

# Comparison of Two Growth Charts in Lesotho: Health Workers' Ability to Understand and Use Them for Action

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## ABSTRACT

**Background:** Two growth monitoring charts widely used for growth monitoring in Africa (the Road-to-Health (RTH) and the Growth Surveillance (GS)) were compared in order to assist the Government of Lesotho to decide on an appropriate national growth chart.

**Methods:** Thirty-four health workers were taught and tested on the RTH during a first week of training and on the GS during a second week (the RTH-GS group), while the order was reversed for another 25 trainees (the GS-RTH group). The health workers were trained and tested on their ability not only to use and interpret the two charts, but also to make the right decisions about specific actions to be taken when growth faltering occurs.

**Results:** There was no difference between scores to the RTH and GS charts after one week of training. After the second week of training, the scores to the RTH chart improved and became better than those to the GS chart. The scores to the GS test did not increase with previous knowledge of the RTH chart.

**Conclusions:** For this reason and others discussed in the paper, the RTH chart was recommended for nationwide use in Lesotho. The adoption of this recommendation was facilitated by the close involvement in this research of public and private agencies responsible for growth monitoring in Lesotho (*Am J Public Health* 1991;81:610-616).

Marie T. Ruel, PhD, David L. Pelletier, PhD, Jean-Pierre Habicht, PhD, John B. Mason, PhD, C. S. Chobokoane, PhD, and Arapang P. Maruping, MD, MPH

## Introduction

Growth monitoring has been promoted by international agencies and local governments as one of the principal activities to combat malnutrition among young children in developing countries.<sup>1,2</sup> Growth charts are used

- as an educational and promotional tool, i.e., to make the dynamic process of growth visible to both health workers and mothers and to motivate them to take action to improve or maintain the child's nutritional status<sup>3</sup> and

- as a screening tool to allow the early detection of growth faltering in children and the targeting of appropriate interventions.<sup>4</sup>

Four conditions are necessary for growth charts to be useful for either educational or screening purposes. First, the child's age and weight data must be reasonably accurate. Second, health workers must be able to understand and interpret growth charts properly. Third, once growth faltering is detected, health workers must be able to identify the appropriate actions that need to be taken. Fourth, mothers must also be able to understand the growth charts and the messages provided by the health workers. The second and third issues are addressed in the present paper and the fourth one is discussed elsewhere.<sup>5</sup>

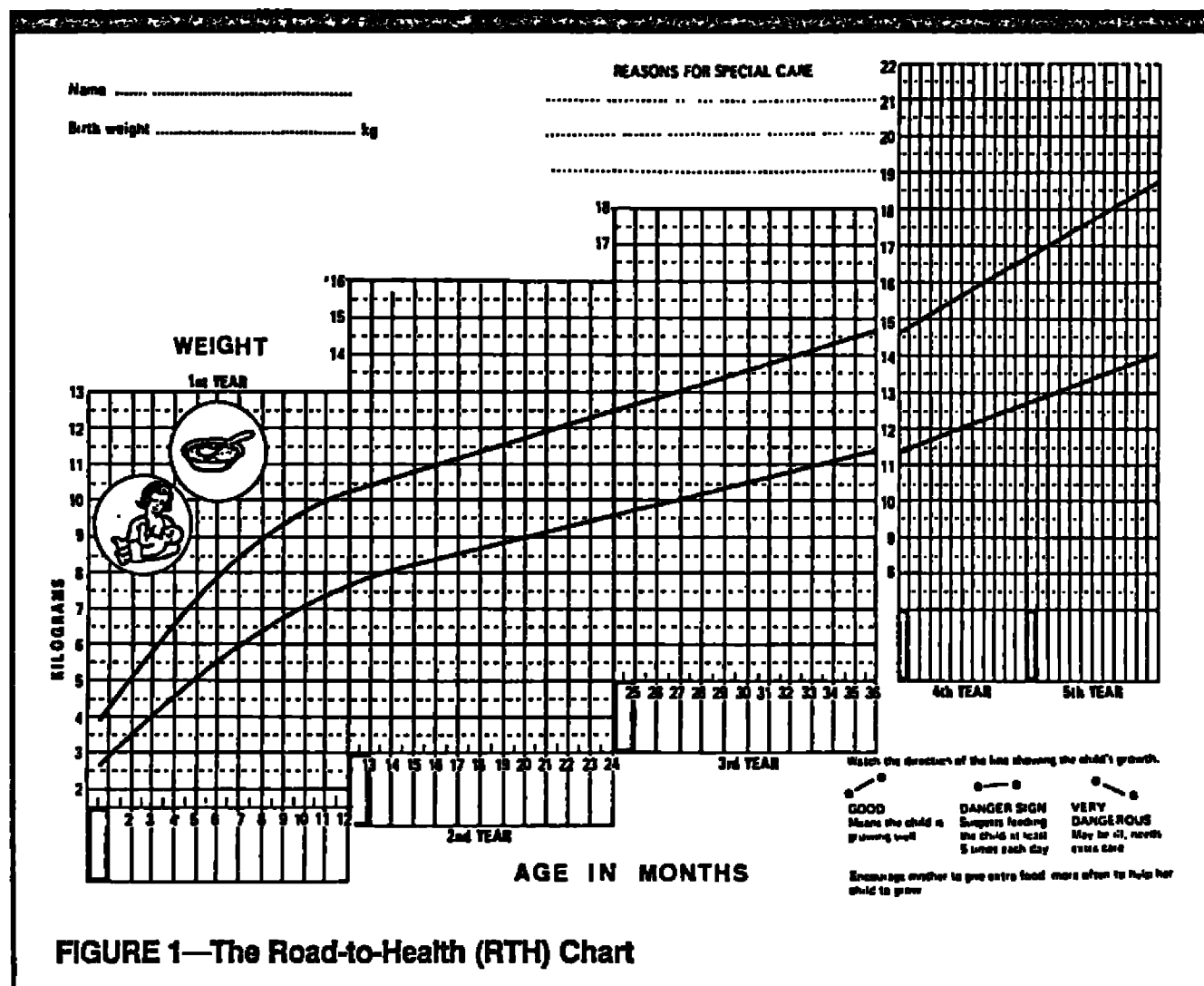
In Lesotho, a small kingdom surrounded by the Republic of South Africa, the concern about health workers' and mothers' ability to understand growth charts originated from the widespread use of two different charts throughout the country. The Ministry of Health, which administered approximately one-third of the Primary Health Care clinics, was using the World Health Organization (WHO)<sup>6</sup>

version of the Road-to-Health chart (Figure 1). The remaining clinics were administered by the Catholic Relief Services and used the Growth Surveillance system.<sup>7</sup> This system consists of two charts: the Master Chart (Figure 2A), retained at the clinic for statistics compilations and the Growth Surveillance chart (Figure 2B), taken home by mothers.

In Lesotho, both charts had strong proponents. Those advocating the Growth Surveillance chart emphasized the fact that this chart had been developed in Africa and was more socially and culturally acceptable for African health workers and mothers. Although the superiority of this chart over the Road-to-Health had never been tested, it was assumed that, for Africans, a straight flat line would be a better graphical representation of adequate growth (regular weight increase) than an ascending slope. On the other hand, the proponents of the Road-to-Health chart felt that African mothers were not different from other mothers in understanding a positive slope as representing adequate growth and a negative slope as a sign of weight loss. Furthermore, proponents of the Road-to-Health chart felt that it was easier for health workers to learn and

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Address reprint requests to Marie T. Ruel, Institute of Nutrition of Central America and Panama (INCAP), Carretera Roosevelt, Zone 11, Apartado 1188, Guatemala, Guatemala, Central America. Drs. Pelletier and Habicht are with the Division of Nutritional Sciences, Cornell University, Ithaca, NY. Dr. Mason is Technical Secretary, ACC/SCN, World Health Organization, Geneva. Dr. Chobokoane is with the Food and Nutrition Coordinating Office, Prime Minister's Office, Maseru, Lesotho. Dr. Maruping is WHO Medical Officer, Harare, Zimbabwe. This paper, submitted to the Journal March 13, 1990, was revised and accepted for publication December 17, 1990.



one represents the median values for the reference population (50th percentile of the National Center for Health Statistics standards for boys<sup>6</sup>) and the lower one represents the NCHS third percentile for girls.<sup>6</sup> The GS chart contains the *percentage* of median weight-for-age (using the Harvard standards)<sup>7</sup> on the vertical axis and age in months on the horizontal one. Thus a straight line on this chart represents a child whose growth continues at a constant percentage of the standard weight-for-age. A green horizontal band (black in Figure 2B) delimits the so-called zone of "adequate growth" which corresponds approximately to the "Road-to-Health" on the RTH chart. A Master Chart (Figure 2A) must be used before plotting the data on the GS chart to find the corresponding percentage of standard weight-for-age for each child.

The decisions to be taken after weighing a child as developed by the Steering Committee (Appendix II) were also taught and used in the final test to assess the health workers' ability to use the charts for decision-making.

### Teaching and Testing Procedures

One experienced teacher, who had been trained by the Catholic Relief Service and the Ministry of Health staff on the GS and the RTH charts, respectively, conducted all the teaching sessions. The format of the lecture on each chart had been standardized so that the amount of time spent on each aspect of the chart was the same for both. All lectures were taped and reviewed by the project director (MR) to ensure uniformity of content and lack of bias in the teaching.

On their first day, all participants were tested on their knowledge and understanding of both charts (baseline test) and information was collected on their previous exposure to the charts and work experience in primary care clinics. Each week of training in each chart consisted of approximately six hours of theory and six hours of practice. The training was done in a classroom setting using case histories. The trainees were instructed on how to calculate age given the date of birth (using a standard technique), how to plot hypothetical weights on growth charts, how to interpret growth curves, and what decisions to make (see Appendix II: Guidelines for Action).

The participants' knowledge, interpretation of the chart, and ability to make the appropriate decisions as prescribed by the Guidelines for Action were tested at the end of each training week. The final tests (one for the RTH and one for the GS)

interpret than the Growth Surveillance chart. UNICEF fostered this study to resolve these differences of opinion.

A Steering Committee, composed of members from various institutions involved in growth monitoring in Lesotho (see Appendix I for the list of participating institutions), was formed to advise the Government of Lesotho in the choice of a single growth chart to be used uniformly throughout the country. The final decision was to be based on the result of two studies, one that assessed health workers' ability to understand and use the charts for decision making (present study) and one that compared mothers' understanding of the two charts.<sup>5</sup> This Committee was involved in discussions and decisions about the various aspects of the research, including setting the objectives, choosing the experimental design, and developing the questionnaires and testing instruments. It also participated in the development of "Guidelines for Action", i.e. guidelines for decisions to be taken from the results of a weighing (Appendix II). Finally, the Steering Committee played a crucial role in facilitating implementation of the study in the field and in reviewing the results and discussing the inferences and implications for the country.

The objectives of the present study were to evaluate health workers' understanding and skills in using and interpreting the two growth charts after one week of training in each one, and in using the information for counseling and referral

decisions according to the actions the Committee felt were indicated.

## Methods

### Study Sample and Design

Fifty-nine health workers from four hospital training centers of Lesotho were included in the study. Each participant was taught the two charts on two consecutive weeks.

A cross-over design was used to examine and take into account possible carry-over effects occurring when the learning of a chart taught second is made easier by the knowledge of the first chart. Therefore, two different treatment sequences were used and training centers were randomly assigned to either one: Hospitals A and B were taught the Growth Surveillance chart first and the Road-to-Health chart second (GS-RTH group), while Hospitals C and D were reversed and taught the Road-to-Health chart first and the Growth Surveillance chart second (RTH-GS group).

### Growth Charts Used

The two charts compared were the RTH (Figure 1) and the GS (Figure 2B) chart. On the RTH chart, weight in kilograms forms the vertical axis and age of the child in months (ranging from 0-60 months) is on the horizontal axis. Two curves are printed on the chart and delimit the "Road-to-Health" zone. The upper

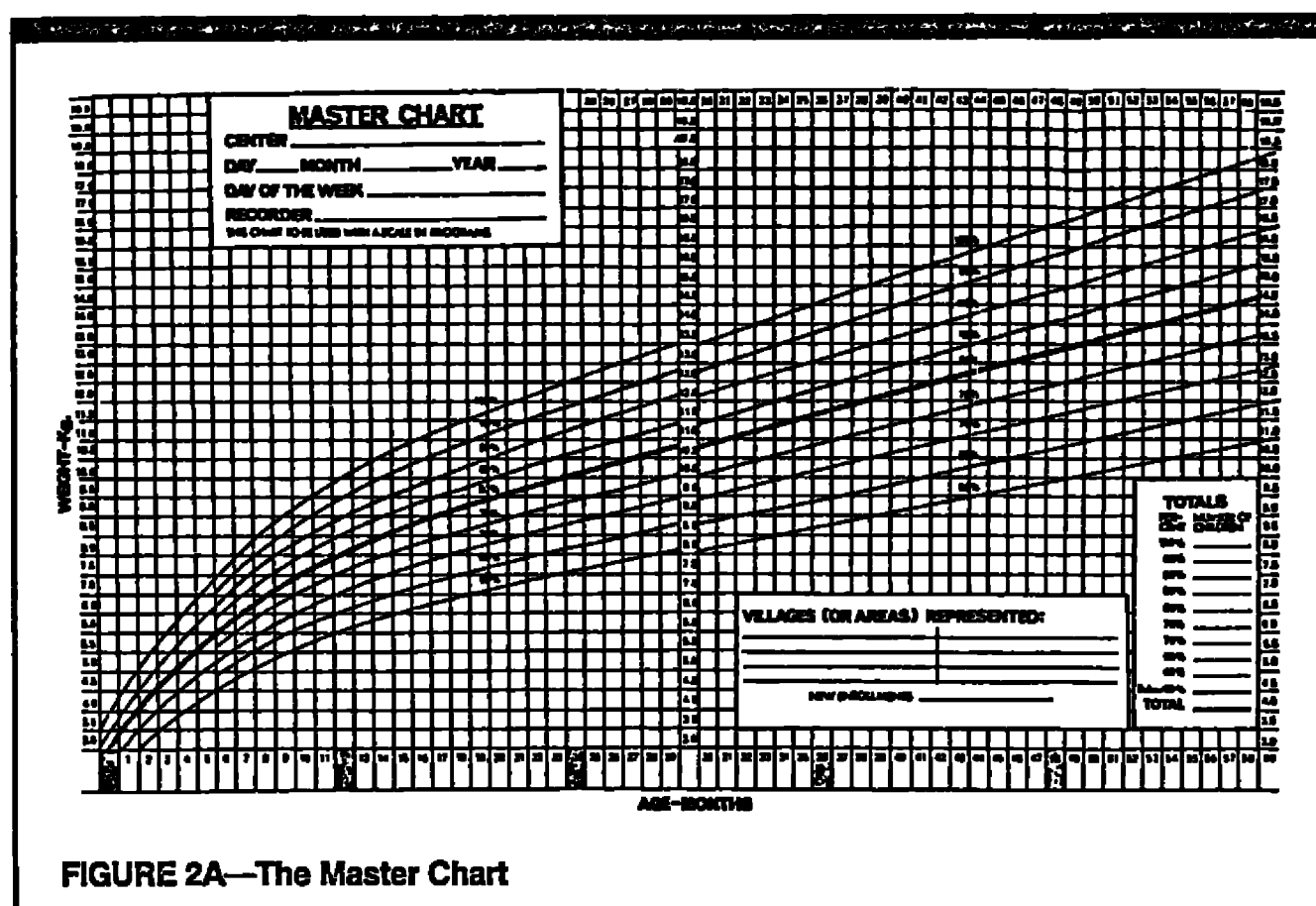


FIGURE 2A—The Master Chart

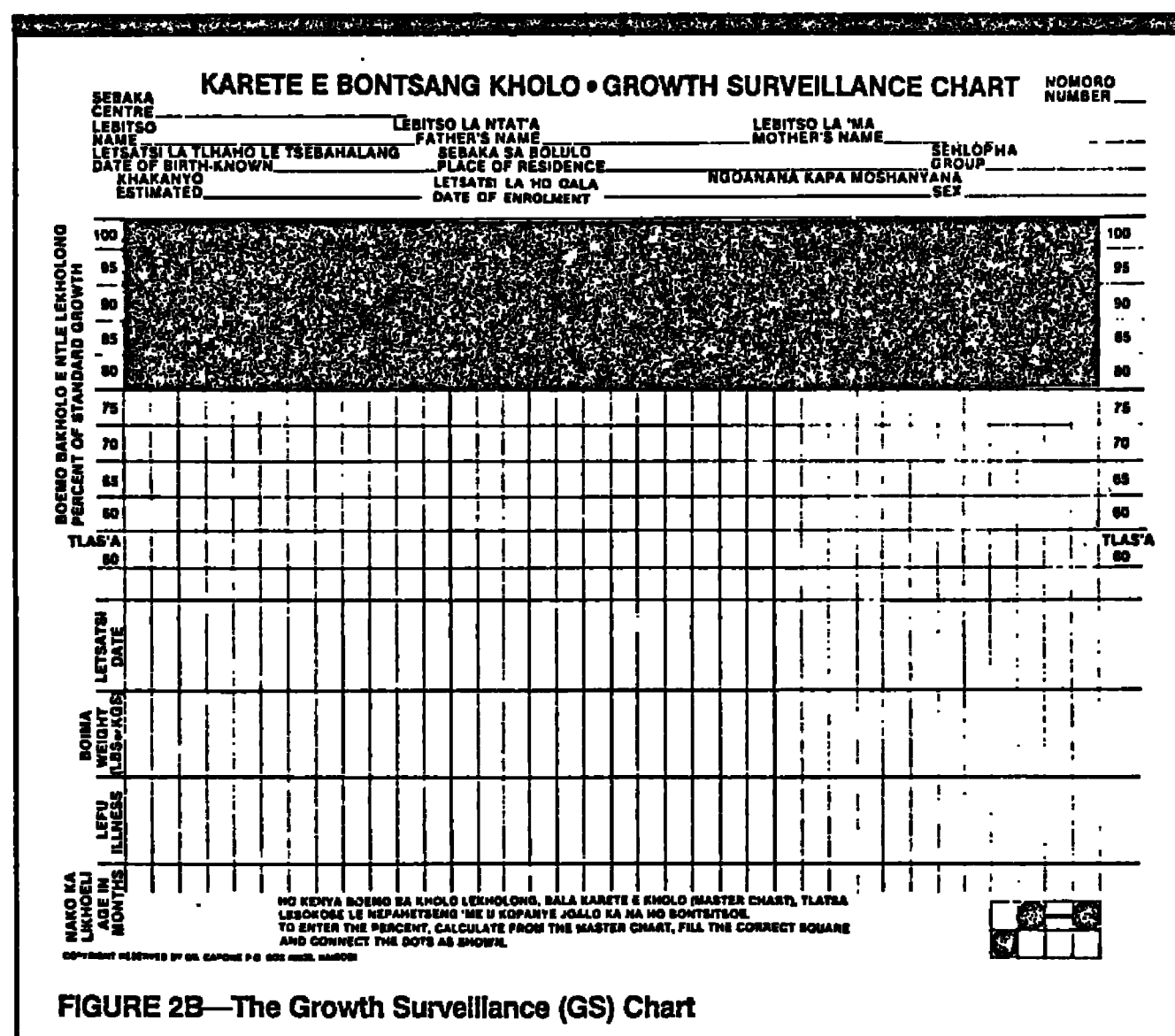


FIGURE 2B—The Growth Surveillance (GS) Chart

were very similar in their format and degree of difficulty. They were composed of case histories with questions on: age calculation, plotting of weights on the charts, interpretation of growth charts, and ability to use the Guidelines for Action.

### Analytical Methodology

The total scores to the final tests as well as their different components were compared using t-tests, and confidence intervals were calculated using standard techniques.<sup>8</sup> The multivariate analysis of variance pro-

cedure (MANOVA)<sup>9</sup> was used to test main effects (chart, teaching period, training center) and interactions (particularly the carry-over effect, or treatment by period interaction); to control for baseline scores, age calculation scores and inter-hospital variability (using a nested design); and to obtain adjusted means and standard errors. The data were coded, entered and analyzed in Lesotho, using the Lesotho Food and Nutrition Coordinating Office (FNCO) micro-computer facilities, and the SPSS/PC+ statistical package.

### Results

The overall score to the baseline test on growth charts knowledge was 3.4 out of 10 possible points and did not differ between training centers. Although work experience varied between participants (from 0 to 48 weeks), their poor knowledge of growth charts suggests that they had never received proper training in either chart.

A positive carry-over effect was found in the ANOVA model (significant interaction between chart and teaching schedule), meaning that prior training in one chart facilitated the learning of the second chart. Due to these findings, comparisons between the charts are presented separately for first training and for second week training.

Table 1 shows the results of the tests after training for all participants grouped by hospital and training schedule. In spite of similar baseline results, some differences between training centers were observed in the final scores. On average, Hospital B had higher scores than the other training centers, for both final tests, while Hospital C had lower scores. To control for the hospital variability, further analyses were done by analysis of variance (MANOVA procedure<sup>9</sup>), using a nested effect model (hospital within training schedule group). The baseline scores were also included in the model as covariates to adjust the final scores. The results of this analysis are presented in Table 2, which shows a comparison of the RTH and GS scores (unadjusted and adjusted) obtained on first week training and upon second week training, for the four hospitals grouped by training schedule. On first week training, the difference between the charts was minimal. Upon second week training, however, the scores to the RTH test were 15–20 percent higher (adjusted and unadjusted means, respectively) than the scores to the GS chart. This large difference between the charts resulted from a positive carry-over effect from first to second week training, observed only when the RTH chart was taught second: the GS-RTH group improved their score markedly from the first to the second week of training (+5.82, unadjusted means), while the RTH-GS group decreased their score from the first to the second week of training (–.76, unadjusted means). Examination of the components making up the total score to the final tests reveals that most of the carry-over effect seen in the GS-RTH group was due to the marked improvements in the interpretation and action questions (Table 1, Hospitals A and B).

**TABLE 1—Results of the Final GS and RTH Tests, by Hospital and Training Schedule\* (Group)**

Group/Hospital	GS Test				RTH Test			
	Age <sup>b</sup>	Plotting <sup>c</sup>	Interpretation/ Action <sup>d</sup>	Total	Age	Plotting	Interpretation/ Action	Total
<b>Group 1: GS-RTH<sup>e</sup></b>								
Hospital A	4.54 (1.13)	3.45 (1.27)	25.15 (8.63)	33.16 (9.67)	4.46 (1.39)	4.46 (0.88)	31.92 (5.63)	40.84 (6.52)
Hospital B	4.00 (0.95)	4.00 (1.00)	33.90 (6.47)	41.90 (7.30)	4.09 (1.73)	4.38 (1.28)	38.09 (3.05)	46.57 (4.33)
A + B Pooled	4.20 (1.04)	3.79 (1.12)	30.56 (8.43)	38.56 (9.22)	4.23 (1.60)	4.41 (1.13)	35.73 (5.14)	44.38 (5.90)
<b>Group 2: RTH-GS<sup>e</sup></b>								
Hospital C	3.10 (1.52)	2.30 (1.70)	23.50 (8.42)	28.90 (11.03)	3.50 (0.97)	3.20 (1.50)	24.00 (8.31)	30.70 (9.47)
Hospital D	3.67 (1.59)	2.80 (1.57)	30.20 (9.06)	36.67 (11.07)	3.73 (1.62)	4.06 (1.28)	28.93 (8.80)	36.72 (10.38)
C + D Pooled	3.44 (1.56)	2.60 (1.61)	27.52 (9.26)	33.56 (11.50)	3.67 (1.38)	3.72 (1.43)	26.96 (8.79)	34.42 (11.50)

\*The sample sizes were: Hospital A (n = 13), Hospital B (n = 21), Hospital C (n = 10), Hospital D (n = 15).  
<sup>b</sup>Age: Calculation of age (maximum score = 5 points). Method was the same for both charts.  
<sup>c</sup>Plot: Plotting of weights on charts (maximum score = 5 points).  
<sup>d</sup>Interpretation and action: Interpretation of growth patterns and decision about actions to be taken, using the chart-specific Tables of Action (maximum score = 41).  
<sup>e</sup>GS-RTH: GS taught first; RTH-GS: RTH taught first.  
 NOTE: The numbers in this table are means with standard deviations in parentheses.

Age calculation scores, on the other hand, did not improve from first to second training, but differed between hospitals, following a similar pattern as that observed for the overall scores. Since age calculation was independent of the charts, the differences observed between hospitals reflected variations in intrinsic learning capabilities of the health workers. An analysis of the sum of the interpretation and action scores was done that controlled for both hospital variability (using the nested design described previously) and differences in learning capability as proxied by age calculation confirmed the inferences drawn from Table 2. There was no substantial difference between the scores of the RTH and GS charts,  $-2.17$  (with 95% confidence intervals (CI) of  $-6.67$  to  $2.33$ ) after the first week of training. A significant improvement in the adjusted interpretation and action score from  $31.81 \pm 1.28$  (standard error) to  $38.16 \pm 1.11$  occurred when the RTH was taught in the second week. This contrasted with no improvement (from  $33.98 \pm 1.84$  to  $33.86 \pm 1.59$ ) when GS was taught in the second week. Thus the final adjusted score for interpretation and action was  $4.3$  (with CI of  $.43$  to  $8.17$ ) in favor of RTH after the second week of training.

## Discussion

In contrast to a previous study that tested health workers' skills in using different growth charts,<sup>10</sup> our study stan-

dardized the educational input across charts, and the participants were tested not only on their ability to understand, use, and interpret growth charts but also on their skills in using the Guidelines for Action to make the right decisions about a particular child. These guidelines were developed by Basotho experts involved and

experienced in growth monitoring and maternal and child care. The feasibility in actual field conditions of implementing the actions proposed was an important consideration in the creation of these guidelines.

The present study had two major findings. First, at the end of the first train-

**TABLE 2—Mean Scores to the GS and RTH Tests, by Group (Schedule of Training) and Week of Training\***

	Results to the Final Test on		Difference between Charts
	GS Chart	RTH Chart	Difference (95% CI) <sup>b</sup>
<b>First week training</b>			
	<b>Group 1: GS-RTH</b> (Hospitals A and B)	<b>Group 2: RTH-GS</b> (Hospitals C and D)	
Unadjusted means	38.56	34.32	+4.24 (−84.9, 32)
(SE)	(1.58)	(2.06)	
Adjusted means <sup>c</sup>	37.41	35.57	+1.84 (−3.94, 7.63)
(SE)	(1.67)	(2.36)	
<b>Second week training</b>			
	<b>Group 2: RTH-GS</b> (Hospitals C and D)	<b>Group 1: GS-RTH</b> (Hospitals A and B)	
Unadjusted means	33.56	44.38	−10.82 (−5.90, −15.74)
(SE)	(2.30)	(1.01)	
Adjusted means <sup>c</sup>	36.04	43.77	−7.73 (−2.46, −13.00)
(SE)	(2.20)	(1.55)	

\*Sample sizes were: group 1 (n = 34) and group 2 (n = 25).  
<sup>b</sup>95% confidence interval.  
<sup>c</sup>The means were adjusted for hospital variability and for baseline scores, using the MANOVA<sup>9</sup> procedure and a nested design model (hospital within group).



ing week, the health workers who were taught the RTH understood their chart as well as those who were taught the GS chart. Thus, the argument that the GS was easier to learn for inexperienced African health workers was not substantiated. Second, when the participants were taught a second chart, those taught the RTH chart scored approximately 15 percent higher than those who were taught the GS chart. This improvement was not observed when the schedule of teaching was reversed: RTH first and GS second.

The improvement when RTH was taught second was achieved mainly through higher scores in the interpretation and action questions which measured the health workers' ability to identify appropriate interventions to be given to hypothetical children from the case histories. Since the guidelines were almost identical for the two charts,\* it was expected that participants would master them better at the end of the second week, irrespective of the teaching sequence. However, our results showed no improvement on these questions and in the total score for those taught the GS chart on the second week (RTH-GS group). This finding suggests that prior knowledge of the RTH did not facilitate the learning of the GS chart and may even have confused the trainees because the visual presentation of growth in the GS chart is counterintuitive.

This finding is important since it is related to a situation that exists in many African countries: health workers that have been using a RTH-type chart for many years have to change to the GS system when the Catholic Relief Service Food and Nutrition Program is introduced; this requires intensive retraining of all the health workers. If the prior knowledge and experience with another chart (in this case the RTH) did facilitate the learning of the GS chart, the whole effort involved in the change of system would be reduced and potentially justifiable. How-

ever, the results of our study suggest that this was not the case in Lesotho.

Therefore, our conclusion from this study is that, in Lesotho, the RTH would be a better choice than the GS chart for two reasons. First, since health workers could learn and understand the RTH as well as the GS chart after the first week of teaching, it would be an appropriate chart for training inexperienced people. Second, and more important, in the context of Lesotho where retraining is a crucial issue, the RTH chart would be superior since second week training on the RTH improved the scores of those previously trained in the GS chart.

These recommendations are in accordance with those made in a concurrent study<sup>5</sup> showing that mothers who were taught the RTH learned significantly more about their chart than those who were taught the GS chart. Thus our overall conclusion from these two studies is that, in Lesotho, the RTH would be a more appropriate national chart than the GS. Nevertheless, it would be useful to replicate these results elsewhere in Africa where literacy of mothers and health workers is lower and more typical of much of Sub-Saharan Africa. It would also be interesting to re-assess health workers' ability to use and interpret the two charts after use in growth monitoring activities.

We believe that the use of information from applied research, such as this, is fostered by the involvement of the national decision makers at all stages of the research process. In Lesotho, the decision was made to use a RTH-type chart on a nationwide basis, as recommended by our study. □

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### APPENDIX I

List of Institutions Participating in the Steering Committee in Charge of the Study

Name of Institution
Bureau of Statistics of Lesotho
Catholic Relief Services
Food and Nutrition Coordinating Office
Joint Program in Nutritional Surveillance of the UNICEF (Eastern and Southern Africa Regional Office) and the Cornell Nutritional Surveillance Program, Cornell University
Ministry of Agriculture of Lesotho
Ministry of Health of Lesotho
Private Health Association of Lesotho
Red Cross
UNICEF, Lesotho Country Program
World Health Organization

\*The only difference was that for the RTH chart, some recommendations were made for children with constant weight (Appendix II). For the GS chart this was not possible because constant weight cannot be observed directly on the chart.

**APPENDIX IIA— Guidelines for Action Based on the Interpretation of Growth Patterns Plotted on the Road-To-Health (RTH) or the Growth Surveillance (GS) Chart**  
**Part 1. For Children Re-attending the Clinic**

Direction of Growth	Age 0–24 months		Age ≥25 months		
	Gaining Weight	Constant/ Losing Weight	Gaining Weight	Constant Weight (only for RTH <sup>a</sup> )	Losing Weight
<b>Position of Dot</b>					
A) Above 80%	<ul style="list-style-type: none"><li>• Regular plan of action<sup>b</sup></li><li>• Praise/encourage</li></ul>	<ul style="list-style-type: none"><li>• Refer to nursing sister</li></ul>	<ul style="list-style-type: none"><li>• Praise/encourage</li></ul>	<ul style="list-style-type: none"><li>• Regular plan of action (if constant weight for 3 months: refer to nursing sister)</li></ul>	<ul style="list-style-type: none"><li>• Refer to nursing sister</li></ul>
B) Below 80%	<ul style="list-style-type: none"><li>• Regular plan of action</li><li>• Home visit</li></ul>	<ul style="list-style-type: none"><li>• Refer to nursing sister</li><li>• Home visit</li></ul>	<ul style="list-style-type: none"><li>• Encourage</li><li>• Follow-up monthly</li></ul>	<ul style="list-style-type: none"><li>• Regular plan of action (if constant weight for 3 months: refer to nursing sister)</li></ul>	<ul style="list-style-type: none"><li>• Refer to nursing sister</li></ul>
<b>Part 2. For New or Irregular Attenders</b>					
Position of Dot	Age 0–24 months		Age ≥25 months		
A) Above 80%	<ul style="list-style-type: none"><li>• Use "thinness chart"<sup>c</sup></li></ul>		<ul style="list-style-type: none"><li>• Encourage monthly visits</li></ul>		
B) Below 80%	<ul style="list-style-type: none"><li>• Use "thinness chart"</li></ul>		<ul style="list-style-type: none"><li>• Use "thinness chart"</li></ul>		
<b>Results of "Thinness Chart"</b>					
Green		Yellow	Red		
<ul style="list-style-type: none"><li>• Praise/encourage</li><li>• Encourage monthly attendance</li></ul>		<ul style="list-style-type: none"><li>• Refer to nursing sister</li></ul>	<ul style="list-style-type: none"><li>• Refer to nursing sister (very critical in children &lt;24 months)</li></ul>		
<p><sup>a</sup>On the GS chart, constant weight is not detected until the child's % weight-for-height (WTH) drops. In this case, constant weight is detected on the GS chart by a downward slope, similar to the effect of a weight loss.</p> <p><sup>b</sup>See Appendix IIB.</p> <p><sup>c</sup>The "thinness chart" is a weight-for-height well chart.<sup>11</sup> The interpretation of the color code is: Green: WTH between 70% and 80% of the NCHS standards Yellow: WTH between 80% and 90% of the NCHS standards Red: WTH between 90% and 110% of the NCHS standards.</p>					

**APPENDIX IIB**  
**Description of the Regular Plan of Action**

**REGULAR PLAN OF ACTION**

1. Inform mother about her own child's growth (as seen on the growth chart). This should be done with all mothers.
2. Briefly interview mothers about their feeding practices. (Consider each age group: 0–3 months; 4–9 months; 9–12 months; over 1 year).
3. Give advice to mothers concerning specific feeding practices for each age group (taking mothers' reported practices into consideration). Suggested advice for each age group:
  - 0–3 months**
    - Breastfeeding
    - Introduce liquids
  - 4–9 months**
    - Breastfeeding
    - Introduce soft foods: cereals, fruits, vegetables, mashed/pureed eggs
  - 9–12 months**
    - Breastfeeding
    - Continue soft foods
    - Introduce solids
    - Start meat/fish/chicken/peas/beans
    - Give frequent meals (>4/day)
  - >12 months**
    - Breastfeeding
    - Adult foods: 3 food groups
    - Frequent meals (>4/day)