

Integrated program achieves good survival but moderate recovery rates among children with severe acute malnutrition in India^{1–4}

Víctor M Aguayo, Vandana Agarwal, Manohar Agnani, Dwarka Das Agrawal, Sheela Bhambhal, Ashok K Rawat, Ajay Gaur, Aashima Garg, Nina Badgaiyan, and Karanveer Singh

ABSTRACT

Background: At any point in time, an average 8 million Indian children suffer from severe acute malnutrition (SAM).

Objective: This article assesses the effectiveness of an integrated model for the management of SAM (IM-SAM) in India comprising facility- and community-based care and using locally adapted protocols.

Design: Children ($n = 2740$) were randomly sampled from the 44,017 children aged 6–59 mo admitted to 199 Nutrition Rehabilitation Centers in the state of Madhya Pradesh (1 January to 31 December 2010).

Results: On admission, 2.2% of children had edema, 23.4% had medical complications, 56% were girls, 79% were in the age group 6–23 mo, and 64% belonged to scheduled tribe or scheduled caste families. Fifty-six children (2.0%) with severe congenital or pathological conditions were transferred to the district hospital. Of the 2684 program exits, 10 children (0.4%) died, 860 (32.0%) did not complete treatment (defaulted), and 1814 (67.6%) were discharged after a mean (\pm SD) stay of 75.8 ± 9.4 d. The mean weight gain among discharged children was 2.7 ± 1.9 g · kg body wt⁻¹ · d⁻¹; on discharge, 1179 (65%) of the children had recovered (weight gain $\geq 15\%$ of initial weight).

Conclusions: The survival rates in the IM-SAM program were very high. However, the moderate recovery rates documented seem to indicate that the protocols currently in use need to be improved. This trial was registered at clinicaltrials.gov as NCT01917734.

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INTRODUCTION

Severe acute malnutrition (SAM)⁵ remains a major killer of children as mortality rates in children with severe wasting—the most widespread form of SAM—are 9 times those in normal children (1). In India, the National Family Health Survey in 2006 indicated that 7.9% of children 0–35 mo old were severely wasted (2). Therefore, despite an economy growing often at nearly 10% annually (3), at any point in time an average 8 million Indian children younger than 5 y (“underfives”) are severely wasted (4). These 8 million children—one-third of the severely wasted children worldwide (4)—are dangerously too undernourished to survive, grow, and develop to their full potential, which is the same potential as that of children in developed countries (5).

The state of Madhya Pradesh is at the epicenter of India’s and the world’s nutrition crisis (6). According to the National Family

Health Survey in 2006, an estimated 12.6% of underfives in Madhya Pradesh— $\sim 1,000,000$ at any point in time—are severely wasted (2). The response to SAM in Madhya Pradesh is led by the National Rural Health Mission (NRHM) of the Department of Health and Family Welfare (7). Currently, NRHM is implementing an integrated program for the management of SAM (IM-SAM). Children with SAM are initially admitted to a facility-based phase in a Nutrition Rehabilitation Center (NRC); after the facility-based phase, children are transitioned to the community-based phase at home.

The objective of this analysis was to evaluate the effectiveness of the IM-SAM program at providing therapeutic care for children with SAM as per national and international standards of care so as to inform the future design and implementation of programs for the delivery of services for children with SAM in India.

SUBJECTS AND METHODS

Madhya Pradesh’s program for the provision of care to children with SAM was initiated in the district of Shivpuri in January 2006. By 1 January 2010, NRHM had established 199 NRCs where children were receiving therapeutic care following

¹ From the Government of Madhya Pradesh, Atal Bal State Nutrition Mission and Integrated Child Development Services Program and National Rural Health Mission, Bhopal, India (MA and DDA); Gandhi Medical College, Bhopal, Madhya Pradesh, India (SB); Bundelkhand Medical College, Sagar, Madhya Pradesh, India (AKR); Gwalior Medical College, Gwalior, Madhya Pradesh, India (A Gaur); and UNICEF, Delhi, India (VMA, VA, A Garg, NB, and KS).

² The opinions expressed on this article are those of the authors and do not necessarily represent an official position of the organizations with which they are affiliated.

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⁴ Address correspondence and reprint requests to VM Aguayo, UNICEF, 73 Lodi Estate, New Delhi 110 003, India. E-mail: vaguayo@unicef.org.

⁵ Abbreviations used: CMAM, community management of acute malnutrition; ICDS, Integrated Child Development Services; IM-SAM, integrated model for the management of severe acute malnutrition; MUAC, midupper arm circumference; NRC, Nutrition Rehabilitation Center; NRHM, National Rural Health Mission; SAM, severe acute malnutrition; WHZ, weight-for-height z score.

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TABLE 1

Composition of locally prepared therapeutic foods in the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)

Ingredients	Liquid F-75 therapeutic milk (per 1000 mL)	Liquid F-100 therapeutic milk (per 1000 mL)	Semisolid therapeutic food (per 1000 g)
Cow milk (mL) ¹	280	900	—
Sugar (g)	65	50	286
Puffed rice (g)	35	—	—
Vegetable oil (g)	20	20	—
Ground nut (g)	—	—	255
Milk powder (g)	—	—	306
Coconut oil (g)	—	—	153
Water (mL)	— ²	— ²	—

¹ ~4.0% fat content.

² Water was added to make 1000 mL.

protocols based on the guidelines for the management of SAM by WHO (8) and the Indian Academy of Pediatrics (9). The detection of children with SAM was ensured in the communities by the Anganwadi workers—the frontline workers of India's Integrated Child Development Services (ICDS) program—in the context of monthly growth monitoring and promotion sessions at the ICDS center, commonly known as the Anganwadi center.

Once at the NRC, the age, weight, height, midupper arm circumference (MUAC), and presence of bilateral pitting edema were determined for each child. SAM was defined as per WHO recommendations by the presence of bilateral pitting edema or the presence of severe wasting (10). Severe wasting was defined by an MUAC <115 mm and/or a weight-for-height *z* score (WHZ) less than -3 of the median WHZ in WHO Child Growth Standards (10). All children 6–59 mo with bilateral pitting edema, and/or WHZ less than -3 and/or MUAC <115 mm were admitted to the NRC.

Once children were admitted to the NRC, a medical doctor conducted a clinical examination on them to detect the presence of medical complications (lethargy, pneumonia, dehydration, fever, tuberculosis, and/or severe anemia) using the criteria for the Integrated Management of Neonatal and Childhood Illnesses (11).

As per protocol, children with edema, and/or medical complications and/or poor appetite were fed locally prepared F-75 therapeutic milk every 2 h for 48 h (stabilization phase) while their medical complications were treated. After completion of the initial 48 h, children were fed alternatively F-75 and locally prepared F-100 therapeutic milk 6 times/d for ~48 h (transition phase). After the transition phase, children were fed F-100 and locally produced semisolid therapeutic food with the aims of initiating rapid weight gain (rehabilitation phase). Children with normal appetite and free of medical complications entered the rehabilitation phase from the day of admission (**Table 1**). All children received a course of broad-spectrum antibiotic.

On completion of a prescribed 14-d stay in the NRC, children were transitioned to the community phase of the program, where they were followed up by the ICDS and NRHM frontline workers. Frontline workers were to ensure that the child benefited from ICDS Supplementary Nutrition Program and returned for a follow-up visit at the NRC every 15 d during the 60 d after discharge. At the 4 follow-up visits, children's weight gain was assessed and mothers were counseled on child feeding and care.

From 1 January 1 to 31 December 2010, a total of 44,017 children 6–59 mo old were admitted to the IM-SAM program.

This study evaluated the effectiveness of the program by analyzing program outcomes in a sample of children ($n = 2740$) randomly selected from among the 44,017 children admitted. The analyses were carried out by using StataCorp 2011 (Stata Statistical Software, release 12). Mean values are provided as \pm SDs; for all tests, $P < 0.05$ was considered significant.

RESULTS

The children admitted were very young: 2156 (78.7%) of the children admitted were in the age group 6–23 mo; 1525 children (55.7%) were girls, and 1757 (64.1%) were from scheduled caste or scheduled tribe families. On admission, 59 children

TABLE 2

Characteristics of children admitted to the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Category	Value
Children referred to NRCs	
Admitted (true positives)	2740 (100)
Not admitted (false positives)	0 (0)
Children admitted to NRCs	
Girls	1525 (55.7)
Boys	1215 (44.3)
6–11 mo old	927 (33.8)
12–23 mo old	1229 (44.9)
24–35 mo old	380 (13.9)
36–47 mo old	98 (3.6)
48–59 mo old	106 (3.8)
Scheduled tribes	1121 (40.9)
Scheduled castes	636 (23.2)
Other backward castes	856 (31.2)
Other	127 (4.7)
With bilateral pitting edema	59 (2.2)
With severe wasting	2681 (97.8)
With medical complications	641 (23.9)
Without medical complications	2040 (76.1)
With complicated SAM ²	700 (25.5)
With uncomplicated SAM ³	2040 (74.5)

¹ Values are n (%). Sample of children ($n = 2740$) randomly selected among the 44,017 children admitted to the program from 1 January to 31 December 2010. NRC, Nutrition Rehabilitation Center; SAM, severe acute malnutrition.

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

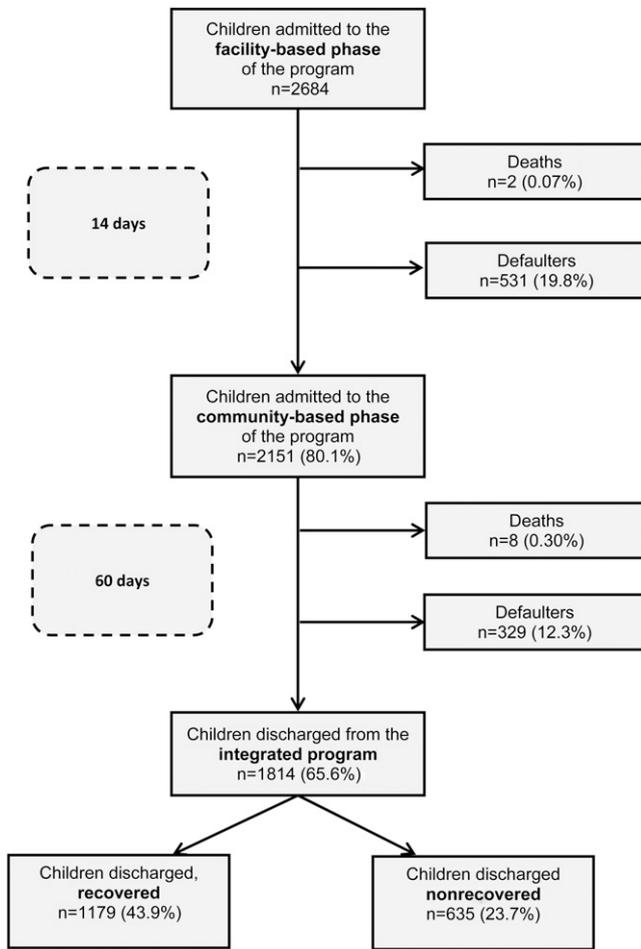


FIGURE 1. Outcomes in the sample of children randomly selected from the 44,017 children aged 6–59 mo admitted to the Integrated Program for Children with severe acute malnutrition, Madhya Pradesh (1 January to 31 December 2010), India.

(2.2%) had edema, whereas the remaining 2681 (97.9%) had severe wasting; of these, 641 had medical complications. Therefore, 700 (25.5%) of the 2740 children admitted had complicated SAM (with edema and/or medical complications), whereas 2040 (74.5%) had uncomplicated SAM (Table 2).

For medical reasons, 56 children (2.0%) with severe congenital or pathological conditions whose clinical management required highly specialized skills were transferred to the district hospital and were not transferred back to the IM-SAM program. The remaining 2684 children (98%) are the “exits”—deaths, defaulters, and discharged—of the program (Figure 1).

The following outcomes were recorded during the facility-based phase of the program:

1) Deaths: 2 children (0.1%) died while in the NRC.

2) Defaulters: 531 children (19.8%) defaulted (they left the NRC before completing 14 d); the mean length of stay in the NRC was 7.5 ± 4.3 d. Of these children, 250 (47%) defaulted in the first week, whereas 281 (53%) defaulted in the second week [65 (12%) defaulters had gained $\geq 15\%$ of their initial weight by the time they defaulted the NRC (data not shown)].

3) Discharged: 2151 children (80.1%) were discharged from the NRC to the community-based phase of the program. The children’s mean weight gain while in the NRC was determined as the total individual weight gain (after loss of edema in the

case of children who had edema at admission) of all the children discharged from the NRC divided by the total number of children discharged. Of the 2151 children discharged, 395 (18.4%) gained $\geq 15\%$ of their initial weight and 1756 children (81.6%) gained $< 15\%$ of their initial weight (Table 3). The children’s mean weight gain while in the NRC was 6.8 ± 5.1 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$, and their mean length of stay was 14.2 ± 1.4 d (Table 4). A total of 826 children (38.4%) had poor catch-up growth (≤ 5 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$), 888 (41.3%) had moderate catch-up growth (5–10 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$), and 437 (20.3%) had rapid catch-up growth (≥ 10 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$). A total of 1405 children (65.3%) gained an average of ≥ 8 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$ (data not shown).

The following outcomes were recorded for the 2151 children transitioned from the facility-based to the community-based phase of the program (Table 5):

1) Deaths: 8 children (0.4%) died while in the community-based phase of the program.

2) Defaulters: 329 children (15.3%) defaulted while in the community-based phase (they missed ≥ 2 consecutive follow-up visits), 142 children (43.2% of defaulters) did not attend any follow-up visit, 98 (29.8%) attended 1 and 89 (27.1%) attended 2 (but missed 2 consecutive ones) follow-up visits, and 107 (32.5%) of the defaulters had gained $\geq 15\%$ of their initial weight by the time they defaulted (data not shown).

3) Discharged: 1814 children (84.3%) were discharged from the community-based phase of the program (mean weight gain: 1.6 ± 1.9 g · kg body $\text{wt}^{-1} \cdot \text{d}^{-1}$; mean length of stay: 61.6 ± 9.4 d) (Table 6).

The following outcomes were recorded at exit from the IM-SAM program ($n = 2684$ children completed the facility- and community-based phases) (Table 7):

1) Deaths: 10 children (0.4%) died while in the program.

TABLE 3

Outcomes at discharge from the facility-based phase of the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Admitted			
Transfers	12 (1.7)	44 (2.2)	56 (2.0)
Exits	688 (98.3)	1996 (97.8)	2684 (98.0)
Total	700 (100)	2040 (100)	2740 (100)
Exits			
Deaths	1 (0.1)	1 (0.1)	2 (0.1)
Defaulters	136 (19.8)	395 (19.8)	531 (19.8)
Discharged	551 (80.1)	1600 (80.2)	2151 (80.1)
Total	688 (100)	1996 (100)	2684 (100)
Discharged			
Recovered	119 (21.6) ^a	276 (17.3) ^a	395 (18.4)
Nonrecovered	432 (78.4)	1324 (82.8)	1756 (81.6)
Total	551 (100.0)	1600 (100.0)	2151 (100.0)

¹ Values are *n* (%). ^a*P* = 0.02 (a multivariate analysis indicated that this difference was not statistically significant after control for children’s age and anthropometric measures at admission). SAM, severe acute malnutrition.

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

TABLE 4

Mean weight gain and length of stay in the facility-based phase of the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Discharged recovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	13.7 ± 4.2 ⁵	13.4 ± 5.5	13.5 ± 5.1
Mean length of stay (d)	14.6 ± 1.8	14.2 ± 2.4	14.3 ± 2.3
No. of children	119	276	395
Discharged nonrecovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	5.3 ± 3.5	5.3 ± 3.8	5.3 ± 3.7
Mean length of stay (d)	14.3 ± 1.1	14.1 ± 1.1	14.2 ± 1.1
No. of children	432	1324	1756
Discharged all children			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	7.1 ± 5.1 ^a	6.7 ± 5.1 ^a	6.8 ± 5.1
Mean length of stay (d)	14.4 ± 1.3	14.1 ± 1.4	14.2 ± 1.4
No. of children	551	1600	2151

¹ Multivariate analysis indicated that this difference was not statistically significant after control for children's age and anthropometric measures at admission: ^a*P* = 0.055. SAM, severe acute malnutrition.

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

⁵ Mean ± SD (all such values).

2) Defaulters: 860 children (32.0% of exits) defaulted the program; 531 defaulters (61.7% of total) were recorded in the facility-based phase, whereas 329 (38.3% of total) were recorded in the community-based phase.

3) Discharged: 1814 children (67.6%) were discharged (mean weight gain: 2.7 ± 1.9 g · kg body wt⁻¹ · d⁻¹; mean length of stay: 75.8 ± 9.4 d), 1179 children were discharged recovered (65.0% of discharged) because they gained ≥15% of their initial weight (mean weight gain: 3.5 ± 1.9 g · kg body wt⁻¹ · d⁻¹; mean length of stay: 75.9 ± 9.7 d), whereas 635 children (35.0%) were discharged nonrecovered because they gained <15% of their initial weight (mean weight gain: 1.2 ± 0.6 g · kg body wt⁻¹ · d⁻¹; mean length of stay: 75.7 ± 8.6 d) (**Table 8**). In summary, of the 2684 program exits, 10 (0.37%) were deaths, 860 (32.1%) were defaulters, 635 (23.7%) were discharged nonrecovered, and 1179 (43.9%) were discharged recovered (Table 7).

An important subset of the 2684 children admitted to the IM-SAM program consisted of the 1379 children who, when transitioned from the facility-based to the community-based phase of the program, were free of medical complications but still had SAM (MUAC <115 mm and/or WHZ less than -3). The outcomes of these children are those of a program for community-management of SAM. Of these children, 8 (0.6%) died, 242 (17.6%) defaulted, 777 (56.4%) were discharged recovered, and 352 (25.5%) were discharged nonrecovered (**Table 9**).

A bivariate analysis indicated that the mean weight gain and recovery rates among children with complicated SAM at admission were significantly higher than those among children with uncomplicated SAM, both in the facility-based and community-based phases of the program. Further investigation showed that there were significant differences in initial anthropometric measures between complicated (*n* = 466) and uncomplicated (*n* = 1348) cases: weight (6.0 ± 13.9 compared with 6.3 ± 15.9 kg;

TABLE 5

Outcomes at discharge from the community-based phase of the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Exits			
Deaths	3 (0.5)	5 (0.3)	8 (0.4)
Defaulters	82 (14.9)	247 (15.4)	329 (15.3)
Discharged	466 (84.6)	1348 (84.3)	1814 (84.3)
Total	551 (100)	1600 (100)	2151 (100)
Discharged			
Recovered	331 (71.0) ^a	848 (62.9) ^a	1179 (65.0)
Nonrecovered	135 (29.0)	500 (37.1)	635 (35.0)
Total	466 (100.0)	1348 (100.0)	1814 (100.0)

¹ Values are *n* (%). Multivariate analysis indicated that this difference was not statistically significant after control for children's age and anthropometric measures at admission: ^a*P* = 0.005. SAM, severe acute malnutrition

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

TABLE 6

Mean weight gain and length of stay in the community-based phase of the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Discharged recovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	2.4 ± 2.1 ⁵	2.2 ± 1.9	2.2 ± 1.9
Mean length of stay (d)	61.6 ± 10.1	61.7 ± 9.5	61.7 ± 9.7
No. of children	331	848	1179
Discharged nonrecovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	0.5 ± 0.8	0.4 ± 0.8	0.5 ± 0.8
Mean length of stay (d)	62.5 ± 11.4	61.2 ± 7.7	61.5 ± 8.6
No. of children	135	500	635
Discharged all children			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	1.9 ± 2.0 ^a	1.5 ± 1.8 ^a	1.6 ± 1.9
Mean length of stay (d)	61.8 ± 10.5	61.5 ± 8.9	61.6 ± 9.4
No. of children	466	1348	1814

¹ Multivariate analysis indicated that this difference was not statistically significant after control for children's age and anthropometric measures at admission: ^a*P* = 0.005. SAM, severe acute malnutrition

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

⁵ Mean ± SD (all such values).

P = 0.001), height (70.2 ± 7.4 compared with 71.4 ± 8.6 cm; *P* = 0.006), age (18.5 ± 9.9 compared with 19.8 ± 1.1 mo; *P* = 0.02), WHZ less than -4 (25.1% compared with 16.3%; *P* = 0.001), and MUAC <110 mm (44.6% compared with 38.7%; *P* = 0.02). A multivariate analysis indicated that the differences in mean weight gain and recovery rates between complicated and uncomplicated cases were not statistically significant after control for children's age and anthropometric measures at admission.

A multivariable logistic regression analysis indicated that the odds of recovery (gaining ≥15% of initial weight) were higher among children who were 6–23 mo old (adjusted OR: 1.03; 95% CI: 1.02–1.04; *n* = 1416), children with WHZ less than -4 SD (adjusted OR: 1.50; 95% CI: 1.21–1.85; *n* = 318), and children with MUAC <110 mm (adjusted OR: 1.74; 95% CI: 1.54–1.96; *n* = 701). Importantly, at discharge, the proportion of children with MUAC <115 mm was significantly higher among the children discharged recovered (≥15% of initial weight; *n* = 1179) than among the children discharged nonrecovered (<15% of initial weight; *n* = 635)—53.1% compared with 31.2% (*P* = 0.001)—whereas the proportion of children with WHZ

less than -3 was not significantly different among children discharged recovered and children discharged nonrecovered (58.6% compared with 60.6%; *P* = 0.371).

DISCUSSION

Three important features of the children admitted are their sex (56% girls), age (79% in the age group 6–23 mo), and social identity (64% from scheduled tribes or castes). Therefore, programs for children with SAM in Madhya Pradesh need to give priority to children younger than 2 y—particularly girls—from socioeconomically disadvantaged groups. Strikingly similar values have been reported in other states of India (12).

The program achieved survival outcomes (0.4% child deaths) that compared favorably with national (<5% child deaths) and international (<10% child deaths) standards of care (13, 14). This is extremely important because the primary objective of the program was to reduce fatality rates among children with SAM. Mortality rates in the IM-SAM program in Madhya Pradesh are significantly lower than those observed in Community

TABLE 7

Outcomes at discharge from the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Exits			
Deaths	4 (0.6)	6 (0.3)	10 (0.4)
Defaulters	218 (31.7)	642 (32.2)	860 (32.0)
Discharged nonrecovered	135 (19.6)	500 (25.0)	635 (23.7)
Discharged recovered	331 (48.1) ^a	848 (42.5) ^a	1179 (43.9)
Total	688 (100)	1996 (100)	2684 (100)

¹ Values are *n* (%). Multivariate analysis indicated that this difference was not statistically significant after control for children's age and anthropometric measures at admission: ^a*P* = 0.01. SAM, severe acute malnutrition

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

TABLE 8

Mean weight gain and length of stay in the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with complicated SAM ²	Children with uncomplicated SAM ³	All children with SAM ⁴
Discharged recovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	3.8 ± 2.1 ⁵	3.5 ± 1.8	3.5 ± 1.9
Mean length of stay (d)	76 ± 10.1	75.9 ± 9.6	75.9 ± 9.7
No. of children	331	848	1179
Discharged nonrecovered			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	1.2 ± 0.6	1.2 ± 0.6	1.2 ± 0.6
Mean length of stay (d)	76.7 ± 11.5	75.4 ± 7.7	75.7 ± 8.6
No. of children	135	500	635
Discharged all children			
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	3.0 ± 2.1 ^a	2.6 ± 1.9 ^a	2.7 ± 1.9
Mean length of stay (d)	76.2 ± 10.5	75.7 ± 8.9	75.8 ± 9.4
No. of children	466	1348	1814

¹ Multivariate analysis indicated that this difference was not statistically significant after control for children's age and anthropometric measures at admission: ^a*P* = 0.0001. SAM, severe acute malnutrition

² SAM with bilateral pitting edema and/or medical complications.

³ SAM without bilateral pitting edema or medical complications.

⁴ Children with complicated or uncomplicated SAM.

⁵ Mean ± SD (all such values).

Management of Acute Malnutrition (CMAM) programs elsewhere (15). Fifty-six children (2.0%) with severe congenital or pathological conditions were transferred to the district hospital and were not transferred back to the IM-SAM program. In a worst-case scenario analysis (ie, these 56 children stayed in the IM-SAM program and died), the death rate in the program (2.4%) would still be low. If confirmed by other studies, reasons for this apparent lower mortality among SAM children in India deserve further investigation.

The proportion of defaulters (32.0%) was higher than national and international standards of care (<15%) (13, 14). Almost two-thirds (61.7%) of the children who defaulted did so during the facility-based phase of the program, potentially because of the high opportunity cost to the family from their child being in a facility for 14 consecutive days. Similarly high defaulter rates have been reported by facility-based programs in India (12, 16, 17). By the time they defaulted the facility-based phase of the program, 65 children (12% of defaulters) had gained ≥15% of their initial weight—the minimum weight gain recommended by WHO to discharge children as recovered (10). Similarly, by the time they defaulted the community-based phase of the program, 107 children (32.5%) had gained ≥15% of their initial weight. Thus, only 25.6% of children defaulted the program before attaining the target weight gain. These children would be the true defaulters had the discharge criteria been based on minimum weight gain rather than on minimum length of stay.

The proportion of children discharged from the program (67.6%) was below national and international standards of care (>75%) (13, 14), mostly because of the significant proportion of children who defaulted the program before completing the required length of stay. The mean weight gain while in the facility-based phase of the program (6.8 ± 5.1 g · kg body wt⁻¹ · d⁻¹) was higher than that achieved by therapeutic programs that have used energy-dense local foods in nutrition rehabilitation units in India (5 g · kg body wt⁻¹ · d⁻¹) (16) but was below the minimum of 8 g · kg body wt⁻¹ · d⁻¹ recommended both nationally and internationally (13, 14). This suggests that the nutrient

quality of the therapeutic foods used in the NRC is suboptimal, potentially because of the absence of some essential nutrients.

The mean weight gain during the community-based phase of the program (1.6 ± 1.9 g · kg body wt⁻¹ · d⁻¹) was lower than that observed in CMAM programs elsewhere (4–5 g · kg body wt⁻¹ · d⁻¹) (15), which indicated that the nutrient density of the foods used in this phase of the program was less than adequate to ensure appropriate weight gain and timely recovery. Evidence shows that appropriate therapeutic foods for CMAM (with a nutrient composition as per WHO recommendations) are as effective or more effective than F-100 in supporting rapid catch-up

TABLE 9

Program outcomes among children who were severely wasted when they were transitioned from the facility-based to the community-based phase of the Integrated Program for Children With Severe Acute Malnutrition, Madhya Pradesh, India (1 January to 31 December 2010)¹

Outcomes	Children with severe wasting
Deaths [<i>n</i> (%)]	8 (0.6)
Defaulters [<i>n</i> (%)]	242 (17.6)
Discharged [<i>n</i> (%)]	1129 (81.8)
Exits [<i>n</i> (%)]	1379 (100.0)
Discharged recovered	
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	2.5 ± 2.2 ²
Mean length of stay (d)	61.6 ± 10.5
No. of children	777
Discharged nonrecovered	
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	0.6 ± 0.9
Mean length of stay (d)	61.1 ± 7.6
No. of children	352
Discharged all children	
Mean weight gain (g · kg body wt ⁻¹ · d ⁻¹)	1.9 ± 2.1
Mean length of stay (d)	61.5 ± 9.7
No. of children	1129

¹ Wasting is defined as a weight-for-height *z* score less than -3 and/or a midupper arm circumference <115 mm.

² Mean ± SD (all such values).

growth in children with SAM (18), can be safely used in community programs (15), are well accepted by Indian children (19), and support a mean weight gain in Indian children that ranges from 5.26 to 7.0 g · kg body wt⁻¹ · d⁻¹ (S Burza, personal communication, 2013; M Ayoya, personal communication, 2010).

Our findings indicate that the odds of recovery were higher among children with lower MUAC or WHZ at admission and that the proportion of children with MUAC <115 mm at discharge was significantly higher among children discharged as “recovered.” These findings question the relevance of a minimum weight gain (≥15% of initial weight) as a valid discharge criterion, because it seems to result in the premature discharge of children with poorer anthropometric measures at admission. There is a growing consensus that a minimum MUAC cutoff may be better discharge criteria (S Collins, personal communication, 2013).

In conclusion, the current strategy, protocols, and therapeutic foods need to be improved. Particular attention should be paid to 1) identifying children with SAM when they are younger and less severely wasted by using MUAC <115 mm (10); mobilizing communities to identify children with SAM early is essential; 2) admitting to NRCs only children with complicated SAM and keeping these children in the NRC until complications disappear and weight gain starts and no longer; 3) providing care for all children with uncomplicated SAM in the community; >50 countries have adopted this approach to address SAM as a public health problem (20); 4) using appropriate therapeutic foods—both in the facility- and community-based phases of the program—in line with the composition recommended by WHO to ensure both adequate weight gain and full recovery (21); appropriate therapeutic foods for CMAM are now manufactured to international quality standards in several countries—including in India—and there is an emerging consensus as to why and how they can be used in India (22–25); 5) discharging children on the basis of a minimum MUAC (≥125 mm for example), not on the basis of a minimum length of stay or a minimum weight gain; and 6) ensuring that once discharged from the IM-SAM program, children benefit from the ICDS program, including its supplementary nutrition and growth monitoring and promotion services, to provide mothers and caregivers with the information, counseling, and support they need to feed and care for their children.

Considering the burden of SAM in India, treating all children with SAM in NRCs is not operationally feasible; facility-based programs for the management of SAM, even if effective in terms of the recovery of treated children, will fail to tackle SAM as a public health problem (26): coverage is of the essence for population level impact (27). In Madhya Pradesh, the state with the largest network of NRCs in India, it is estimated that <5% of children with SAM are ever treated. Three-fourths of the children admitted to the program had uncomplicated SAM. International guidelines recommend that such children be cared for through a CMAM program (28). There is consensus among Indian scientists and practitioners that CMAM for children with uncomplicated SAM is an unavoidable alternative (29) because this approach is safer to children (lesser risk of cross-infection) and less costly to families and the health system (26).

The experience in Madhya Pradesh demonstrates that existing health systems can be strengthened with feasible adjustments to provide effective care for children with SAM through an

integrated model that comprises facility- and community-based therapeutic care; while saving lives, the IM-SAM program in Madhya Pradesh is paving the way for evidence-based strategies to care for children with SAM in India.

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