

Community-based rehabilitation of severely malnourished children: a review of successful programmes

Ann Ashworth

**London School of Hygiene and Tropical Medicine
July 2001**

SUMMARY

Many hospitals discharge children before they reach 90% weight-for-height and there is evidence that many of these children remain malnourished and have repeated infections, or relapse and die. Any strategy to resolve the problems associated with early discharge must therefore support catch-up growth and improve immune function, and provide timely access to health care when infections arise.

The purpose of this review is to consider whether children, after initial hospital treatment for severe malnutrition, could be successfully discharged into the care of lower-level health facilities for continuing rehabilitation. The options examined were nutrition centres (12 studies), clinic-based programmes (6 studies), and programmes involving domiciliary visits (9 studies).

Only six of the twenty-seven programmes were considered successful, with weight gains of >5g/kg/day and low mortality. Of these, two were delivered through nutrition centres (Bangladesh, South Africa) and two through health clinics (Guinea Bissau, Malawi) and they fed children on site, providing at least 5 meals/day of a modified high-energy milk or high-energy modified family meals. Two domiciliary programmes were also considered successful (Tanzania, Bangladesh). Four of the six successful programmes received some form of external support and their sustainability could be questioned. Most successful programmes were of short duration (<5 weeks) and they made considerable efforts to teach mothers about child feeding and provided opportunities for mothers to practise preparing children's meals.

Three of the six programmes rehabilitated children without prior hospital treatment (Bangladesh, Guinea Bissau, Malawi) and two programmes were managed by the hospital even though rehabilitation took place in the community (Bangladesh, South Africa). Only in Tanzania were children treated in hospital and then discharged to a community-based facility for continuing care, and the referral system was considered weak. There is therefore little documented evidence of successful, robust systems for the back-referral of malnourished children for nutritional rehabilitation.

1. INTRODUCTION

1.1 Background

Over 50% of deaths in children aged 0-4 years are associated with malnutrition, and high priority is therefore given to its prevention and treatment. Regrettably, hospital treatment of severely malnourished children is often poor and outmoded and consequently case-fatality rates are high (1). To improve treatment and reduce mortality, the World Health Organization has published guidelines for the management of severe malnutrition in first referral facilities (2) and a manual (3). These activities form part of the WHO/UNICEF initiative of Integrated Management of Childhood Illness (4).

The treatment of severe malnutrition comprises a short stabilisation phase to treat life-threatening conditions and a longer rehabilitation phase to replenish wasted tissues. If a child is very ill on admission, the initial phase usually takes about one week. In the rehabilitation phase, if children receive appropriate dietary treatment, rapid weight gains (i.e. catch-up growth) can be achieved enabling severely wasted children to 'recover' in about 4-6 weeks. Children are considered to have recovered when they reach 90% of the median weight-for-height (-1SD) of the reference population of the National Center for Health Statistics (NCHS). Recovery of immune function, however, can take twice as long as nutritional recovery (5).

Many hospitals discharge children before they reach 90% weight-for-height. This might be because they a) have a bed shortage b) have budgetary constraints c) rely on clinical judgement of improved status rather than attained weight-for-height d) have high rates of nosocomial infection, e) are unsuccessful due to poor treatment practices. Early discharge also occurs in response to parental request, especially if the mother is required to remain in hospital throughout the child's stay.

The dangers associated with sending children home before they have recovered are:-

- they remain malnourished because their home diet is inadequate for catch-up growth
- their immune function remains impaired and they are prone to repeated infections
- continuing malnutrition and repeated infections lead to a high risk of relapse and death.

One example of this high risk is seen in a recent follow-up of Kenyan children who were discharged after having been treated in hospital for an average of 10 days. Within 1 month of discharge 24% had died, and a further 12% died within 18 months (6). Of the survivors, 44% remained malnourished. In Niger, among hospitalised children who were discharged at -2SD weight-for-height and traced 3-16 months later, 18% were found to have died and 28% of survivors were malnourished (7). The risk of dying was twice as high in children aged <18 months (32%) than in older children (15%).

Any strategy to resolve the problems associated with early discharge must therefore include:-

- a diet that will support catch-up growth and improve immune function
- timely access to health care when infections arise
- continuing care to assess progress, provide support, and take action when needed.

1.2 Referral back: an option for continuing care

The purpose of this review is to consider whether children, after initial hospital treatment for severe malnutrition, could be successfully discharged into the care of lower-level health facilities for continuing rehabilitation.

1.3 Terms of reference

- To review the literature regarding community-based nutrition rehabilitation delivered through nutrition centres, health clinics, or domiciliary visits, but excluding very controlled settings.
- To describe successful programmes and report staffing, effectiveness and sustainability.
- To make recommendations on how lower-level facilities could support, continue and/or complete the process of nutritional rehabilitation.

2. METHODS

Literature search: a combination of database searches and hand-searching was used. These included Medline, Popline, PubMed and BIDS (CAB Abstracts).

Measures of success: Since catch-up growth is the main aim of the rehabilitation phase, an acceptable rate of weight gain (>5g/kg/day) was taken as the main measure of success. Other indicators of success were low mortality (<5%) and low relapse/readmission rates (<10%) during the actual period of rehabilitation. Where longer-term mortality, relapse and growth data were available, these have also been examined.

Reporting the results: The findings are reported as follows:-

Section 3.1 reviews the literature pertaining to nutrition centres, both day-care and residential, and describes successful programmes. Nutrition centres situated within hospital compounds are excluded as these were considered not to fall within the terms of reference.

Section 3.2 presents the corresponding information for clinic-based rehabilitation. Most clinic-based programmes provide out-patient advice only, but some health clinics function as nutrition centres and these are included in this section as they operate within the context of a clinic.

Section 3.3 examines rehabilitation through home visits. Such programmes can be linked to health clinics, nutrition centres, or hospitals. Their distinguishing feature is that the service is delivered at home. Any programme that incorporated home visits is included in this section.

3. RESULTS

The findings from 27 studies are reviewed. On the whole, the quality of the studies is disappointing both from a methodological perspective and in their general presentation. In some studies the sample size is small and losses during the study period are often high. If children lost have higher mortality and relapse rates and poorer catch-up growth than those followed, then the reported results will be subject to bias. Few authors report rates of weight gain (g/kg/day) and for the most part I have calculated these from other data given. In many studies, percent weight-for-age is used for classifying the severity of malnutrition and impact of treatment, but this measure is of limited value as low weight-for-age can coexist with normal weight-for-height, and rapid catch-up growth is only possible for children with a deficit in weight-for-height. On the few occasions where readmission rates are reported, it is rarely possible to distinguish readmissions for malnutrition from those for dehydration etc. Few authors provide details of the programme or services offered, staffing levels or child attendance. Few report costs.

3.1 Nutrition centres

The description 'nutrition centre' covers a wide-range of facilities from simple village huts staffed by local women to spacious purpose-built, fully-equipped units with nursing and medical staff. Their common feature is that they all provide meals for children to eat on site. Some large, specialised 'nutrition centres' function as referral hospitals and these are not included in this review.

3.1.1 Early studies of nutrition centres (pre-1980)

Nutrition rehabilitation centres (NRCs) were first proposed by Bengoa in 1955 (8,9). He perceived a centre as a simple construction in the community where up to 30 mild or moderately malnourished children would attend for 6-8 hours/day, 6 days/week and receive 3 meals for about 3-4 months. Mothers would help cook and clean on a voluntary basis and learn about good feeding practices and childcare. Where such participation was not possible, mothers would have a weekly meeting with the

supervisor at which practical demonstrations would be given. The dual aims were to correct children's weight deficits and to teach mothers. Bengoa gave high priority to teaching mothers about child feeding and health care as his long-term aim was prevention of malnutrition. The duration of 3-4 months was based on the time needed for mothers to learn, rather than on the time needed to rehabilitate children.

Day-care NRCs were considered impractical and inappropriate for sparsely populated rural areas where distance would preclude daily attendance. For these situations, residential NRCs were advocated. Residential NRCs were also considered suitable for severely malnourished children whose medical complications had been successfully treated in hospital but were not recovered in terms of their weight. The result of this dual target population was that nutrition centres often cared for mild, moderate and severe cases. In terms of staffing, Bengoa considered that a public health or auxiliary nurse could take charge, provided there was general supervision from a doctor and a nutritionist or dietitian.

NRCs were particularly popular in the 1960s and 1970s and the performance of these early NRCs has been reviewed previously (10-12) and so will not be repeated here. In general, the conclusions were that NRCs had low mortality and a favourable effect on the growth of malnourished children while they attended the centre, but this was rarely sustained once they left. Possible reasons for the latter were that a) more attention was given by staff to feeding and caring for children than to educating mothers, b) the advice to mothers was unrealistic with too much stress on provision of meat, fish and eggs, c) abject poverty constrained some families' ability to alter their feeding practices, d) the child's carer at home was not the person who attended the centre e) fathers were not involved yet they were influential in resource allocation and families' eating habits.

Although 70-80% of children attending well-operated NRCs showed catch-up growth, the actual rates of recovery were slow, primarily due to low energy intakes (12). This is exemplified in Tanzania where, during a 14-month rehabilitation period, energy intakes averaged 82kcal/kg/day and mean weight-for-height only increased from 77% to 81% (13). In many centres poor supervision was a further factor and lack of on-site medical staff meant that treatment for children who became ill was often delayed, leading to loss of weight (12). In urban NRCs, child attendance tended to be more erratic and mothers' participation more difficult to achieve than in rural centres. This was attributed to a greater proportion of urban mothers working for a wage and the greater mobility of urban families (11). Typically the mean change in weight-for-age during 4 months' rehabilitation was a modest 4-5% (10).

3.1.2 Studies of nutrition centres since 1980

Table 1 summarises twelve studies (14-26) divided into day-care nutrition centres and residential nutrition centres. In each section the studies are listed chronologically. Two were considered successful (18,24) and are described in section 3.1.3.

Day-care nutrition centres: Seven studies describing the performance of day-care rehabilitation centres were located (14-20) but only the programme in Niger (19) simulates the situation of interest in this review, namely treatment of children referred from hospital to a lower-level facility for continuing rehabilitation. In this study, children with moderate or severe malnutrition were treated in the National Hospital in Niamey and, after resolution of diarrhoea, dehydration or other acute condition, were randomly referred to one of eleven local day-care nutrition centres or to an inpatient section of the hospital reserved for malnourished children. The median duration of inpatient stay before randomisation was 7 days. Inpatients were looked after by a nurse and received three meals/day, and a doctor made rounds each morning. The local day-care rehabilitation centres typically had nursing staff but no doctor, and mothers came early in the morning with their children and prepared a meal with food partly provided by the centre and partly by themselves. At some centres the children left at the end of the morning and in some they stayed for lunch. Education sessions were held in both types of location. In the first two weeks of treatment, mortality was ~12% for children sent to the day-care centres and ~24% for those who remained as inpatients. After discharge further deaths occurred, bringing the total deaths in the 6 months from the start of rehabilitation to 41% among inpatients and 33% among day-care children. Thus neither location could be considered to provide successful treatment either in the short or longer term.

Although the other day-care centres in Table 1 had lower mortality than in Niger, their rates of weight gain were disappointing, and only the programme in Bangladesh approaches success (18) and this is described in section 3.1.3. Three programmes provided 3-5 meals daily for 6 days/week (14,16,18) and one provided just one meal/week (15). Most provided maternal education and most expected mothers or carers to attend for extended periods, the median being 3 months. Some children attended intermittently or discontinued and in the four studies with data (16-18, 20), the median drop-out rate was 15%.

Residential nutrition centres: Five studies were located (21-26) and are summarised in Table 1. The duration of treatment was shorter than for day-care centres, with a median of 5 weeks. Mortality tended to be lower in residential centres compared with day-care nutrition centres (median 4% vs 10%) and rates of weight gain appeared more rapid. Information regarding discontinuation is limited to centres in the Philippines and India, and their rates were higher than any reported for day-care centres. In rural centres in the Philippines, 24% absconded or were discharged against medical advice (21) and in India 27% were discharged within two weeks because their mothers did not want to stay (23).

The only study that reports low mortality and acceptable rates of weight gain is from South Africa (24,25). This centre also fits the description of a facility receiving cases of severe malnutrition for rehabilitation after initial treatment in hospital and is described in the following section.

3.1.3 Successful nutrition centre-based programmes

The successful rehabilitation centres are notable in specifically reporting their dietary management, giving details of menus, recipes and meal frequency, indicating an awareness of the vital role nutrition plays in rehabilitation. Emphasis is given to providing high energy, high protein intakes to achieve rapid catch-up growth. Their approach to teaching mothers is holistic and there is emphasis on providing opportunities for mothers to learn by practising what they are taught.

a) Day-care, Bangladesh (18). Two nutrition centres in Dhaka for treating uncomplicated non-oedematous malnutrition were the focus of this study. The centres had been developed in the city's poorest areas in collaboration with local community nutrition councils who had donated the facilities and were responsible for their maintenance. The centres were open for 8h/day and staffed by urban volunteers who received 2 months' additional training and supervision through the Urban Health Extension Programme (UHEP) of the International Centre for Diarrhoeal Disease Research. The UHEP provided personnel, food and technical support. Each centre had 5 volunteers and a capacity of 25 children, giving a staff:patient ratio of 1:5. Each volunteer had been trained for specific duties. A physician visited weekly and supervised the programme.

Children were given a high dose of vitamin A and immunised at admission, and given antibiotics if signs of infection were present. Three meals and two snacks were fed daily prepared from low cost, energy-dense, locally available foods using recipes that had been tested for acceptability and ease of preparation. Health education included causes and prevention of malnutrition, prevention and treatment of diarrhoea, immunisation, family planning, hygiene and childcare. Mothers actively participated in meal preparation.

The mean weight-for-height of those who completed treatment increased from 73% to 83% in 4 weeks. This is consistent with a rate of weight gain of ~5g/kg/day. Mortality is not specifically mentioned, but one can reasonably infer that there were no deaths. Some 12% of children failed to complete treatment, the main reason being that daily centre attendance by mothers caused loss of wages and became an economic burden. Female children attended less frequently than boys, suggesting that more inconvenience may be tolerated for the benefit of male children than for girls.

In an earlier study (16), the education programme is described in more detail. Each lesson was pre-tested for interest and comprehension by mothers, and ease of presentation by staff. Informal participatory techniques were used including storytelling, role plays, discussions, pictures and participant demonstrations. A demonstration garden was maintained. The mean rate of weight gain was 3.3g/kg/day and lower than in the study described above, probably because children were less wasted.

The centres in this programme received malnourished children from the community, either by referral from clinics or from surveillance surveys. In theory, these centres would also seem suitable to rehabilitate severely malnourished children after initial hospital treatment. The reality, however, was that the community nutrition councils found it difficult to provide for maintenance, repair and security of the centres and volunteer community participation without external funding. The sustainability of a community-resourced programme is thus questionable.

b) Residential, South Africa (24,25). The Gold Fields nutrition centre, 30km from Pretoria and linked to the Medical University of Southern Africa, was established in 1986 in response to the continuing high prevalence of malnutrition in the district. It also provided the University's community health care services. Children were only admitted to the centre if serious complications had been treated and their condition was stable. Of those admitted, 81% had first been treated for an average of 10 days in hospital. Whenever possible children and carers resided at the centre, otherwise they attended on a daily basis. The rehabilitation diet was based on low cost family foods and was high in energy and protein. The children were fed 6 times a day. Emphasis was given to carers practising feeding their children and this was achieved in a supportive and caring environment. To help overcome the problem of poverty, mothers were taught to make the most of what they had at home and enhance self-sufficiency by increasing garden productivity, raising small livestock and planting fruit trees. Income-generating skills, such as needlework, knitting and childminding, were taught, as was child-spacing. Teaching aids included posters, flip charts, videos, songs and role plays. During their stay, carers' attachment to their children increased, as did their awareness of their children's emotional needs. Staffing was multidisciplinary and, from the range of activities provided and the individual support given to carers, it is reasonable to assume that staffing levels were good.

Mean weight-for-height at admission to the centre was 85% and this increased to 89% after an average stay of 10 days. The mean weight gain was 42g/day (~6g/kg/day). Children were discharged when weight gain was good and the carer could demonstrate that she was able to put into practice what she had been taught. In cases of extreme need, carers at discharge were given skim milk powder or peanut butter, and micronutrient supplements. All were given a growth chart. At follow-up, 80% could produce the card and 69% had attended a clinic or the centre for checking progress. The mean weight-for-height was 99% at follow up, which on average was 12 months after discharge, but 18% had deteriorated.

At follow-up, 74% of carers remembered the advice to add peanut butter, fat or sugar to the child's cereal, and 74% had implemented this advice. Although 51% remembered advice about frequent meals, only 26% followed it. Only 19% remembered the advice on hygiene. What the carer remembered or implemented, however, appeared to bear little relation to the child's nutritional status at follow-up. There was an increase of about 10% in the families who kept poultry and animals for milk, and 20% had vegetable gardens compared with 7% at admission. Some 60% of

carers told neighbours what they had learned at the centre. In 1989, two satellite nutrition clinics were opened as part of local clinic services, one functioning as a day-care centre and the other as a weekly nutrition clinic, two of the aims being to manage patients at home whenever possible and provide follow-up care.

3.2 Clinic-based rehabilitation

Table 2 summarises six studies of clinic-based treatment, four of which provided advice to carers on an outpatient basis (27-30). Of these four, none was convincingly successful. In the programme in Pakistan (30), although the authors reported success, the weight gains are difficult to evaluate and 22% discontinued.

Two successful programmes in terms of rates of weight gain are those in Guinea Bissau (31) and Malawi (32). Case-fatality was <5% in Guinea Bissau and 7.5% in Malawi. In Malawi, all the children were oedematous and would normally be considered in need of referral to hospital for medical care. For the purpose of this review, we can assume that oedematous children being treated in hospital would only be discharged to clinic-based care if their oedema had resolved (2). In Malawi, resolution of oedema took 10 days on average. Thus, if we exclude deaths in the first 10 days of this study as reflecting deaths in the initial treatment phase, the case-fatality rate for clinic-based rehabilitation in Malawi falls from 7.5% to 3.7%. In the context of this review, it is therefore reasonable to conclude that both these programmes meet the criteria of success, and they are described below in section 3.2.1.

3.2.1. Successful clinic-based rehabilitation programmes

The approaches to treatment in the two successful programmes are interesting in that both involved a) establishing rehabilitation centres within rural clinics and b) implementation, at least in part, of the WHO dietary guidelines.

a) Day-care clinic, Guinea Bissau (31). This evaluation was in Gabu region where a health technician and nurse visited villages every 3-4 months. In 1987, nutrition rehabilitation centres were created inside two health centres and a third was set up in a district hospital. The centres were staffed by government auxiliary nurses with no medical supervision. If a severely malnourished child (<60% weight-for-age) was found in a village and there was a space at the clinic, then the nurse met with the family and close relatives in the presence of the village health committee. This usually helped the family take a decision to attend the rehabilitation centre at the clinic. Since this was a day-care centre, mothers from outlying districts had to find overnight lodgings for themselves and child.

The nurses had 2 years' general training and 2 weeks' specific training on malnutrition and rehabilitation. Most children received antibiotics for 5 days and the

rehabilitation diet in the centre was 3-4 milk-based feeds/day. Additional feeds were taken home or to the lodgings. The World Food Programme provided dried skimmed milk and oil, and some of the sugar and rice. Families provided millet flour, rice, honey, cooking utensils, fuel for cooking (charcoal) and bed linen. Little information is given about the content of the education programme. Nurses spent 2-4h each day in the centre and the rest of their time was spent in other health centre activities.

The mean duration of rehabilitation was 13 weeks and the mean weight gain was 37g/day. From other data presented I estimate the rate of weight gain to be ~6g/kg/day. The mean weight-for-age SD score improved from -4.52 to -2.76 during the 13 weeks' rehabilitation. Mortality during treatment was 4.8% and few deaths occurred within 48h. About half the late deaths were from AIDS, tuberculosis and cerebral malaria. For malnourished children who could not be accommodated in the clinic, 21.5% died within 30 months, compared to 15.8% for children treated at the clinic (RR 0.75, 95%CI 0.57-0.99). Post-discharge relapse to severe malnutrition among treated children was 1.4%.

Compliance from families was excellent and only 3% absconded despite the long period of rehabilitation. This was attributed, at least in part, to the initial village discussions and active community participation in the establishment and monitoring of the overall health care programme. These discussions, however, might also have led to self-selection bias by which only those who felt able to attend for 13 weeks actually enrolled.

b) Residential clinic, Malawi (32). The clinic-based component of this study was in three typical rural clinics in southern Malawi. All had inpatient facilities and the mean stay was 19 days. The children were cared for by a nurse, with supervisory visits by a paediatrician every 2-4 weeks. Oral rehydration and intravenous fluids were used cautiously to avoid excess sodium and fluid loads. All children received antibiotics and a milk-based diet comprising a starter formula (66kcal and 1g protein/100ml) and then a catch-up formula (114kcal and 4.1g protein/100ml) and enriched porridge (maize, soy, sugar and oil) when appetite and oedema improved. The ingredients came as a premix from the World Food Programme. Six feeds/24h were given and the target energy intakes in the stabilisation and rehabilitation phases were 79 and 170kcal/kg/day, respectively. Electrolyte imbalances and micronutrient deficiencies were corrected by Nutriset's Combined Mineral Vitamin (CMV) mix, but only during half the study period.

On average, children at admission were aged 29 months with a weight-for-height SD score of -1.7 after loss of oedema. Mean weight gain from admission was 6.4g/kg/day. Since all the children were losing oedema during this time, the true rate of tissue accretion is likely to be twice this rate. The provision of CMV was associated with lower mortality and faster rates of weight gain (6.1 vs 4.7g/kg/day) in the study overall. The authors reported a striking improvement in anorexia and irritability with the introduction of CMV. The proportion of children who left the facility without approval was 10%.

3.3 Rehabilitation with home visits

Nine studies were located and these are summarised in **Table 3**. Three programmes provided community-based care for cases of severe malnutrition after initial treatment in hospital (38,41,42), but monitoring of these programmes still remained largely with the referral hospital. Only two approached the criteria of success set for this review. The domiciliary programme in Bangladesh (42-45) came closest to meeting the criteria, with a low case fatality rate (3.5%), no relapses, and a mean weight gain from admission of 4g/kg/day. Since 98% had oedema which took 21 days on average to resolve, the true rate of tissue accretion may have exceeded 5g/kg/day. The Tanzanian programme (38) had a mortality of 8% but this was over a 6-36m period and case-fatality could have been <5% in the shorter term. Relapses were 13% during this 6-36m period. These programmes are described in section 3.3.1, as they might have met the criteria of success set for this review if the analyses had been confined to the oedema-free rehabilitation period.

The Jamaican programme of early discharge and continuing community-based care (41) was unsuccessful despite provision of a catch-up formula. In this randomised trial, after treatment of infections, loss of oedema, return of appetite, and weight gain of at least 5g/kg/day for 3 consecutive days, children either remained in hospital or were discharged early. The latter received weekly home visits from community health aides who delivered a supply of catch-up milk formula with a composition of 134kcal and 3.5g protein/100ml if correctly reconstituted. A measuring cup was provided. The health aides also provided multivitamins and folic acid, and advice on breastfeeding and weaning according to Ministry of Health guidelines. The catch-up milk (590ml) was intended as a supplement to the child's usual intake. The mother was expected to double the child's usual fluid intake. Whether this was achieved is unclear. Experience elsewhere is that food intended as a supplement often replaces the usual diet, in which case the net increase in energy intake can be small.

3.3.1. Home visiting programmes that were assumed successful

a) Home visits, Tanzania (38). The initial phase of treatment in this programme was at Mbozi hospital, which is in the south western highlands. The hospital had a 20-bedded wing for severely malnourished children adjacent to the paediatric ward and was run by 2 nursing assistants, aided by medical staff when emergency treatment was needed. Medical and dietary management was kept simple so as to be manageable by the limited staff. Measles vaccination, a high dose of vitamin A on admission, daily mineral and vitamin supplements, antibiotics if infection was suspected, and 5-6 milk-based feeds (100kcal/100ml) were provided. Family foods prepared by mothers were introduced after a few days.

Staff involved in educational activities had to master the local dialects and show empathy and respect for the mothers' own views. During their hospital stay, mothers participated in daily discussions on topics related to health and nutrition, and were actively involved in cooking and gardening. Continuing evaluation was used as a tool for training and motivation of hospital staff.

Children, 70% of whom were oedematous at admission to hospital, were referred back for community care as soon as they lost oedema, were free of infection, had good appetite and had started to gain weight. On average they were discharged after 19 days as inpatients. The case-fatality rate among inpatients was 9%, and 17% absconded. At discharge, each child received two notes, one for the health worker and one for the 'ten-cell' leader with a request to help with the follow-up. After 12m, 28% of children had not been registered, either because carers had not handed over their referral notes or because they had absconded from hospital. Of those who were registered at MCH clinics, 76% were seen more or less regularly and/or visited at home. Of those discharged from hospital, 8% died 6-36 months later and 13% relapsed and had to be readmitted. The percentage >90% weight-for-height increased during the follow-up period from 36% to 86%. Of those who absconded, 41% died.

The overall programme aimed to provide information and feedback to village and district leaders to help promote community participation and action. As a result, women's groups and church leaders regularly organised meetings and seminars in their villages, including child health and nutrition topics, and developed projects to promote vegetable gardens and orchards. Primary school teachers organised simple nutrition surveys using pupils to help collect information. Training for teachers, refresher training for health workers, and supervision of follow-up by doctors from the hospital, helped to build trust and respect. Efforts were made to avoid being dismissive and critical of traditional healers as this caused discomfort to villagers and could deter them from attending hospitals and clinics. Steps were therefore taken in this programme for open-mindedness, exchange of knowledge and mutual respect.

The author concluded that dedicated and innovative persons can be found everywhere in local communities, and that the most constructive role that 'involved outsiders' can play is to catalyse and support local initiatives. She considered, however, that relying on mothers or others to transmit messages was a weakness of this referral system.

b) Home visits, Bangladesh (42-45). The Children's Nutrition Unit in Dhaka was established in 1975 as a referral centre for severe malnutrition. It had 60 inpatient beds and day-care facilities for another 40 children, and was largely financed by Save the Children Fund, UK. Admission criteria to the Unit were weight-for-height <60% of the NCHS reference median and/or oedema. Admissions were ~1300/year and 20,000 less severe cases were treated annually as outpatients. Staff comprised 12 nurses for the inpatients and 1 nurse and 2 auxiliaries for the day-care patients, and 7 doctors covering both inpatients and the day-care patients, giving a

staff:patient ratio of 1:5. All children received broad-spectrum antibiotics on admission with appropriate adjustments once the results of laboratory investigations became known. Potassium, magnesium and micronutrients were provided whilst at the Unit. Iron was withheld in the stabilisation phase. A cautious approach to feeding was followed initially, with emphasis on small, frequent feeds. After stabilisation, high intakes of energy and nutrients were provided to promote rapid catch-up growth.

In 1990, a home-visiting service was introduced and a randomised trial was undertaken to compare the cost-effectiveness to reach 80% weight-for-height of three approaches to treatment. These were i) inpatient care throughout, ii) day-care throughout, and iii) day-care for one week followed by weekly home visits for one month or until oedema disappeared, and then fortnightly visits. Multivitamins and ferrous sulphate were provided for those home-visited. None of the groups received zinc. The time and costs to attain 80% weight-for-height were compared. The institutional costs taken into consideration were capital costs and operational costs. The latter included salaries, utilities, laboratory tests, medical supplies and food. Parental costs included wage loss, transport and child's food at home.

Whilst at the Unit, mothers or carers received 20 minutes structured instruction each day on topics relevant to child feeding, disease prevention and family planning. They also participated in cooking demonstrations and actual practice of meal preparation. The domiciliary group received additional instruction during their week at the Unit, particularly what to feed, how much, and how often. The bowl and cup used in the practice sessions were given for the child to take home.

Mortality in the domiciliary group was 3.5% and the median time taken to reach 80% weight-for-height was 35 days, in contrast to 21 days and 18 days respectively for the day-care and inpatient groups. The rate of weight gain in the domiciliary group averaged 4g/kg/day, compared with 6g/kg/day for day-care and 11g/kg/day for inpatients. Infection, poor appetite and non-adherence to the dietary advice adversely affected weight gains at home. Infections were reported in 38% of study weeks. The authors concluded that better weight gains and improved resistance to infection might have been achieved if children sent home early had continued to receive potassium and magnesium, and if all children had been given zinc. Financial constraint was the main reason for not feeding the prescribed amounts, or the prescribed feeding frequency at home.

Despite slower rates of weight gain, the most cost-effective treatment was domiciliary care with one week prior day-care. In this group, the institutional cost to achieve 80% weight-for-height was half the cost of day-care and one-fifth the cost of inpatient treatment. Parental costs were substantially higher for domiciliary care than for other treatments, but nevertheless parents preferred this approach despite their poverty. Day-care was the least liked option and had a 17% discontinuation rate. Neighbours took an interest in the home visits and appeared to assimilate the advice being given to the target child's family, suggesting that domiciliary care may have wider impact due to a 'ripple effect'.

A trusting relation with the designated home visitor was established during the week of day care which created an unbroken chain of support and interaction. The domiciliary home visitors were very motivated and carefully selected and trained. They gave feasible advice and understood the importance of being sympathetic and supportive rather than castigating, and to involve fathers and grandparents in decision-making. Including older members helped to break taboos which might otherwise have impeded treatment. The home visitors were trained to weigh and examine children and differentiate minor from major illnesses so they could refer back when necessary.

The children were followed for 12 months after reaching 80% weight-for-height. During this time, 1.5% of the domiciliary group died and none relapsed. The mean weight-for-height increased to 91%. Morbidity was high, particularly diarrhoea and pneumonia, indicating a need for continuing medical support through accessible facilities. Following the trial, early discharge with home visits became a routine service at the Children's Nutrition Unit. Parents were offered a choice of inpatient, day-care or domiciliary care. Mothers of recovered children also acted as informal peer counsellors to give help and encouragement to other mothers rehabilitating their children at home.

3.4. Effectiveness, sustainability and staffing

Four 'successful' programmes were found based on the criteria that were set for this review, namely mortality <5%, relapse <10% and weight gain >5g/kg/day. Two were delivered through nutrition centres (Bangladesh day-care and South Africa residential) and two through health clinics (Guinea Bissau and Malawi). They share several features:

- all fed children on site, and provided at least 5 meals/day
- all provided a modified high-energy milk or high-energy modified family meals
- all were aware of the basic principles of treatment
- most made considerable efforts to teach mothers about child feeding and used a variety of teaching methods
- most provided opportunities for mothers to practise preparing children's meals
- most were <4 weeks' duration
- most had an integrated approach which addressed social, economic and health needs.

Three of the four had external support and their sustainability could therefore be questioned. In the programme in Bangladesh, the support comprised UHEP personnel, food and technical assistance. In Guinea Bissau and Malawi, the clinics received food via the World Food Programme and in addition Malawi received CMV from Nutriset. The Gold Fields programme in South Africa appears more self-sufficient, utilising local low-cost foods and modifying them to meet the nutritional needs for catch-up growth. The Unit is linked to the Department of Family Practice of

the Medical University of Southern Africa, which may have better access to resources than rural district hospitals.

Two further programmes, in Tanzania and Bangladesh, were assumed successful. These provided domiciliary visits. Tanzania has a strong rural health care network of which the ten-cell-leaders are an important part. In the programme described in section 3.3.1, ten-cell-leaders and health workers worked closely together, following-up children after early discharge, monitoring progress and encouraging adherence. Nevertheless, limitations of the system have been reported, including lack of systematic follow-up and home visits by many of the health workers (38). In Bangladesh, the home-visiting programme was more cost-effective than day-care or inpatient treatment (42-45). Rates of weight gain were slowest among the home-visited children but they recovered with no increased risk of mortality either during the rehabilitation period or in the following 12 months. It is possible that rates of weight gain would have been enhanced from the mean of 4g/kg/day if zinc, potassium and magnesium had been provided at home. Provision of zinc could also improve immune function. The home visitors were employed by the Children's Nutrition Unit and this is likely to lead to greater accountability than if the follow-up is divested to a lower facility.

Programmes that rely on clinic-based advice may be the most sustainable, but weight gains were slow and little evidence was found of success as defined in this review. In Indonesia, mortality was 17% with clinic-based treatment (27).

Little information is provided about staff:patient ratios in the papers reviewed, but it would seem that some successful programmes operate with few staff (31,32,38). Cost-effectiveness was rarely studied, the notable exception being the randomised trial in Bangladesh (42), which is discussed above in section 3.3.1. The policy at the Children's Nutrition Unit was to discharge patients at 80% weight-for-height and the aim of the cost-effectiveness comparisons was to examine alternative ways of reaching this target. It must be remembered that for health services whose hospitals currently discharge early, any continuing rehabilitation in the community is likely to be an additional expense, as it will be a new activity.

Some programmes were following basic principles of treatment yet appeared unsuccessful (34-37,39). Possible reasons for their poor performance are discussed in section 3.5.

3.5 Poorly performing centres

The definition of poor performance in this review was mortality >5%, or relapse rate of >10%, or a rate of weight gain <5g/kg/day, during the rehabilitation period. These criteria work well if they are applied to the specific period of rehabilitation. They are less satisfactory for studies where progress is assessed after several months as it is not possible to separate what might be reasonably considered 'rehabilitation' from 'follow-up'. Rapid weight gains only occur when children have a weight-for-height

deficit. When children approach a normal weight-for-height, their rates of weight gain fall to 1-2g/kg/day. A low rate of weight gain derived over a long period may thus mask a good rate of weight gain during rehabilitation. Also the longer the study period, the more chance the child has to relapse or die. Caution is therefore needed when attempting to interpret studies where progress is assessed after actual treatment has ended.

Poor performance is not in doubt in many of the studies reviewed. There are three main reasons for poor rates of weight gain. These are:-

- low energy density of the rehabilitation diet
- too few meals
- children are not wasted

There is a notable dearth of information about how children were fed in many of the programmes that were unsuccessful. One must assume that this omission reflects a failure to recognise that the malnourished child has special nutritional needs and that if children are to be rehabilitated with family meals these must be modified to increase their energy and nutrient density.

Some programmes, however, performed poorly despite promoting energy-dense diets (34-37,39). These were all domiciliary programmes and two provided the ingredients for a high-energy milk (36,39). One of these was in Trinidad and provided a milk/sugar mix which mothers were to mix with oil, and then mix with water (36). The authors do not comment on the reasons for low weight gain, but it is possible that the oil, which was also provided, was not used for the intended purpose. Without the addition of oil, the mix would be ineffective. Mothers often need considerable persuasion to add oil to children's feeds, fearing diarrhoea. In Jamaica (39), the high-energy milk was intended as a supplement but may have served as a replacement, losing its effectiveness. Provision of free food for feeding malnourished children at home was ineffective in Kenya as the special feeding of one child in a family was against traditional beliefs (34,35). Why the South African domiciliary study was not successful is unclear, but high rates of diarrhoeal illness and other intercurrent infections may have contributed (37). The authors concluded that dietary advice alone was insufficient and that other health measures were needed.

In some poorly performing centres, the need for frequent feeds was overlooked. Provision of three meals is insufficient for rapid growth and probably accounts, at least in part, for the slow weight gain in some centres (14,19). Because a child's stomach has a relatively small capacity, frequent feeds are important to maximise energy intakes during the rehabilitation phase. In some poorly performing centres, the feasibility of the advice was also questionable.

Poor performance associated with the attempted rehabilitation of children who are not wasted is largely due to the use of Gomez grades (low weight-for-age) as entry criteria. If children are low weight-for-age because they are stunted, they will take a long time to improve. In some studies, for example in Zaire (14) and Brazil (20), a

considerable proportion of the children were already >80% weight-for-height at entry to the programme. This means that if children were to have a good rate of weight gain initially, it will be of short duration as they will quickly attain a normal weight-for-height and then rapid weight gain will cease. If they remain in the programme, any early rapid gain will be masked by slow gains later. In Brazil, children were kept in the programme for 8 months on average, in the misguided expectation of reaching Gomez grade I. This led to considerable waste of resources and disillusionment of staff who were unaware that the children's low Gomez grades were due to stunting.

4. DISCUSSION

There is clear evidence that early discharge from hospital without continuity of adequate care is a death sentence for many children (6,7,19,46,47). Hospitals with a policy of early discharge and no system of follow-up are usually unaware of high post-discharge mortality. Failure of children to appear at outpatient clinics is easily misinterpreted as parental indifference and irresponsibility, rather than to the death of the children. Early discharge should therefore only be considered if there is adequate referral for effective community-based care.

Of the 27 community-based programmes included in the review, only four were considered successful on the basis of pre-set criteria and two others were assumed successful. Poor performance has thus been a common experience among facilities attempting to rehabilitate malnourished children outside hospital. The main problem is slow rates of weight gain and this is due to inappropriate feeding. Of the successful programmes, only in Tanzania were children treated in hospital and then discharged to an independently managed, community-based facility for continuing care (38). The referral system depended on the carer giving the local health worker and ten-cell-leader a note from the hospital and this was reported as a weak system. The other programmes either had no prior hospital treatment (18,31,32) or the initial treatment centre also provided the community-based programme (24,42). Thus there is little documented experience of functioning systems of referral in which malnourished children have been discharged from hospital to lower level facilities for community-based care, and no examples of reliable systems.

One of the striking impressions about the successful programmes is their energy, empathy and commitment. Most of the successful programmes went beyond the narrow confines of rehabilitation and addressed the wider social, economic and health issues that face poor families. Most had structured programmes for teaching mothers and carers about child feeding and health promotion. Some included home gardening, small livestock production, and income generation. Most required mothers to practise what they learned. Various teaching methods were used within any given programme, and instruction was provided daily. For success, these activities require motivated staff with an aptitude for working with poor families.

All three delivery systems (nutrition centres, clinics and home visits) featured among the successful programmes, indicating that any delivery system can achieve rehabilitation provided it meets the nutritional goals for catch-up growth. It is unlikely that a single system will be applicable for all situations worldwide. Some options may be better suited to urban families than to scattered rural populations, or to mothers working for a wage than to those at home. For successful rehabilitation after early discharge, the system chosen should satisfy the two following conditions:-

- **Achieve dietary intakes that will promote catch-up growth and improve immune function.**

The main feature of the successful programmes identified in this review is their clear focus on achieving high energy and protein intakes through the frequent feeding of modified diets, and provision of potassium, magnesium, zinc and multivitamins. If one considers the nutritional requirements for catch-up growth, this emphasis is to be expected. Intakes of at least 150kcal and 4g protein/kg/day are prerequisites for rapid weight gain. This requires diets with an energy density of at least 100kcal/100g and 11% of the energy from protein. Such diets can be formulated from milk, sugar and oil, or from local food mixtures. Milk-based diets are advantageous and promote better rates of weight gain and improved intestinal function than isocaloric maize-soya-egg diets (32,48).

Target intakes are most easily achieved when meals are prepared at a facility and feeding is supervised. For children who are rehabilitated at home, the preparatory work needed to identify feasible, culturally appropriate diets that will meet the energy and protein specifications should not be underestimated (49). Carers are more likely to follow advice about what to give, how much and how often if they practise what to do under supervision. The bottom-up participatory approach to modifying local foods is a common feature of successful, sustainable interventions to improve child nutrition.

A ready-to-use catch-up food (Plumpy Nut) resembling peanut butter is available from Nutriset and has been designed for the rehabilitation phase. It contains the necessary micronutrients and it resists bacterial contamination. It has been successfully used in emergency feeding centres (50) and has the potential for use in home rehabilitation but its cost-effectiveness and sustainability are unknown.

- **Be accessible and convenient in order to provide timely treatment of infections and close monitoring of progress.**

Although residential and day-care rehabilitation achieves higher rates of weight gain than home rehabilitation, daily attendance represents a large investment of time by mothers and carers who invariably have other responsibilities that compete for this time. As a result, drop-out rates are often high. Typical discontinuation rates among the studies reviewed were 20-30%. The exception seems to be Guinea Bissau (31) where mothers attended daily for 13 weeks and only 3% discontinued. Preliminary discussions with village leaders may have convinced carers of the need to continue and/or may have allowed carers to make

suitable home arrangements during their absence. If a residential or day-care system is planned, it should be for as short a period as possible. Severely wasted children should achieve 90% weight-for-height in 4-6 weeks if the nutritional goals are met.

Further considerations are the personality and motivation of health workers and their acceptance by the community. These were considered key factors for success in Tanzania (38), and in Bangladesh great stress was placed on the attitude and motivation of the home visitors (42). Governmental child health services may not be able to exercise the same degree of control on staff appointments and dismissal as some of the successful programmes described above.

5. RECOMMENDATIONS

5.1 Possible options for community-based rehabilitation

Table 4 sets out possible options for continuing rehabilitation through community-based care and their relative advantages and disadvantages. Options 1 and 2 involve supervised feeding at residential or day-care nutrition centres where the aim would be to achieve rapid weight gain and provide practical education sessions for mothers and carers. These centres would be a 'half-way-house' between the hospital and the clinic. They would need to be integrated into the child health services to ensure onward referral from the nutrition centre to the local clinic for longer-term follow-up. Option 3 has similar objectives, but in this case the feeding centre is sited at the clinic, with referral straight from the hospital.

For Options 4-6, children would be referred straight from the hospital to the clinic for continuing care either through clinic visits or home visits. Rehabilitation would be achieved at home with modified high-energy, high-protein local foods, or possibly local foods supplemented by, for example, ready-to-use Plumpy Nut. Experience suggests that home visits are more effective than clinic visits.

The Options are flexible and can take family circumstances into consideration. For example, a child might be referred to a nutrition centre initially and attend daily (Option 2). Then after 1-2 weeks of very rapid growth, and when the carer has gained skills and confidence to achieve catch-up growth at home, the child could be referred for home-based rehabilitation (Option 4 or Option 5) with weekly visits for weighing and assessing progress.

5.2 Research recommendations

- There is no documented evidence of successful robust systems for the referral of malnourished children from hospital to the community for continuing rehabilitation. Efficient systems of transfer and tracking that avoid gaps in treatment during

referral need to be identified and tested. The onus of responsibility also needs delineating, including whether the hospital relinquishes responsibility for the child during rehabilitation or retains full or partial accountability.

- Instruction to mothers and carers about child feeding and health promotion should begin in hospital, especially if home rehabilitation is envisaged. A basic curriculum and effective systems for teaching mothers need to be identified and tested.
- If rehabilitation through home visits is to be considered, research will be needed to determine the optimum frequency of visits.
- Anecdotal reports suggest peer support groups may help families achieve catch-up growth at home. Consideration could be given to testing their value.
- Achieving catch-up growth at home requires teaching families how to make high-energy, high-protein meals from local low-cost foods. Guidelines are needed on how to achieve modifications that are feasible, culturally appropriate and have the required nutrient content. A description of the formative research needed for this process is already available in the Adaptation Guide for the IMCI Module on Nutrition Counselling, but consideration could be given to expanding this to include how to check if the energy and protein contents are appropriate. Guidelines will need field-testing and their effectiveness in achieving catch-up growth determined.
- Rates of weight gain at home might be improved by a) provision of micronutrient supplements, b) provision of ready-to-use catch-up food fortified with micronutrients. Research to test their effectiveness is warranted.
- Some children fail to achieve catch-up growth with home-based rehabilitation. Research is needed to determine if these children or their families share certain characteristics that could be used to identify them as high risk and in need of additional care.
- Advice given at home visits may produce a 'ripple effect' among neighbouring families and influence their infant care and feeding practices. This potential benefit of home visits warrants investigation.
- The rehabilitation phase is considered to end when children attain -1SD (90%) weight-for-height. Few programmes use weight-for-height. The feasibility of using this criterion in community-based programmes needs to be tested.

Table 1. Nutrition Rehabilitation Centres

AUTHOR; COUNTRY; YEAR PUBLISHED (Ref)	TYPE OF STUDY	AGE: ADMISSION CRITERIA and/or SEVERITY OF MALNUTRITION	CHILDREN ENROLLED	STAFF:CHILD RATIO	PRELIMINARY HOSPITAL TREATMENT	REHABILITATION				FOLLOW-UP			
						DURATION OF TREATMENT or ITME WHEN ASSESSED	MORTALITY (%)	RELAPSE (%)	WEIGHT GAIN OR PROGRESS	COST PER CHILD	FOLLOW-UP	LATER MORTALITY (%)	LATER RELAPSE (%)
DAY-CARE CENTRES													
Brown et al. Zaire 1980 (ref 14)	CC	5-24 months Only 29% <85% wt/ht	106 pairs		6	12 wks 3 meals @ 6d/wk	NR	NR	Weight gain not significantly different from controls matched for age and wt/ht.	NR	After 12m, no significant benefit in wt/ht versus controls	NR	NR
Ojofeitimi & Teniola, Nigeria 1980 (ref 15)	O	9-48 months	30		4(for some only)	12 wks 1 meal @1d/wk	3.3	6.7	Mean wt gain 1.9g/kg/d *	NR	Not done	NR	NR
Stanton et al. Bangladesh 1987 (ref 16)	O	18-48 months MUAC <12.5cm Mean wt/age 55%; Mean wt/ht 78%	85	1:3	4(for 3 only)	3-5 wks 3 meals + 2 snacks @6d/wk	1.2	NR	Median wt gain 3.3g/kg/d* Median wt/ht :- At entry 78% After 3 weeks 83% After 5 weeks 86%	NR	After 6m, median wt/ht was 83%	NR	NR
Asokan et al. India 1992 (ref 17)	O	Grade III (Gomez)	213		NR	12 months	10.0	NR	56% reached Grade II 12% reached Grade I	NR	Not done	NR	NR
Fronczak et al. Bangladesh 1993 (ref 18)	O	6-59 months MUAC <12cm or wt/ht 60-79% Mean wt/age 51%	161	1:5	6	Mean 4 wks 3 meals + 2 snacks daily	NR (can infer 0)	NR	At admission, mean wt/ht = 73% At discharge, mean wt/ht = 83% Mean wt gain ~5g/kg/d *	US\$ 140 for 4 wks+ 5 follow-up home visits	After 12m, mean wt/ht = 93%	NR	2.5
Chapko et al. Niger 1994 (ref 19)	RCT	5-28 months Wt/ht <-2SD or kwashiorkor Median wt/ht -3.16 SD	53 Hospital 47 NRC		4median 7 days, then randomised to remain or transfer to NRC	13 days hospital 12 days NRC. 3 meals/d hospital 1 or 2 meals/d NRC	24% hospital 12% NRC (estimated from graph)	NR	At entry to NRC, mean wt/ht = -3.0SD and at discharge = -2.5SD	Hospital had120% higher cost per patient day	After 6m ex-NRC mean wt/ht = -0.3SD and ex- hospital = -1.0SD (estimated from graph)	0-6m:- 41%hosp. 33% NRC	NR
Monte et al. Brazil 1998 (ref 20)	O	53% < 18 months Most used Gomez grades. Also social need. Grade I: 40% Grade II: 47% Grade III: 14% Only 27% <80% wt/ht.	1399 (20 centres)		NR	Mean 8.7 m	13.8 ≥40% in 2 centres <5% in 18 centres	NR	Wt gain:- <2g/kg/d 79.3% 2-4g/kg/d 15.9% >4g/kg/d 4 8%	NR	Not done	NR	NR

Table 1. Nutrition Rehabilitation Centres (continued)

AUTHOR; COUNTRY; YEAR PUBLISHED (Ref)	TYPE OF STUDY	AGE: ADMISSION CRITERIA and/or SEVERITY OF MALNUTRITION	CHILDREN ENROLLED	STAFF:CHILD RATIO	PRELIMINARY HOSPITAL TREATMENT	REHABILITATION				FOLLOW-UP			
						DURATION OF TREATMENT or TIME WHEN ASSESSED	MORTALITY (%)	RELAPSE (%)	WEIGHT GAIN OR PROGRESS	COST PER CHILD	FOLLOW-UP	LATER MORTALITY (%)	LATER RELAPSE (%)
RESIDENTIAL CENTRES													
Lampley et al. Philippines 1980 (ref 21)	O	Mean age 32.5 months Grades II & III (Gomez) Mean wt/age: 59%	64	1:5	4only if severe + complications	Mean 10 wks	4.3	NR	Mean wt gain 2.6g/kg/d * At admission, mean wt/age = 59% At discharge, mean wt/age = 66%	NR	After 8m, mean wt/age was 68%	1.7	NR
Ramprasad & Williams India 1980 (ref 22)	O	Grades I-III (Gomez) Grade I: 13% Grade II: 33% Grade III: 53%	90		6	~4-6 wks	5.6	NR	Mean wt gain ~100g/d. At admission, 53% were grade III. At discharge, 18% were grade III.	NR	Done (no details)	NR	NR
Roy et al. India 1980 (ref 23)	O	Grades I-III (Gomez)	112		4(for some only)	Mean 5 wks	1.8	0	Mean wt gain 29g/d * In a subset (n=46):- at admission, 79% were grade III. at discharge, 57% were grade III.	3.3Rs/d (1978 cost)	After 3m, 13% of the subset were grade III.	3.6	NR
McIntyre et al. South Africa 1992 (ref 24, 25)	O	Mean age 16 months Mean wt/age 64% Mean wt/ht 85%	73		4(majority) Mean10 days in hospital	Mean 10 days 3 meals + 2 snacks	None	NR	Mean wt gain 42g/d Mean wt gain 6.1g/kg/d * At admission, mean wt/ht = 85% At discharge, mean wt/ht = 89%	NR	After 12m, mean wt/ht = 99% Mean wt gain 1.1g/kg/d *	None	4.0
Ibekwe & Ashworth Nigeria 1994 (ref 26)	O	Wellcome classification	803		6	Mean 5 wks	21.8	NR	Mean wt gain 6-7g/kg/d	NR	NR	NR	NR

wt/ht = weight-for-height

wt/age = weight-for-age

MUAC = mid-upper arm circumference

NR = not reported

O = observational study

CC = case control study

RCT = randomised controlled trial

* value derived by this reviewer from other data given by the authors.

Table 2. Clinic-based rehabilitation

AUTHOR; COUNTRY; YEAR PUBLISHED (Ref)	TYPE OF STUDY	AGE AND ADMISSION CRITERIA or SEVERITY OF MALNUTRITION	CHILDREN ENROLLED STAFF:CHILD RATIO	PRELIMINARY HOSPITAL TREATMENT	REHABILITATION				FOLLOW-UP												
					DURATION OF TREATMENT or TIME WHEN ASSESSED	MORTALITY (%)	RELAPSE (%)	WEIGHT GAIN OR PROGRESS	COST PER CHILD	FOLLOW-UP	LATER MORTALITY (%)	LATER RELAPSE (%)									
Husaini et al. Indonesia 1982 (ref 27)	O	6-36 months Grade III (Gomez) or oedema but not severely ill	108	6 (except 2)	6 months 12 fortnightly clinic visits	16.6	Yes	In a subset (n=49):- mean wt gain 1.7g/kg/d* After 6m, 24% were >90% wt/ht.	NR	Not done	NR	NR									
Castillo et al. Chile 1983 (ref 28)	O	<2 years Wt/age <-3SD if <2years Wt/age <-2SD if <1year	a) 286 at regular clinics b) 27at special clinic	6	12 wks	NR	NR	In the subset (n=274)of those <-2SD wt/age:- a) 31% reached -1SD wt/age b) 73% reached -1SD wt/age	NR	Not done	NR	NR									
Bredow & Jackson Jamaica 1994 (ref 29)	O	<3 years Grades II & III (Gomez) or oedema	36	6	Mean 5.6 months Mean 6 clinic visits: weekly if ill, otherwise monthly	2.7	0	Mean wt gain 2.7g/kg/d*if grade III Mean wt gain 1.4g/kg/d* if grade II At admission, mean wt/age = 62% At review, mean wt/age = 73%	NR	NR	NR	NR									
Jamal et al. Pakistan 1995 (ref 30)	O	<5 years Grade III (Gomez)	135	6	Mean 13 wks Weekly or fortnightly clinic visits	1.5	NR	Mean wt gain ~25g/d* At admission, mean wt/age=45%* At discharge, mean wt/age =66%*	NR	NR	NR	NR									
Perra & Costello, Guinea Bissau 1995 (ref 31)	CC	6-47 months <60% wt/age	a) 354 cases b) 684 untreated controls	6	Mean 13 wks Cases attended clinic's day care centre	a) 4.8 b)11.9	a) 0 b)NR	Mean gain 37g/d. Mean wt gain ~6.0g/kg/d* Wt/age SD score:- <table style="margin-left: 20px; border: none;"> <tr> <td></td> <td>Cases</td> <td>Controls</td> </tr> <tr> <td>at entry</td> <td>-4.52</td> <td>-4.15</td> </tr> <tr> <td>3m later</td> <td>-2.76</td> <td>-3.6*</td> </tr> </table>		Cases	Controls	at entry	-4.52	-4.15	3m later	-2.76	-3.6*	NR	Up to 18m, significant benefit in wt/age versus controls, but not significant from 18-36m	0-9m:- a) 9% b)11%	1.4
	Cases	Controls																			
at entry	-4.52	-4.15																			
3m later	-2.76	-3.6*																			
Brewster et al. Malawi 1997 (ref 32)	O	Mean age 29 months Oedematous malnutrition	373	6	Mean 19 days Resided at clinic	7.5 (overestimate as includes initial treatment phase)	NR	6.4g/kg/day (underestimate as includes resolution of oedema)	NR	Not done	NR	NR									

For abbreviations see footnote to Table 1

Table 3. Domiciliary nutrition rehabilitation

AUTHOR; COUNTRY; YEAR PUBLISHED (ref)	TYPE OF STUDY	AGE AND ADMISSION CRITERIA or SEVERITY OF MALNUTRITION	CHILDREN STUDIED	STAFF:CHILD RATIO	PRELIMINARY HOSPITAL TREATMENT	REHABILITATION				FOLLOW-UP			
						DURATION OF TREATMENT or TIME WHEN ASSESSED	MORTALITY (%)	RELAPSE (%)	WEIGHT GAIN OR PROGRESS	COST PER CHILD	FOLLOW-UP	LATER MORTALITY (%)	LATER RELAPSE (%)
Khare et al. India 1976 (ref 33)	O	<5 years oedematous malnutrition	32		6	Assessed after 15 months Food + weekly home visits until status improved	6.2	6.2	Mean time to lose oedema 8wks %wt/age:- At entry After 15m < 60% 60% 43% 61-70% 25% 38% 71-80% 9% 19%	Rs 7.4 parents Rs 16.0 food/drugs	Not done	NR	NR
Verkley & Jansen; Kenya 1983 (ref 34,35)	O	≤65% wt/age Mean age 23 months Mean wt/ht ~80%	32		6	6 months Food + home visits if failed to attend clinic	0	NR	Mean wt gain ~1g/kg/d* At admission, mean wt/age= 61% At discharge, mean wt/age = 66%	Ksh 496/- per child	After 4m, mean wt/age = 65%: After 10m=68%	3.1	NR
Gueri et al. Trinidad 1985 (ref 36)	O	< 5 years Grades II & III (Gomez) Mean age 25 months	a) 59 b) 27		6	16 wks a) Food + ≥8 visits/m b) Food + 1visit/m	NR	0	Mean wt gain: a) 1.1g/kg/d* b) 0.9g/kg/d* % grade III:- (a) (b) at entry 17% 14% after 16wks 8% 0%	Cost to the centre: a)US\$76.8 b)US\$22.5	Yes (duration not given). % grade III:- a) 13% b) 0%	NR	a)3.4 b) 0
Glatthaar et al. South Africa 1986 (ref 37)	RCT	7-36 months; ≤ 72% wt/age or ≤ 79% wt/age + oedema or wt/ht <95% Mean age 18 months	a) 65 b)75 controls		6	3 months a) 6 home visits b) No visits (controls)	a) 11.7 b) 5.4 controls		Mean wt/ht:- (a) (b) at entry 81% 82% after 3m 88% 87%	NR	After 9m, wt/ht:- a) 91% b) 91%	a) 0 b) 0	NR
Roosmalen-Wiebenga Tanzania 1988 (ref 38)	O	At admission to hospital:- 53% kwashiorkor 18% marasmic-kwash 29% marasmus	475		4(all) (mean 19d)	MCH services: home visits by health worker	Within 6-36m of discharge 8% died, and 13% relapsed.		% <90wt/ht:- at entry 88% at hospital discharge 64% after 12m or more 14%	N/A	NR	NR	NR
Heikens et al Jamaica 1989 (ref 39)	RCT	3-36 months <80% wt/age no oedema Mean wt/age 66% Mean wt/ht 83% Mean age 15 months	a) 39 b) 43		6	3 months a) Food + 1 home visit/m for 3 months b) 1 home visit/m	a) 2.6 a) 18.0 b) 0 b) 16.0		Mean weight gain 0-3m:- a) 1.5g/kg/d* b) 1.3g/kg/d* Mean wt/ht z-score:- (a) (b) at entry -1.9 -1.8 after 3m -1.4 -1.6 (estimated from graph)	NR	After 3m, mean wt/ht:- a) -1.8 b) -1.6 (estimated from graph)	None	a) 7.7 b) 7.0
Fernandez-Concha et al. Peru 1991 (ref 40)	O	Grades II & III (Gomez) Mean wt/ht ~88% Mean age 18 months	54		6	12 months	1.8	7.4	% wt/age:- grade II grade III at entry 87% 13% after 3m 47% 2% after 12m 19% 0%	\$21/child	Not done	NR	NR

Table 3. Domiciliary nutrition rehabilitation (continued)

AUTHOR; COUNTRY; YEAR PUBLISHED (ref)	TYPE OF STUDY	AGE AND ADMISSION CRITERIA or SEVERITY OF MALNUTRITION	CHILDREN STUDIED STAFF:CHILD RATIO	PRELIMINARY HOSPITAL TREATMENT	REHABILITATION						FOLLOW-UP		
					DURATION OF TREATMENT or TIME WHEN ASSESSED	MORTALITY (%)	RELAPSE (%)	WEIGHT GAIN OR PROGRESS	COST PER CHILD	FOLLOW-UP	LATER MORTALITY (%)	LATER RELAPSE (%)	
Heikens et al. Jamaica 1994 (ref 41)	RCT	3-36 month <80% wt/age Mean wt/age 59% Mean wt/ht 81% Mean age 11 months	a) 40 stayed in hospital until recovery b) 39 early discharge	4(all) a) mean 40d b) mean 18d	Assessed at 6m post-discharge b) Food for 3m+folate + multivitamins + monthly home visits	a) 0 b) 2.6	NR	Mean wt gain (early rehabilitation) a) >7g/kg/d b) ~1.1g/kg/d Mean wt/ht z-score:- (a) (b) at entry -2.0 -1.9 at discharge -0.5 -1.2 6m post discharge -0.5 -0.8	NR	After 36m, mean wt/ht z- score a) -0.5 b) -0.7	None	None	
Khanum et al. Bangladesh 1994 (ref 42-45)	RCT	12-59 months <60% wt/ht and/or oedema Mean wt/age 48% Mean wt/ht 67% Mean age 25 months	a) 173 inpatient b) 134 day- care c) 130 early discharge	4(all) c) 7 days	Until ≥80% wt/ht and oedema-free Mean days:- a) inpatient: 18 days b) day-care: 23 days c) domiciliary 35days	a) 3.5 b) 5.0 c):3.5	a) 0 b) 0 c) 0	Mean wt gain:- a) inpatient: 11g/kg/day b) day-care: 6g/kg/day c) domiciliary 4g/kg/d (all are underestimates as these include resolution of oedema)	Cost to centre /child to rehabilitate a)\$156 b)\$59 c)\$29	After 12m:- mean wt/ht a) 91% b) 91% c) 91%	a) 3.4 b) 1.5 c) 1.5	a)1.2 b) 0.7 c) 0	

For abbreviations see footnote to Table 1

Table 4. Possible options for community-based care

System	Advantages	Disadvantages
<p>OPTION 1 Refer to district residential nutrition centre for up to 4 weeks.</p>	<ul style="list-style-type: none"> • Supervised feeding and best chance of success. • Opportunity for teaching mothers and for practice. 	<ul style="list-style-type: none"> • Only feasible if can maintain sufficient patient numbers. • Potential high drop-out rate if carers' attendance conflicts with other responsibilities. • High institutional cost.
<p>OPTION 2 Refer to local day-care nutrition centre for up to 4 weeks.</p>	<ul style="list-style-type: none"> • Supervised feeding and high chance of success. • Opportunity for teaching mothers and for practice. 	<ul style="list-style-type: none"> • Will need more centres than for Option 1. • Potential high drop-out rate if carers' attendance conflicts with other responsibilities. • High institutional cost
<p>OPTION 3 Refer to local clinic that functions as a feeding centre (residential or day-care) for up to 4 weeks.</p>	<ul style="list-style-type: none"> • Supervised feeding and high chance of success. • Opportunity for teaching mothers and for practice. • Able to function with few children as staff have other clinic duties. • Facilitates long-term care. 	<ul style="list-style-type: none"> • Will need to equip clinics • Staff may resent extra duties; may need extra staff. • Potential high drop-out rate if carers' attendance conflicts with other responsibilities. • Many children could exceed staff capacity. • Moderate/high cost
<p>OPTION 4 Refer to local clinic for weekly or twice-weekly clinic visits for weighing, health check, and reinforce teaching.</p>	<ul style="list-style-type: none"> • Sustainable. • Facilitates continuity of long-term care. • Low cost. 	<ul style="list-style-type: none"> • Little evidence of success. • Little opportunity for carers to practise. • Frequent clinic attendance may be difficult if live far from clinic.
<p>OPTION 5 Refer to local clinic for follow-up weekly home visits for weighing, health check, and reinforce teaching.</p>	<ul style="list-style-type: none"> • Potentially sustainable. • Facilitates long-term care. • Low cost. • Few drop-outs. • CHWs sees home conditions and can target advice accordingly. • Potential ripple effect. 	<ul style="list-style-type: none"> • Little precedence so success rates unknown. • Need CHWs with motivation to home-visit and willingness to travel to distant families.
<p>OPTION 6 Refer to clinic for follow-up and provide convenience food e.g. Plumpy Nut.</p>	<ul style="list-style-type: none"> • Potentially successful. • Facilitates continuity of long-term care. 	<ul style="list-style-type: none"> • No precedence so success rates unknown. • Questionable sustainability.

REFERENCES

1. Schofield C, Ashworth A. Why have mortality rates for severe malnutrition remained so high? *Bull Wld Health Org* 1996; 74: 223-229.
2. World Health Organization. *Management of the child with a serious infection or severe malnutrition* (WHO/FCH/CAH/00.1). WHO: Geneva, 2000.
3. World Health Organization. *Management of severe malnutrition: a manual for physicians and other senior health workers*. WHO: Geneva, 1999
4. World Health Organization. *Improving child health. IMCI: the integrated approach*. WHO/CHD/97.12. WHO: Geneva, 1997.
5. Chevalier P, Sevilla R, Sejas E et al. Immune recovery of malnourished children takes longer than nutritional recovery: implications for treatment and discharge. *J Trop Pediatr* 1998; 44: 304-307.
6. Reneman L, Derwig J. Long-term prospects of malnourished children after rehabilitation at the Nutrition Rehabilitation Centre of St Mary's Hospital, Mumias, Kenya. *J Trop Pediatr* 1997; 43: 293-296.
7. Pecoul B, Soutif C, Hounkpevi M, Ducos M. Efficacy of a therapeutic feeding centre evaluated during hospitalization and a follow-up period, Tahoua, Niger, 1987-1988. *Annals Trop Paediatr* 1992; 12: 47-54.
8. Bengoa JM. *Nutrition et alimentation tropicales*. Recueil de Conférences du Cours de Formation de Nutritionnistes en Afrique au Sud du Sahara organisé par le FAO, l'OMS et le Gouvernement français Marseille. 1955.
9. Bengoa JM. Nutrition rehabilitation centres. *J Trop Pediatr* 1967; 13: 169-176.
10. Beaudry-Darisme M, Latham MC. Nutrition rehabilitation centers – an evaluation of their performance. *Envir Child Health* 1973; 19: 299-332.
11. King KW, Fougere W, Webb RE et al. Preventive and therapeutic benefits in relation to cost: performance over 10 years of Mothercraft Centers in Haiti. *Am J Clin Nutr* 1978; 31: 679-690.
12. Beghin ID, Viteri FE. Nutritional rehabilitation centers: an evaluation of their performance. *Envir Child Health* 1973; 19: 404-416.
13. Kraut H, Kreysler J, Lal K et al. Rehabilitation of undernourished children in Tanzania using locally available food. *Ecol Fd Nutr* 1978; 6: 231-242.
14. Brown RC, Brown JE, Teeter RA. Evaluation of a nutrition center program in rural Africa. *J Trop Pediatr* 1980; 26: 37-41.

15. Ojofeitimi EO, Teniola SO. Evaluation of nutrition rehabilitation centre in Ile-Ife, Oyo State, Nigeria. *Wld Rev Nutr Diet* 1980; 35: 87-95.
16. Stanton BF, Phillips N, Clemens JD et al. An urban nutrition education and rehabilitation centre: a description of the programme and change in nutritional status of children who were enrolled. *Trop Geog Med* 1987; 39: 287-295.
17. Asokan JS, Sampathkumar V, Abel R. Response of the poor to a nutritional rehabilitation programme. *J Trop Pediatr* 1992; 38: 335-336.
18. Fronczac N, Amin S, Laston SL, Baqui AH. *An evaluation of community-based nutrition rehabilitation centers*. Urban FP/MCH Working Paper No. 10. International Centre for Diarrhoeal Disease Research, Bangladesh, 1993.
19. Chapko MK, Prual A, Gamatie Y, Maazou AA. Randomized clinical trial comparing hospital to ambulatory rehabilitation of malnourished children in Niger. *J Trop Pediatr* 1994; 40: 225-230.
20. Monte CMG, Ashworth A, Sa MLB, Diniz RLP. Effectiveness of nutrition centers in Ceara state, northeastern Brazil. *Pan Am J Public Health* 1998; 4: 375-382.
21. Lamptey PR, Florencio C, Picar B. Comparison of nutriwards and nutrihuts in the northern Mindanao region (Region X) of the Republic of the Philippines. *Fd Nutr Bull* 1980; 3: 8-16.
22. Ramprasad V, van Williams W. Nutrition education through nutrition rehabilitation. *J Trop Pediatr* 1980; 26: 123-126.
23. Roy AK, Rao AR, Srinivas DK, Ghosh MN. Community level malnutrition vis-à-vis the role of nutrition rehabilitation centre. *Indian J Med Res* 1980; 72: 846-853.
24. MacIntyre UE, Bac M, Kuzwayo PMN et al. Combating protein-energy-malnutrition in a rural/peri-urban Southern African black population. *J Roy Soc Health* 1991; 111: 183-187.
25. MacIntyre UE, Bac M, Walker ARP. Rehabilitation from protein-energy malnutrition: a study on its effectiveness. *South Afr J Epidemiol Infect* 1992; 7: 14-19.
26. Ibekwe V, Ashworth A. Management of protein-energy malnutrition in Nigeria: an evaluation of the regimen at the Kersey Nutrition Rehabilitation Centre. *Trans Roy Soc Trop Med Hyg* 1994; 88: 594-595.

27. Husaini YK, Sulaeman Z, Basuki SM et al. Outpatient rehabilitation of severe protein energy malnutrition (PEM). *Fd Nutr Bull* 1982; 8: 55-59.
28. Castillo C, Salvatierra V, Mejias MC et al. Treatment of children suffering from severe malnutrition in an area of Santiago, Chile. *Bull Pan Am Health Org* 1983; 17: 387-395.
29. Bredow MT, Jackson AA. Community-based, effective, low cost approach to the treatment of severe malnutrition in rural Jamaica. *Arch Dis Child* 1994; 71: 297-303.
30. Jamal A, Billoo AG, Hussain T, Khanani R. Rehabilitation of grade III protein energy malnutrition on out patients basis. *J Pak Med Assoc* 1995; 45: 312-314.
31. Perra A, Costello AML. Efficacy of outreach nutrition rehabilitation centres in reducing mortality and improving nutritional outcome of severely malnourished children in Guinea Bissau. *Eur J Clin Nutr* 1995; 49: 353-359.
32. Brewster DR, Manary MJ, Graham SM. Case management of kwashiorkor: an intervention project at seven nutrition rehabilitation centres in Malawi. *Eur J Clin Nutr* 1997; 51: 139-147.
33. Khare RD, Shah PM, Junnarkar AR. Management of kwashiorkor in its milieu – a follow-up for fifteen months. *Indian J Med Res* 1976; 64: 1119-1127.
34. Verkley MTB, Jansen AAJ. A mixed ambulatory-home nutrition rehabilitation programme in a rural area in Kenya. *East Afr Med J* 1983; 60: 15-21.
35. Jansen AAJ, Verkley MTB. Ambulatory home nutrition rehabilitation in rural Kenya. *J Trop Pediatr* 1986; 32: 258-262.
36. Gueri M, Andrews N, Fox K et al. A supplementary feeding programme for the management of severe and moderate malnutrition outside hospital. *J Trop Pediatr* 1985; 31: 101-108.
37. Glatthaar II, Fehrsen GS, Irwig LM, Reinach SG. Protein-energy malnutrition: the role of nutrition education in rehabilitation. *Hum Nutr: Clin Nutr* 1986; 40C: 271-285.
38. van Roosmalen-Wiebenga MW. *Nutrition rehabilitation in the south western highlands of Tanzania: a two way learning process*. Drukkerij & Pasmans, Gravenhage, 1988.
39. Heikens GT, Schofield WN, Dawson S, Grantham-McGregor S. The Kingston Project. 1. Growth of malnourished children during rehabilitation in the

- community, given a high energy supplement. *Eur J Clin Nutr* 1989; 43: 145-160.
40. Fernandez-Concha D, Gilman RH, Gilman JB. A home nutritional rehabilitation programme in a Peruvian peri-urban shanty town (*pueblo joven*). *Trans Roy Soc Trop Med Hyg* 1991; 85: 809-813.
41. Heikens GT, Schofield WN, Dawson SM, Waterlow JC. Long-stay versus short-stay hospital treatment of children suffering from severe protein-energy malnutrition. *Eur J Clin Nutr* 1994; 48: 873-882.
42. Khanum S, Ashworth A, Huttly SRA. Controlled trial of three approaches to the treatment of severe malnutrition. *Lancet* 1994; 344: 1728-1732.
43. Ashworth A, Khanum S. Cost-effective treatment for severely malnourished children: what is the best approach? *Health Policy & Planning* 1997; 12: 115-121.
44. Khanum S, Ashworth A, Huttly SRA. Growth, morbidity, and mortality of children in Dhaka after treatment for severe malnutrition: a prospective study. *Am J Clin Nutr* 1998; 67: 940-945.
45. Khanum S. *A comparison of the cost-effectiveness of alternative approaches to the treatment of severely malnourished children*. PhD thesis, University of London, 1994.
46. Ogbuide O, Osuhor PC. Morbidity and mortality patterns among malnourished children in Benin City, Nigeria. *Trop Doctor* 1984; 14: 178-180.
47. Hennart P, Beghin D, Bossuyt M. Long-term follow-up of severe protein-energy malnutrition in eastern Zaire. *J Trop Pediatr* 1987; 33: 10-12.
48. Brewster DR, Manary MJ, Menzies IS et al. Comparison of milk and maize based diets in kwashiorkor. *Arch Dis Child* 1997; 76: 242-248.
49. Brown KH. Appropriate diets for the rehabilitation of malnourished children in the community setting. *Acta Paediatr Scand* 1991; Suppl 374: 151-159.
50. Briend A, Lascala R, Prudhon C et al. Ready-to-use therapeutic food for treatment of marasmus. *Lancet* 1999; 353: 1767-1768.