN, 2007). CMAM programmes use ready-to-use therapeutic foods (RUTFs) to treat the majority of children in their own homes rather than as inpatients. Public health impact is achieved through a network of outpatient treatment (OTP) sites aiming to improve access to care and maximise population coverage. CMAM also emphasises active case finding and timely treatment, before infections and other clinical complications of SAM develop and before a child deteriorates to the stage where intensive inpatient medical inputs are needed (Collins, 2007; Collins et al., 2006; Valid, 2006; WHO, UNSCN, 2007). Community-based treatment of SAM has been facilitated through the development of ready to use therapeutic foods (RUTF). RUTFs for the treatment of SAM are usually groundnut based pastes, mixed with oil,
sugar and dried skimmed milk, and have the same nutritional composition as F100, but are shelf stable.

WHO now recommends an integrated system of inpatient and community-based care for children with severe acute malnutrition (WHO, UNSCN, 2007). This is based on the principle, developed by Collins, that children with complicated SAM should be treated as inpatients, and children with uncomplicated SAM should be treated as outpatients (Collins & Yates, 2003). (See figure 6)

![Acute malnutrition diagram]

**Figure 6: Classification of acute malnutrition**
Source: (Collins & Yates, 2003)

1.4 HIV

1.4.1 *Clinical characteristics and epidemiology*

Human immunodeficiency virus (HIV) is a retrovirus, which causes acquired immunodeficiency syndrome (AIDS). Two strains of the HIV virus exist: HIV-1 and HIV-2. HIV-1 is the cause of most infections globally and is easily transmitted. HIV belongs to the Lentivirus family. Lentiviruses typically cause long duration illnesses, with a long incubation period (Levy, 1993). HIV begins its life cycle when it binds to the CD4 receptor on the surface of a T cell. After fusing with the host cell the virus then releases RNA. HIV uses reverse transcriptase to create viral DNA from RNA. The newly formed HIV DNA, now called a provirus integrates into the nucleus of the host cell. In an otherwise healthy adult the asymptomatic period may last for 10-15 years.
or even longer. During this time the lymphocytes are mounting an immune response to the virus. The provirus will produce copies of the HIV virus and release them into the host, to continue the cycle of infection and replication (USDHSS, 2005). There is evidence to suggest that the period of HIV progression in young children is much quicker than for adults; 34% of untreated children will progress to serious disease in one year and 69% within five years (Little, et al., 2007).

Viral load will spike in the weeks following initial infection, and then decline. During the asymptomatic period the virus will continue to replicate, causing CD4 lymphocyte decline. As the CD4 count declines, viral load will increase, overwhelming the body's immune system (see figure 7). As HIV progresses to AIDS, the body is vulnerable to opportunistic infections, for example Kaposi's sarcoma, tuberculosis or oral thrush.

![Graph showing CD4+ cell count and viral load over time](image)

**Figure 7: The progression of HIV to AIDS**
Source (BBC, 2009)

### 1.4.2 HIV testing
HIV testing is now widely available for adults through rapid tests which cost less than $1USD each. For children ages <18 months, however HIV testing remains a challenge. Rapid tests rely on the detection of HIV antibodies to diagnose HIV. For the first 15-18 months of life a child born to an HIV-infected mother may retain maternal HIV antibodies, yet not be HIV-infected. This can lead to false positive HIV tests. Children ages less than 18 months of age, who test positive for HIV using a
rapid test must be re-tested using a viral polymerase chain reaction PCR test, or be retested after 18 months of age to confirm diagnosis (WHO, 2006). In resource-limited settings like Malawi, PCR testing is not widely available due to lack of equipment and trained personnel as well as the high cost of PCR testing. This can lead to delays in treatment for children.

There are two commonly used methods of staging HIV infection. The CDC and WHO systems use both CD4 count and clinical symptoms to classify stages of disease. People living with HIV (PLHIV) who have a CD4 count <200 cells/µL, and/or who have an opportunistic infection categorised as an AIDS-defining illness are diagnosed with AIDS under the CDC system (CDC, 1993; WHO, 2007). For children under five years of age WHO recommends using CD4 as a per cent of all lymphocytes rather than absolute CD4 count as a staging criterion. In young children CD4 count tends to fluctuate more within an individual child than CD4% does (WHO, 2007). CD4% below 15% is classified by WHO as advanced disease in children under five (WHO, 2007).

The previous WHO system used only clinical signs and symptoms to stage HIV. The advantage of a clinical system is that it can be used in low resource settings where CD4 count testing is not available, however due to the increasing availability of CD4 testing in low resource settings and the poor sensitivity and specificity of clinical algorithms WHO revised their guidelines.

HIV can be transmitted sexually, through the exchange of blood or blood products or from mother to child. Mother to child transmission (MTCT) can occur during pregnancy, during delivery or while breastfeeding. MTCT of HIV in the UK is now virtually unknown, although in sub-Saharan Africa it remains a major public health issue. Sixty per cent of the PLHIV in sub-Saharan Africa are female (UNAIDS, 2008). In no other region do women represent more than half of PLHIV. The number of new infections among children each year globally has stabilised but still remains unacceptably high at over 350 000 new infections per annum (see figure eight). Most of these infections are occurring in sub-Saharan Africa where interventions to prevent MTCT are unavailable or poorly implemented.
In 2007 there were an estimated 33 million PLHIV globally. Although the percentage of people living with HIV has stabilised since 2000, there are still more new infections than deaths, and HIV treatments are continuing to extend life (UNAIDS, 2008). Southern Africa is home to only 10 per cent of the world’s population, but 67% of the global population of PLHIV. Figure nine demonstrates the clustering of HIV infections in sub-Saharan Africa.

**Figure 9: Adults and children living with HIV/AIDS in 2007**
Source (UNAIDS, 2008)

HIV prevalence in Malawi has stabilised and is declining somewhat, although it remains unacceptably high. Adult (15–49 years) HIV prevalence was estimated at
14% [6.9%–21.4%] in 2005 (UNAIDS, 2006). Median HIV prevalence among pregnant women at sentinel surveillance sites has remained between 15 and 17 per cent since 2000 (Malawi, 2004). HIV prevalence at antenatal clinics in Lilongwe fell from 27 per cent in 1996 to 17 percent in 2003, before rising slightly again in 2005 to 19 per cent. There are also regional differences in the prevalence of HIV. HIV infection is more common in the south, where some communities have a prevalence as high as 20–22% (in Mulanje, Mangochi, Thyolo and Blantyre), but levels are considerably lower in the north (8%) and central regions (7%) (UNAIDS, 2007).

1.5 HIV and SAM
Generally high prevalence of HIV and malnutrition are clustered globally in the same regions. Sub-Saharan Africa, including Malawi faces a high prevalence of both malnutrition and HIV. HIV and malnutrition are related both epidemiologically and physiologically. Figure 10 depicts the relationship between good nutrition and HIV. Of course the inverse relationship also exists. HIV like other infections can increase nutritional needs, and common opportunistic infections like diarrhoea or oral thrush can cause decreased intake and increased losses.

This relationship between nutrition and infection is of heightened importance when severe acute malnutrition develops, especially in children, as mortality is common for children with SAM, especially those with complicated malnutrition (Fergusson & Tomkins, 2008; Schofield & Ashworth, 1996). Diarrhoea in particular makes a child with SAM vulnerable (Amadi, et al., 2001; Amadi, et al., 2005).
Given the clinical complexity and challenges of HIV-related SAM, it is striking that current international guidelines for SAM rehabilitation (Valid, 2006; WHO, 1999; WHO, 2003b) have minimal mention of the issue. This reflects the rapid and recent emergence of evidence, plus the time lag for translation into policy. However, the gap is becoming critical in HIV prevalent settings and urgently needs to be addressed to tackle poor outcomes, high mortality, and strains on already limited TFP resources (Heikens, Amadi, Manary, Rollins, & Tomkins, 2008; Manary & Sandige, 2008). There is a dearth of clinicians trained in the management of paediatric SAM (Heikens, Amadi, et al., 2008) and updating guidelines is an important means of supporting non-specialist staff proving the majority of front-line care.

A 2006 assessment of nutritional care for children living with HIV in Kenya, Malawi and Zambia concluded that across the region HIV testing and treatment were increasingly being offered in nutritional rehabilitation programmes, although coverage of testing remained low. Even when HIV infection was identified treatment...
using cotrimoxazole and/or antiretroviral treatment was always available (UNICEF, 2008a).

In most cases uptake of testing is high for children receiving nutritional rehabilitation. Recent studies at both the community and facility level have reported over 90% uptake (Bahwere, et al., 2008; Thurstans, Kerac, Maleta, Banda, & Nesbitt, 2008). This stands in contrast to earlier data from research conducted in 2001 in Malawi where “many mothers/caretakers chose not to receive post test counselling” (Ndekha, Manary, Ashorn, & Briend, 2005). Although the proportion of mothers electing not to get their results in the Ndekha et al. study is not explicitly stated, it does seem that over time the uptake of testing has increased. Perhaps this is indicative of an increased openness surrounding HIV in Malawi, and could also be related to increasing availability of treatment including cotrimoxazole and paediatric ART. Operational factors may also have an impact. Between 2005 and 2007 Action Against Hunger monitored the uptake of testing within its nutrition rehabilitation programme in 46 of 96 nutrition rehabilitation units in Malawi. A survey conducted at the 46 units had the following findings:

Units with a high uptake of HIV testing and counselling:
- Have a staff member trained in the process
- Provide the testing and counselling in the unit
- Offer testing and counselling on admission.

Units with a low uptake of HIV testing and counselling:
- Do not always offer the service
- Offer testing and counselling only on referral from medical staff
- Have an overall staff shortage.

The vast majority of facilities providing nutritional rehabilitation across Malawi and Zambia have no paediatricians. In Malawi in 2003–04 there were only 1·13 physicians and 25·6 nurses per 100 000 people (WHO, 2005). Staff report feelings of uncertainty about prescribing paediatric antiretroviral treatment, especially for younger children, particularly where the PCR test and CD4 percentage are not available (UNICEF, 2008a). More technical resources (training, testing equipment
and related supplies) are needed to provide the PCR test and determine CD4 percentage. Roles and responsibilities also need evaluation to ensure staff are being used to their full capacity.

Children entering nutritional rehabilitation units through outpatient programmes also need to be tested for HIV, but testing and treatment services may not be operating in cooperation with many sites. Outpatient care for children with severe acute malnutrition has the potential to increase coverage for severe acute malnutrition through community-based case finding and to improve nutritional treatment outcomes through earlier intervention (Bahwere, et al., 2008; Sadler, Bahwere, Guerrero, & Collins, 2006). These benefits could also be extended to the testing and treatment of HIV among those with severe acute malnutrition. However, this requires strong links between the outpatient therapeutic programme and HIV testing and care as well as inpatient nutrition rehabilitation services, including common referral and monitoring and evaluation forms.

Although some important findings have been published showing encouraging results about update of testing at the community level in CMAM, more research needs to be done in high HIV prevalence areas. For example in Lusaka, Zambia and in Thoylo, Malawi CMAM is operating in high prevalence settings. Data on update of testing and mortality, as well as lessons learnt on community engagement are awaited to inform future programmes.

From the data available, up to 40 per cent of the children treated as inpatients were HIV-infected, compared with approximately 5 per cent in some outpatient nutritional rehabilitation programmes in Malawi (Sadler et al., 2006). Both the Lusaka and Thoylo programmes offer universal HIV testing with high uptake. Children are all provided with testing and treatment through their local health centre. The programme in Lusaka is of particular interest because of the close collaboration and successful capacity building between the Zambian MOH and Valid International, as well as the operation of CMAM in an urban environment.
1.6 Scaling Up Treatment

The number of children in need of antiretroviral treatment far exceeds the current capacity for treatment. Some of the barriers to providing treatment to children include:\(^1\)

- A shortage of staff with the training, experience and confidence to diagnose and treat HIV-positive children. Malawi faces a dramatic shortage of paediatricians, and most rural hospitals have no trained paediatrics staff.
- Antiretroviral treatment regimens include a minimum of three medications for maximum effectiveness. These medications are often in the form of syrups, some of which taste unpleasant and require refrigeration.
- Few combined treatment formulations are available for children.
- Paediatric syrups are more expensive than adult medications. Global activism has been successful in reducing the costs of antiretroviral treatment for adults, and now it is important to advocate similarly for affordable paediatric formulations.
- Research and development of paediatric antiretroviral medication lags behind that for adult treatments. This is due to the relatively small market for paediatric treatment in the industrialized world.
- CD4+ and CD4 per cent tests are important for making treatment decisions for children, but they require whole blood, and there are few machines for measuring CD4 and CD4 per cent available in each country.
- Both the PCR and CD4+ tests are expensive.
- Diagnosing HIV is challenging in children less than 18 months of age where PCR testing is not available. Physicians are hesitant to initiate antiretroviral treatment without a confirmed HIV diagnosis.

Where antiretroviral treatment is not yet available, HIV-positive children who are severely malnourished can receive nutritional therapy and cotrimoxazole. Advocacy for countrywide availability of paediatric antiretroviral drugs must continue. Without them, only limited treatment can be integrated into nutrition programmes.

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\(^1\) Adapted from Reporting on Children in the Context of HIV/AIDS
Truly integrated HIV care into nutrition programmes will require policy, guidelines, training, capacity building, supplies, and monitoring and evaluation.

1.7 Prevalence
The clinical presentation of SAM has become increasingly complex in southern Africa with the advent of paediatric HIV. A 2008 systematic review and meta-analysis of HIV prevalence (Fergusson & Tomkins, 2008) found that overall, 29.2 per cent (1427/4891) of children from 17 studies were HIV-infected (see table two).

Nine out of 17 studies reporting on HIV prevalence included children less than fifteen months of age in their sample and did not have access to PCR testing to confirm HIV test results (studies C, D, G – I, M, N, P & Q). This could lead to false positives due to persistent maternal antibodies, therefore potentially overestimating HIV prevalence. The HIV prevalence from these nine studies was 36.7 per cent (1005/2737).

The eight remaining studies either had access to PCR testing (Studies J, L & O) or data available from children >15 months of age (studies A, B, E, F & K). From these five studies, 24.0 per cent (400/1664) of children were HIV-infected.

The analysis of overall HIV prevalence, including children at risk of false positives due to maternal antibodies, generates a higher prevalence of HIV (36.7 per cent vs. 24.0 per cent). This is likely due, in part, to false positive tests. This difference is not, however, solely due to the influence of the maternal antibodies, as five out of eight studies using ELISA in children <15 months were conducted in two large, urban teaching hospitals (Queen Elizabeth Hospital, Blantyre, Malawi and the University Teaching Hospital, Lusaka, Zambia). These hospitals tend to have a high proportion of children with SAM admitted with medical complications and are therefore likely to have a higher prevalence of children with HIV.
**Table 2: HIV prevalence in SAM**

<table>
<thead>
<tr>
<th>Study #</th>
<th>Author/Year</th>
<th>Research setting</th>
<th>Research Method</th>
<th>HIV prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(Mgone, et al., 1991)</td>
<td>Tanzania Paediatric ward, large referral hospital</td>
<td>Case control</td>
<td>25/102 (25.5)**</td>
</tr>
<tr>
<td>B</td>
<td>(Kurawge, Gattszi, Kleinfeldt, Rehle, &amp; Buttery, 1993)</td>
<td>Rwanda Paediatric ward, large referral hospital</td>
<td>Prospective cohort</td>
<td>11/66 (16.7)**</td>
</tr>
<tr>
<td>C</td>
<td>(Prazuck, et al., 1993)</td>
<td>Burkina Faso NRU, referral hospital</td>
<td>Prospective cohort</td>
<td>60/428 (14)</td>
</tr>
<tr>
<td>D</td>
<td>(Akenzam, Koskinemi, Ekandem, Bolanin, &amp; Vahen, 1997)</td>
<td>Nigeria Hospitals and rural survey</td>
<td>Point prevalence</td>
<td>4/206 (1.9)</td>
</tr>
<tr>
<td>E</td>
<td>(Ticklay, Nathoo, Suzya, &amp; Brady, 1997)</td>
<td>Zimbabwe Paediatric ward, large referral hospital</td>
<td>Prospective cohort</td>
<td>68/140 (48.6)**</td>
</tr>
<tr>
<td>F</td>
<td>(Chintu, et al., 1998)</td>
<td>Zambia NRU in large referral hospital</td>
<td>Case control</td>
<td>39/167 (23.3)</td>
</tr>
<tr>
<td>G</td>
<td>(Keseler, Daley, Malenga, &amp; Graham, 2000)</td>
<td>Malawi NRU in large referral hospital</td>
<td>Prospective cohort</td>
<td>86/250 (34.4)</td>
</tr>
<tr>
<td>H</td>
<td>(Yeung, Wilkinson, Escott, &amp; Olks, 2003)</td>
<td>South Africa Paediatric ward, rural South African hospital</td>
<td>Prospective cohort</td>
<td>37/73 (50.7)</td>
</tr>
<tr>
<td>I</td>
<td>(Amadi, et al., 2001; Amadi, et al., 2005)</td>
<td>Zambia NRU in large referral hospital</td>
<td>RCT</td>
<td>106/196 (54.1)</td>
</tr>
<tr>
<td>J</td>
<td>(Bachou, Tumwine, Mvakidrome, &amp; Tylleskär, 2006; Bachou, Tylleskär, Downing, &amp; Tumwine, 2006)</td>
<td>Uganda NRU in large referral hospital</td>
<td>Prospective cohort</td>
<td>64/213 (30)**</td>
</tr>
<tr>
<td>K</td>
<td>(Thuraments, et al., 2008)</td>
<td>Malawi 12 NRUs across Malawi, urban/rural</td>
<td>Point prevalence</td>
<td>113/522 (21.6)**</td>
</tr>
<tr>
<td>L</td>
<td>(Chinkhumba, Tomkins, Banda, Mkanganga, &amp; Fergusson, 2006)</td>
<td>Malawi 1 urban 2 rural hospital based NRU</td>
<td>Prospective cohort</td>
<td>79/454 (17.4)**</td>
</tr>
<tr>
<td>M</td>
<td>(Sandigo, Ndekha, Band, Ashorn, &amp; Manjory, 2004)</td>
<td>Malawi Large referral hospital integrated CMAM</td>
<td>RCT</td>
<td>78/260 (30)</td>
</tr>
<tr>
<td>N</td>
<td>(Ndekha, et al., 2005)</td>
<td>Malawi Large referral hospital integrated CMAM</td>
<td>RCT</td>
<td>93/375 (24.8)</td>
</tr>
<tr>
<td>O</td>
<td>(Bahwere, et al., 2007)</td>
<td>Malawi CTC, rural Malawi</td>
<td>Prospective cohort</td>
<td>224/90 (4.5)</td>
</tr>
<tr>
<td>P</td>
<td>(Kerac &amp; Bunn, 2007)</td>
<td>Malawi Large referral hospital; (early discharge to CTC)</td>
<td>Chart review</td>
<td>355/690 (51.4)</td>
</tr>
<tr>
<td>Q</td>
<td>(K. Sadler, Kerac, Collins, Khengere, &amp; Nesbitt, 2008)</td>
<td>Malawi Large referral hospital integrated CMAM</td>
<td>Prospective cohort</td>
<td>166/259 (71.8) ****</td>
</tr>
</tbody>
</table>

* HIV status for children included in sample <15 months of age was confirmed by PCR
** Children <15 months of age were not included
**** Routine testing was not performed. HIV testing was conducted according to clinical indication.
The prevalence of HIV varied widely between studies; lower HIV prevalence (<5 per cent) was found in studies D & O and higher HIV prevalence (>50 per cent) in studies H, I, P & Q. In study D, children were recruited from both the hospital setting, as well as by rural community-based survey. Study O was conducted in a community-based therapeutic feeding programme in a rural setting. Studies A, B, C, E-H, I, P & Q were all conducted in large, referral hospitals in high HIV prevalence settings and, in study Q, HIV testing was conducted based on clinical indication.

Even within studies, HIV prevalence varied. Study K (urban and rural Malawi) reported a significantly higher prevalence in the southern region of Malawi (36.9 per cent), than in the northern (23.1 per cent) or central regions (10.9 per cent) ($p = .001$). Study L found one of their data collection sites (a rural community hospital) had an HIV prevalence of only 4.5 per cent (5/110), compared with 36.3 per cent (61/138) based at a central referral hospital in urban Malawi ($p=.001$).

Therefore, high prevalence of HIV is frequently observed in urban referral hospitals in regions of high HIV prevalence. Within high prevalence countries there are likely to be pockets of lower HIV prevalence, as demonstrated in the Malawi DHS (Malawi, 2004) and reflected in this review (studies K, L & O).

1.8 Mortality
A 1996 review of mortality in five decades of malnutrition rehabilitation showed that mortality was often high (around 20-30 per cent, and 50-60 per cent among oedematous children) in nutrition rehabilitation programmes (Schofield & Ashworth, 1996), and these figures were unchanged over the fifty years of treatment, despite advances in medicine. The review concluded that poor care was often the cause of death for a malnourished child. Although some inpatient nutritional rehabilitation programmes have been able to achieve case fatality rates below 5 per cent, they tend to be supported by humanitarian organisations with high levels of staff and resource provision and they tend to treat children with uncomplicated SAM (Collins & Sadler, 2002; Prudhon, Briend, Laurier, Golden, & Mary, 1996).

In her 2001 article ‘Treatment of severe malnutrition’, Ashworth summarises the key components of the WHO “ten step” guidelines for nutritional rehabilitation (Ashworth,
She again reinforces in this article the importance of clinical competence and staff training and engagement with guidelines in reducing mortality for children with SAM. Two comments were published in response to her paper. The authors made the point that while it is certainly good to have internationally accepted guidelines for the treatment of children with SAM, problems with inpatient treatment still persist. Availability of services remains limited as many families do not have a nutritional rehabilitation unit close by. Furthermore, concerns over overcrowded and unhygienic wards were raised, as well as the limiting factor of availability of therapeutic feeds (Briend, 2001). In a few sub-Saharan African countries, including Malawi, Unicef and several international NGOs play a role in procuring and distributing F75, F100 and RUTF in partnership with the Malawi MOH. Therapeutic feeds are expensive and require infrastructure for sustained and safe ordering, distribution and storage of supplies. In many countries the supply chain is often broken, causing interruptions in availability of care for children with SAM. Where F100 is not available WHO has provided a recipe to hospitals to produce it using dried skimmed milk, oil and sugar. It is essential, however that an expensive multivitamin mix (CMV) is added to the recipe to replicate the nutritional content of F100. In some cases this formula is made without the CMV, providing a nutritionally inadequate therapeutic feed.

The authors went on to make the comment that while the guidelines were invaluable, poor quality of care was not the only factor contributing to high mortality among children with SAM. While low mortality has been achieved in nutritional rehabilitation programmes run by relief organisations, these children were generally food insecure, but previously well, while hospitals are often treating sick children, children with SAM and infections (Manary, 2001). In particular HIV was mentioned as an important infection contributing to high mortality. Manary (2001) made the point that sepsis was a common cause of death among these children and that sepsis cannot be reversed with an antibiotic. An example was given of an intensive programme of nursing care for children with SAM, following WHO guidelines, under research conditions where mortality remained high at twenty per cent (Manary & Brewster, 2000). Manary (2001) emphasised that infections play an important role in determining outcome in nutritional rehabilitation of children with complicated malnutrition, and also that although the WHO guidelines (WHO, 1999) represented a major step forward in the
care of children with severe acute malnutrition, that much more research needed to be done, particularly in the area of intensive management of complicated cases.

Over the last 10 years, important reductions in SAM mortality have been achieved. Both facility-based and community-based strategies have played major independent but complementary roles in achieving these reductions. (Ashworth, et al., 2004; Collins, 2007; Collins, Dent, et al., 2006; Puoane, Cuming, Sanders, & Ashworth, 2008; Puoane, et al., 2004). As part of the Lancet series on maternal and child under-nutrition, authors looked at ‘what works’ in nutrition to improve health and survival. One of the recommended interventions was management of childhood severe acute malnutrition. Only randomised control trials were included. Meta-analysis of nine studies resulted in a risk ratio of 0.45 (95% CI 0.32–0.62; random effects) when comparing treatment using WHO protocols to other facility-based care. While the authors recognised the important role of CMAM, they did not find any RCTs investigating the impact of CMAM on mortality (Bhutta, et al., 2008). Additionally the authors caution that any differences must be interpreted cautiously as by definition cases treated using CMAM are less complicated and those children are at lower risk of mortality.

Bhutta et al. (2001) estimated that 276 000 children who are younger than 5 years die each year of causes associated with severe acute malnutrition in the 36 focus countries they examined. This results in approximately 9.2 disability-adjusted life years (DALYs). They advise that application of the WHO protocols could reduce the number of deaths by 55%, and prevent 152 000 deaths in hospitals or health facilities. With the addition of a complementary CMAM programme for children with uncomplicated malnutrition these reductions in mortality could potentially be much greater.

Efforts to improve inpatient care and clinical management of children with SAM have borne some success with many NRUs showing reduced incidence of mortality after programmes of staff training and engagement with the WHO guidelines for inpatient nutritional rehabilitation. Adequate numbers of motivated and trained staff were key to achieving these successes and participatory approaches were used successfully to increase staff accountability and feelings of confidence and pride in their work.
Other recommendations included building communication networks, and conducting audits with feedback to staff (Ashworth, et al., 2004; Puoane, et al., 2008; Puoane, et al., 2004).

In this series of papers Ashworth and colleagues blame ‘operational factors’ for high incidence of mortality in nutritional rehabilitation, most notably physician and nurse error. An audit of charts performed by a senior physician as part of the research found that 50% of mortality before guidelines were due to doctor error and 28% to nurse error. These deaths were judged as avoidable. It is not clear when reading the paper exactly what criteria were used to determine error, and avoidable death. Also, relying on medical records to assess clinical action and competence may not be reliable and is dependent on the accuracy and completeness of charts. Finally, in many cases children may have presented with or developed complications that could not be identified or responded to in a low resource setting. While without a doubt increasing the number of committed, trained staff working in nutritional rehabilitation programmes is an important step to reducing mortality. This is a challenging task as almost all hospital and clinic facilities in sub-Saharan Africa, particularly in Malawi, are under-staffed and under-resourced (Heikens, Amadi, et al., 2008). There is also a compelling body of literature which shows that even when the guidelines are accurately implemented, some mortality is unavoidable, especially in a low resource setting among children with complicated SAM.

Most of the data available on SAM and HIV is drawn from studies conducted in inpatient NRUs which do not have the supporting outpatient elements of CMAM. It is important to recognise that this is a select patient group, whose data does not reflect HIV and SAM prevalence and mortality at population level. TFPs run at hospital facilities usually provide services to a large catchment area. This requires patients to travel long distances to access care and inpatient nutrition rehabilitation require the child with SAM and their carer to remain at the facility until nutritional recovery is attained. The distance to travel to access a TFP will influence uptake of services.

Even in countries where paediatric nutrition rehabilitation and/or HIV care programmes are reporting low mortality in nutritional rehabilitation programmes, if these children are only a small proportion of children with SAM nationally, then the
programme success is limited, as mortality among children with SAM at the population level may still be high. Programmatic success when treating a small proportion of children in need of care will not help progress toward national and international goals (for example the MDGs) in sub-Saharan Africa to reduce child mortality.

These problems of coverage can be improved through an integrated programme of facility and ‘Community-based Management of Severe Malnutrition (WHO, UNSCN, 2007). CMAM has increased coverage and service provision for SAM at the community level, including community-based case finding (Valid, 2006; WHO, UNSCN, 2007). This has increased the proportion of all children with SAM who are identified and treated (Collins, 2007; Collins, Dent, et al., 2006). Increased coverage and earlier identification of SAM has led to reduced morality in paediatric SAM (Collins, 2007; Collins, Dent, et al., 2006; Fergusson & Tomkins, 2008). As HIV-infected children are more likely to become malnourished, HIV testing in CMAM will also increase the proportion of HIV-infected children identified.

It is important to clarify that reduced mortality for HIV-infected children with SAM treated using the CMAM system is likely to be related to early identification of malnutrition, reduced opportunity of cross infection because of home treatment, and possibly improved maternal engagement with the CMAM programme because she is able to care for her child at home, without interrupting other aspects of her work, home and community life (Bandawe & Kabwazi, 2003; Collins, 2007; Guerrero, 2005).

In a 2006 literature review and meta-analysis the efficacy and effectiveness of community-based treatment of severe acute malnutrition used the criteria that to be effective programmes must report mortality of <5% and weight gain of at least 5g/kg/day. Thirty-three studies were examined and overall 33% of programmes were deemed effective. When a subgroup of 13 programmes reported since 1995 was analysed 62% were effective. Importantly, none of the programmes operating within an MOH system without external assistance by a non-governmental organisation (NGO) were effective. This has implications again when looking at attaining global goals of reducing mortality and improving survival. If nutritional rehabilitation
programmes cannot operate without the support of an international organisation, then their sustainability must be questioned. National scale up of programmes with adequate coverage which can be integrated into routine MOH care at the community and facility level are essential if improving survival among children with SAM at a population level is to work.

A 2008 meta-analysis of ten studies in both CMAM and NRU based nutritional rehabilitation programmes reported that HIV-infected children were significantly more likely to die than HIV-uninfected children (see figure 11); (30.4 per cent (346/1137) vs. 8.4 per cent (185/2190), p < .001) RR = 2.78 [CI = 2.03 – 3.82] (Fergusson, Tomkins, 2008).

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>HIV infected</th>
<th>HIV uninfected</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Weight</td>
</tr>
<tr>
<td>Amadi 2001</td>
<td>25</td>
<td>105</td>
<td>10</td>
</tr>
<tr>
<td>Bachou 2006</td>
<td>20</td>
<td>64</td>
<td>30</td>
</tr>
<tr>
<td>Bahwere 2007</td>
<td>4</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Chinkhumba 2008</td>
<td>28</td>
<td>79</td>
<td>39</td>
</tr>
<tr>
<td>Kerac 2007</td>
<td>106</td>
<td>355</td>
<td>25</td>
</tr>
<tr>
<td>Kessler 2000</td>
<td>33</td>
<td>86</td>
<td>37</td>
</tr>
<tr>
<td>Ndekha 2005</td>
<td>11</td>
<td>93</td>
<td>8</td>
</tr>
<tr>
<td>Sadler 2008</td>
<td>92</td>
<td>186</td>
<td>11</td>
</tr>
<tr>
<td>Sandige 2004</td>
<td>7</td>
<td>78</td>
<td>1</td>
</tr>
<tr>
<td>Ticklay 1997</td>
<td>20</td>
<td>68</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>346</strong></td>
<td><strong>1137</strong></td>
<td><strong>2190</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.15; Chi² = 25.62, df = 9 (P = 0.002); I² = 65%
Test for overall effect: Z = 6.32 (P < 0.00001)

**Figure 11: Forest plot mortality risk and HIV infection in SAM**

There were several issues affecting the heterogeneity and comparability of the data in this meta-analysis. Along with SAM, Chintu et al. (1998) and Amadi et al. (2001 & 2005) included the presence of chronic or acute diarrhoea as an entry criterion for their study. Sandige et al. (2004) and Ndekha et al. (2005) recruited children for community-based treatment of severe acute malnutrition after a period of hospital stabilisation. Mortality was not described during this stabilisation period. Sadler et al. (2008) tested children for HIV if there was a clinical indication. Thurstans et al. (2008) reported only on HIV prevalence and not on mortality. Different HIV testing methods were used in the studies. Bachou et al. (2006), Bahwere et al. (2997) and Chinkhumba et al. (2008) had access to PCR to confirm the HIV test results of
children <18 months of age. Although they did not have access to PCR, Ticklay et al. (1997) and Thurstans et al. (2008) excluded children <15 months of age to reduce the risk of false positive HIV ELISA tests due to the presence of maternal antibodies. Mgone et al. (1991) and Kurawige et al. (1993) reported on HIV prevalence in children >15 months separately from those <15 months.

Use of medication to treat HIV is potentially a confounding variable; however, the use of medication to treat HIV is not well reported in these studies. None of the studies report separately on outcomes for children taking cotrimoxazole. Antiretroviral therapy (ART) was available to children in only one of the studies, and the authors did not report mortality in those HIV-infected children on ART separately from those not on ART.

Another potentially confounding variable affecting all of the studies is the unknown number of children who died after admission to the nutritional rehabilitation programme but before they could be tested for HIV. It is likely that, due to the higher mortality overall among HIV-infected children, HIV infection might also be prevalent among those children who die soon after admission.

All of the children in each study (except Akenami et al., 1998) were recruited using convenience sampling of children presenting at hospital or community-based programmes for severe acute malnutrition rehabilitation, rather than active screening and recruitment at a community level. Akenami et al. (1998) used sampling from both hospitals and rural survey.

Although these issues with heterogeneity in the data exist the confidence interval describes a significant, positive relationship between HIV infection and mortality among children with SAM. A Mantel Haenszel chi square test confirmed that the data were heterogeneous ($\chi^2 = 23.97$, df = 8, $p = 0.002$). The inconsistency ($I^2$) was 67 per cent, which indicates that 67 per cent of the variability in the relative risk between the studies was due to heterogeneity. While it is true that the relative risk varied widely between the studies, when examining Figure 11 it is clear that all relative risks were above 1.5, and seven out of nine studies had relative risks above 2.0. This indicates that, while the size of the effect of HIV on mortality among children with
SAM cannot be determined conclusively by this review, the effect does exist, and is clinically significant (Fergusson & Tomkins, 2008).

Through examination of the findings of the meta-analysis, and also the consistent message from each individual study, it is clear that HIV infection increases the risk of mortality among children with SAM.

It is important that this thesis examines mortality because although HIV infection has been shown to increase the risk of mortality for children with SAM (Fergusson, 2008), few studies have been able to accurately determine HIV status in children less than fifteen months of age, or have been able to conduct a follow-up study after children achieve nutritional recovery. Furthermore, only one previous study has measured CD4 percentage among children with HIV and SAM (Bachou et al., 2006b); and, the impact of low CD4 percentage on mortality was not discussed by the authors. Finally this study is an example of an international NGO working in collaboration with MOH and CHAM staff to provide care, rather than an NGO operating an independent TFC, with a high input from international staff. This type of operational research is important to guide policy and practice.

1.9 Nutritional recovery
As discussed in the previous section, case fatality rates among children with SAM are often as high as 20 – 30 per cent (Schofield and Ashworth, 1996); particularly among children with SAM complicated by infection. HIV infection is common in children with SAM in sub-Saharan Africa; particularly in urban referral hospitals (Fergusson & Tomkins 2008), and HIV infection increases risk of mortality. Now that paediatric antiretrovirals (ARVs) are becoming increasingly available, it is important to develop a greater understanding of the impact of HIV on nutritional rehabilitation of SAM.

Few studies, however, have reported on nutritional recovery, survival and growth among children with SAM and HIV. Two studies in Malawi of children with SAM, treated as outpatients with ready to use therapeutic food, reported nutritional recovery. In the second study, 56 per cent (52/93) of HIV-infected children achieved nutritional recovery, defined as 100 per cent weight for height index (W/H) (Ndekha...
et al., 2005). This study, however, does not give a complete picture of nutritional recovery in HIV, as children were recruited after a period of hospital stabilisation where children were treated with antibiotics and for acute bacterial infections, and started on nutritional rehabilitation. Children were only randomised to their RUTF feeding regimen after “resolution of their infectious and metabolic complications” (Ndekha, et al., 2005). Mortality was not described by the authors during this period. The duration of hospital stay before discharge and entry into the study was approximately two weeks. As most of the inpatient mortality for children with SAM occurs during the first few days after admission, the mortality and recovery figures may be very misleading in this research.

Loss to follow-up is another important factor when evaluating recovery; this is especially important in a community-based nutritional rehabilitation programme. The outcome of the children lost to follow-up is unknown. In this study, mothers were expected to bring their children back to the NRU for follow-up, and defaulters were not traced at home. Eleven children of 93 were lost to follow-up before six weeks (11.8 per cent), and a further ten after six weeks (10.8 per cent). The Sphere Minimum Standards in Disaster Response state that a minimum of 75 per cent of children with SAM should recover in a nutritional rehabilitation programme, and there should be <15 per cent of children lost to follow-up (Sphere, 2004).

In the Ndekha et al. (2005) study 23 per cent of children were unaccounted for. Although the proportion of children who recovered (56 per cent) was quite low, the high loss to follow up makes this figure difficult to evaluate.

A final point to consider when evaluating the recovery reported in this study is that the target definition for recovery was 100 per cent weight for height. Most studies use 85 per cent weight for height as the definition of recovery from SAM, as this is equivalent to the discharge criteria recommended by WHO (WHO, 1999).

In a second study reporting on nutritional recovery (defined as achieving a weight for height z-score of > -0.5), 78 per cent (202/260) of children overall and 59 per cent (46/78) of HIV-infected children (Sandige et al., 2004) achieved nutritional recovery. Sandige et al. (2004) reported a significantly-slower weight gain in HIV-infected
children compared to uninfected children (3.6 ± 4.7 g/kg/day vs. 5.6 ± 4.0 g/kg/day, p < 0.001). This study also recruited children with severe acute malnutrition after a period of hospital stabilisation after resolving oedema and other complications. In addition children who were moderately malnourished with a weight for height z score of - 2SD were recruited (Sandige, Ndekha, Briend, Ashorn, & Manary, 2004).

Another issue to consider is that in the Sandige et al. (2004) study 30 per cent of the HIV-infected children fell into the category of death/relapse/failure to achieve target weight. While this is interesting data it would be much more useful to see this category broken down and to have the authors report how many children died, relapsed or failed to achieve target weight. In grouping this category important information about the outcome of nutritional rehabilitation is lost.

It is interesting to see relapse and failure to achieve target weight mentioned. In many research papers reporting on outcomes in nutritional rehabilitation programmes mortality is reported alone, and recovery is not reported. Recovery cannot be assumed for all children who do not die. For example, many children in nutritional rehabilitation programmes are transferred to the paediatric ward in the same, or a different facility if complications are developed. These children may be likely to die after the transfer, but their mortality is not counted within the programme statistics. This is an important reason to look not only at mortality, but also recovery statistics.

It is not possible to draw conclusions regarding nutritional recovery in children with SAM and HIV based on the available evidence. Further research is needed where children are enrolled at point of admission into a nutritional rehabilitation programme, and followed-up until an outcome can be determined. Standard definitions of nutritional recovery should be used to allow comparability between studies and application to future policy and programming.

1.10 Maternal nutritional and HIV status
High prevalence of HIV and an associated increased risk of mortality among children with SAM have led to increased integration of HIV testing and treatment services into nutritional rehabilitation in Malawi. Nutritional rehabilitation programmes are
becoming important entry points for paediatric HIV care. Little is known, however, about the prevalence and severity of HIV among carers of children with SAM. In most paediatric nutrition rehabilitation programmes, carers do not receive medical assessment and treatment.

As in other countries in southern Africa, the prevalence of HIV in Malawi among women of child-bearing age is high. In 2003, the National AIDS Commission of Malawi reported that 19.8 per cent (95 per cent CI 19.0 per cent to 20.7 per cent) of women attending antenatal clinics were HIV-infected (NAC, 2003).

Maternal health and wellbeing is an important determinant of child health and survival. The results of a longitudinal study of 10,000 mothers in Uganda showed that, in children born to an HIV-infected mother, the mother’s HIV status was a strong predictor of child mortality with a hazard ratio of 3.2, independent of the child’s HIV status. The authors concluded that programmes aimed at the welfare of children should take into account the independent effect of mothers’ HIV and vital status (Nakiyingi et al., 2003). Similarly, another study from Uganda showed high mortality among children of HIV-infected mothers; including a hazard ratio of 2.04 (P < 0.001) for child mortality if the mother had HIV and 3.78 (P < 0.001) if the infant was also infected (Brahmbhatt et al., 2006). In a cohort of 767 child mother pairs in Malawi, children of HIV-infected mothers had an increased risk of being severely underweight (RR = 2.0, CI 1.4 – 2.9) (Maleta, Virtanen, Espo, Kulmala, & Ashorn, 2003). Maternal short stature also increased risk of underweight, but the impact was not significant.

Moreover, there is growing evidence that poor maternal mental health may affect child growth and nutritional status (Rahman et al., 2002; Rahman et al., 2004; Rahman et al., 2007; Rahman et al., 2008). The ninth step in the WHO ‘ten steps’ approach is to ‘provide stimulation, play and loving care’ (WHO, 1999, 2003b). Psychosocial stimulation plays an important role in nutritional recovery and has been shown to improve growth and development (Nahar, et al., 2008). In nutritional rehabilitation programmes, in both inpatient and community level care mothers are usually the main caregivers. A mother who is malnourished, depressed and sick may not be able to provide adequate care for her child.
The HIV and nutritional status of mothers and other carers of children with SAM remains unknown. Nutritional rehabilitation programmes are an important entry point for HIV care, not only for a child with SAM, but also for that child’s family. Research is needed to determine nutritional and HIV status of mothers and other carers of children with SAM in order to inform programme planning to provide family HIV care through nutritional rehabilitation.

1.11 Quality of care

The UNICEF conceptual framework for malnutrition identifies food, health and care practices as key underlying causes of malnutrition. Care practices are under-explored factors in the literature on child survival in malnutrition. Caregiver perspectives, (including staff, as well as mothers and other carers) are critical to a better understanding of nutrition rehabilitation. As early as 1951, a study in two orphanages in post-war Germany showed that attentive and affectionate care by staff was a more important determinant of weight gain in children than additional rations (Widdowson, 1951). A 2008 study conducted in an NRU in Bangladesh established that psychosocial stimulation between carers and children significantly increased child growth and development (Nahar et al., 2008). Studies in programmes providing nutritional rehabilitation to children with SAM have demonstrated the importance of staff training, implementation of guidelines and staff commitment to providing quality care in reducing mortality among children with SAM (Deen et al., 2003; Ashworth et al., 2004).

Maternal health and wellbeing also have a powerful impact on child growth and survival. Maternal HIV infection has been shown to impact on incidences of premature birth and low birth weight, as well as on infant malnutrition and mortality (Halsey et al., 1990; Nakiyangi et al., 2003). There is also a growing body of evidence to show that poor maternal mental health negatively affects child growth and nutritional status (Rahman et al., 2002; Rahman et al., 2004; Rahman et al., 2007; Rahman et al., 2008). Maternal health is particularly important in nutritional rehabilitation, as staff-to-patient ratios are usually very low, and mothers and other carers provide most of the hands-on care for their children, including feeding.
The link between HIV and increased mortality in children with severe acute malnutrition is now well-established in the literature (Kessler et al., 2000; Bachou et al., 2006a; Chinkhumba et al., 2008; Sadler et al., 2008). However, it is recognised that social, operational and programmatic factors also have a dramatic impact on child survival in cases of severe acute malnutrition (Ashworth et al., 2004; Collins, 2007; Heikens et al., 2008a; Heikens et al., 2008b). There is little evidence available that has explored these factors and their impact on the quality of care in nutrition rehabilitation from the caregiver perspective in inpatient care. CMAM, however, has community engagement as one of its core elements (Guerrero, 2005). In a 2003 evaluation of CMAM in Dowa, Malawi, several key factors were explored regarding the impact of social and cultural factors on nutritional rehabilitation (Bandawe & Kabwazi, 2003).

Malnutrition is sometimes seen in Malawi as a medical condition, resulting from an illness or lack of food, but it is also commonly believed to have a spiritual origin. This is particularly true of oedematous malnutrition (kwashiorkor or swelling). Some people have recognised the correlation between abrupt weaning and swelling, and others believe that when children swell it means there has been infidelity in the family. Marasmus (low weight for height) is more commonly recognised as being linked to illness or lack of food.

This CMAM evaluation report stated that after the food shortage which occurred in 2001 in Malawi, there was a change in the way that families viewed hunger. When malnourished children received food supplementation families could see a dramatic change in their health status (Bandawe & Kabwazi, 2003). This caused a shift to more people recognising the link between food intake and expression of signs of malnutrition. This is an important link for community mobilisation regarding increasing coverage and uptake of services for treatment of SAM. Perceptions of malnutrition should be explored in both inpatient and community-based care as they provide the foundation for good understanding of, and commitment to, care.

The mother was recognised in the report as the person in the family who controls food resources and cooks for the whole family. However, most mothers said they did not know what to feed their children to prevent malnutrition, and that nutritionally
dense foods like milk, meat and eggs are not commonly found in villages, and are expensive. The report confirmed what is commonly observed in nutritional rehabilitation programmes; that mothers often abruptly wean their older child when they suspect they are pregnant again.

One of the most important sociocultural issues affecting quality of care for children with SAM as inpatients is the fact that the child’s mother or other carers must accompany the child to the NRU and remain there until the child is discharged. The decision to take the child to the NRU has a major impact on a mother’s work, home and community life. Mothers do not make this decision independently but must consult with the child’s father and possibly also village elders (Bandawe & Kabwazi, 2003). Fathers must fulfil the role of looking after other children at home while the mother is away with the malnourished child. Some mothers complain that the fathers lack the skills to fulfil this role, or that they do not look after the children because of drunkenness. Women also reported that being away in the NRU often caused marital conflict, and concerns over potential infidelity (Bandawe & Kabwazi, 2003).

Within the NRU, due to overcrowding and understaffing the majority of hands on care is provided by mothers. It is important to recognise the impact of socio cultural factors on the quality of care that children with SAM receive. In particular it is valuable to explore these issues in the context of high HIV prevalence. Further research is necessary to explore the perceptions and experiences of both health staff in the NRUs and also mothers. Although Malawi has adopted a national CMAM policy, children with complicated malnutrition are still treated as inpatients. Further qualitative research in the inpatient setting can build on findings at the community level and these findings can influence the design and implementation of nutritional rehabilitation programmes to improve quality of care.

Although there has been some success in recent years at lowering mortality among children with SAM being treated as inpatients through improved inpatient clinical management, many NRUs are continuing to report high mortality. When incidence of mortality exceeds the minimum international standards concerns over quality of care are raised. Some researchers believe that most of the mortality in nutritional rehabilitation is caused by health worker error, and that improving training and staff
commitment to nutritional rehabilitation would lead to dramatic reductions in mortality. While improving staff training and engagement is certainly an important part of reducing mortality some facilities are reporting high levels of resistant mortality even after introduction of WHO guidelines.

In some cases mortality in children with SAM may be related to complications and infections which are not resolved by following standard nutritional rehabilitation protocols. In Malawi, where prevalence of HIV is high, opportunistic infections in children with SAM may contribute to high mortality and poor recovery rates in NRUs.

This thesis will undertake to report on the impact of HIV on inpatient nutritional rehabilitation in Malawi. The most important objective of nutritional rehabilitation is to prevent morality in children with SAM. This thesis will explore the impact of HIV on mortality, including looking at the relationship between immune suppression (as measured by CD4%) and mortality. Along with preventing mortality, promoting recovery is also an essential aspect of nutritional rehabilitation. This thesis will report on nutritional recovery in HIV-infected and uninfected children, and compare their rates of weight gain. Mothers and other carers are also essential to achieving good quality of care for children with SAM. This thesis will report on nutritional and HIV status amongst mothers of children with SAM, and will explore the perceptions of mothers and health care staff on quality of care in nutritional rehabilitation in an HIV endemic setting.
1.12 Aim and objectives

Aim
To explore the impact of HIV on the treatment and care of children with severe acute malnutrition in Malawi.

Objectives
To investigate:

1. mortality and nutritional recovery in HIV-infected and uninfected children with SAM;
2. HIV infection and nutritional status in carers of children with SAM;
3. caregiver perspectives on quality of care for children with SAM.