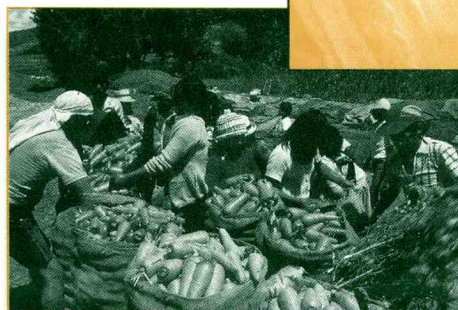
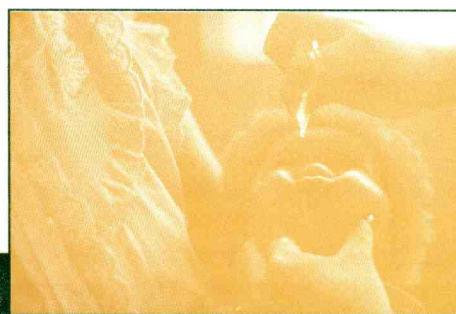


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# Monitoring Vitamin A Programs



 The  
Micronutrient  
Initiative

# Monitoring Vitamin A Programs

Editors:

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ARC 401  
C-8-111  
201 104112



Published by the Micronutrient Initiative  
PO Box 8500, Ottawa ON Canada K1G 3H9

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**Canadian Cataloging in Publication Data**

Main entry under title:  
Monitoring vitamin A programs  
Includes bibliographical references.  
ISBN 1-894217-00-4

1. Vitamin A deficiency--Prevention. I. Cervinskas, Jenny  
II. Houston, Robin III. Micronutrient Initiative (Association).

RA645.V56M67 1998 614.5'9396 C98-900375-2

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Cover photo credits: Top, UNICEF/92-411/Lemoyne; Left, IDRC; Right, MI

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# In memoriam

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This publication is dedicated to the memory of Timothy Stone. Tim, Executive Director of PATH Canada, died on 23 November 1996 while on a mission to Ethiopia and Tanzania to work on vitamin A projects.

Tim devoted much of his life to working to improve people's well-being. With humility and dedication, Tim directed an intense concentration and passion to society's problems and sources of needless suffering such as micronutrient malnutrition, the proliferation of tobacco use in developing countries, landmines, and diseases like malaria and AIDS. This document is one of the last pieces of work with which Tim was involved. Tim is missed by all those who met him, but he lives on in his writings and the contributions he has made to strengthening health and nutrition programs worldwide.

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# Foreword

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The turn of the century, which should herald the virtual elimination of vitamin A deficiency in the world, is fast approaching. Since 1990 when this goal was set at the World Summit for Children, awareness of the problem and action to ensure its elimination have increased enormously. Preliminary results of a recent MI review of global trends in the prevalence of vitamin A deficiency indicate a significant decrease over the past decade. Over the same period, the prevalence of subclinical deficiency shows an upward trend, partly as a result of improved assessment techniques. Today vitamin A deficiency continues to be a problem of enormous magnitude in more than 70 countries; it is a major contributor to child mortality and morbidity and affects as many as 78 million children at a severe or moderate level.

Vitamin A deficiency is being addressed through a combination of interventions: dietary improvement, pharmaceutical supplementation, and food fortification. Although the focus so far has been on providing supplements to young children, other interventions including fortification of common foods, and the promotion of foods rich in vitamin A are gaining ground as they are more sustainable without external support. However, the impact of these measures has been uneven owing to inadequate implementation of programs, poor coverage, and ineffective monitoring.

Experience has revealed new ways to improve the effectiveness of interventions through better communications on dietary practices, expanded channels of supplement delivery, and new opportunities for fortification of staple foods. Such improvements must be supported by well-designed dietary information systems, standard setting, quality control, regulation, and enforcement.

Although the impact of vitamin A interventions can be measured periodically in a population using clinical and biochemical indicators, there is also a need for process monitoring on an ongoing basis. This will ensure the effectiveness of the interventions in delivering required quantities of the micronutrient on a continuous and sustained basis. Increasingly, interventions require the participation of several sectors and careful monitoring at various stages is a critical requirement.

This manual is an attempt to respond to the need for guidelines in the design and implementation of low-cost monitoring systems for vitamin A interventions. It is designed for program managers who are seeking easy-to-follow steps for establishing monitoring systems. Such monitoring systems can also provide a measure of progress toward the goal of ensuring adequate vitamin A status for the population. The guidelines are based on field experience in a variety of countries. However, they must be adapted to suit specific situations and locally determined needs for information.



The Micronutrient Initiative is committed to supporting the global elimination of micronutrient deficiencies and believes that the provision and dissemination of important technical information is key to achieving this objective. We hope that this manual will help in the integration of monitoring systems into vitamin A programs on an ongoing basis to help identify bottlenecks and constraints and overcome them to increase program effectiveness.

*M.G. Venkatesh Mannar*  
*Executive Director*  
*Micronutrient Initiative*

# Preface

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The development of this document began in mid-1995 following completion of an earlier publication entitled *Monitoring Universal Salt Iodization Programmes*. The general idea was to work with experts in various aspects of vitamin A programs and provide a reference document on monitoring of vitamin A interventions that would be useful to program managers. The project was much more complex than imagined. Our goal of incorporating into this document some practical monitoring tools already in use in developing countries was difficult to achieve. Controversies were brewing about the bioavailability of beta-carotene in fruits and vegetables; methods to assess dietary intake of vitamin A were under examination; and vitamin A food fortification programs had not been initiated in many developing countries. For a time the whole project was set aside.

We thank everyone who contributed throughout the lengthy process that brought the document to this point — those who helped develop various sections, those who helped with the framework that provides consistency across sections, and others who patiently reviewed various drafts. Without their input, the document would not have evolved and, although it is by no means complete, it does reflect the hard work of many. We especially thank James Akre, Paul Arthur, Shawn Baker, Sharon Bell, Nicholas Cohen, Joanne Csete, Nita Dalmiya, Omar Dary, Saskia de Pee, Rosalind Gibson, Rolf Klemm, Harriet Kuhnlein, Glen Maberly, Haile Mehansho, Zora Lukmanji, Rose Nathan, David Nelson, David Ross, Sheila Vir, Clive West and Keith West, who all gave freely of their time and energy. Susan Burger, Sian Fitzgerald, Jonathan Gorstein, Janice Johnston, Lynda Keiss, Barbara Underwood, and Caesar Victora deserve a special mention for their contributions.

We appreciate the assistance of Carrie Smith in word processing, Susan Stockwell and Sandra Garland in editing, Alison Greig and Tanya Guay for invaluable assistance that ensured the completion of this document, and Debbie Rupert for layout. We are grateful for the financial support of the Canadian International Development Agency for making this publication possible.

We hope that this distillation of the work of so many reflects the basic elements needed for monitoring vitamin A program activities in a way that is useful to those struggling to establish sustainable national programs and stimulates action to strengthen program monitoring. If it does, then the contributions of those involved will have been worthwhile.

We invite readers to offer comments on the text. Suggestions for improving the manual and examples of readers' experiences in monitoring vitamin A programs and the problems they have encountered would be most welcome. Please use the form provided at the back of this manual.



# 1

# Introduction

---

## **PURPOSE OF THIS MANUAL**

The aim of this manual is to provide guidance on monitoring vitamin A programs. It will interest those involved in designing and implementing programs to eliminate vitamin A deficiency. It should also interest those responsible for monitoring some element of a vitamin A program or evaluating its impact.

People from many sectors, at various administrative levels, are involved in actions to eliminate vitamin A deficiency. Managers at a central, provincial, or district level, whether in government, nongovernmental organizations (NGOs), or private industry, may all find this manual useful.

The manual is designed to

- Introduce key concepts, principles, issues, and terminology related to monitoring interventions to eliminate vitamin A deficiency
- Provide a framework for monitoring the main interventions (i.e., supplementation, dietary improvement, and food fortification)
- Suggest examples of key indicators for measuring progress of these interventions
- Supply information about methods and tools that may be useful in the design and implementation of monitoring activities
- Provide information about the best references and sources of technical support for program monitoring (see Appendix A)

## **WHAT THIS MANUAL DOES NOT DO**

This manual is focused on monitoring vitamin A programs; it does *not* provide guidance on the design of these programs. For those who want to learn more about vitamin A deficiency and the design of programs for its prevention and elimination, see *Further reading* at the end of the various chapters.

This manual provides guidance and a framework for monitoring; it does *not* provide a blueprint or prescribe a single model for monitoring vitamin A interventions.

The primary focus of this manual is on assessing the process of

delivering an intervention, although some information on assessing the biological impact of vitamin A interventions — “impact monitoring” — is also presented.

## HOW TO USE THIS MANUAL

This manual is meant to stimulate thinking about monitoring activities. The guidance it provides is based on collective wisdom gained from experiences throughout the world and on recent published reports on monitoring nutrition interventions. The manual can only provide ideas and make suggestions. Specific information and the monitoring activities needed in each country, for each program, and for every setting will be unique.

Not everyone will find all parts of the document relevant in the context of their country or in terms of their own roles and responsibilities related to vitamin A programs. Some of it may be too technical; some sections may not provide enough detailed information. We urge you to become familiar with this document, think about your own program, then use this manual to help stimulate thinking about how to monitor the program or projects in which you are involved. Focus on the sections you find most relevant and, above all, be imaginative and responsive to your own context.

Although no manual can substitute for appropriate training, some may find the concepts presented here useful for developing training curricula and materials for monitoring activities.

## THE PROBLEM OF VITAMIN A DEFICIENCY

Vitamin A deficiency is a problem of public health significance in over 70 countries (Fig. 1.1; WHO and UNICEF 1995; UNICEF/MI/Tulane University 1997). It is prevalent in parts of most countries in Africa, Asia, and some areas of Latin America, the Caribbean, and the western Pacific. It affects large numbers of preschoolers, school-aged children, and women of child-bearing age. Over 78 million children under 5 years of age are affected by vitamin A deficiency, putting them at risk in terms of their health and survival. About 3 million of these children have some form of vitamin A related eye disease, ranging from night blindness to irreversible partial or total blindness. Of the quarter to half million people who go blind each year, about two-thirds die shortly after, often within weeks.

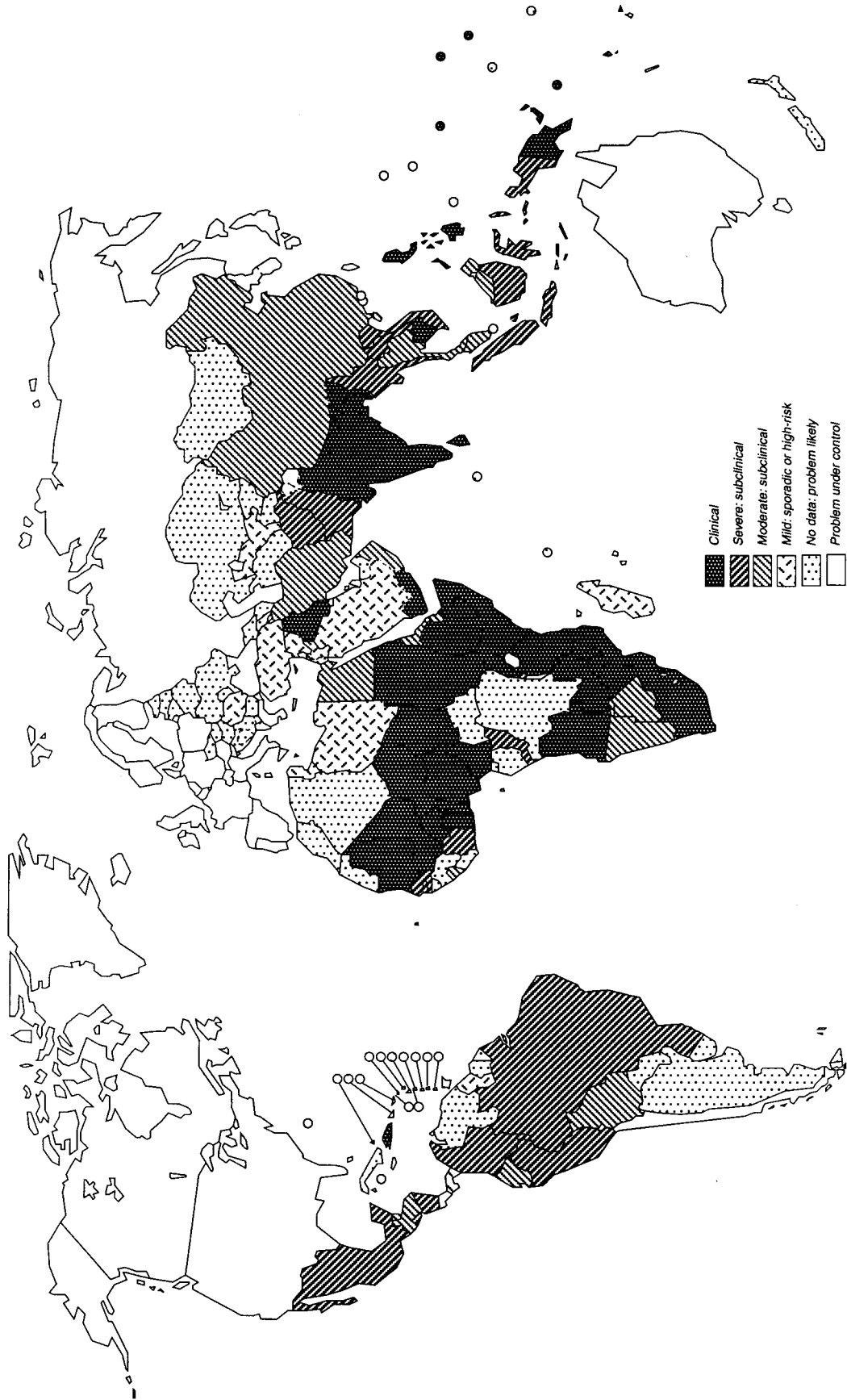
### **SUBCLINICAL VITAMIN A DEFICIENCY**

Tissue concentrations of vitamin A low enough to have adverse health consequences, even if there is no evidence of xerophthalmia. Subclinical deficiency may be categorized as mild, moderate, or severe.

Eye diseases are only one way in which vitamin A deficiency strikes its victims. A much larger number of children are affected at a SUBCLINICAL LEVEL. The deficiency can reduce the ability of their bodies to fight infection, increasing the severity of common childhood infections like measles and diarrheal diseases, which may even lead to death. Controlled trials have demonstrated that improving the vitamin A status of young children who are deficient in this nutrient reduces mortality 23% on average (Beaton et al. 1993).

Governments and other concerned parties all over the world have recognized the magnitude and severity of the problem of vitamin A

Figure 1.1. Countries in which vitamin A deficiency is a public health problem.



Source: WHO and UNICEF (1995).  
 The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines represent approximate border lines for which there may not yet be full agreement.

deficiency and have pledged their support in its elimination. In the first half of the 1990s, three major international forums were held: the World Summit for Children (1990), the Policy Conference on Ending Hidden Hunger (1991), and the International Conference on Nutrition (1992). Collectively, they have established the following goal for the year 2000:

*The virtual elimination of vitamin A deficiency and its consequences, including blindness.*

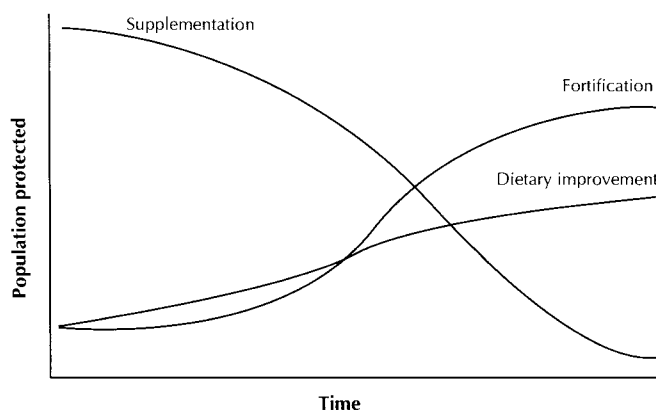
## INTERVENTIONS TO ELIMINATE VITAMIN A DEFICIENCY

Several concrete, well-defined actions, if effectively implemented, can achieve dramatic success in the prevention and control of vitamin A deficiency. They can be broadly grouped into those that rely on pharmaceutical means to overcome the deficiency (i.e., supplementation with vitamin A); “food-based approaches,” which include dietary improvement measures such as agricultural programs, nutrition education and communications; and food fortification. An effective program will usually involve a combination of these interventions (UNACC/SCN 1994).

Supplementation, improving diet by changing patterns of food production, distribution, and consumption, and fortification are complementary strategies and most countries where vitamin A deficiency is a public health problem use several or all of them. In the long term, the aim is to ensure that the dietary provision of vitamin A is sufficient to satisfy normal requirements. The expectation is that, over time, supplementation programs will be phased out and replaced by sustainable, food-based strategies and public health approaches that will work in concert to eliminate vitamin A deficiency (Fig. 1.2). The rate at which this change occurs will vary greatly depending on the situation in each country.

Public health and disease control measures (e.g., promoting and supporting breastfeeding; controlling parasitic infections by improving environmental sanitation and personal hygiene or using antiparasitic drugs; immunizing against measles) can also help to eliminate vitamin A deficiency. However, a full discussion of these measures and their monitoring is outside the scope of this manual.

Figure 1.2. Complementary strategies to reduce vitamin A deficiency.



# 2

## Monitoring: a tool for decision-making

---

### **M O N I T O R I N G**

A management function that uses the methodical collection of data to determine whether the material and financial resources are sufficient, whether the people in charge have the necessary technical and personal qualifications, whether activities conform to work plans, and whether the work plan has been achieved and has met the original objectives. — UNICEF

MONITORING is used to track the progress of a program and oversee, periodically, its implementation. It can establish the extent to which inputs, resources and activities, work schedules, targeted outputs, and other required actions are proceeding according to plan (UNICEF 1991). If problems are detected, the information gathered can be used to take timely corrective action.

Monitoring can also refer to the systematic checking of a condition or set of conditions, such as the health or nutritional status of women and children. This is sometimes

referred to as “impact” monitoring because it is used to measure the effectiveness of interventions and, thus, progress toward the goal of eliminating vitamin A deficiency.

In all countries where vitamin A deficiency is a public health problem and there is an ongoing program to eliminate it, monitoring should be carried out routinely. In practice, monitoring covers a wide range of activities and can focus on programs, projects, or services, or on different aspects of them (e.g., what the program provides, how this is done, how the efforts are received, and what effect they have on behaviour and the level of deficiency).

### **Monitoring can help:**

- Determine if a program is proceeding according to plan. Monitoring can answer such questions as, What is happening in this intervention? Are the activities that were planned actually being carried out? Are they being carried out effectively?
- Improve program performance. Monitoring can help reveal whether human and material resources are being used efficiently, effectively, and at a cost that the program can afford.
- Provide information to guide major decisions and actions, such as reallocation of resources or intensification or lessening of effort. For example, monitoring program effectiveness can provide a basis for adjusting strategies and provide the opportunity for phasing out program components, such as universal supplementation, as appropriate.



- Measure the achievement of targets and follow trends in selected indicators.
- Empower those responsible for monitoring at each administrative level, enhance understanding about the intervention, and stimulate the capacity to take local action to improve the effectiveness of the intervention.

Monitoring activities will generally differ according to the interventions used: supplementation, dietary improvement, or food fortification. These three basic interventions to prevent and control vitamin A deficiency often form the main components of a nation's vitamin A program, and they can be complementary. Yet, they generally have different organizational and resource requirements, different objectives, and different time lines for achieving an impact; therefore, requirements for monitoring and measuring success will also differ.

## INDICATORS

### INDICATOR

An indicator is a measure used to demonstrate change as a result of an activity, project, or program.

The main challenge in establishing or improving a monitoring system is to be clear about the purpose of monitoring and to select the most appropriate INDICATORS for measuring progress. An indicator is a measure used to demonstrate change as a result of an activity, project, or program. Where direct measurement is not feasible, indirect or proxy indicators may be used. Indicators are often targets to be achieved by specific times.

### In selecting indicators, consider:

- The scope of the monitoring exercise should be determined by the amount of detail required to meet the information needs of decision-makers.
- A minimum number of well-chosen indicators should be selected.
- Indicators should be linked to program objectives to allow measurement of performance against pre-established targets.
- Indicators should provide timely information for decision-making.
- Indicators should be technically feasible to measure and should lend themselves to regular assessment.
- For the indicators chosen, it should be possible to determine the quality of the data provided.

### Indicators should be:

- Measurable — quantifiable (a percentage, ratio, or number)
- Comprehensible — mean the same thing to everyone
- Valid — measure what they claim to measure
- Verifiable — can be checked
- Sensitive — reflect changes in the situation

## **STEPS IN MONITORING**

A monitoring plan should be included when an intervention is being designed, even if actual data collection is only foreseen at a later stage. Designing the monitoring system should be an integral part of program planning. Steps that can be used in monitoring vitamin A interventions are outlined below.

### **Designing the monitoring system**

1. Review and specify the objectives of the intervention.
2. Identify the decision-makers and decide on the scope and focus of the monitoring exercise. Designate an organization or person to be responsible for monitoring.
3. Select the key indicators and their standards.
4. Choose the data sources and the methods that will be used to collect data. Find out if there are existing means to collect the required data or if there is a need to establish a new system for data collection.
5. Assess the cost, time, and human resources needed to carry out the monitoring plan. Estimate the budgetary needs of alternative monitoring designs and choose the most appropriate and feasible design.
6. Select sample sites and decide on type and size of sample (e.g., when using surveys, interviews, or questionnaires).
7. Prepare and pretest data collection instruments and develop data collection procedures.

### **Implementing the system**

8. Identify staff at all levels who will carry out the monitoring activities and ensure that they are trained.
9. Collect, prepare, tabulate, and analyze the data.
10. Summarize findings, formulate recommendations, and write a report or prepare presentations. Be sure recommendations are useful to ensure effective follow-up actions.
11. Present or report the findings and recommendations.
12. Take appropriate action.

### **Assessment**

13. Review the advantages and limitations of the work plan for monitoring.
14. Determine ways to improve the monitoring system.

## WHO NEEDS INFORMATION?

What use will be made of the data being collected during monitoring and by whom? Unless there is a clear objective and a defined audience of decision-makers for each indicator, the whole monitoring exercise may be wasted.

Different decision-makers may want answers to very different questions; therefore, their information needs may vary considerably. Information from monitoring may be used at national, district, and community levels. Monitoring data are needed by policymakers, program planners, field managers, researchers, and field staff. Decision-makers and project managers in development assistance organizations outside a country may also find information from monitoring useful. Examples of information needed by decision-makers involved in a vitamin A program comprising various interventions are listed in Table 2.1.

**Table 2.1. Examples of information needs of the various decision-makers involved in a vitamin A program.**

Decision-maker	Information needed	Possible decision
School principal	Is information about vitamin A deficiency being provided in our school?	Request training for teachers. Incorporate teaching materials into school curriculum.
District agricultural officer	Are the vitamin A rich foods being promoted by the Ministry of Agriculture available?	Intensify and expand local production of recommended foods.
Health centre manager	Is my stock of vitamin A capsules sufficient?	Request regular delivery of more capsules.
District health manager	Are most children in my district receiving regular supplements?  Who is being left out?	Expand supplementation activities.  Examine possible reasons for weaknesses.
Ministry of health program manager	Are any districts not achieving the desired program coverage?	Focus resources on low coverage districts.
Donor agency policy advisor	Is our agency's investment in the country's vitamin A program reducing mortality?	Continue/discontinue support to the program. Expand it to other countries.
NGO leader of an agricultural project	Are preschool children eating the eggs, fruits, and vegetables produced by our project?	Intensify quality of inputs and services provided. Refine educational messages.
Sugar factory manager	Is sugar leaving the factory with an adequate level of vitamin A?	Strengthen training in quality control. Seek technical assistance.

## A FRAMEWORK FOR MONITORING

In this manual, discussion of the monitoring of vitamin A programs is based on the following elements:

- Intervention provided
- Program aspect (i.e., provision, utilization, coverage, and impact)

- Information needs
- Key indicators
- Data sources for these key indicators
- Methods to measure the indicators
- Presentation and use of the findings of the monitoring exercise

For each intervention, discussion focuses on provision of services, utilization of those services, coverage of the population, and impact of the intervention. This framework has been adapted from a more complex one developed by UNICEF's Evaluation and Research Office (Habicht et al. 1996). In subsequent sections of this manual, this framework is applied with more detail to the monitoring of supplementation, dietary improvement, and food fortification programs.

The framework presents a logical sequence from provision to impact. Unless provision is adequate, utilization will be low. Utilization, on the other hand, determines the level of coverage, which in turn largely determines impact. When monitoring shows that provision and utilization are inadequate, there is limited need for the more complex assessment of coverage and impact. Thus, by answering simple questions using basic indicators determined from data that are relatively easy to collect and analyze, one can minimize the need for more sophisticated measurements.

Such factors as timing and cost must also be considered when designing a monitoring plan. In general, assessment of provision and utilization can be carried out with some frequency, even beginning soon after the intervention has been implemented, as this can help local decision-

### CATEGORIES OF INDICATORS

**Provision:** Resources and activities of the program, provided to ensure availability and accessibility of goods or services to the target population. These must be provided in a timely manner and with the proper combination of resources and activities, according to plans. These goods and services are sometimes referred to as *inputs* and *processes*. It is assumed that the provision of services or goods is done according to some standard of quality. Provision is a prerequisite for utilization.

- **Goods:** Inputs or resources such as vitamin A capsules, seeds, seedlings, money, fuel, vehicles, training documents, fortificants.
- **Services:** Training, workshops, supervisory visits, assignment of staff, management of program, community activities.

**Utilization:** The use of the goods and services that have been provided by the intervention. This is demonstrated by acceptability and demand. Utilization is sometimes referred to as *outputs*.

**Coverage:** An estimate of the proportion of the target population reached by the intervention. Good coverage results from good provision and utilization. The measurement of coverage is usually accomplished by a population-based survey.

**Impact:** The effect on the behaviour, health, or nutrition status of the population that is attributable to the overall combination of interventions. For vitamin A programs, this is often measured by biological indicators of vitamin A status. Impact on the population depends on coverage.

makers to fine-tune the activity. On the other hand, coverage estimates are often undertaken later in a program cycle and are carried out periodically.

The cost of monitoring increases rapidly with the complexity of the system. Provision and utilization may be assessed inexpensively through site visits or the routine collection of data from health, agriculture, or other services. Monitoring coverage (and impact), on the other hand, may require household surveys and procedures that may be more costly. Accurate

### **THOSE WHO GATHER THE INFORMATION SHOULD BE ABLE TO USE IT**

Community-based monitoring may be used to gauge the progress of a program. This approach uses a local information system managed by the people who are participating in program implementation, e.g., health or nutrition promoters. Involving program implementers in the monitoring process enables them to become aware of problems as they arise and, therefore, prevent them in the future.

An example of community-based monitoring might involve gardening promoters who are each responsible for 50 to 100 households. Each month, the promoter completes a simple report, providing information on such key indicators as the number of households adopting a specific vitamin A rich food. This monthly report should require no more than 5 to 10 minutes to complete and might consist of fewer than 10 questions requiring a yes or no answer or an easily calculated number (e.g., number of participants).

Promoters should track these indicators from month to month and discuss the data at a monthly progress meeting. Important qualitative information concerning the reception of the messages and reactions of the community to the promotion activities and educational materials can be obtained through key informant interviews and focus group discussions.

For every 10 to 12 promoters, a coordinator can consolidate the information for a larger geographic area, perhaps the district. It can be recorded monthly on a graph or chart and consolidated every 3 to 6 months into a single report. If promoters are not able to complete the reports themselves, this could be done in the group at the monthly meeting. At this meeting as well, problems can be discussed, supplies distributed and other issues attended to.

National program managers can make use of the district level data to direct national program decisions. It has commonly been difficult to maintain the flow of information from community to the national level, and program managers may need to simplify the number of indicators needed. As well as providing information essential for decision-making at the national level, community monitoring can also lead to the community understanding and addressing its own nutritional problems, and may increase the likelihood of overall program success.

coverage data are seldom routinely available. In general, the cost of program monitoring should be compatible with the overall program budget.

## **SOURCES OF DATA AND COLLECTION METHODS**

Once information needs are known and key indicators have been selected, the question of how to obtain the information remains. Most monitoring systems will require the collection of both quantitative and qualitative data. Often, a variety of data collection methods can be used. Methods to use available information, such as routine records, logistics records, treatment registers, growth charts, activity reports, and population-based surveys, should be reviewed before new data collection tools are designed. Sometimes forms already in use can be modified to collect the needed information.

In general, it is more likely that data on provision and utilization will be found in existing sources. Household surveys, possibly one that is already planned, may be useful to obtain representative data on coverage. Lot quality assurance sampling (LQAS) may be useful for assuring the quality of fortified foods and for measuring supplementation coverage. These methods and others are described in chapter 3, *Methods for monitoring vitamin A programs*.

## **USING MONITORING INFORMATION AND PROVIDING FEEDBACK**

Monitoring systems are useful only if the information generated by them provokes responses, and corrective action is taken when needed. Monitoring involves collecting, analyzing, and using data to improve decision-making and program performance continuously. The flow of information must be at a level and in a format that is appropriate for easy access and use by decision-makers.

If information generated from monitoring reveals a problem, action should be taken. The type of action will depend on the intervention. For example, in dietary improvement programs, there may be a need for further education and social marketing or, perhaps, for program components in the agriculture sector. For supplementation programs, there may be distribution or logistics problems to correct or issues of compliance to address. In fortification programs, there may be production-level quality assurance issues, losses of fortificant during storage or shipping, or inappropriate labelling issues to correct.

## **ORGANIZATION OF MONITORING**

Monitoring can be conducted at all levels — local, national, and even global. In general, the level that records the information should be able to use it. Designing data collection systems with this principle in mind will improve the chances that the information will be collected carefully and put to use. When findings are not used at the level of data collection, data reporting can become irregular and of poor

quality. Information generated at each level should be useful at that level, and every effort should be made to demonstrate this to data collectors. Program workers and community members should also feel some ownership of the routine information collected.

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# 3

# Methods for monitoring vitamin A programs

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The following methods are those most commonly used in monitoring vitamin A projects. The brief descriptions provide enough information for readers to select those most appropriate for a specific project; sources of more in-depth information are listed at the end of the chapter.

The methods discussed here are

- Use of existing data
- Site visits
- Key informant interviews
- Community interviews
- Focus groups
- Observation
- Rapid assessment procedures (RAPs)
- Food frequency questionnaires
- Market surveys
- Population sampling and survey designs, such as cluster sampling and lot quality assurance sampling (LQAS)

Although many of these methods are qualitative, some of the data generated can also be quantified and analyzed.

### **Factors to keep in mind when choosing a method:**

- ***Appropriateness*** — the fit between the specific method, the task, and the available resources and time
- ***Compatibility*** — the effectiveness with which particular methods can be combined
- ***Sequence*** — the application of methods in logical order, e.g., applying a method suitable for identifying a broad range of possible issues for investigation before using methods suitable for in-depth investigation of a specific subset of those categories

In many cultures there are gender differences in food production, distribution, consumption, and knowledge; therefore, it is also important to record the sex of both informants and those whose behaviour they are reporting. In some cases, other social characteristics such as ethnicity, age, and religion may also be important. Awareness of the relevance of these social characteristics



to vitamin A programs is often missing from texts on monitoring methods and prototype instruments.

Enough time and resources must also be allocated for selecting appropriate types and levels of analysis. Descriptions tend to focus on methods and instruments for collecting data rather than on the analysis of those data. An accurate assessment of the resources needed for analysis and the appropriate type and level of analysis is important in determining the effectiveness of monitoring efforts.

## USE OF EXISTING DATA

A wide range of data, both quantitative and qualitative, that are useful for monitoring vitamin A interventions can be found in existing documents. Sources include routine records, such as treatment registers and growth charts from the health sector, supervisors' reporting forms and production records from the agricultural sector, and quality control reports and sales records from the food industry. Also, census data, literacy and school enrolment statistics, market records, and information collected by NGOs can be used. Such data may be useful in generating and answering monitoring questions, checking the validity of data obtained from other sources, and setting standards of comparison.

Making the best use of existing data entails

- Locating potential sources and identifying the most relevant information
- Establishing effective and efficient means of access
- Conducting a clearly focused analysis of the data

## SITE VISITS

### NATURAL SETTING

The location in which the target population normally functions.

Site visits are not, strictly speaking, a monitoring method but they do offer an opportunity to apply other monitoring methods, singly or in combination. For example, key informant interviews, community interviews, or focus group discussions may be organized more easily because of the "sense of occasion" that accompanies visits by outsiders. Such visits also make it feasible to review existing data that are not easily accessible from a distance and to collect information from local representatives of other agencies and organizations. In addition, site visits are a prerequisite for direct observation of the NATURAL SETTING, which provides both new information and opportunities to cross-check data.

Paying attention to the timing and regularity of site visits may give rise to additional opportunities. For example, visits may be scheduled to permit direct observation of the relationship between seasonal crop cycles and the availability and consumption of vitamin A rich foods. Alternatively, visits may be timed so that certain monitoring data are collected consistently at the same time of the year to allow longitudinal analysis. The regularity of site visits can influence the strength and depth of relations with key informants and, thus, the quality and variety of data available from these sources.

## KEY INFORMANT INTERVIEWS

### **I N F O R M A N T**

A person who gives information about any topic we are interested in learning about.

The strength of key INFORMANT interviews is the depth of information they provide. In the context of monitoring, they draw on the knowledge of stakeholders, such as community members, providers of health or agricultural services, factory managers, or legislators to analyze a program's progress, its strengths and weaknesses, and the ways in which program strategies might be made more effective. This technique is also useful for identifying new factors that may affect the program, because the method gives the informant considerable scope in responding.

Key informants should be selected for their knowledge of the subject being investigated as well as their ability to articulate their views. Key informants may include professionals and community leaders, if appropriate, but should not necessarily be limited to such authority figures. In the case of vitamin A interventions, an important category of key informant would be mothers and other primary child care givers. Others might include local health centre personnel, traditional healers, birth attendants, shopkeepers, agricultural extension agents, and representatives of community groups, particularly women's groups. In choosing key informants, include all relevant categories of expertise, as only a small number of informants are involved and their views cannot be considered representative of the community in a statistical sense. Issues arising from key informant interviews can be further explored using other methods such as focus groups.

Key informant interviews may be conducted by a program staff member or a community member involved in monitoring who is trained in a flexible, responsive, probing interviewing technique, rather than a directive one. An essential characteristic of key informant interviews is their openness and the degree to which they are directed by the informant rather than the investigator. Although such interviews are clearly focused on particular topics, instead of based on a structured list of questions, the interviewer listens attentively, follows up answers with further probing questions, and encourages the key informant to narrate, list, enumerate, and expand. This technique yields not only data of great richness and depth, but also unpredictable information and innovative analysis.

Ideally, interviews with key informants should take place regularly over a period of time. As relationships develop between key informants and the interviewer, the quality and utility of both information and analysis provided by key informants should improve.

## COMMUNITY INTERVIEWS

Discussions with a heterogeneous group of community members are referred to as community interviews. This technique is an effective way to obtain a range of views and experience on particular topics at the community level. Interviewing a cross-section of people should yield a diversity of information and views, thus introducing an element of cross-checking and validation not available in an individual interview. The strength of this technique is in the range and variety of information it yields, rather than either the breadth or depth of coverage of specific questions.

Although community interviews have a number of advantages, they are not useful for discussion of sensitive information and have a tendency to yield statements of ideals rather than information on actual behaviour. Effective interviewers encourage the expression of alternative views and attempt to minimize group pressure on individual speakers. Informal conversations after community interviews provide an opportunity for eliciting information from people who may have felt inhibited in a group meeting.

Where programs and projects are being monitored in terms of provision, use of goods and services, and coverage, it is best that the interviewer not be a staff member. The interviewer must be perceived by the group to be neutral, as the success of such community interviews is susceptible to perceptions of vested interests and power relations.

## **FOCUS GROUPS**

The value of focus groups is the breadth of data they provide on a specific topic. Focus groups can quickly and economically provide substantial amounts of insightful qualitative information that may be particularly valuable in determining how the target population perceives the intervention's messages, why behaviour modification is or is not occurring, or the reasons for success or failure with respect to utilization rates or coverage levels.

Focus groups usually involve a small number of people, generally 6 to 12, of similar background or experience (e.g., the same sex, age group, socio-economic situation, ethnic group, occupation, or education level) who discuss a limited topic. Adequate coverage of various perspectives on an issue is generally achieved by organizing several focus groups, each representing a different constituency, e.g., birth attendants, vendors, mothers, and service providers.

The investigator assumes the role of moderator rather than interviewer. He or she guides the discussion to ensure that all participants have an opportunity to speak, all points of interest are addressed, and the discussion remains focused on the selected topic. Ideally, a recorder is also present to allow the moderator to give full attention to facilitating exchanges among the participants.

Before the session, the moderator develops a list of questions to guide discussion. To ensure a productive session, the moderator should invite each participant in person and speak with her or him before the meeting to explain the objectives and procedures to be followed. Above all, the moderator must put the participants at ease so that they feel free to share their ideas.

Focus group sessions should take place in an environment in which the participants feel comfortable and one that is "neutral" in terms of the interests of the investigators. For example, a community health centre is not an appropriate place for meetings about local medical beliefs or the use of different health resources. A municipal hall or a community centre would be a more appropriate choice (Scrimshaw and Hurtado 1987).

Like other techniques, focus groups have some limitations. Although they are effective for eliciting and exploring breadth of opinion and

discovering the range of views on a subject, they cannot indicate how these views are distributed in the wider community. Focus groups are not effective for exploring complex beliefs or behaviours. Like community interviews, focus groups tend to provide a view of what is socially acceptable, as opposed to what is actually done. Focus groups have been used extensively in the agriculture and health sectors and in social marketing; they are gaining in popularity in nutrition programs.

### **QUALITATIVE VERSUS QUANTITATIVE**

Qualitative methods entailing face-to-face contact with and active participation by target populations provide greater depth and originality of information than quantitative or semiquantitative methods. Qualitative techniques are particularly useful for investigating why a program is or is not achieving its objectives, how the target population perceives the messages of the intervention, and why behaviour modification is or is not occurring. These methods complement closed-ended quantitative and semiquantitative studies and, if properly applied, are reliable and valid.

However, caution must be exercised in generalizing the results of qualitative surveys, as the number of informants is usually limited and thus the study group may not be representative of the general population. An additional limitation is that qualitative methods do not provide information on actual dietary intakes of vitamin A; but they can be extremely useful for collecting information on food habits and beliefs, dietary patterns, and knowledge, attitudes, and practices regarding vitamin A rich foods and vitamin A deficiency.

Sampling techniques are used to select a subset of the population being studied. There are two broad categories of techniques: those based on probability theory, such as random, stratified, and cluster sampling, and those, such as quota, purposive, snowball, and convenience sampling, which are more often encountered in qualitative research, where probability sampling techniques are generally not appropriate. Although the value of probability sampling rests on the assumption that the sample represents the larger population, nonprobability sampling techniques allow researchers to select samples based on other relevant factors, such as similarity, dissimilarity, relationship, specific characteristics such as expert knowledge, and so on. Informants selected by nonprobability sampling techniques can be considered "typical" of the categories they represent, although not necessarily "representative" of the population as a whole.

## **OBSERVATION**

Direct, systematic observation can yield useful information on behaviour patterns and physical conditions relevant to vitamin A projects. Such information can be used to cross-check information obtained through other methods, to identify trends, practices, and conditions of which informants are not aware, and to reveal contradictions or inconsistencies in values, beliefs, intentions, and practices.

An important consideration in collecting data through observation is the question of scope. One way of defining scope is to classify observations as

descriptive, focused, or selective (Spradley 1980). At the broad end of the range, descriptive observation entails collection of all available information. Focused observation narrows the scope to information about a specific domain or question. Selective observation asks specific questions, focusing on observable differences with respect to particular phenomena.

Any exposure to the “natural setting” for vitamin A use provides an opportunity for collection and analysis of observations. The difference between casual observation and use of this technique as a monitoring method is a rigorous, structured, systematic approach to the recording and analysis of the collected information.

## **RAPID ASSESSMENT PROCEDURES (RAPs)**

RAPs represent a repertoire of techniques for collecting information quickly, cost effectively, and with strong community participation. In terms of monitoring vitamin A projects and programs, RAP methods are valuable for answering the questions what, why, and who.

Many of the methods routinely used in RAPs, such as interviewing, have already been discussed. Others make use of diagramming and visualizing or ranking and scoring. Collectively, these techniques can provide four types of information relevant to vitamin A program monitoring: spatial, temporal, social, and evaluative.

- *Spatial information* generated by RAPs could include relational mapping of the distribution of food resources, health services, and vulnerable groups.
- *Temporal information* could include food production and consumption timelines, trends, and seasonal calendars.
- Examples of *social data* are the ranking of individuals and groups in terms of wealth or well-being, which can be useful in identifying and targeting vulnerable groups, as well as community assessments of institutions and their services.
- *Evaluative ranking* can yield information about preferences, problems, opportunities, and solutions.

The effectiveness of many of these techniques depends on allocating adequate time to the exercises and establishing relationships of trust with community members.

## **FOOD FREQUENCY QUESTIONNAIRES**

Semiquantitative methods, such as food frequency questionnaires and market surveys (below), can be used to assess dietary vitamin A intake or availability in populations or communities. Food frequency questionnaires based on recall can be used to determine the dietary intake of the population or community and risk of vitamin A deficiency. The food frequency questionnaire attempts to address usual diet, the reference period generally being the previous week, month, or a specific season. The rationale is that long-term intake is more important than intake on a few specific days.

## ANALYZING QUALITATIVE DATA

Although qualitative data may seem unwieldy, searching for patterns, then identifying and interpreting categories, relations, and themes can illuminate how and why systems work, do not work, or could work better. As the frameworks for analyzing qualitative data emerge to a great extent from the data themselves and change in response to new data, analysis is continuous, beginning with data collection and ending when the results are written up. The following steps may be helpful in the analysis of qualitative data:

- **Looking at the whole** — Establish an overview of each item. For example, read the transcript of each interview or focus group session from beginning to end to get a sense of the whole. This is important in identifying and later modifying the appropriate analytic units and in establishing the larger context in which they are embedded.
- **Taking it apart** — Systematically sort, select, and organize the data so that patterns can be identified. Typically this stage involves
  - developing a coding system based on the project team's needs and the categories emerging from the data (several codes can be applied simultaneously)
  - coding the data and recoding them as necessary
  - sorting the coded material into patterns that reflect key categories, themes, and the relation between them
  - recognizing not only consistencies but also anomalies and contradictions
  - providing feedback into the data collection process (e.g., identifying new and better questions and identifying information that needs to be cross-checked).
- **Putting it back together** — Consolidate the categories, relations, and themes, look at the larger picture they make, describe it, and consider the implications for action.
- **Presenting the results** — The results of qualitative analysis can be presented in the form of text, but also in other effective formats, such as matrices, charts, and diagrams.

In many areas where vitamin A deficiency is a problem, illiteracy and low levels of education prevail, and it may be difficult to ask people to keep a record of what they eat. People seem to be able to describe what they usually eat better than what foods were eaten at a specific time in the past, although "usual" diet may reflect "desired" diet. Identifying one or two specific foods relevant to the program may allow more accurate reporting.

Food frequency questionnaires are less time consuming to administer and analyze than many quantitative methods for measuring food intake (e.g., weighed intake); therefore, a larger sample size can be obtained. In literate populations, these questionnaires can be self-administered, decreasing monitoring costs. When the necessary infrastructure exists, data processing is rapid and may permit rapid feedback to the target population.

The food frequency questionnaire is limited in that it does not provide exact information on individual intake; this may only be obtained by direct observation using weighing and recording techniques. The tool was originally designed to identify those at risk of severe over- or undernutrition; however, it is a flexible survey tool that can be used in monitoring such factors as behaviour change at the population level in response to an education program or other food-based intervention.

A food frequency questionnaire has two components: a list of selected food items whose intake is of interest; and response categories for describing the frequency of their consumption. In addition, data on serving size may be collected.

## The food list

The decision to include an item in a food frequency questionnaire requires an assessment of its importance as a source of vitamin A or other critical nutrients such as fat. Two criteria on which to base the selection of food items are the amount of vitamin A contributed by the food per day and the percentage of total nutrient intake derived from the food. Some items are eaten in large quantities by relatively few individuals and make only a modest contribution to average intake. On the other hand, frequently eaten foods with a moderate concentration of vitamin A may contribute as much over the long term as foods with a high concentration that are eaten only occasionally.

Another important consideration is the age group to whom the questionnaire will be applied. For example, for children under 2 years of age, the foods listed need be only those consumed by this age group, as determined by focus group discussions. For this age group, duration of breastfeeding and the age of introduction of vitamin A containing foods should also be noted.

The list should include food items consumed reasonably often and those with a substantial vitamin A content whose intake varies from person to person. A relatively small number of foods need to be considered to estimate total vitamin A intake. For example, the pattern of consumption

### VITAMIN A RICH FOODS

The following "core list" of foods might be considered in a questionnaire to estimate total vitamin A intake, but should be adapted to the national context.

whole milk	carrots
butter or margarine	dark green leaves
eggs (with yolk)	dark yellow or orange squash or pumpkin
liver (including poultry)	yellow or orange sweet potato or yam
fish liver oil	vitamin A fortified foods
red palm oil	
ripe papaya	
ripe mango	

of only seven foods explains over 90% of the variation in vitamin A intake and these foods contribute 61% of total intake in the Chinese diet; whereas 10 foods contribute more than 90% of total vitamin A among preschool-age Guatemalan children.

The questionnaire should also note all dietary fat sources. Most efforts to increase dietary intake of carotenoids by young children also try to increase fat intake. Related items should be organized by traditional food groups. More specific items should precede general ones.

## Response categories

Response categories define the range of consumption frequencies for each food on the food list. In choosing these frequency categories, researchers must consider how often a particular food is likely to be consumed and how long the body will store vitamin A. For example, most people eat margarine, butter, or oil frequently, whereas liver is consumed only occasionally or not at all; therefore, the categories for the oils might be in terms of times per day and for liver in terms of times per month or year. Ideally, the frequency categories should not differ by more than twofold from one to the next, i.e., 2 times per day, every day, every 2 days, every 4 days.

## Serving size information

Whether serving size information is collected depends on the objectives and the resources available for monitoring. If the goal is to classify individuals, data on portion size will provide little useful information because intra-individual variation is large and few people can accurately estimate serving sizes. On the other hand, some information on portion sizes is desirable when the primary food sources are carotenoids and when the target group is children of weaning or preschool age.

Specifying unit sizes will increase the clarity of the questions and provide additional information, e.g., “How often do you consume *a cup* of milk, or *one egg*?”

## Common methods

Several methods have been developed to assess dietary intake. Some are used to assess average dietary composition and estimate the adequacy of vitamin A intake for a given population. Others enable assessment of a community's risk of inadequate vitamin A intake based on frequency of consumption of vitamin A rich foods. These methods continue to be tested, revised, and validated against biologic measures of vitamin A status.

The two most commonly used methods are those of Helen Keller International (HKI) and the International Vitamin A Consultative Group (IVACG).

**The HKI method** determines community risk of inadequate vitamin A intake. In this method, it is recommended that 50 mothers in each of 15 communities be surveyed. Each mother is asked on how many of the past 7 days a specific child has eaten each of up to 28 specific foods (Rosen 1992). These foods can be classified into four groups: major sources of



vitamin A (with more than 100 retinol equivalents per 100 g food); major sources of fat, oil, and protein; staple foods; and a food that is almost never consumed (a distracter item) (Rosen et al. 1993).

The results of an HKI survey can be tabulated by hand. A community is considered to be at risk of inadequate vitamin A intake if the mean frequency of consumption of animal sources of vitamin A is 4 or fewer days a week or if the mean weighted frequency of consumption of plant and animal sources is 6 or fewer days a week. If at least 70% of the surveyed communities (11 out of 15) meet one of these two criteria, the entire area is considered to have a deficiency problem. The method has been validated in three country studies, but further testing is required. A manual on this method and further information on its use can be obtained from HKI (see Appendix A).

**The IVACG method** was developed to identify populations with inadequate vitamin A intake. It was designed for use in conjunction with biochemical and clinical indicators of vitamin A status. This method can also be a useful educational tool in providing immediate guidance to mothers about vitamin A rich foods. The first step is to identify locally available vitamin A containing foods that are included in the diets of young children. This can be done through a qualitative survey of local markets, gardens, donated foods, and other sources. Breast milk, vitamin A supplements (sold or distributed free of charge), wild foods, sauces, vitamin A fortified foods, and snack foods sold by street vendors should not be overlooked. The identified foods are then scored (low, medium, or high) based on the vitamin A content in a small portion. Classification may be based on general knowledge or a food composition table, if one is available.

The second step is to determine the size of the usual small, medium, and large portions of each food. This information can be collected in focus groups of mothers or, occasionally, may be available from food consumption surveys. The sizes of medium and large portions are usually multiples of a small portion, i.e., medium portions are generally 2 and large portions are 3 or sometimes 4 times the small portion. Portion sizes, in grams, are then converted to common household measures, e.g., teaspoons, cups, matchboxes, etc.

Using this information, a questionnaire including these items in the food list is developed and administered by local workers to a random, representative sample of mothers. For each item, the frequency of intake is determined along with the portion size. IVACG recommends recording *two* reference points for frequency of consumption of the indicator foods: number of times in the previous 24 hours and the usual frequency on a daily, weekly, or monthly basis.

Two indices are calculated from this information: the "consumption index" and the "usual pattern of frequency." From these, the household-level risk of

### VITAMIN A ACTIVITY

The joint FAO/WHO Expert Consultation (FAO 1988) recommended that the vitamin A activity of foods be expressed in terms of retinol equivalents (REs).

1  $\mu\text{g}$  retinol = 1 RE

1 IU = 0.3  $\mu\text{g}$  retinol = 0.3 RE

1  $\mu\text{g}$  beta-carotene = 0.167 RE

1  $\mu\text{g}$  other provitamin A carotenoids = 0.084 RE

**Note:** Provitamin A carotenoids exhibit vitamin A activity in biologic systems. Not all carotenoid compounds have this property.

inadequate vitamin A intake (low, medium, or high) is determined based on the following guidelines: high risk means consumption of less than 67% of the recommended daily allowance (RDA), medium risk is consumption of 67–100% of RDA, and low risk is consumption of 100% of RDA.

Further research is required to determine the reliability and validity of the IVACG method, particularly regarding the values used to assign the level of risk of inadequate vitamin A intake. The IVACG method is suitable for application by community-level workers with guidance from professionals and has been used by NGOs, health ministries, community groups, and research institutes in more than 20 countries. A manual and further information can be obtained from the IVACG Secretariat (see Appendix A).

The HKI and IVACG methods have been described in detail and applied in dozens of situations. Yet, they have limitations (and do not provide exact values for vitamin A intake). However, those who wish to assess dietary intake of vitamin A or the risk of vitamin A deficiency should become familiar with these methods, so that they might use them directly or, as many people have done, adapt them to suit the needs and interests of their own situation.

A new method, called the 24-hour vitamin A semiquantitative method (24-VASQ), is being developed (HKI 1997). In it, foods are classified as animal, vegetable, or fruit (with an additional category for fortified foods) and further categorized by portion size. Further information about this method should be available soon.

## **MARKET SURVEYS**

Market surveys provide information about food for sale in local markets (Fig. 3.1). Their main advantage is that they require fewer resources than household-level surveys. However, market surveys cannot provide information about food consumption at the household level or about intrahousehold distribution.

Underlying the market survey is the assumption that foods for sale are ultimately bought and used. Thus, by examining the supply and cost of foods sold or traded in open-air markets, stores, and elsewhere, one can obtain a preliminary idea of the availability of vitamin A containing foods. Although this technique can provide information on food sources at the community level, the resulting data must be interpreted in conjunction with other information on agricultural activity and the extent of foraging for wild foods.

A market survey identifies sources of vitamin A potentially available in the community, their seasonality, cost, and usual buyers. Information should also be collected regarding the quantities and regularity with which these foods are present in the market. Vendors could also be asked whether the foods are generally bought for human or animal consumption. If reasonably reliable population data are available, a first approximation of food availability per household can also be derived from market survey data.

## Steps in conducting a market survey

1. Identify the suppliers from whom the target population purchases foods, i.e., markets, stores, warehouses, street vendors.
2. Randomly select a sample of each of these sources (e.g., in a district of 100 villages, visit three to five of each type). If the community is large, choose a larger sample.
3. Walk through the market, and determine which vitamin A rich foods are sold and in which seasons.
4. Talk with some of the vendors to determine
  - What quantity of these foods are available, during which season, and at what price.
  - Who buys these foods.
  - Whether they are primarily for human or animal consumption.
  - Where they obtain the stocks they sell in the market.
  - Whether they have difficulty in regularly obtaining any of the foods.

Figure 3.1. Market survey sample form.

Date: _____									
Place: _____									
Food item	Unit of measure*	Raw or prepared	Commercial food source			Months available	Price range	Price per serving	Usually purchased by†
			Market	Store	Street vendor				
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									
<p>Source: Modified with permission from Blum et al. 1997.</p> <p>* Common unit by which item is sold, e.g., bunch, bundle, piece, mound, local dry or wet measure, international dry or wet measure, etc.</p> <p>† This should include gender and age (child, adult, etc.). Other categories which are relevant or significant will change with context, i.e., age, gender, caste, ethnicity, religion, etc.</p>									

## POPULATION SAMPLING AND SURVEY DESIGN

Occasionally, it is necessary to assess the prevalence (the number of existing cases as a proportion of the total population) of vitamin A deficiency or the proportion of people who have received a specific intervention. For example, a survey might be carried out to estimate the prevalence of night blindness, the proportion of children with low serum retinol levels, the proportion of children who have received a vitamin A supplement in the previous 12 months, or the proportion of households using a vitamin A fortified product. Such representative surveys often address two or more related questions simultaneously.

Population surveys are usually based on a sample (a limited number of people, households, villages) that must be representative of the larger population. Such surveys serve two purposes: they provide a realistic estimate of the proportion of people or households with a certain characteristic in the population, which is useful for planning purposes; and they allow comparisons with previous or subsequent population-based surveys to determine whether the situation is improving or deteriorating.

The type of survey used in population sampling depends on the type of question to be addressed. For example, the question “what is the overall proportion of individuals or households with a characteristic in a specific geographic area?” is best answered using a cluster survey; whereas “where are the ‘problem’ areas (i.e., areas with a high prevalence of vitamin A deficiency or areas with low intervention levels)?” can be addressed using the lot quality assurance sampling (LQAS) method. Cluster surveys provide an estimate of the proportion of individuals or households with a characteristic and LQAS is used to identify villages with either a high prevalence of vitamin A deficiency or inadequate intervention coverage. These survey methods are described below, and more detailed information is available in Sullivan et al. (1995).

## CLUSTER SAMPLING

**CLUSTER SAMPLING** is the selection of groups of study units (clusters) instead of the individual units.

It may be difficult or impossible to survey a random sample of all the units of a study population, either because a complete list does not exist, or because of logistic difficulties (e.g., visiting people scattered over a large area may be too time consuming). However, if the units can be compiled into CLUSTERS (e.g., villages or wards), a sample of these groupings can be randomly selected.

Clusters are often geographic units (e.g., districts, villages) or organizational units (e.g., clinics, training groups). Population-based cluster surveys are useful for determining the proportion of individuals with a characteristic in a specific geographic area, e.g., the proportion with vitamin A deficiency or the proportion who have received an intervention.

Because cluster surveys can be expensive and time consuming, *every attempt should be made to incorporate the assessment into existing or planned surveys*, such as those performed for the Expanded Programme on Immunization (EPI), the Childhood Diarrheal Disease Program, demographic and health surveys, or expenditure and food purchasing surveys. Only if it is not possible to incorporate the collection of vitamin A information into another survey should a separate one be designed and implemented.

The first step in a cluster survey is to define the geographic area or areas to be studied. For example, should only one survey be carried out for a whole country, or is there a need to perform separate surveys in different regions? The national government may wish to have representative information from a mountainous area and from the plains, or another

### **USING MULTIPLE-INDICATOR CLUSTER SURVEYS TO ASSESS PROGRAM COVERAGE**

It is sometimes difficult to determine the exact question to use in household cluster surveys. However, since 1995, dozens of countries have conducted multiple-indicator cluster surveys (MICS) of households to collect data on a variety of health and nutrition indicators. Many of these countries used or adapted a standard model questionnaire developed by UNICEF (1995) to collect the minimum data needed on most of the indicators used to assess progress toward the mid-decade goals set at the World Summit for Children.

The question modules for vitamin A (see opposite) provide examples of questions that can be used for a specific intervention. The wording of these questions should be tailored to fit a country's own vitamin A intervention program, and additional questions may also be appropriate.

These modules were devised to obtain the information needed to estimate indicators of the goal "the virtual elimination of vitamin A deficiency" defined as "at least 80% of all children under 24 months of age in areas with vitamin A deficiency receive adequate vitamin A." The indicator is the proportion of children under 2 years of age receiving adequate vitamin A (in known deficient areas only). The operational definition of the indicator will vary according to the program strategy in a specific country.

The question modules are designed to determine the proportion of the population (either families or children) reached by the program by measuring

- The proportion of children who have received a *vitamin A supplement* within the prescribed period of time,
- The proportion of households with a *fortified product* that is given to children in those households or
- The proportion of mothers who have heard the program message and put it into practice by *changing dietary habits* (the proportion of children who eat the target foods).

These questions provide information about the extent to which the program is reaching its target population, rather than the extent of vitamin A deficiency or adequacy of vitamin A intake.

**Vitamin A modules.**

Cluster no. \_\_\_\_\_ Household no. \_\_\_\_\_ Child no. \_\_\_\_\_

For the questions in modules A, B, and C, below, fill in the appropriate number in the response column at right.

Module A (for countries with a supplementation program)		Response
A.1	<p>Has [NAME] ever received a vitamin A capsule (supplement) like this one? (Show capsule or dispenser)</p> <p>Yes 1 No 0 ⇨ go to next module DK* 9 ⇨ go to next module</p>	
A.2	<p>How many months ago did [NAME] take the last capsule? (DK = 99)</p>	
Module B (for countries with a food fortification program)		
B.1	<p>We would like to know if some food products are used in your household. Do you have [fortified food product] in the house? Would you show us?</p> <p>Yes (seen) 1 Yes (not seen) 2 No 0 ⇨ go to next module</p>	
B.2	<p>Since last [day of week], did [name] eat [fortified food product]? (Show product package and prompt: Used in cooking? Stirred in drinks? etc.)</p> <p>Yes 1 No 0 DK 9</p>	
Module C (for countries with a dietary education program)		
C.1	<p>Have you heard any [country-specific] messages that promote certain foods that are important for sight and help prevent blindness?</p> <p>Yes 1 No 0 ⇨ go to next module DK 9 ⇨ go to next module</p>	
C.2	<p>Can you tell me what some of these foods are? (Circle code if mentioned. Do not prompt. List vitamin A rich foods that are country/region/season-specific. The foods need not be limited to 2 types, as in this example.)</p> <p>Food 1 (country-specific) Yes 1 No 0</p> <p>Food 2 (country-specific) Yes 1 No 0</p> <p>Other responses _____ Yes 1 No 0</p>	
C.3	<p>Since last [day of week], did [name] eat any of the following foods? (List country/region/season-specific target vitamin A food source.)</p> <p>Food 1 (country-specific) Yes 1 No 0 DK 9</p>	

\*DK = Don't know.

geographically defined region. “Stratification” is the term used to describe the subdivision of a large geographic area into separate regions for survey purposes, and an adequate number of clusters must be selected for each region to be representative. Thus, overstratification can be costly and time consuming.

The second step involves selecting the clusters. Usually 30 clusters are chosen for each region to be studied in such a way that all members of the population have an equal chance of being selected. This proportionate to population size (PPS) sampling method is described in more detail in Sullivan (1995), Binkin et al. (1992), and WHO (1991).

Once the clusters are selected, each one is visited and households are chosen that are representative of the entire cluster. Because this may be difficult, simpler (and perhaps less representative) methods may be used. The number of units (households or individuals) required depends on a number of issues, such as the expected proportion with the condition and the desired precision of the results. For relatively common events, 10–40 units should be selected from each cluster (Sullivan et al. 1995). Thus, for each region to be studied, a 30 × 30 survey is common (30 clusters of 30 households each), resulting in a sample of 900 households for a given region. More detailed information on sample-size calculations can be found in Lwanga and Lemeshow (1991).

In analyzing the survey data, software that takes into account the survey design should be used, e.g., the CSAMPLE program in Epi Info Version 6 (Dean et al. 1994). It is also important to remember that sampling errors, measurement errors, and the skill of the survey team members can influence results. Survey results should not be presented as precise figures but as estimates. Tables should be kept simple, straightforward, and presented with a clear purpose. Data should be presented in an aggregate fashion rather than by cluster to prevent individual clusters from being inappropriately singled out for intervention at the expense of a broader intervention program.

Although the calculation of a proportion for PPS surveys is straightforward, the calculation of confidence intervals is more complex. The confidence interval is an important part of the results because it provides a range within which the estimate is “true.” The width of the confidence interval provides an idea of the precision of the survey; the narrower the confidence limits, the greater the precision. In comparing one area to another or the results of two surveys performed at different times in the same area, confidence intervals will help show whether differences are significant.

## **LOT QUALITY ASSURANCE SAMPLING**

Lot quality assurance sampling (LQAS) can be useful for identifying “problem” areas, i.e., those with a high prevalence of vitamin A deficiency or where an intervention is inadequate. In cluster surveys, the primary goal is to estimate the overall proportion of people with a characteristic by questioning the fewest people in the smallest number of clusters. In contrast, the goal of LQAS is to identify deficient “lots,” such as villages, i.e., those with either a high prevalence of vitamin A deficiency or inadequate levels of an intervention, by sampling the smallest number of people in a village.

LQAS has its origins in industry where it is used to determine whether a “batch” or “lot” of items meets a specified standard of quality. For example, a manufacturer of light bulbs may produce lots of 2000. For every lot, he or she wants to be able to assure that a certain minimum number of light bulbs work or, conversely, that only a small number will fail. It would be inefficient to test every single light bulb. LQAS is a way to determine the smallest number of “items” to test to be sure that the “lot” is acceptable.

LQAS has been used in immunization programs to identify immunization clinics (“lots”) in which children are inadequately immunized. Within every clinic, a sample of immunization records is checked and the adequacy of each child’s immunizations determined. If the records reveal too many children not properly immunized, the clinic “fails” and further action is taken to confirm whether a problem truly exists. If enough children are properly immunized, the clinic will “pass” and no corrective action is needed. In this way, it is possible to focus efforts where they are needed. “Lots” can be villages, clinics, schools, or some other grouping; the principles remain the same. In a vitamin A program, lots may pass or fail with respect to capsule coverage, availability of fortified foods, or acceptance of a dietary program, for example.

### Sample size for LQAS

LQAS is designed to show whether a lot (e.g., children in a village or records at a local health clinic) meets a specific standard, which is usually decided on at the national or provincial level. Two important values that must be determined are the number of items to sample ( $n$ ) and the “threshold value” ( $d^*$ ), i.e., the maximum number of unacceptable items in a single lot that will indicate whether the lot passes or fails. The actual number of items that fail in a specific lot is designated  $d$ . The selection of  $n$  and  $d^*$  must take into account

- The program goal, e.g., the desired proportion of the population to be covered ( $P_a$ )
- The proportion in a lot below which it would be designated a failure ( $P_o$ ).

Reasonable values for  $P_a$  and  $P_o$  depend on the specific situation in which they are applied. When households in a village are sampled, they should be randomly selected from throughout the village.

### Examples of LQAS for monitoring a vitamin A supplementation program

Table 3.1 lists precalculated sample sizes needed for various desired coverage levels. For example, if the long-term goal of a national program is for 90% of eligible contacts to have received adequate supplementation during the past year ( $P_a = 90\%$ ), and program managers would like to identify villages where fewer than 50% of eligible contacts have received adequate supplementation during the past 12 months ( $P_o = 50\%$ ), then the number of households to sample ( $n$ ) would then be 8 and the threshold value ( $d^*$ ) would be 1. If more than one eligible contact is found to not have received adequate supplementation during the past 12 months (i.e., the actual number of failures  $d \geq 2$ ), the village would fail. If all the samples were adequate or there is only one failure, the village



would pass. A passed village could be assumed to be one in which more than 50% of eligible contacts received the supplement.

As the coverage of vitamin A supplementation improves and fewer villages fail at the current  $P_o$  level, that level might be increased, for example, to 70% which would correspond to  $n = 26$  and  $d^* = 3$ . Initially, the  $P_o$  value should not be set too high or the majority of villages will fail. This would defeat the purpose of focusing intervention efforts on areas with the biggest problems. On the other hand, setting the  $P_o$  level too low might result in too few or no areas failing.

In another example, a provincial health officer would like to identify districts where there is inadequate *availability* of vitamin A supplements (or any other facility-based intervention). The target goal is for 95% of all distribution points (e.g., health clinics, outreach clinics, village health posts) that offer capsules to have adequate stocks on hand to cover the needs of all eligible contacts for the next 3 months. Initially, the provincial health officer would like to identify districts in which fewer

**Table 3.1. Calculated IQAS sample sizes needed for various values of desired coverage ( $P_a$ ) and the level defining a passing or failing grade ( $P_o$ ).\***

$P_a$	$P_o$	$n$	$d^*$	$P_a$	$P_o$	$n$	$d^*$	$P_a$	$P_o$	$n$	$d^*$
99%	95%	123	2	90%	80%	83	10	80%	65%	56	13
	90%	42	1		75%	42	5		60%	33	8
	85%	23	0		70%	26	3		55%	22	5
	80%	16	0		65%	18	2		50%	15	4
	75%	11	0		60%	13	2		45%	11	3
	70%	9	0		55%	10	1		40%	9	2
	65%	7	0		50%	8	1		35%	7	2
	60%	6	0		45%	6	1		30%	5	1
					40%	5	1		25%	4	1
95%	85%	60	4	85%	70%	50	9	75%	55%	61	18
	80%	32	2		65%	30	6		50%	35	10
	75%	21	1		60%	20	4		45%	23	7
	70%	15	1		55%	14	3		40%	16	5
	65%	11	1		50%	11	2		35%	12	4
	60%	8	0		45%	8	2		30%	9	3
	55%	7	0		40%	6	1		25%	7	2
	50%	5	0		35%	5	1				

\* Level of significance = 5% and power = 80%

than 75% of the distribution points have a 3-month supply of capsules. How many distribution points must be visited in each area?

The “target” goal for the proportion of distribution points with a 3-month supply ( $P_a$ ) is 95%; the threshold limit ( $P_o$ ) is 75%. Using the table, the total number of samples ( $n$ ) will have to be 21; and the acceptance number ( $d^*$ ) will be 1. That is, in each district, 21 distribution points will be selected at random and visited. If none or only one distribution point does *not* have adequate supplies of vitamin A capsules, the district passes. If two or more distribution points have inadequate supplies of capsules, then the district fails.

Note that figures in the table are based on a significance of 5% and power of 80%. Tables with different significance and power levels can be found in Lwanga and Lemeshow (1991), and a discussion of significance and power for LQAS appears in Sullivan et al. (1995).

Although these examples refer to aspects of a supplement program, LQAS can apply to any intervention. For example, rather than determining which districts have an inadequate supply of vitamin A supplements, a provincial officer could identify districts in which seed stocks were not available. Thus, the target goal might be for 95% of agriculture offices to have adequate seed stocks for the upcoming growing season. The officer might want to identify districts in which fewer than 75% of agriculture offices had adequate seed supplies. The same sample sizes as noted above can be applied. Any defined “lot” can be classified as meeting or not meeting a given criteria for any vitamin A intervention or activity.

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# 4 Supplementation programs

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## KEY QUESTIONS TO ASK ABOUT...

### PROVISION

- Are supplements available, accessible, and adequate in terms of quality?
- How does the quantity of supplements available compare with the total needs of the target population?
- What proportion of staff are trained?
- Are supplementation activities routinely supervised?

### UTILIZATION

- Are supplements being used by the target population?
- At what proportion of eligible health contacts do children and postpartum mothers receive a supplement?
- What proportion of the targeted communities has participated in orientation regarding vitamin A deficiency and program activities?

### COVERAGE

- Is the target population being reached?
- What proportion of the target population is receiving regular supplementation?

## ABOUT SUPPLEMENTATION PROGRAMS

Supplementation is the fastest way to improve the vitamin A status of populations in which deficiency of this nutrient is endemic. In these programs, which are usually aimed at young children and lactating women, vitamin A is provided in capsule or liquid form. Three approaches are generally used (WHO 1997):

- **Universal distribution** — Vitamin A is administered periodically to all preschool-aged children in communities at risk of vitamin A deficiency or a large dose is given to women at delivery or within the following 8 weeks. Although, in most countries, high doses ( $\geq 50\,000$  IU) are provided to these target groups, periodic administration of low doses is being introduced in many settings.
- **Targeted distribution to high-risk children** — A large dose of vitamin A is given to infants and children diagnosed with measles, severe protein-energy malnutrition, acute or prolonged diarrhea, or acute respiratory infection.
- **Xerophthalmia treatment** — High dose supplements are given on diagnosis of any active stage of XEROPHTHALMIA.

### XEROPHTHALMIA

An eye disorder in which vitamin A deficiency causes the conjunctiva and cornea to become abnormally dry. Without treatment this condition can lead to severe damage to the cornea.

See Appendix B for a more detailed discussion of supplementation schedules for the prevention and treatment of vitamin A deficiency.

Although supplementation programs have been shown to be low-cost, acceptable, and effective in the short term (UNACC/SCN 1994), they do not address the two primary factors that lead to deficiency, that is, an inadequate level of dietary vitamin A consumption to satisfy physiologic needs and a high frequency of infections.

The effectiveness of supplementation programs depends on levels of coverage and compliance: with 65% coverage, the prevalence of mild xerophthalmia in 1 to 4 year olds was reduced 75–80%; 85% coverage can result in a 90% reduction in the prevalence of severe xerophthalmia. With coverage below 25%, vitamin A supplementation is unlikely to have any impact on xerophthalmia (UNACC/SCN 1994, p.15).

Routine contact with health services can present opportunities to reach at risk groups. For example, children and postpartum women may be given supplements at immunization, child health, and postnatal clinics, or during special events such as national immunization days or campaigns for the eradication of polio and neonatal tetanus.

Many countries are also using other routine contacts between government extension workers and families to deliver vitamin A supplements. Extending programs beyond the health sector can boost coverage, especially where health services are limited. Alternative channels include nutrition and agriculture extension workers, nongovernmental organizations (NGOs), community development workers, traditional birth attendants, and women's groups. Private-sector routes, such as pharmacies, appear promising, especially for low-dose supplements. Successful distribution through this route will depend to a large extent on cost recovery and developing awareness among individual families of the problem of vitamin A deficiency.

## WHY IS MONITORING IMPORTANT?

Effective monitoring is of special importance to the success of vitamin A supplementation programs. Monitoring is important for the following reasons:

- ***To increase coverage of those at highest risk*** — Achieving high coverage and sustaining it have been the most frequent problems encountered in vitamin A supplementation programs. Problems often arise because distribution of vitamin A supplements is through existing health services, which are often limited by low coverage themselves, by inadequate flow of supplies, or by the unreliability of vertical delivery systems.
- ***To ensure safety*** — Effective monitoring of coverage and the practices of health care workers and others who administer supplements can reduce the risk of people receiving incorrect or inadequately spaced doses of vitamin A.
- ***To improve program effectiveness*** — Major reasons for low or declining coverage are erratic availability of supplements at the local level, health worker disinterest and fatigue, and missed opportunities for supplementation. These constraints arise from inadequate attention to the logistics of delivering vitamin A to target populations and to lack of awareness of the importance of vitamin A to health and development on the part of health care workers and beneficiary populations.
- ***To reduce recurring costs*** — Monitoring can demonstrate the effectiveness of targeting, which will help reduce capsule wastage and focus on ensuring delivery of supplements to intended beneficiaries.

## ISSUES IN MONITORING SUPPLEMENTATION PROGRAMS

Several issues are of particular importance in establishing monitoring activities for supplementation programs:

- ***Supply management*** — Supplementation programs are continually hampered by difficulties in supply management such as inaccurate local assessment of supplement needs, poor practices in maintaining buffer stocks, inventory and stock rotation, and lack of attention to the need for timely reordering and delivery of supplements to peripheral areas. Monitoring should alert decision-makers to interruptions in supply before distribution comes to a halt.
- ***Recording of doses received*** — Accurate recording of the receipt of supplements by targeted individuals is of critical importance: poor record-keeping may prevent reliable measurement of coverage; supplements may be delivered through more than one channel; and reliable recording can detect duplication or gaps in coverage reducing the risk of multiple dosing or missed opportunities.
- ***Sustaining supplement distribution*** — Field experience shows that inadequate training, skills upgrading, or supervision of peripheral health care workers may lead to “program fatigue,” where low motivation among these workers results in a decline in supplementation coverage over time.



- **Community awareness** — Low coverage may be due to a lack of information at the local level, where community members, especially women, may be unaware of local supplementation programs and their purpose.

## THE MONITORING FRAMEWORK

In developing a monitoring plan for a supplementation program,

- find out whether the supplement has been provided
- determine whether it is consumed
- estimate the proportion of the target population covered. If the indicators measured suggest that the program is effective in reaching the target population, there should be a measurable positive impact on vitamin A status.

Program managers have an essential role in designing simple formats and systems for reporting activities and training peripheral units in how to analyze and use the information obtained. Once they determine information needs and agree on a set of program indicators, program staff must develop and field test appropriate instruments, modify methods of data collection and analysis, then carefully introduce monitoring procedures to all staff. (See *Steps in monitoring* in chapter 2.)

Table 4.1 shows the framework for program monitoring adapted for supplementation programs and lists some indicators that can be used.

Activity	Questions	Examples of key indicators	Data collection methods
Provision	Are the supplies and services available?	Number of facilities offering capsules per 100 000 people	Routine data on number of facilities that provide supplements
	Are they accessible?	Availability of supplements as a proportion of the target population Number of capsules in supply Cost of capsules	Routine stock data, inventory inspection Routine data plus census information on population distribution
	Is the quality adequate?	Proportion of staff responsible for distributing supplements with adequate knowledge on supplementation	Observation of service delivery, key informant interviews, activity reports
Utilization	Are the services being used?	Number of capsules distributed per 1000 children or postpartum women	Routine distribution data
Coverage	Is the target population being reached?	Proportion of all preschool children or postpartum women receiving regular supplements	Household coverage surveys
Impact	Did health and nutrition status improve?	Trends in serum retinol levels Trends in deaths and hospital admissions	Household surveys Routine reporting data (if available) or demographic surveys

## A PROJECT MONITORING SYSTEM USED IN THE PHILIPPINES

**Key interventions** — Nutrition education and vitamin A supplementation.

**Objectives** — Increasing the proportion of high-risk groups receiving a vitamin A capsule (during the previous 6 months) to 60% in Zamboanga del Sur, Northern Samar, and Quezon provinces. High-risk groups include children with xerophthalmia, children 6 to 59 months who are underweight or who present with measles, severe acute respiratory infections, or chronic diarrhea, as well as postpartum mothers.

**Delivery mechanism** — Xerophthalmia detection and capsule distribution are undertaken by rural midwives and volunteer health workers. These activities are integrated with annual child weighing. About 200 000 underweight preschoolers and about 80 000 postpartum mothers are reached with vitamin A supplements.

### **Monitoring activities**

- Quantities of vitamin A capsules provided to municipalities by provincial health offices (40 municipalities per province on average) are monitored monthly.
- Adequacy of supplies at the municipal level is routinely assessed during supervisory visits to municipalities by provincial monitoring teams composed of technical personnel who train, monitor, and supervise.
- A monitoring checklist for health workers, used during supervisory visits by the provincial nutritionist, helps determine the feasibility of supplementation activities at health centre level. For example, it was found that due to the number of children seen during the annual weighing program, it was difficult for midwives to detect cases accurately in addition to weighing children.
- In 1992, a special monitoring study was undertaken to determine the proportion of target groups receiving capsules in the past 6 months and identify problems encountered by health workers in integrating vitamin A supplementation and eye assessment into the weighing program as well as factors affecting mothers' participation in the supplementation program.
- Studies of pre- and postintervention prevalence of xerophthalmia and supplement coverage were undertaken.

### **Lessons learned from routine monitoring and special studies**

- *Provincial monitoring teams* — Routine supervisory visits are critical. Disease-targeted distribution is difficult to monitor as coverage varies from year to year with disease incidence, and it is difficult in practice to monitor supplementation coverage through health workers.
- *Involve trainers in monitoring* — It was important for trainers to visit fieldworkers soon after program initiation. Visits increased field staff confidence in their ability to detect, treat, and manage vitamin A deficiency.
- *Provide adequate supplies and logistics* — Adequate supply and logistics support are crucial. Aside from the vitamin A capsules themselves, important items include monitoring forms for field implementors, checklists for monitoring teams, and travel expenses.
- *Special studies of program processes* — The routine monitoring system focused on availability of vitamin A capsules. However, program managers required additional information to assess the adequacy of provision and utilization. The 1992 study focused on coverage, the problems met by the field implementors, and the perception of mothers regarding the effectiveness of vitamin A.
- *Feedback of findings to implementors* — Only when the problems, issues, strengths, and weaknesses of program implementation are clearly presented and analyzed will they be acted on by program managers and leaders. The project's monitoring system provides opportunities for field implementors (midwives and village health workers) to share the findings of supervisory visits and regular monthly reports with local leaders and Department of Health officials through consultative meetings and feedback sessions.

Source: Helen Keller International, *the Philippines* (1994), personal communication

Those selected should be directly relevant to the project's objectives, and the established information needs, targets, and conditions.

## **MONITORING PROVISION**

An adequate and timely flow of vitamin A supplements — from out-of-country supplier to central stores to distribution point to target individual — is fundamental to an effective program. Running out of supplies, either at health centre, pharmacy, or other distribution sites, or at district or central levels is a common problem. It is essential to have information regarding the availability of vitamin A supplies to prevent disruption of distribution.

Setting local targets for supplementation activities (e.g., the number and frequency of sessions during which supplements are delivered) and assessing the quality of service delivery (indirectly measured through supervision, training, and awareness creation) are also important.

In some settings, there is a fee for vitamin A supplements. It may be important, especially if fees are being introduced, to assess how this affects access and use of supplements. Monitoring can help do this.

### **Sources of data**

- Importation records
- Shipping documentation (for tracking supply at national level)
- Procurement registers (from supplier)
- Records at central stores
- Stock records at health centres, pharmacies, or other distribution sites

Inventory log books at the central level may provide information on quantities of supplements received from local and external sources (including, for example, the Ministry of Health, UNICEF, bilateral development assistance agencies, and NGOs) as well as quantities shipped to subnational distribution points. Information collected on the provision and accessibility of vitamin A supplements can help identify distribution points that require special attention.

Other sources of data for monitoring indicators of provision, particularly quality of service delivery, include

- Activity reports from the ministry of health, NGOs, and other agencies participating in special immunization days or campaigns for administering vitamin A
- Records of supervisory visits by program managers, district and local technical officers, and medical officers

A modified form used in the Philippines at the municipal level to monitor the activities of rural midwives is shown in Figure 4.1. It includes questions relating to capsule supply as well as the midwives' practices when providing the supplements. In this project, provincial health officers prepare annual targets for vitamin A capsule supplementation and determine supply requirements. Supply monitoring involves tracking

quantities of supplements at the municipal and provincial levels. Provincial staff collect information on the number of capsules received and distributed and calculate the balance.

**Figure 4.1. Abridged checklist used at the municipal level to monitor the activities of rural midwives in the Philippines.**

Activity	Yes	No	Reason	Action
Are health workers asking mothers about their child's behaviour in dim light (for night blindness or xerophthalmia)?				
Are health workers detecting signs of vitamin A deficiency in the proper way?				
Are health workers giving the correct dosage of vitamin A capsules?				
Do health workers explain what the capsule is and what it is for?				
Do health workers ask mothers about their children receiving vitamin A capsules within the last 6 months?				
Do the health workers have enough capsules to cover their target population?				
Do health workers use the under-5 card for recording distribution of capsules?				
Are report forms available?				
<i>Source: Helen Keller International, the Philippines (1994), personal communication.</i>				

Effective supply monitoring requires a strong commitment and confidence that information collected will lead to corrective action, particularly at peripheral levels. Effective requisitioning and distribution of supplies by field staff requires a high level of awareness of vitamin A problems, and familiarity with supply and procurement procedures. This may be difficult to achieve if staff turnover is high.

Efforts to strengthen input monitoring at peripheral levels will be largely wasted if distribution problems are at the central level. In situations where the upward reporting of stock records proves difficult, special surveys or evaluation studies may provide useful information more rapidly and at a lower cost than routine reporting.

Great care must be taken to avoid placing additional demands on local and district health and development workers for reporting and data analysis. However, training in data analysis will almost certainly be required, particularly at the site where supplements are distributed. Reporting forms may have to be produced, their timely distribution ensured, and staff trained in their use.

Often, routine reports provide only brief descriptions of activities and numbers. Encouraging the analysis of local problems and posing solutions can help improve programs.

In some settings, the large number of organizations involved in

Figure 4.2. Observation checklist used in Niger during distribution of vitamin A capsules.

Department:						
Administrative division:						
Health program:				Code:		
Supervisor:						
Observation (no.)	1	2	3	4	Problem	Action
Date						
Health officer						
<b>OBSERVATION OF SERVICE DELIVERY</b>						
Does the health officer						
1. examine the eyes of children and pregnant or lactating women?						
2. question the mother about night blindness?						
3. determine when the last preventive dose of vitamin A for high-risk groups was given?						
4. provide the indicated preventive doses?						
5. administer curative doses?						
6. tell the patient when to come back?						
7. enter the dose in the health record and the register?						
<b>INTERVIEW WITH HEALTH OFFICER</b>						
Does the health officer know						
8. the target groups for preventive dosing? (children 6 months to 6 years, lactating women within 8 weeks of delivery)						
9. preventive treatment doses? (children 6–11 months: capsule every 6 months; children 1–6 years: 1 capsule every 6 months; lactating women: 1 capsule within 8 weeks after childbirth)						
10. the signs and symptoms of xerophthalmia?						
11. the target groups for curative treatment? (night blindness, xerophthalmia, measles, severe malnutrition)						
12. the dosing regime for curative treatment?						
13. foods rich in vitamin A? (liver, fresh milk, egg yolk, yellow or orange fruit, baobab leaves, green leafy vegetables)						
<b>OBSERVATION OF FORMS, REGISTERS, AND REPORTS</b>						
Does the health officer						
14. record the vitamin A treatment in the register?						
15. administer correct doses?						
<b>OBSERVATION ON HEALTH EDUCATION</b>						
Has the health officer learned to						
16. master the messages and communication techniques?						
17. use the appropriate educational materials and the health education manual?						
18. hold the session in a suitable location?						
<b>INVENTORY INSPECTION</b>						
19. Is there a sufficient inventory of capsules?						
20. Does the person in charge know when and how to order capsules?						
21. Are the capsules protected from light and heat?						
22. Are the capsules within the expiry date?						
<b>INTERVIEW WITH CLIENTS</b>						
Does the mother know						
23. about night blindness?						
24. about the importance of vitamin A capsules?						
25. which foods are rich in vitamin A?						
Remarks:						
Signatures						
Supervisor:				Health Officer:		
Source: Adapted and abridged from a form developed by the Ministry of Health, Niger, and HKI.						

vitamin A supplementation efforts might create a need to coordinate data collection and analysis. In such cases, tracking provision can help determine the level of coordination and standardization of supplementation that might be important to ensure complete coverage of target groups.

In addition to problems related to capsule supplies, a low awareness of the problem of vitamin A deficiency and a low demand for vitamin A capsule programs can lead to poor coverage. Monitoring of education campaigns and the quality of services provided at health centres or distribution points can help address these problems.

## MONITORING UTILIZATION

Indicators of the use of supplements offered by health or community services provide a measure of distribution and, potentially, demand for vitamin A supplements. Information on service use, disaggregated by target group and administrative or geographic area, can provide decision-makers with crude estimates of program effectiveness, targeting effectiveness, and levels of community awareness and compliance. Note, however, that these estimates cannot substitute for measures of coverage.

### Sources of data

- Routine written and verbal reports by district and local medical or pharmacy officers and other health or community workers
- Activity reports from NGOs and agencies (e.g., forms used during participation in special immunization days or campaigns for administering vitamin A).

The checklist used by supervisors in Niger to record observations made during the distribution of vitamin A capsules (Fig. 4.2) also provides information about the utilization of the services. The vaccination card used in Niger includes space to record the administration of vitamin A (Fig. 4.3).

Comparing trends in the use of services with targets stipulated in local

Figure 4.3. Back of vaccination card used in Niger.

Type of vaccine	1st dose	2nd dose	3rd dose	1st booster	2nd booster
B.C.G.					
D.T.P.					
Oral polio					
Measles		---	---	---	---
Yellow fever		---	---	---	---
Tetanus					
Meningococcal					
Vitamin A administered					

and national plans of action can help program managers identify health centres or districts with low utilization rates, which may indicate distribution problems at the health centre level, low quality of services resulting from inadequate staff training or supervision, or more general problems of community awareness or confidence in the services providing vitamin A.

Data on use may also indicate too many missed opportunities for supplementation or supplement wastage. Monitoring may help differentiate logistic and supply issues from compliance issues, and may highlight areas needing special attention.

If program monitoring shows that either provision or utilization is inadequate, there is little rationale for investing in more complex and costly measures of program coverage and impact.

## **MONITORING COVERAGE**

Precise and reliable estimates of supplementation coverage are important for assessing the degree of achievement of program progress and to measure program effectiveness. Measures of coverage can provide decision-makers at local, district, and national levels with reliable information for reformulating supplementation targets and program objectives, strategies, and activities. Monitoring also permits the determination of trends in coverage, identification of reasons for low coverage or missed opportunities for supplementation, and the prevalence of repeated dosing after too short a time as well as other information essential for improving coverage and overall program performance.

### **Sources of data**

- Home-based child health cards or immunization records
- Clinic records of treatment given to outpatients at child health and expanded program of immunization (EPI) outreach sessions
- Information from community and household visits by community and other outreach workers
- Survey questionnaires

Surveys that measure supplementation coverage directly in a representative sample of people drawn from target groups in a given population may be important because they include underserved populations that may be omitted from reports. Health service statistics can provide information on the number of people seen or the number of visits, but they rarely provide information on the entire population at risk or the total population that is covered by the service.

Questionnaires may be combined with measurement of night blindness, dietary intake, costs, and qualitative survey methods (see example in box, *How a complex, ongoing monitoring system provides information about supplementation coverage in Bangladesh*). Cluster surveys measuring vitamin A supplementation coverage may also be integrated into EPI or diarrheal disease surveys.

**Table 4.2. Comparison of methods for collecting data on coverage.**

	<b>Cluster sampling</b>	<b>LQAS</b>	<b>Sentinel community surveillance</b>
<b>Information provided</b>	Precise estimate of the proportion of target groups covered by supplementation	Adequacy of supplementation coverage and areas where further identification of program inputs are required	Trends in supplementation coverage, collected from a single village or cohort considered to be representative of a population of interest, e.g. targeted children in rural areas, urban areas, etc.
<b>Data source</b>	Questionnaire; take-home health or immunization cards	Questionnaire; take-home health or immunization cards	Registration or take-home health or immunization cards
<b>Administrative level</b>	National, provincial, district	National, provincial, local, depending on the corrective responses to be made, e.g., further targeting of supplements to high-risk areas	Depends on at which administrative level responses will occur. Sentinel sites are commonly taken to reflect large population groups
<b>Frequency of data collection</b>	Special surveys "piggy-backed" onto EPI or other coverage surveys that use cluster sampling method	Special surveys done at intervals frequent enough to cover all areas for which representative information is needed	Special surveys "piggy-backed" onto other sentinel site surveillance activities
<b>Sample size and sampling method</b>	30 clusters, e.g., villages selected at random, where a minimum of 7 children in each age group will be selected from households	Sample size depends on lower and upper thresholds of program performance (see chapter 3)	Sample size depends on expected level of coverage, precision, and desired confidence in the estimate
<b>Who collects data</b>	District and subdistrict health workers and NGO workers supervised by regional and national managers; trained teams	Community health workers or NGO field staff supervised by personnel with expertise in LQAS	District and subdistrict health workers and NGO workers supervised by regional and national managers
<b>Analysis</b>	Provides an estimate of the proportion of children who have received at least one capsule within past 6 months, by age	Estimates whether a population area, e.g., village or township, meets a specified level of coverage of supplements	Provides information on trends in coverage over time
<b>Advantages/disadvantages</b>	Provides representative coverage data for geographic area chosen; may be costly	May have greater community involvement; identifies problem areas; does not provide exact coverage estimate	Less costly and simpler to establish; likely not representative of larger area due to influence of repeated measurement

Cluster surveys, lot quality assurance sampling (LQAS), and sentinel community surveillance are population-based methods that may be used for collecting information about program coverage. These methods are compared in Table 4.2 and additional details on cluster surveys and LQAS are provided in chapter 3, *Methods used in monitoring vitamin A projects*.

Household surveys are often the best source of data on program coverage, and such surveys (using cluster sampling techniques) have been used extensively to monitor supplementation programs. Often, it will be possible to incorporate questions about vitamin A supplements into existing surveys (see section on cluster sampling in chapter 3, *Methods for monitoring vitamin A programs*, and the description of the nutrition surveillance project in Bangladesh below).

Sentinel community surveillance, which may be less onerous to establish, may not be representative, especially after repeated visits by field teams. Sentinel sites are locations, selected as representative of the region (city, state, country) being analyzed, in which the entire population, or a subset of the entire population (for example, all women), is surveyed periodically to detect changes attributable to interventions made over a wider geographic area. The sites constitute a stratified sample of the total number of communities or population clusters in that area. Thus an entire country, region of the country, city, or district of any size may have



its sentinel sites. Among other features, this inclusion of the “universe” in each site makes sentinel community surveillance more cost effective than random sample surveys in that more people or households can be covered for the same amount of resources. At a given cost, this method provides larger numbers for analysis than the typical random sample, making it possible to disaggregate further without losing statistical power (Ledogar and Andersson 1993).

### **HOW A COMPLEX, ONGOING MONITORING SYSTEM PROVIDES INFORMATION ABOUT SUPPLEMENTATION COVERAGE IN BANGLADESH**

In October 1990, the Nutrition Surveillance Project (NSP) was established to create a permanent system to monitor health and nutrition status in Bangladesh. Through a partnership of 21 organizations, the program is able to cover 41 rural sentinel sites (subdistricts or *thanas*) and 4 urban slum wards. Data are collected every 2 months from about 16 000 children and 14 000 households. Two sampling strategies are used:

- In rural areas, the basis for data collection is a non-random sample of *thanas* in a given area with an appropriate infrastructure (an NGO working in the area, communication facilities, etc.). In each *thana*, 50% of the unions (smaller districts) are randomly selected. From these unions, 25 villages are selected by proportionate to population size (PPS) sampling. At the village level, the EPI listing of households is used to select randomly a starting household with at least one child of target age (6–59 months), and 20 children are measured in each village. The cluster of villages remains the same over time but a new starting household is selected each time.
- In urban slum areas, a sample is selected from a list of households prepared by partner NGOs.

Urban data collection sites correspond to the NGOs' working areas and are not representative, whereas the rural sentinel sites are assumed to be representative of *thanas* generally and the rural area as a whole.

Each partner organization hires data collection staff dedicated to NSP activities. HKI provides 6 weeks of basic training followed by bimonthly refresher training. HKI also undertakes independent quality control through unannounced repeat measurements of surveyed households. A special form is used to collect information on aspects relevant to nutrition, including vitamin A capsule supplementation and the mother's report of night blindness in herself and her children. Household socio-economic and distress status and village-level price and disaster information are collected separately. After inputting and “cleaning,” the data are incorporated into a central database managed by HKI. Quality control data are treated the same way; the information provided is used to develop the refresher training materials for the next round of data collection.

After each round of data collection, a two-page report summarizing trends is prepared. Over 550 concerned national institutions receive these reports. In-depth studies on relevant topics are also published at that time.

Through ongoing monitoring of vitamin A capsule distribution in rural Bangladesh over 5 years, the NSP has demonstrated that the strategies combining vitamin A capsule distribution with National Immunization Days and a National Vitamin A Week have led to major improvements in vitamin A capsule coverage.

*Source: Helen Keller International, Bangladesh, project documents and NSP-generated data.*

Although there is now a growing body of experience with LQAS and sentinel surveys as applied to vitamin A interventions, these methods may not be familiar to local technical advisory services or funding agencies.

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# 5

# Dietary improvement programs

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## KEY QUESTIONS TO ASK ABOUT...

### PROVISION

- Are dietary education messages being disseminated with sufficient frequency?
- Are educational messages culturally appropriate and are they understood?
- Are educational messages based on available, affordable foods that the vulnerable groups eat?
- Are district staff knowledgeable and capable of delivering messages?
- Does the population have access to well-trained agricultural extension workers?
- Are agricultural inputs (seed, fertilizer) available?

### UTILIZATION

- Are educational activities being taken advantage of?
- Are home garden materials being obtained and used?
- Are household members increasing their consumption of a recommended vitamin A rich food?

### COVERAGE

- Are educational messages reaching the target population?
- What proportion of the target population is receiving dietary interventions?
- Is the target population consuming adequate amounts of vitamin A?

## ABOUT DIETARY IMPROVEMENT PROGRAMS

Unlike supplementation programs, which are usually the responsibility of the health system, dietary programs also involve agriculture, education, industry, and other sectors. A wide range of activities can contribute to improving dietary intake of vitamin A. These include programs to increase consumption of animal products, agricultural programs involving special seeds or improved farming practices, targeted education directed toward the more vulnerable members of the household, and programs addressing seasonal dietary deficiencies. Many of these will involve efforts to mobilize the community and the use of program “promoters.”

Strategies to promote the increased dietary intake of vitamin A can be grouped into four major categories:

- ***Nutrition education and communication-based strategies*** — These aim to increase the consumption of vitamin A rich foods through behaviour change, e.g., increasing duration of breastfeeding.
- ***Agricultural and home provision strategies*** — These aim to increase the production and availability of vitamin A containing foods, as well as their consumption. Examples of these interventions include agricultural extension services, household food production, gardening, and preservation techniques. Nutrition education activities strengthen and complement these efforts.
- ***Modification of food pricing policies and improving marketing efficiency*** — Price is a major factor in consumers’ decisions to purchase micronutrient-rich foods (Bouis 1991). Food and pricing policies can dramatically affect food availability; low prices for the consumer and fair prices for the producer can help to increase consumption of vitamin A rich foods.
- ***Plant selection and breeding*** — Improving the micronutrient content of soils and selective breeding can increase yields and produce crops with a higher micronutrient content. This strategy may contribute to sustainable solutions to vitamin A deficiency, but is still in the early stages of research.

In this manual, we concentrate on the first two of these strategies as they are the most widely practised.

## WHY IS MONITORING IMPORTANT?

Monitoring of programs aimed at improving dietary vitamin A intake is needed to determine whether activities are occurring as planned and whether they are resulting in changes in behaviour and improvements in diet. Monitoring provides information that can be used

- ***To improve the delivery and quality of services*** — Whether the activity involves delivering an educational message, changing agricultural practices, or increasing consumption of a specific food, monitoring can help determine the effectiveness of the process used.
- ***To increase understanding of the effect on consumers*** — Monitoring provides information needed to determine whether what is being delivered is having an effect, e.g., whether seeds are being planted or whether educational efforts are understood and accepted.

- **To find out to what degree the target population is being reached** — In dietary programs, “coverage” can be understood as either the proportion of the target population reached by the intervention or the proportion with demonstrated improvement in diet. In supplementation programs, a high level of capsule consumption is sufficient; however, acceptance of dietary programs is not as directly linked to improvement in vitamin A status, e.g., although a large number of households may plant gardens, the produce grown may not necessarily be consumed.

## ISSUES IN MONITORING DIETARY IMPROVEMENT INTERVENTIONS

Key issues that affect the design and effectiveness of monitoring dietary improvement interventions include

- **The multisectoral nature of the interventions** — Dietary programs generally involve multiple sectors and include both centrally administered and community-based activities. Determining what information is needed and who collects it will require clear work plans coordinated across all involved sectors.
- **Management of inputs and provision of supplies and services** — Like supplementation programs, dietary interventions are often plagued by difficulties in service delivery. For example, nutrition educators cannot do a good job if they do not have an adequate supply of educational materials that are appropriate for the target audience. Agricultural extension agents cannot provide high-quality services if seeds, water, and other necessary supplies are not available.
- **Measurement of behaviour change** — Diet is influenced by many factors: some of them can be controlled by the individual, others are beyond his or her control (see Table 5.1). In designing a monitoring plan, it is important to identify which of these factors should be reviewed and how relevant data will be collected and used.
- **Methods for assessing dietary intake** — Obtaining accurate quantitative information on nutrient intake is demanding. Although

Table 5.1. Factors that influence diet.

Knowledge, attitudes, and beliefs (predisposing factors)	Skills and resources (enabling factors)	Factors sustaining change (reinforcing factors)
Food preferences	Availability and cost of foods	Social recognition
Knowledge of nutrient needs	Time availability	Imitation of others
Cultural traditions	For gardening, land, water, investment capital, seeds, fertilizer, pest and disease control, fences	Appreciation of new vitamin A rich food, garden produce, or meals prepared
Beliefs in the properties and appropriateness of foods		Approval by family members
Values concerning how time and money are used	Food storage and preparation facilities, including cooking fuel, water, and utensils	Evidence of better health of family members

widely used, semiquantitative dietary assessment methods need further development. Limiting factors include inaccuracy of dietary recall for both type and quantity of foods consumed, variability in vitamin A content, and the difficulty of assessing the intake of young children. Qualitative methods are often underused in the assessment of various aspects of dietary intake, such as food habits and patterns and reasons for not consuming vitamin A rich foods. Qualitative dietary assessment information is useful for developing appropriate messages to influence behavioural change. See chapter 3, *Methods for monitoring vitamin A programs*, for a discussion of dietary assessment methods.

Assessment of actual dietary intake requires information on the vitamin A and provitamin A content of foods. Such databases exist and are continuously being improved and expanded. Review of the most recent information about the foods grown and consumed in the project area is important. However, this information may not be available for many local foods or it may be inaccurate depending on local conditions.

**RETINOL** is the form of vitamin A metabolized by humans and animals. It is found in liver, eggs, whole milk, and cheese. Plants contain provitamin A carotenoid compounds, which must be converted to retinol in the body.

Controversy has arisen recently over estimates of the vitamin A activity of provitamin A carotenoids in plants. Carotenoids are more dependant than RETINOL on other dietary elements (primarily fat) and physiologic factors (healthy epithelium) in terms of their solubility and rate of uptake and bioconversion. Therefore, some concern persists about the extent to which carotenoids from various plant sources, especially dark-green leafy vegetables, can improve vitamin A status.

#### **Factors that affect bioavailability**

- Animal sources of vitamin A are better absorbed than plant sources.
- A daily intake of dietary fat below 5–10 g reduces vitamin A absorption.
- Absorption of vitamin A from orange and yellow fruits (e.g., mango, papaya) and vegetables (e.g., pumpkin, squash, sweet potato) is greater than from dark-green leafy vegetables.

## **THE MONITORING FRAMEWORK**

Developing a monitoring plan needs careful thought, and program managers face difficult decisions about what aspects of the program are most important to monitor. The most effective starting point is to decide on a carefully selected set of simple indicators. For dietary programs, these indicators will be quite varied, depending on the sectors involved and the types of activities undertaken. Decisions will be made by people in different sectors and at different levels, from central planners to community leaders. Traditional upward reporting of data related to the program is not likely to be successful for this complex array of activities, and the selection of a minimum number of indicators useful to those collecting the data is important.

Dietary programs may benefit from emphasis on more decentralized

collection and use of data. Unlike supplementation programs, in which centralized information is necessary to monitor coverage and plan supply logistics, dietary programs attempt to generate change at the community level, and understanding issues at this level is important.

Examples of indicators of the provision of inputs and services, the use of those services, coverage, and biological impact are listed in Table 5.2. Because the types of activities undertaken in these interventions are so

**Table 5.2. Framework for monitoring vitamin A dietary improvement programs.**

Activity	Questions	Examples of key indicators	Data collection methods
<b>Provision</b>	Are the dietary education messages being disseminated with sufficient frequency?	Number and frequency of radio/TV broadcasts Number of materials printed, produced; educational meetings held	Routine media coverage reports Routine reports
	Are educational messages based on locally available, affordable foods that the vulnerable groups eat?	Number of mothers understanding messages and posters	Focus group discussions, market surveys
	Are district staff knowledgeable and capable of delivering messages?	Number and evaluation of training efforts	Training evaluation reports
	Are agricultural inputs (seeds, fertilizer) available?	Number of agriculture extension offices with adequate supplies	Routine reports, supervisory visits
	Does the population have access to agricultural extension workers?	Number of extension workers working in target areas	Routine reports
<b>Utilization</b>	Are educational activities being taken advantage of?	Attendance at educational meetings	Program activity reports
	Are specific vitamin A rich foods being consumed?	Trends in household food consumption % of families using eggs, liver, or other single vitamin A rich source being promoted	Focus groups Survey
	Are home garden materials being obtained and used?	Home garden materials distributed	Supervisory reports, supply forms
<b>Coverage</b>	Is the target population being reached by educational messages?	% of target population who have seen or heard and understood messages	Knowledge, attitudes, and practices survey
	Has the target population improved its dietary practices?	% of target population consuming specific promoted vitamin A rich foods	Knowledge, attitudes, and practices survey, cluster survey
	Is the target population consuming adequate vitamin A?	% of target population consuming vitamin A rich foods	Dietary intake survey
<b>Impact</b>	Did nutritional status improve?	Trends in vitamin A status	Household survey



variable, it is not possible to anticipate all the indicators that might be most appropriate; the selection listed is meant to generate ideas for specific programs.

## **MONITORING PROVISION**

Information needs and indicators used for monitoring the provision of inputs and services designed to improve dietary intake of vitamin A will be specific to each intervention and each situation. Whether focusing on changing diet through education, crop improvement, or promoting solar drying, each intervention involves a unique set of inputs and processes that should result in acceptance or use of the service. Each participating sector will have to define indicators to measure how well that service is being provided.

An educational intervention may involve trained educators delivering messages through the mass media, a poster campaign, or community education, all designed to influence behaviour. It may focus on promoting a single food that is rich in vitamin A, such as eggs or liver. An agricultural program might provide materials (e.g., seeds, fertilizer) or technical support (e.g., a review of planting dates, advice on crop rotation, design of a solar dryer) through extension workers. Regardless of the type of service, it is necessary to find out whether it is actually being delivered. If messages to modify behaviour are developed, but not understood, the expected change in behaviour will not occur. If seeds are released from a central nursery, but not received by farmers, monitoring the program's impact will be irrelevant.

### **INDICATORS OF ADEQUATE PROVISION**

Small-scale gardening projects have proven successful when the following resources are available (FAO/ILSI 1997). Some of these may be useful in selecting indicators of provision of services.

- irrigated land or nearby access to water
- seed for locally adapted plants with high germination rates
- capital or credit for purchasing inputs and meeting other costs
- training (e.g., through agricultural extension) if there is inadequate existing knowledge about how to grow and care for crops produced in local agro-ecological conditions and soils
- adequate time or available labour
- access to the knowledge and technology needed to provide fencing as required
- access to markets and storage or preservation techniques
- ability to withstand drought conditions
- knowledge of and access to soil improvement techniques and pest control measures

## Sources of data

- Statistics about the number and type of education and training sessions
- Statistics about the amount of educational material printed or frequency of message delivery
- Rapid surveys or focus group discussions to determine whether messages are appropriate and understood
- Activity reports of service providers and supervisors, including focus group discussions on program quality and usefulness
- Records kept by extension workers, supervisors, or program volunteers
- Stock and distribution records at nurseries and other seed distribution outlets

Key informant interviews or focus group discussions may be particularly helpful to determine the response to educational efforts or attitudes about desired changes in agricultural practices, food preparation methods, or dietary patterns. For example, early in a program designed to improve weaning practices, it might be necessary to learn current cultural beliefs about feeding young children. These techniques can also be used to help program staff understand traditional beliefs about planting or factors contributing to slow program progress.

Broader-based methods using more representative groups can be used to determine whether services are reaching all communities in the target area. For example, LQAS allows classification of a community as “passing” or “failing” according to a set of criteria or indicators (see chapter 3, *Methods for monitoring vitamin A programs*). For example, if the program is monitoring activities to improve availability of foods rich in vitamin A through education programs or provision of seeds, provision might be considered “acceptable” when more than 50% of households in a community have access to those services. LQAS can be used to classify communities as having met this criterion or not.

Data on the provision of services should stimulate improvement in program logistics, supervision of activities, educational messages, and overall program management. For example, if monitoring reveals that workers are not adequately informed about vitamin A deficiency, training should be evaluated and intensified. Messages for education and communication programs might be changed in response to findings from focus group discussions on how those messages are interpreted. If agriculture activities are weak because of disruption of needed inputs, procedures for ordering and delivering can be improved.

Monitoring data can also reveal geographic areas where problems exist with delivery of services. For example, in regions with limited access to media, alternative communication and educational methods might be needed. Monitoring can identify areas where the health, education, or agricultural infrastructure is weak and where few extension workers are available to carry out the program. Areas might be identified where it is not possible to deliver seeds, fertilizer, or other agricultural inputs.

## MONITORING UTILIZATION

Services may be available, but not used by the target population. Media messages may be broadcast, but people may not listen. Nutrition education sessions may be provided, but not attended. Agricultural extension workers may offer program activities and have the necessary materials to support them, but the target population may not use these services. Monitoring utilization provides information about demand for and use of the services being provided and feedback about whether they are appropriate.

### Sources of data

- Supervisors' or extension workers' reports on participation in meetings or community training workshops
- Inventory records showing agricultural materials distributed and used, such as number of gardens planted, plant yields, and food supplies stored
- Specially designed questionnaires on program acceptance, administered on a periodic basis, perhaps through group interviews

Some monitoring activities might not provide program managers with information directly, but will rather be used to strengthen community involvement and the demand for and use of services. Community-based process monitoring recognizes that local people, such as health or agriculture promoters, teachers, and community volunteers who participate in the implementation of a program, should be actively involved in its monitoring. This will enable them to understand whether the services provided are being taken advantage of or whether modifications are needed. For example, promoters might help develop a simple questionnaire that can be administered periodically to determine attitudes about seeds provided or to measure behaviour change in feeding practices. Results can be reviewed with community leaders, and data can be aggregated to monitor larger geographic areas. This type of community empowerment is particularly relevant in gardening, food preservation, and small agriculture or livestock programs because the ability to modify these programs often rests with the community members.

With good data on both provision and utilization of services, program managers can focus on problem areas and on ensuring optimum coverage.

Intense monitoring of a home gardening project in Vietnam (see box) was designed to demonstrate the link between nutrition education and behaviour change and the resulting improvement in health. Although most programs will not need such a complex monitoring system, this example shows what is possible in closely supervised projects. A similar example from Bangladesh is also provided (see box).

## **A FOOD-BASED APPROACH TO NUTRITION IMPROVEMENT AND ELIMINATION OF VITAMIN A DEFICIENCY IN PRESCHOOL CHILDREN**

The *Nutrition Improvement Project with Special Reference to Vitamin A Deficiency through Increased Production and Consumption of Appropriate Foods* is one of the first internationally recognized “nutrition-driven” agriculture projects to focus on the production of vitamin A rich foods, nutrition education, and monitoring of vitamin A status and growth. The project offered a unique opportunity to monitor the effect of improved diet on vitamin A status in infants and young children in Vietnam.

The major interventions in the project, carried out from 1991 to 1993, were nutrition education, particularly for pregnant women and mothers of children under 5 years of age and the promotion of home gardening, especially the production of vitamin A rich foods. Promotion of home gardening included training and the provision of seeds and seedlings. A network of community volunteer educators (CVEs) ensured delivery of nutrition education to the target group. Provision and utilization of services (nutrition education sessions, training, seeds, seedlings) were recorded monthly by the CVEs.

To determine the causal link between the interventions and the health and nutritional status of the children, indicators of provision, utilization, coverage, and impact were included in the monitoring framework of the project. Monthly records were kept of activities completed. Also, every 6 months, surveys were carried out to measure changes in knowledge and child feeding practices, food production and use, food consumption patterns, and nutritional status (wasting, stunting, underweight). Morbidity from acute respiratory infection and diarrheal disease was assessed every 3 months, and an assessment of vitamin A status through eye examination was carried out at baseline and follow up.

Mothers’ knowledge of nutrition and the importance of vitamin A improved. Home gardens resulted in increased production and intake of vitamin A rich foods. The project resulted in a significant reduction in the incidence of respiratory and diarrheal infections at the pilot site. The monitoring framework provided useful data on indicators in the causal chain between education, behaviour change, and improved health and nutrition.

*Source: Tu Ngu et al. (1995); review of project documents.*

### **MONITORING COVERAGE**

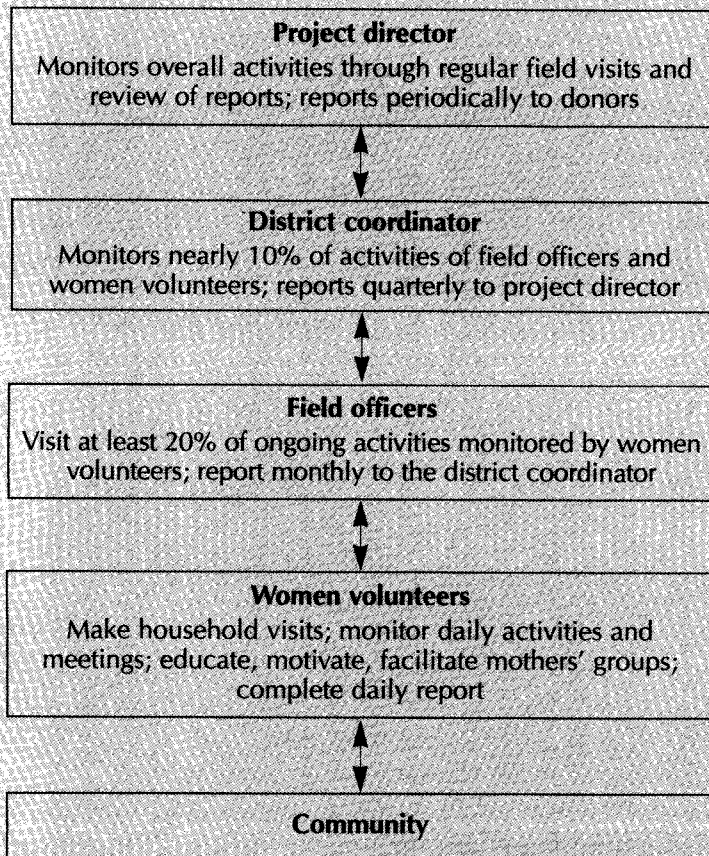
Achieving high program coverage with a dietary improvement intervention does not necessarily mean that the target population is consuming an adequate amount of vitamin A. Measuring coverage in dietary programs must involve estimating how well the program is reaching the target population as well as measuring the resulting improvement in dietary practices. Coverage relates not only to the proportion of the population receiving the interventions, but also on the proportion improving their dietary practices *in response to* those interventions. For example, for a home gardening or solar drying

## MONITORING SYSTEM FOR THE NUTRITION BLINDNESS PREVENTION PROGRAM IN BANGLADESH

In northern Bangladesh, the NGO Worldview International Foundation is implementing a large program to eliminate vitamin A and other micronutrient deficiencies in children under 5 years of age in three *thanas* (subdistricts). Specific objectives are to increase knowledge about the causes of vitamin A deficiency and the means to eliminate it among the target population and to increase the production and consumption of vitamin A rich foods.

Activities to meet these objectives include developing education materials and organizing nutrition education sessions; providing agricultural training to mothers' groups; training women volunteers; establishing nurseries and school and community gardens; and conducting participatory training of government and community leaders and NGO workers.

A comprehensive monitoring system is used to measure progress of ongoing activities on a regular basis at various levels of implementation. Data are collected through field visits, household visits, observation, community and group meetings, key informant interviews, and surveys. At each level of data collection, the information is reviewed, often in group meetings, so that changes can be made to improve the program if needed.



A series of reports are completed, based on data collected daily, monthly, semi-annually, and annually at various levels (see flow chart). Information is transferred from the community level to the project headquarters in the capital city.

Emphasis is placed on ensuring that needed inputs are provided in sufficient quantity and quality (e.g., fencing, seeds and water for the nurseries and gardens; culturally appropriate training materials; number and quality of training sessions; and knowledgeable fieldworkers and women volunteers for the education interventions).

Periodic, in-depth evaluations of the project are conducted by a Joint Review Team comprising project staff and external evaluators. To date, the project has made a significant impact in the target population by increasing the production of micronutrient-rich foods, increasing consumption of these foods, and reducing night blindness.

*Sources: Sirajul Islam, project director, Worldview International Foundation, Bangladesh, October 1997, personal communication; review of project documents and monitoring tools.*

program, measurement of coverage might involve determining the number of households that have established home gardens or are using solar drying divided by the total number eligible under the program. However, an additional coverage estimate would involve determining the number of people in households with gardens or dryers who are now consuming adequate amounts of vitamin A rich foods.

If the intervention consists of promoting a single vitamin A rich food, monitoring coverage can include estimating not only the number of households receiving the educational message, but also the proportion actually consuming the promoted food. Estimating the former requires information about overall program implementation, whereas measuring the latter requires assessment of dietary intake.

Regardless of the type of dietary intervention, some estimate of how well the program is reaching the target population as well as some measure of the resulting improvement in dietary practices is important.

## Sources of data

- Community surveys, carried out, perhaps, through household visits by community workers or extension agents
- Media surveys to determine the proportion of the population listening to educational messages
- Market surveys to obtain information (such as cost, seasonal availability, and public demand) about vitamin A containing foods
- Food frequency or other surveys to determine levels of consumption of vitamin A rich foods

Because coverage estimates are meant to determine a proportion of the population, it is important to consider how well the information collected represents the overall target population. More quantitative methods, such as cluster surveys and LQAS are useful (see chapter 3, *Methods for monitoring vitamin A programs*).

Several methods can be used to assess dietary intake at the population level:

- Direct quantitative methods to estimate vitamin A intake
- Direct semiquantitative methods to determine individual and household consumption using food-frequency questionnaires (e.g., HKI and IVACG methods)
- Indirect methods to determine community-level availability of vitamin A rich foods (e.g., through market surveys and focus group discussions)

Both the HKI and IVACG methods for assessing dietary intake are described briefly in chapter 3, along with information on how to learn more about them. These methods are used to quantify the consumption of foods high in vitamin A and assess the risk of deficiency in individuals or communities.

Indirect methods, such as market surveys can provide a first approximation of food availability to households if reasonably reliable population data are available. However, they are limited by lack of information on actual consumption by individuals in the household.

Coverage surveys to assess dietary intake are demanding in terms of resources and are usually only recommended every 2 or 3 years. Ideally, information on vitamin A intake should be collected as part of other nationally representative surveys.

Monitoring coverage provides decision-makers with information useful for reassessing and possibly revising objectives, strategies, and activities. For example, if it is found that coverage is low in certain areas, program efforts can be intensified at that location, or further investigation may be undertaken to uncover the reasons for program failure. The decision to continue support for a policy or a project might also rest on whether it can be shown that the intervention is leading to an improvement in vitamin A status or the health of a population.

## MONITORING IMPACT

Assessing the impact of dietary programs on vitamin A status relies on clinical and biologic indicators as discussed briefly in the section on *Impact measurements using core indicators*. For supplementation and fortification programs, coverage is a reasonable surrogate for impact. For dietary programs, good program coverage does not guarantee adequate intake, and assessment of dietary change and impact are important.

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# 6

## Food fortification programs

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### KEY QUESTIONS TO ASK ABOUT...

#### PROVISION

- Are fortified foods available?
- Is the vitamin A content of the fortified food adequate?
- Is the quality of fortified foods and their retail storage condition checked routinely?
- Are there mechanisms and resources for corrective action if standards are not met?

#### UTILIZATION

- Are fortified foods accepted, and are they being purchased by the target population?
- Is there demand for such products in the community?

#### COVERAGE

- What proportion of the population has access to fortified foods?
- Is the target population being reached with adequately fortified food?
- What proportion of the target population regularly consumes the fortified foods?

## ABOUT FORTIFICATION PROGRAMS

Food fortification can be an economical, flexible, and socially acceptable way to improve the nutrient intake of groups at risk, and it has contributed significantly to better nutrition in a number of industrialized countries. For example, fortification of milk and margarine with vitamins A and D and fortification of cereals with iron have greatly reduced the prevalence of deficiencies in these nutrients. Processed foods are reaching greater numbers of people all over the world, and many of these foods have been fortified.

Although vitamin A has been added to a variety of foods in developed countries, in developing countries, the only large-scale fortification efforts have concentrated on sugar and fats or oils in certain countries (sugar in Guatemala, Honduras, and a few other Central American countries; cooking fats and oils in India and Pakistan; margarine in the Philippines and a few other countries). Besides sugar, fats, and oils, milk and milk powder, biscuits, porridge, rice, and even tea and condiments (Lotfi et al. 1996) can be fortified with vitamin A with good results. The fortification of flours with vitamin A and other micronutrients is also attracting attention.

## WHY IS MONITORING IMPORTANT?

As fortification programs expand, there will be increasing need to monitor the quality of the fortified food and evaluate its contribution to the alleviation of vitamin A deficiency. Usually the responsibility of ensuring progress toward specific program and nutritional objectives lies with the government, and monitoring can help to ensure and sustain high program coverage and the achievement of program goals. Information in this chapter will also be useful to managers of facilities that produce vitamin A fortified foods to strengthen quality assurance at the point of production. Currently, the field of monitoring food fortification in the Third World is poorly developed.

Monitoring of fortification programs differs from monitoring of other interventions, in that it is concerned with the quality and availability of the product of a food-processing company as it moves from factory to consumer. Invariably, this involves interaction between public regulatory agencies, private industry, trade, and public health services.

In this chapter, we draw on experience in the limited number of vitamin A fortification programs to illustrate what is involved in organizing and implementing monitoring systems and to provide insight into what constitutes an operational monitoring system. The extensive experience gained in fortifying salt with iodine has provided useful guidance as planners now move to fortify other foods with vitamin A.

Monitoring is vitally important to the success of a food fortification program for the following reasons:

- ***To improve program effectiveness*** — A fortification program can only be effective if a high-quality fortified product is produced,

delivered, accepted, and consumed by the target population on a continuous and self-sustaining basis. Weak monitoring and poor quality assurance are the major reasons for the limited impact of food fortification programs in several countries. For example, in Pakistan it is mandatory to fortify oil with vitamin A, but as no monitoring system exists, the law has not been enforced. Consequently, the vitamin A content of the fortified oil varies considerably, and the intervention's effectiveness is low. In a Guatemalan pilot program in which maize flour was fortified with minerals and vitamins including vitamin A, monitoring revealed that the initial 95% participation of a village community dropped to 30% in a few days because of rapid deterioration in taste of fortified tortillas when stored for more than a day (Kielmann 1980).

- ***To ensure compliance with government standards*** — Monitoring systems will provide information on the extent to which the product conforms to national standards at points of production and consumption. This information is needed to enforce compliance through regulation and encourage voluntary corrective action by the producer.
- ***To focus on coverage of those at highest risk of vitamin A deficiency*** — Monitoring systems can provide estimates of average intake and of vulnerable groups consuming the fortified food. This can enable corrective action in terms of expanding production of the fortified food or correcting distribution bottlenecks. For example, in India, fortification of cooking fat with vitamin A at a level of 7.5 µg retinol per gram of fat was made compulsory in 1953; only later was it found that this product was mainly consumed by upper- and middle-class households (Mannar 1989). Furthermore, the average amount of the fat consumed was 3 g a day, which provided 22.5 µg of vitamin A a day — only about 4% of the RDA (Sridhar 1997). Thus, the amount of vitamin A received from this level of consumption is too low to have any appreciable impact on vitamin A status.
- ***To identify problem points in the fortification process*** — As food moves from the factory to the household, it generally goes first to distributors, then to retail outlets. In some cases, foods are fortified outside the country and imported for eventual consumption. Monitoring must occur at various critical points, starting at the production level and ending at the household level, where the fortified food is stored, prepared, and consumed.
- ***To ensure safety*** — Effective monitoring will ensure that the vitamin A content of the fortified food is within the desired range. This is important although the risk of receiving undesirably high levels of vitamin A through a vitamin A fortified food is low.

## ISSUES IN MONITORING VITAMIN A FORTIFICATION PROGRAMS

A number of issues are of special importance when monitoring fortification programs.

- ***The amount of vitamin A added to a food*** — The level of vitamin A fortification will depend on dietary requirements; expected losses during distribution, handling and processing; the consumption

level of the selected food (especially by at-risk groups); and the amount of vitamin A already available to the population in question from other sources (diet, vitamin A capsules).

The amount of vitamin A permitted in the food will be established by the government or, in the absence of legislation or regulations, might be set by the food industry itself. The amount of fortificant might have to be modified over time, for example, in response to changes in nutritional goals, in the daily diet of the population, or in the level of intake of the food vehicle by the target population.

#### LAWS AND REGULATIONS

The legal environment determines whether a given commodity must be fortified (i.e., mandatory) or whether it is simply legal to do so (i.e., optional), and regulations refer to the acceptable standards for the product

- **The regulatory environment** — One aspect of monitoring fortification programs that differs somewhat from monitoring supplementation or dietary improvement programs is the crucial role that REGULATION plays. An effective fortification program depends to a large extent on the existence of an adequate legal framework and an enabling regulatory environment.

Legal standards for fortified foods are designed to protect the consumer — to ensure that safe and efficacious amounts and types of the fortificant are added to the food and that the required quantity of fortificant remains in the food until the time of consumption, providing for reasonable losses during transportation and storage. Consumers should be informed about what they are buying so that they can make appropriate food choices. It is also useful to ensure that all producers act under the same rules and conditions.

An enabling regulatory environment will encourage the production and supply of fortified products that meet standards. Not all

### SAFETY AND VITAMIN A LEVELS IN FOODS

Usually small amounts of vitamin A above the RDA for short periods are not harmful. Only a sustained daily intake over 40 000–50 000 IU (12 000–15 000 µg) in adults and 20 000–25 000 IU (6000–7500 µg) in infants and young children can cause toxic effects (Health and Welfare Canada 1983). Such high levels are unlikely to be ingested in foods fortified with vitamin A; a much greater hazard is due to incorrect or accidental intake of highly concentrated pharmaceutical preparations of vitamin A for an extended period. For fortification to be effective and remain within the upper safe limit, it should supply at least a third of the RDA for children aged 3–5 years (250–400 µg a day) as they are most vulnerable to the effects of both vitamin A deficiency and toxicity.

In calculating the desired vitamin A concentration in a product, the minimum need for vitamin A, the maximum safe level, and the lowest and highest rates of intake of the product to be fortified should all be considered. Arroyave and Dary (1996) provide an example of such calculations for sugar fortification. Sugar consumption in the lowest economic quartile is assumed to be 20 g/day. For this amount to provide the base retinol needs of preschoolers (i.e., 200 µg/day), it should contain 10 µg retinol per gram of sugar. On the other hand, if the highest economic quartile consumes 150 g of sugar a day, then the amount of retinol added should not exceed 20 µg/g for their intake to remain below 3000 µg of retinol a day (the maximum safe level). The final decision might be to choose the midpoint, i.e., 15 µg retinol per gram of sugar, which will provide enough vitamin A for basic needs and still be safe at the higher levels of consumption. This level will also allow for losses of vitamin A during handling and storage.

countries have legal standards for vitamin A fortified foods. However, there should at least be food industry standards or guidelines that include the generally accepted practices for quality assurance and quality control.

- ***Working with the private sector*** — Food fortification cannot be done without the cooperation of food processors, who are often in the private sector. Strengthening communication between the public and private sectors is very important in fortification programs. The business and regulatory environment in the country should motivate the food industry to produce and sell fortified goods that meet standards. In retrospect, some Latin American governments now recognize their error in not including industry in discussions relating to food fortification programs. For example, when standards for the fortification of sugar were initially set in Guatemala, the vitamin A content was established without taking into consideration the technical constraints faced by the sugar industry.

A mechanism that allows for ongoing communication with the food industry and other interested parties will encourage public–private sector collaboration and offer the industry a chance to make contributions to the government’s policymaking processes.

- ***Public–private sector responsibilities and relations*** — It is important to define roles and responsibilities for collecting information on production, distribution, consumption, coverage, and enforcement.

As, in most instances, fortification is carried out by the private sector, the government’s role is to ensure compliance with standards and to facilitate the contribution of fortified products to the alleviation of vitamin A deficiency. The role of the private sector lies mainly in ensuring the quality of the fortified product during production, distribution, and sale.

## **THE MONITORING FRAMEWORK**

Monitoring activities should ensure that a vitamin A fortified product contains a sufficient amount of the vitamin and that it reaches the target population. The indicators used to monitor fortification efforts reflect the need to determine the quality and safety of the products and their availability to the populations at greatest risk. If the indicators suggest that the fortification program is working, there should be a measurable improvement in vitamin A status.

Examples of indicators that might be used to monitor the provision, use, coverage, and impact of adequately fortified foods are listed in Table 6.1.

Monitoring is carried out at various levels — production or importation, wholesale and retail, and household. The production and importation levels are the most important point for monitoring the fortification activity. Monitoring at the household level is essential to determine whether the product reaches the target population and that the vitamin A content is adequate and to evaluate impact. Monitoring at the wholesale or retail levels will be restricted mainly to ensuring that the products are well packed, labeled, and stored appropriately, as further efforts at this level would be expensive and complex.

**Table 6.1. Framework for monitoring a vitamin A food fortification program.**

Activity	Questions	Examples of key indicators	Data collection methods
<b>Provision</b>	Is the fortified food available in sufficient quantity?	Amount of fortified food produced (crude and per capita)	Food industry statistics Production records and quality control reports
	Are the distribution/sale outlets accessible to the population?	Number and location of sales/distribution outlets	Commercial census Government statistics
	Is the quality of the food adequate?	Vitamin A content of fortified food	Food analysis using quantitative or semiquantitative assay methods
<b>Utilization</b>	Is the fortified food being distributed? Purchased?	Sales and distribution of fortified food (crude and per capita)	Food industry statistics Market survey
<b>Coverage</b>	What proportion of the target population is eating fortified foods?	Proportion of all children under 5 or postpartum women regularly consuming sufficient amounts of fortified food	Household surveys
<b>Impact</b>	Did health and nutrition improve?	Time trends in serum retinol levels	Household surveys Routine reporting data (if available) or special surveys
		Time trends in deaths and hospital admissions	

## **MONITORING AT THE PRODUCTION AND IMPORTATION LEVELS**

Monitoring at the production and importation levels involves action by food producers and the government. Product quality control is primarily the responsibility of the producer, with external checks by government agencies — a process critical to ensure both adequacy of vitamin A content and safety.

### **Internal monitoring by the producer**

Monitoring at the production level or point of importation is probably the most crucial part of any monitoring system. If problems exist and food does not meet standards at this level, it will not meet standards at any other point in the distribution system, and consumers will not receive an adequate amount of vitamin A from the food that is meant to provide vitamin A in their diet. Responsibility for monitoring at this level belongs primarily to the private producers or importers.

It is not enough for producers to simply add a fortificant to their products; they should also have a quality assurance (QA) plan and a process for monitoring their system continuously that includes routine and periodic collection and analysis of samples to ensure that they meet government or industry standards.

## ASSURING QUALITY

The quality assurance plan should specify:

**Production and mixing methods** — for the premix (if one is used) and for the food to be fortified

**The people responsible** — who is responsible within the plant for what QA activity (e.g., food sampling, nutrient analysis, equipment checks, packaging and labeling checks, storage area checks)

**Sampling procedures** — frequency of sample taking, the method of sample analysis, criteria for the acceptability of results

**Maintenance** — equipment maintenance schedule

**Reporting** — reporting requirements and corrective action to be taken when problems are identified. Producers should keep quality control records, such as log books and control charts (Fig. 6.1), and make them available to government inspectors on request.

### Internal monitoring should reveal whether:

**PREMIX** is formed by combining a filler (cornstarch, oil, antioxidants, or the food vehicle) with a concentration of the nutrient (or multiple nutrients). The premix is then added to bulk quantities of the food vehicle in the correct proportion to ensure the specified nutrient concentration is evenly distributed in the fortified product.

- The process of vitamin A fortification is proceeding effectively, and the amount of vitamin A added to products meets required government or industry standards
- Adjustments in the fortification process are required
- Procedures for fortification, labeling, packaging, and storage are being followed
- There is sufficient PREMIX in storage as well as at the point of use
- Workers' knowledge of quality assurance and control is adequate
- The criteria for fortification level are being met

### Useful indicators

- Number of tonnes of vitamin A fortified products produced per unit of time
- Proportion of fortified products failing to meet industry standards
- Amount of retinol or premix used per day (this can then be checked against the amount of final product)
- Amount of fortificant in stock and its storage period

The producer must meet all legal requirements specifying quality control activities. However, the law typically will only require that the producer engage in routine and periodic QA, leaving the details to the producer to work out according to his or her own judgement. These details should reflect the standard in the industry or generally accepted practices in the country.

### Methods of data collection

Sources of data may include records on the production volumes per unit of time, importation records, shipment documentation, and procurement



records (e.g., for premixes). Log books and inventory records may provide information on the amount of ingredients available or used for fortification purposes. Quality control charts, reports, and inspection forms that include observations of plant performance and results of analyses and note obstacles in the production process are valuable sources of information for internal production monitoring.

In-line sampling or batch sampling during production, using statistical criteria should be performed. The sampling method chosen depends on the situation and analytic capability in the production plant.

**VITAMIN A** in the form of retinol, retinyl acetate, or retinyl palmitate is available as an oil solution, an emulsion, or a dry stable preparation that can be incorporated into a premix or added directly to food. The choice of which form to use depends on whether the food vehicle is oil-based, water-based, or a dry product to which water may be added before consumption.

If premix is used, both it and the process that produces the fortified product must be monitored. Although the quality of the premix can be adequate, the efficacy of the fortification process can be weak. Because of improper or insufficient mixing, a high percentage of samples may contain some VITAMIN A, but only a fraction of them may be fortified within the desired range.

Vitamin A content can be measured quantitatively or semiquantitatively. Assays may be performed using sophisticated laboratory tests, such as high-pressure liquid chromatography. Although this method is sensitive and highly specific, it requires well-trained staff and costly equipment. Instead, simpler methods such as spectrophotometry (a quantitative method) or colorimetry (a semiquantitative method) can be used for vitamin A determination in samples. Rapid semiquantitative testing can easily be done in the factory or at other sites. These methods are described in detail by Dary et al. (1996) and IVACG (1982).

Importers should test random samples of the food and ingredients they

Figure 6.1. Example of a quality control log for fortified sugar.

Shift	Semi-quantitative (µg/g)*	No. bags premix used (A)	No. sacks sugar produced (B)	A/B	Quantitative (µg/g)†	Observations‡

Laboratory manager \_\_\_\_\_

Inspector \_\_\_\_\_ Date \_\_\_\_\_

\* ND (not detected), <5 µg/g, 5-<10 µg/g, 10-<15 µg/g, 15-20 µg/g, or >20 µg/g.

† This column is filled when data are obtained by spectrophotometry or high-pressure liquid chromatography.

‡ These should explain missing or anomalous data and the corrective measures taken.

Source: Adapted from Dary and Arroyave (1996).

receive. It may be sufficient to verify claims of certification of conformity with food standards with a few analyses. Importers must also routinely check packaging, labeling, and storage conditions, report problems, and take corrective action that is within their control.

Corrective action should follow once a problem is identified. For example, if vitamin A content is out of the desired range, then the amount of premix or vitamin A added must be adjusted. If labeling or packaging is inadequate, the production manager should be informed and appropriate changes made.

## **External monitoring by government**

The government will use the monitoring information it collects, preferably in consultation with the private sector, to assess critical elements that may call for program modifications and to ensure that standards for food fortification are met consistently.

Government inspectors must check whether food under production meets legal or government standards in terms of fortificant level, packaging, labeling, and storage conditions and whether the producer's quality assurance and control procedures are properly implemented and adequate records kept.

Inspectors might also have to collect other information, not necessarily related to regulation, to assess how well the provision component of the fortification program is functioning. For example, they might gather data on production quantities of particular foods and compare them with the overall needs of the population to check whether producers should be encouraged to produce more fortified food if fortification is not mandatory.

Inspection of import facilities is similar, but may include review of tender specifications and shipping documents.

### **External monitoring should reveal whether:**

- Internal quality control is being carried out correctly
- Records show that government standards are being met consistently
- Independent vitamin A testing confirms the producer's reports
- Equipment is properly maintained to maximize production of vitamin A fortified products that meet government standards
- The level of staff training is adequate

### **Useful indicators**

- Proportion of products adequately fortified on external inspection
- Number of external quality assurance checks per year

Laws and regulations will typically establish which agency is charged with inspecting food. Usually, the government will employ specially designated food inspectors or public health officers. If laws and regulations do not specify the frequency of inspections, the ministry charged with the responsibility of inspecting must determine what is feasible, given available resources and the incidence of previous problems at the food processing site.

If the level of inspection (national, provincial, district, or local) is not specified, the government must determine the roles of inspectors at each level based on their competence, available resources, and other practical considerations.

### **FOOD FORTIFICATION REGULATIONS**

The purpose of regulations governing food fortification is to ensure certain nutritional properties, quality, safety, and proper procedures. Generally, regulations should at least specify

- Foods that must be fortified with vitamin A
- Foods that are permitted to be fortified with vitamin A
- Standards to which fortification of a food with vitamin A should conform\*
- Requirements for packaging and labeling
- Quality assurance activities required of producers and retailers
- Frequency of government inspections of food and the facilities of food producers and retailers
- Circumstances under which the government must take enforcement action, and the actions permitted

\* Standards of composition for fortified foods can be established or guided by the standards of the Codex Alimentarius Commission

### **Methods of data collection**

Government inspections should be unannounced, and inspectors should

- Observe production processes
- Take random samples of the fortified food being produced
- Review the quality assurance plan and records to get a general idea of whether the food consistently meets standards and to ensure that quality assurance and control activities meet legal or industry standards and that corrective action is taken when indicated
- Inspect product packaging and labeling to ensure that they meet standards
- Inspect storage areas to ensure that food is being stored properly and according to standards
- Review conditions of storage and transportation

In addition to on-site inspections, which require a major commitment of resources and, thus, probably cannot be carried out frequently, the government may require producers to submit random samples periodically for analysis in government laboratories and, possibly, copies of quality control records.

Data on the vitamin A content of the fortified products can be collected by reviewing production records and premix or fortificant usage over the same period, checking premix or fortificant purchases and stocks and evaluating whether these are consistent with registers, and by analyzing samples.

## MONITORING SUGAR FORTIFICATION IN GUATEMALA

**Why fortification?** — In response to widespread vitamin A deficiency in Central America, in the early 1970s specialists at the Institute of Nutrition of Central America and Panama (INCAP) established the feasibility of fortifying sugar with retinyl palmitate and identified simple fortification machinery for sugar mills. Based on WHO recommendations, the fortification level was set at 15 µg (50 IU) per gram of sugar (average daily sugar intake by preschoolers was about 20 g). Tests showed that sugar retains sufficient levels of vitamin A during its shelf life (8–14 months) under hot, humid conditions (the half-life of vitamin A is 5–7 months). In 1974, the Guatemalan congress passed a law requiring fortification of all sugar produced for the domestic market with vitamin A at the WHO-recommended level. Although the practice lapsed when currency problems made importation of retinol concentrate difficult, the law was revived in 1992 when it was shown that the fortification program had had a significant impact on the health of Guatemalans.

**Fortifying sugar with vitamin A** — During the final stage of sugar production in Guatemala the sugar slurry is dewatered in a series of centrifuges of varying capacities. A premix of vitamin A in sugar (retinyl palmitate with vegetable oil, an antioxidant, and sugar) is prepared by the Association of Sugar Producers (ASAZGUA) and supplied to all mills. It is packaged in opaque polyethylene liner bags and labeled with the date of production. At the mills, vitamin A premix is added to the sugar as it is transported by conveyor belts, after centrifugation, either before or after it passes drying turbines. The premix is added at a uniform rate to ensure the specified concentration of vitamin A in the final product. The fortified sugar is packaged in 50-kg woven polypropylene bags, which are sealed and labeled as fortified with the name of the producer.

**Monitoring is carried out at several stages:**

- **Monitoring by the private sector (internal monitoring):** ASAZGUA is made up of owners of the 17 sugar mills in the country. It has contributed to the design of premix feeder equipment, supervises production and distribution of the premix, and monitors the final product at the production level. ASAZGUA has placed staff in each mill to draw samples, test them at its laboratory in Guatemala City, and inform mill managers of any discrepancies. Individual mills have hired and trained staff to handle the premix and have upgraded their laboratory facilities to check the quality of the sugar and measure its vitamin A content.
- **External monitoring:** The Food Control Division (FCD) of the Ministry of Health is in charge of monitoring the fortification program. FCD staff visit mills and take samples during the sugar production season. Samples are tested at a central laboratory. In 1991–93, test results revealed that although 85–90% of the sugar was fortified, the level of fortification was not uniform. However, now more than 60% of sugar samples reach homes with sufficient amounts of vitamin A (more than 5 µg/g).
- **Impact measurement:** Vitamin A fortified sugar has become the main source of this nutrient for the population at risk of vitamin A deficiency, and it has had a clear impact. The prevalence of low plasma retinol (less than 20 µg/dL) in preschool children has been reduced, and the prevalence of vitamin A deficiency is now only 15% in Guatemala, mainly due to the availability of vitamin A fortified sugar.

*Sources: Arroyave et al. (1979); Dary et al. (1996).*

A schedule should be developed by the government to collect samples from large producers of vitamin A fortified food products for determination of vitamin A content at an independent laboratory. In addition, at the time of inspection, products can be tested “on the spot” using rapid-test kits.

Results of inspections and analyses should be kept by an agency of the government and summarized periodically. These summaries should contain a report of the proportion of all samples meeting government standards as well as more detailed information on individual producers, comparing internal and external monitoring data. In collaboration with the producers, the government should develop guidelines that describe the steps to be taken to correct the problem if products are not properly fortified.

For both internal and external quality assurance, LQAS may make product testing more efficient. This method (described in chapter 3) allows a defined lot or batch to be classified as passing or failing, based on a small number of samples. Sampling can be done using quantitative or semiquantitative assays, as discussed in the previous section on internal monitoring.

During an inspection, inspectors may provide suggestions for further improvement and draw attention to certain inadequacies that may adversely affect product quality. Although some of these observations may not be covered by regulations (and, therefore, may not lead to legal action), they can be viewed as supportive services provided by the government to increase the effectiveness of fortification programs.

## **MONITORING AT THE WHOLESALE AND RETAIL LEVELS**

As an initial strategy, the government should not devote a great deal of resources to monitoring at this level, as monitoring production and importation provides critical initial information, and monitoring at households provides needed end-stage information.

With appropriate packaging and reasonable transportation time, losses from production to consumption should be minimal. However, if samples reaching households fail to meet government standards for vitamin A content, and there is no evidence of production-level lapses, monitoring at the wholesale and retail levels may help explain the problem.

It is essential to avoid making monitoring requirements too burdensome for wholesalers and retailers. Rather, the primary responsibility for monitoring at this level should fall on the government. The main quality assurance activity of wholesalers and retailers should be routine examination of their stock to ensure that it is well packaged and labeled, regular inspection of storage areas, and assurance that handling practices minimize transit time.

## **MONITORING AT THE HOUSEHOLD LEVEL**

Once production-level monitoring has determined that an adequate level of vitamin A is being added to the fortified food, the next step is to ensure that the product is reaching the households and that it still contains the required amount of vitamin A.

## **PRACTICAL MONITORING AT THE WHOLESALE AND RETAIL LEVELS**

In Central America, INCAP recommends that monitoring of fortified sugar at the wholesale level be carried out only twice a year for the most important distribution centres. Sacks are inspected at the district or regional level by inspectors from the Ministry of Health to ensure that they are correctly labeled. Four 50-g samples from an equal number of randomly selected bags of each brand of sugar are tested on-site to determine retinol content using a semiquantitative assay. Results are recorded. In small distribution centres and at the retail level, only packaging and labeling are checked.

Corrective action is taken, if needed. For example, sugar that is not identified as fortified is confiscated. If criteria for retinol content are not fulfilled, the program manager is informed and a "technical audit" is considered.

*Source: INCAP/ICAITI/OMNI/ILSI 1998.*

### **Household-level monitoring can be used to determine whether:**

- The fortified food product is reaching the households, i.e., coverage
- The product found in the household is fortified with the required amount of vitamin A
- Serious losses during distribution are suspected, requiring adjustments in the fortification process or in the distribution of the product

## **DETERMINING RETINOL LEVEL IN FORTIFIED SUGAR AT THE HOUSEHOLD LEVEL**

In Central America, mills are required to fortify sugar at the rate of 15 mg retinol/kg sugar. For monitoring purposes, 80% of the composite samples for each shift must have retinol levels between 10 and 20 mg/kg; all must have at least 5 mg/kg. However, because of natural degradation during storage and distribution, the target at the household level is for all samples to contain retinol, with at least 80% containing more than 5 mg/kg.

The plan for household-level monitoring in Guatemala calls for a national survey, carried out annually preferably between harvest seasons. Sugar samples will be collected from households in each sampling unit. Composite samples will be prepared by combining a teaspoon of sugar (5–7 g) from each sampling unit for each brand. If only one brand is found in a sampling unit, at least two composite samples will be prepared. A single laboratory will determine the retinol content of each sample, preferably by quantitative assay.

The responsibility for carrying out the survey will lie with the Epidemiological Surveillance Unit or the Food Control Division of the Ministry of Health. The public school system may participate in the household-level surveys.

Survey results are to be published in an annual report, which will include a section on corrective actions to be taken when problems are identified.

*Source: INCAP/ICAITI/OMNI/ILSI 1998.*

## MONITORING FORTIFICATION OF MARGARINE IN CANADA

When Canadians were advised to reduce their intake of saturated fats by, for example, substituting margarine for butter, fortification of margarine with vitamin A was made mandatory in 1977 to prevent possible deficiency resulting from the change in diet. Monitoring is focused on the production level, as advanced packaging techniques prevent degradation and loss of added vitamins during transport and storage. The fortification process is monitored both internally and externally.

- **Internal monitoring:** Manufacturers are responsible for QA through routine monitoring. About 10–15 samples are randomly collected during production, whenever a new batch or lot is made, and analyzed for vitamin content. Health Canada recommends methods for analysis; if other methods are used, manufacturers must be able to prove that they produce comparable results. Also, manufacturers may add more than the required level of less-stable formulations to ensure that the product will meet the label declaration at the time of sale.
- **External monitoring:** The Health Protection Branch of Health Canada is responsible for ensuring nutritional adequacy of the Canadian food supply, and develops nutritional standards and guidelines for food fortification programs. Until recently, compliance with regulations was monitored by the Field Operations Directorate, but it is now carried out by the new Canadian Food Inspection Agency.

Government inspectors visit plants about twice a year. Following instructions set by the Health Protection Branch, the inspectors determine whether

- adequate levels of vitamins A are being added by examining the company's calculations
- the company checks written specifications on receipt of each lot of vitamins to ensure that levels are the same as those used for their addition calculations
- quality control measures for the premix are carried out and written mixing procedures are followed to ensure even distribution of the vitamin premix
- vitamin analysis, using an acceptable method and sampling plan, is being done on all fortified products at least monthly and more frequently if deviations are encountered
- the manufacturer's instructions regarding the storage of vitamins are being followed.

The inspectors review production records of the exact amount of vitamin premix added to each batch and compare daily tabulations of actual vitamin usage versus actual margarine production; compare all results of analyses with calculated values and theoretical values to ensure correlation; review records of the theoretical calculations yielding the correct range in the finished product; and review company specifications for the premix. On receipt of each new lot of premix, the potency claim should be visually verified to ensure that it is at the same level as that on which the calculations for additions are based.

The inspectors also check to see that the following control measures are in place to ensure the correct operation of the fortificant premix metering device:

- recording of the initial in-line testing of the metering device for accuracy of delivery and for determining the correct setting
- periodic testing and recording of the accuracy of delivery of the metering device during each shift
- recording of a visual check every 1–2 hours of the fortificant reservoir to ensure that the premix is being used at a consistent rate
- daily recording of the meter setting
- daily recording of actual vitamin usage versus actual production of the fortified product
- regular analysis of the fortified product and copies of reports.

In general, Canada is encouraging the adoption of the Hazard Analysis Critical Control Point (HACCP) system, which places greater emphasis on inspection and reduces the need for costly analyses. The HACCP system identifies specific hazards and measures for their control to ensure the safety of food. It is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing.

Following the HACCP system helps ensure the good manufacturing practices (GMPs) described in *Code of Practice. General Principles of Food Hygiene for Use by the Food Industry in Canada*, which has been adapted from the Codex Alimentarius Commission's general principles. GMPs guide both government inspectors and the industry on what is needed to achieve safe, wholesome, and nutritious food products. Supplements to the *Code of Practice* give details of specialized operations such as the addition of nutrients to foods.

*Source: Health Canada (1993).*



## Useful indicators

- Proportion of households in which the fortified product is available
- Proportion of at-risk members of the households consuming an adequate amount of the fortified product
- Proportion of household samples meeting government requirements for vitamin A content

Government monitoring at this level is primarily useful in terms of feedback to the program, rather than regulation. Monitoring should examine consumption, including intrafamily distribution practices, and storage and cooking practices. Samples should be taken to determine the fortificant level at the time of consumption. Depending on monitoring data from other levels in the same region, food that does not contain adequate fortificant, even though it has been stored and handled properly by the household, might be traced through the distribution chain to determine where the problem lies. This should not occur often if monitoring at other levels is effective.

Where fortification is required by law and a limited number of food vehicles are chosen, monitoring at the household level may be important to determine coverage and the effectiveness of the program in eliminating vitamin A deficiency. If fortification is permitted but not required and many foods are involved, it may be more difficult to determine coverage. In any case, determining how much fortified food is consumed and the vitamin A level in that food may be challenging and requires considerable resources.

## Methods of data collection

To determine the proportion of households using adequately fortified foods, a representative, population-based survey should be carried out. Coverage surveys do not have to be frequent: once every 2 or 3 years may be sufficient. Once most households are using vitamin A fortified foods, surveys can be performed less frequently. Usually, the government will be involved in planning and carrying out such a survey. (See the section on cluster sampling in *chapter 3, Methods for monitoring vitamin A programs.*)

Surveys can be expensive and time consuming. A separate survey should be designed and implemented only if it is not possible to incorporate data collection on the availability, use and consumption of fortified foods at the household level into other regular or planned surveys.

If coverage surveys identify low use of vitamin A fortified products or if more information is required on the distribution of fortified food throughout a region or the nation, additional data collection strategies at the household level may have to be considered. For example, to find out whether specific geographic areas exist where high proportions of households do not have adequately fortified food, the LQAS method may be useful. (See *chapter 3, Methods for monitoring vitamin A programs.*)

Data collection using LQAS usually takes place at the district or subdistrict level, perhaps in specific geographic areas. The primary purpose of LQAS at the household level is to identify whether the proportion of the households in a village using vitamin A fortified food is adequate. The village will either “pass” or “fail” based on the results of

the sampling. If the village passes, no additional follow-up is needed. If it fails, it may be necessary to carry out a larger survey in the village to confirm that too few households are using the fortified food and to determine the reasons for this. A survey at the wholesale and retail level may also be performed at the same time.

To measure the amount of vitamin A in a fortified food, quantitative or semiquantitative assays can be done (see *Internal monitoring* above).

Assessing the intake of vitamin A fortified foods can be done using quantitative or semiquantitative methods. See chapter 3, *Methods for monitoring vitamin A programs*, for a discussion of dietary intake assessment methods and population-based surveys.

## FURTHER READING

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# 7

## Measuring impact using core biologic indicators<sup>1</sup>

Three measures — serum retinol, breast milk retinol, and night blindness — are recommended as core indicators for determining vitamin A status (WHO 1996), based on practicality, feasibility, and measurability at reasonable cost. These indicators are sufficiently sensitive and specific to assess reliably subclinical vitamin A status in areas or populations and to monitor and evaluate programs designed to eliminate the problem as a public health concern. The target values for these core indicators are shown in Table 7.1. This chapter contains a brief review of the field application of each indicator. For more in-depth information on their measurement and use, see WHO (1996).

Table 7.1. Core indicators for assessing vitamin A status.

Indicator	Target prevalence for the year 2000
Functional Night blindness (in children 24–71 months of age)	<1%
Biochemical Serum retinol $\leq 0.70 \mu\text{mol/L}$ or Breast milk retinol $\leq 1.05 \mu\text{mol/L}$ or $\leq 8 \mu\text{g/g}$ milk fat	<5%  <10%

Decreased mortality and morbidity can also be expected when vitamin A status is improved in a vitamin A deficient population. There may also be a social impact (measured using indicators such as the empowerment of women, policy adoption by governments) and an economic effect (measured by disease-adjusted life years [DALYs]), on health services. Discussion of these effects is beyond the scope of this manual; references on methods to measure mortality and morbidity and the social and economic impact of nutrition interventions are provided at the end of this chapter (Van Ginneken 1993; Valadez and Bamberger 1994; UN 1995; David 1996).

<sup>1</sup>The material in this chapter has been extracted with permission from WHO (1996), which also contains information about other biologic indicators (e.g., the clinical indicator, xerophthalmia, and subclinical ones, measured by relative dose response tests), a histologic indicator measured by impression cytology, and a host of ecologic and demographic indicators associated with a risk of vitamin A deficiency

## SERUM RETINOL

Because a number of factors affect the level of retinol in the blood, it is not a reliable indicator of vitamin A status in individuals. However, for populations, the frequency distribution of serum retinol concentrations can be very informative. Indeed, serum retinol is probably the most commonly used measure of vitamin A status in program monitoring and evaluation.

Vitamin A circulates in the blood as retinol attached to its specific carrier protein, retinol-binding protein (RBP), which in turn is bound to a larger protein, transthyretin, that also transports thyroxine. Some retinyl ester is found in the blood, but at low concentrations except following vitamin A supplementation or a meal rich in vitamin A.

Serum retinol concentration decreases during acute and chronic underlying infections, making measurement unreliable in infected people. In populations, seasonal patterns of certain diseases may cause serum retinol shifts that are unrelated to vitamin A intake. As a result, the comparison of serum retinol distribution among different populations requires cautious interpretation. Changes over time within a population can usually be interpreted with greater confidence than differences between populations. Field collection procedures and the analytical methods are well established (May 1996).

**Table 7.2. Comparison of analytical methods to determine serum retinol.**

High-pressure liquid chromatography	Fluorescence	Ultraviolet spectrophotometry
<ul style="list-style-type: none"> <li>• highly specific</li> <li>• highly sensitive</li> <li>• high equipment cost (USD 15 000–40 000)</li> <li>• difficult to maintain</li> <li>• can measure retinol and retinyl ester individually</li> </ul>	<ul style="list-style-type: none"> <li>• sensitive</li> <li>• quick</li> <li>• relatively inexpensive</li> <li>• laboratory must take precautions to avoid contamination from interfering fluorescing substances</li> <li>• measures total vitamin A</li> </ul>	<ul style="list-style-type: none"> <li>• least sensitive</li> <li>• lowest cost for equipment (USD 5000–15 000)</li> <li>• measures total serum vitamin A</li> </ul>

**Table 7.3. Prevalence rates and minimum sample size needed to assess the severity of vitamin A deficiency in a population based on level of serum retinol.**

Severity of vitamin A deficiency as a public health problem	Prevalence of serum retinol $\leq 70$ mmol/L in children 6–71 months	Minimum sample size*
Mild	2 to <10%	—
Moderate	10% to 20%	865
Severe	>20%	385

\* To achieve precision of 20% at the 95% confidence level, assuming simple random sampling. Cluster surveys are likely to require a larger sample size.

## Acceptability

Measurement of serum retinol concentration requires the collection of blood by either venipuncture or finger prick. Where infection with human immunodeficiency virus (HIV) is prevalent, careful consideration should be given to the risks involved, and well established procedures for blood collection should be followed.

## Feasibility

Blood collected by venipuncture or finger prick should be protected from light and chilled (not frozen) until centrifuged (after clotting but within 12 hours of collection). The separated serum should then be frozen and protected from light, oxygen, and desiccation until analyzed. These are the minimum conditions required for reliable measurements.

Serum retinol can be determined by high-pressure liquid chromatography, fluorescence, or ultraviolet spectrophotometry (Furr et al. 1993). The methods vary in terms of specificity, sensitivity, and cost, and each of these methods requires well-trained technicians capable of maintaining strict quality control. A summary description of these methods is shown above (Table 7.2).

## Performance

Population distribution curves and the proportion of people below selected cut-off values can be useful in characterizing the vitamin A status of a population, especially in areas of vitamin A deficiency, and in evaluating changing conditions, e.g., the response to an intervention program.

As mentioned above, acute and chronic infections can confuse the interpretation of serum retinol concentrations, because these conditions affect RBP and decrease serum retinol levels even if vitamin A intake is adequate. Likewise in cases of protein–energy malnutrition, RBP synthesis and hence serum retinol may be low. In addition, normal serum retinol values change with age (increasing from infancy to adulthood); therefore, the age distribution of the population should also be considered.

## Interpretation

A value of  $\leq 0.70$   $\mu\text{mol/L}$  indicates low vitamin A status. The prevalence of this level of vitamin A in a population are used by WHO (1996) to indicate the severity of the public health problem (Table 7.3).

Because no one clinical indicator is considered definitive in determining vitamin A status, the consultation (WHO 1996) recommended that, before concluding that an important public health problem exists, at least two indicators should be assessed or one indicator must be strongly supported by a composite of several indirect demographic and ecologic risk factors.

## **VITAMIN A IN BREAST MILK**

The level of vitamin A (as retinyl palmitate) in breast milk is a direct reflection of a mother's vitamin A status. It also provides indirect information about the vitamin A status of the breastfed infant (Stoltzfus and Underwood 1995). All infants are born with low stores of vitamin A and depend on an immediate supply from breast milk. Breast milk continues to be their only supply of vitamin A until they are ready for complementary foods. Thus the concentration of vitamin A in breast milk serves as an indicator of an infant's likely vitamin A status.

Breast milk vitamin A is also useful for identifying high risk areas or populations and for monitoring changes in the vitamin A status of communities. Randomly chosen mothers can represent the larger population, and breast milk is often more easily obtained than blood.

To date, no country has used the routine collection and assessment of breast milk vitamin A for monitoring vitamin A programs. However, work is currently underway in Indonesia to investigate the feasibility and usefulness on a large scale (Bloem, M.W., HKI, Jakarta, personal communication, 1997).

### **Acceptability**

Collection of breast milk samples by female health workers is generally acceptable. Acceptability will depend largely on the cultural context and can be improved if the staff carrying out the collection can effectively address the mother's potential concerns about giving milk samples. Mothers often worry about the quality of their milk; in this case the collection of breast milk for analysis may be appealing to them, particularly because they can easily understand the link between their milk and the health of their child. Mothers should be assured that giving a sample of their milk will not reduce the amount of milk that their baby will receive, but rather that the breast will be stimulated to produce even more when milk is removed.

### **Feasibility**

Vitamin A concentrations in breast milk vary greatly immediately after childbirth, but stabilize later. To avoid collecting colostrum and transitional milk, samples should be taken 1 to 8 months postpartum. Vitamin A concentrations also vary during a single feeding. Although this must be considered when assessing the vitamin A status of individuals, population data will not be affected, assuming that samples are collected throughout the day and at various times after the last feeding. If it is not possible to ensure random distribution, breast milk retinol per gram of milk fat should be calculated (Ferris and Jensen 1984).

A sample of about 5 mL of breast milk should be collected in air-tight tubes or vials and protected from light. As soon as possible after collection and homogenization by gently swirling, precise volumes should be measured out for longer-term storage. Premeasured vials of milk can be stored at -20°C until they are analyzed (Stoltzfus et al. 1993).

Analytical procedures for determining the concentration of vitamin A in breast milk are similar to those for determining retinol in serum, using high-pressure liquid chromatography, spectrophotometry, or fluorometry. It is essential that standard laboratory procedures are followed and that

quality control is ensured. As with serum retinol measurements, cost will depend on the procedure chosen.

## Performance

The association between vitamin A concentration in breast milk and other maternal and infant indicators of vitamin A status is sufficiently strong to be used as an indicator of vitamin A status at the population level. However, the sensitivity and specificity of breast milk vitamin A levels are not sufficient to identify vitamin A deficiency in individual infants.

The distribution of breast milk vitamin A levels can provide information on the prevalence of mild-to-moderate vitamin A deficiency in infants. However, clinical vitamin A deficiency is extremely rare among breastfed infants (Underwood 1994), and breast milk vitamin A concentration is not a sensitive indicator of risk of clinical vitamin A deficiency.

## Interpretation

In vitamin A sufficient populations, average breast milk vitamin A concentrations range from 1.75 to 2.45  $\mu\text{mol/L}$ , whereas in a vitamin A deficient population, average values are below 1.4  $\mu\text{mol/L}$ . Based on the dietary requirements of infants and usefulness in monitoring changes in the vitamin A status of mothers, a level of 1.05  $\mu\text{mol/L}$  or 8  $\mu\text{g/g}$  milk fat has been selected as the minimum concentration required to prevent subclinical vitamin A deficiency in the first 6 months of life (Underwood 1994).

Reference data are still being compiled for breast milk retinol. This means that the criteria selected by the consultation (WHO 1996) based on current, limited experiences will have to be revised as field experience increases (Table 7.4).

**Table 7.4. Prevalence rates and minimum sample size needed to assess the severity of vitamin A deficiency in a population based on level of vitamin A in breast milk.**

Severity of vitamin A deficiency as a public health problem	Prevalence of breast milk vitamin A $\leq 1.05 \mu\text{mol/L}$ ( $\leq 8 \mu\text{g/g}$ milk fat) in lactating women	Minimum sample size*
Mild	<10%	—
Moderate	10–25%	865
Severe	>25%	289

\* To achieve precision of 20% at the 95% confidence level, assuming simple random sampling. Cluster surveys are likely to require a larger sample size.

## NIGHT BLINDNESS

Night blindness (poor sight adaptation to the dark) is the first functional manifestation of vitamin A deficiency that can be measured. Night blindness is most reliably assessed in children between the ages of 24 and 71 months using interview techniques. Data have been collected on night blindness among pregnant and lactating women; however, few representative population-based surveys have been done among adult female populations.



Night blindness is useful for assessing community vitamin A status and for identifying areas where a risk of vitamin A deficiency among children is expected. However, night blindness is not very discriminating, and the subjective nature of the indicator makes it open to misinterpretation unless there is a well-recognized symptom in the community.

The advantage of night blindness as an indicator is that members of a community can often grasp its meaning as a sign of vitamin A deficiency, and they can see improvement as a result of an intervention. This can raise awareness in the community of the importance of the problem and can be useful in raising public support and the demand for an intervention program.

## Acceptability

Assessment of night blindness using an interview technique does not usually pose any problems of acceptability.

## Feasibility

Obtaining reliable information on night blindness through interviews requires the existence of a local word describing the condition, and that the word is specific to vitamin A deficiency. In some cultures, the word for night blindness may have multiple meanings. A series of questions focusing on responses specific to vitamin A deficiency sometimes results in a more reliable response. For all of these reasons, it is important to field-test the reliability of local words before undertaking a large-scale survey. It is also important to standardize the procedure for gathering such data, including the training of interviewers and their approach to asking questions.

Assessing night blindness does not require specialized equipment and, therefore, is less expensive than measuring biologic indicators such as serum retinol or breast milk vitamin A. Because of the low prevalence of night blindness, a larger sample size is needed for its measurement than for the biochemical indicators; this is associated with greater cost. There is also a significant age-based trend in the prevalence of night blindness. Comparisons should only be made among specific age groups, such as preschool-age children (24 to 71 months), school children (6 to 14 years of age), or adults (15 years and over). Night blindness can also be sensitive to seasonal variations in vitamin A status.

**Table 7.5. Prevalence rates and minimum sample size needed to assess the severity of vitamin A deficiency in a population based on night blindness.**

Severity of vitamin A deficiency as a public health problem	Prevalence of night blindness in children 24–71 months old	Minimum sample size*
Mild	<1%	—
Moderate	1 to <5%	4706
Severe	≥5%	1825

\* To achieve precision of 20% at the 95% confidence level, assuming simple random sampling. Cluster surveys are likely to require a larger sample size.

## Performance

Although night blindness can be useful for assessing vitamin A deficiency in communities, the association is not reliable at the level of the individual.

## Interpretation

Suggested interpretations of the prevalence of night blindness in children 24 to 71 months old and minimum sample sizes for identifying a vitamin A deficiency public health problem are given in Table 7.5.

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# Appendix A

## Sources of technical support for program monitoring

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### **Asian Vegetable Research and Development Centre (AVRDC)**

PO Box 42, Shanhua 741  
Taiwan, Republic of China  
Tel: 886 6 583-7801  
Fax: 886 6 583-0009  
Website: [www.avrdc.org.tw](http://www.avrdc.org.tw)

### **Food and Agriculture Organization (FAO)**

Vitamin A Program  
Food Policy and Nutrition Division  
Viale Terme di Caracalla  
Rome 00100  
Italy  
Tel: 39 6 5797-3330  
Fax: 39 6 5797-3152  
Website: [www.fao.org](http://www.fao.org)

### **Helen Keller International (HKI)**

90 Washington Street  
New York, NY 10006  
USA  
Tel: 212 943-0890  
Fax: 212 943-1220  
Website: [www.hki.org/index.html](http://www.hki.org/index.html)

### **International Network of Food Data Systems (INFOODS)**

Food and Nutrition Programme for Human and Social Development  
United Nations University  
Charles Street Station  
PO Box 500  
Boston, MA 02114-0500  
USA  
Tel: 617 227-8747  
Fax: 617 227-9405

or

Barbara Burlingame  
Crop and Food Research  
Palmerstone North Research Centre  
Private Bag 11030  
Palmerstone North  
New Zealand  
Tel: 64 6 351-8300  
Fax: 64 6 351-7050  
Email: [burlingame@crop.palm.cri.nz](mailto:burlingame@crop.palm.cri.nz) or  
[infoods@crop.cri.nz](mailto:infoods@crop.cri.nz)  
Website:  
[www.crop.cri.nz/foodinfo/infoods/infoods.htm](http://www.crop.cri.nz/foodinfo/infoods/infoods.htm)

### **International Vitamin A Consultative Group (IVACG)**

IVACG Secretariat  
c/o The Nutrition Foundation, Inc.  
1126 16th Street, NW  
Washington, DC 20036  
USA  
Tel: 202 659-9024  
Fax: 202 659-3617  
Email: [omni@dc.ilsi.org](mailto:omni@dc.ilsi.org)  
Website: [www.ilsi.org/ivacg.html](http://www.ilsi.org/ivacg.html)

### **Micronutrient Initiative (MI)**

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PO Box 8500  
Ottawa ON  
Canada K1G 3H9  
Tel: 613 236-6163  
Fax: 613 236-9579  
Email: [mi@idrc.ca](mailto:mi@idrc.ca)  
Website: [www.idrc.ca/mi](http://www.idrc.ca/mi)

**Opportunities for Micronutrient Interventions (OMNI)**

OMNI Project  
c/o John Snow Inc.  
1616 North Fort Myer Drive, Suite 1100  
Arlington, VA 22209  
USA  
Tel: 703 528-7474  
Fax: 703 528-7480  
E-mail: omni@dc.ilsa.org  
Website: www.jsi.com/intl/omni/home

**Program Against Micronutrient Malnutrition (PAMM)**

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Rollins School of Public Health  
1518 Clifton Road, NE  
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USA  
Tel: 404 727-5417 or 727-5416  
Fax: 404 727-4590  
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**Sight and Life Task Force**

PO Box 2116  
Basel  
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Tel: 41 61 691 22 53  
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**United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition (UNACC/SCN)**

c/o World Health Organization  
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CH-1211, Geneva 27  
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E-mail: accscn@who.ch

**United Nations Children's Fund (UNICEF)**

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New York, NY 10017  
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Tel: 212 326-7000  
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E-mail: netmaster@unicef.org  
Website: www.unicef.org

**United Nations Children's Fund (UNICEF)**

Nutrition Division  
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**World Health Organization (WHO)**

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Division of Food and Nutrition  
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Website: www.who.ch

# Appendix B

## Supplement schedules for the prevention and treatment of vitamin A deficiency<sup>1</sup>

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Vitamin A supplements are used in two situations:

- To treat those with acute xerophthalmia and others in immediate need of improved vitamin A status
- To prevent vitamin A deficiency where the periodic administration of supplements is determined to be the most feasible and cost effective means of improving vitamin A status.

In some areas, it may be possible to increase the dietary consumption of vitamin A to adequate levels among all population groups relatively quickly. In other regions and populations (e.g., those affected by periodic drought, chronic poverty, and food shortages), vitamin A supplementation may be required until adequate intake from dietary sources can be assured.

Typically, vitamin A will be provided as a capsule or tablet or as an oil-based preparation, given orally.

### **UNIVERSAL DISTRIBUTION**

Universal distribution involves the periodic administration of supplemental doses of vitamin A to all preschool aged children with priority given to age groups (e.g., 6 months to 3 years) and regions at greatest risk (Table B.1). All women in high-risk areas should also receive a high dose of vitamin A within 8 weeks of childbirth. For pregnant women, smaller doses (e.g., 5000–10 000 IU) can be given more frequently (even daily) throughout the pregnancy.

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<sup>1</sup> This information has been reproduced with permission from the World Health Organization. The source document (WHO et al. 1997) provides more detailed information, and it is highly recommended for any person or group involved in planning or administering vitamin A supplementation programs.

## TARGETED DISTRIBUTION TO HIGH-RISK CHILDREN

Infants and children with severe protein–energy malnutrition or infections such as measles, diarrhea, respiratory disease, and chickenpox have an increased risk of vitamin A deficiency. In view of strong evidence indicating that vitamin A deficiency occurs in clusters, siblings and children living in the same home or community as children with xerophthalmia are also at increased risk. All such children are high-risk children; prevention of vitamin A deficiency among these groups can be achieved by targeted distribution programs (Table B.2).

<b>Table B.1. High-dose universal distribution schedule for prevention of vitamin A deficiency.</b>	
<b>Target group</b>	<b>Dose of vitamin A</b>
Infants <6 months of age*	
Non-breastfed infants	50 000 IU orally
Breastfed infants whose mothers have not received vitamin A supplements	50 000 IU orally
Infants 6–12 months of age	100 000 IU orally every 4–6 monthst
Children >12 months of age	200 000 IU orally every 4–6 monthst
Mothers	200 000 IU orally, within 8 weeks of delivery
<p>* Programs should ensure that infants &lt;6 months of age do not receive the larger dose intended for mothers. It may be preferable to use a liquid form of the supplement for infants to avoid confusing capsules of different dosages.</p> <p>† Evidence suggests that vitamin A reserves in those with a deficiency can fall below optimal levels 3 to 6 months after a high dose; dosing at 4- to 6-month intervals should be sufficient to prevent serious consequences of vitamin A deficiency.</p>	

<b>Table B.2. High-dose prevention schedule for children at high risk* of vitamin A deficiency.</b>	
<b>Target group</b>	<b>Dose of vitamin A</b>
Infants <6 months	50 000 IU orally†
Infants 6–12 months	100 000 IU orally†
Children >12 months	200 000 IU orally†
<p>* High-risk children are those with measles, diarrhea, respiratory disease, chickenpox, other severe infections, or severe protein–energy malnutrition, or who live in the vicinity of children with clinical vitamin A deficiency.</p> <p>† Those known to have received a routine high-dose vitamin A supplement within the last 30 days should not receive an additional dose.</p>	

## TREATMENT OF XEROPHTHALMIA

With the exception of women of reproductive age, the treatment schedule in Table B.3 applies to those with all stages of active xerophthalmia, including those with night blindness, conjunctival xerosis with Bitot's spots, corneal xerosis, corneal ulceration, and keratomalacia.

## WOMEN OF REPRODUCTIVE AGE

Women of reproductive age with night blindness or Bitot's spots should be treated with a daily dose of 5000–10 000 IU of vitamin A for at least 4 weeks. Such a daily dose should never exceed 10 000 IU, although a weekly dose not exceeding 25 000 IU may be substituted.

**Table B.3. Treatment schedule for xerophthalmia for all age groups except women of reproductive age.\***

Timing of treatment	Dose of vitamin A†
Immediately on diagnosis	
Infants <6 months	50 000 IU
Infants 6–12 months	100 000 IU
Children >12 months	200 000 IU orally
The next day	Same age-specific dose‡
At least 2 weeks later	Same age-specific dose¶*

\* Caution: Women of reproductive age with night blindness or Bitot's spots should receive daily doses  $\leq 10\,000$  IU or weekly doses  $\leq 25\,000$  IU. However, all women of childbearing age, pregnant or not, who exhibit severe signs of active xerophthalmia (i.e., acute corneal lesions) should be treated as above.

† For oral administration, preferably in an oil-based preparation.

‡ The mother or other responsible person may administer the next-day dose at home.

¶ To be administered at a subsequent health-service contact.





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The ***Micronutrient Initiative*** (MI) was established in 1992 as an international secretariat within the International Development Research Centre (IDRC) in Canada by its principal sponsors: the Canadian International Development Agency, IDRC, the United Nations Children's Fund, the United Nations Development Programme, and the World Bank. MI's mission is to help achieve the goals of the World Summit for Children that relate to the alleviation or elimination of micronutrient deficiencies. It focuses on advocacy, building alliances, the development and transfer of technology, support for national and regional initiatives, capacity building, and the resolution of key operational issues.

The ***Program Against Micronutrient Malnutrition*** (PAMM) is a collaborative effort of the Rollins School of Public Health at Emory University, the Centers for Disease Control and Prevention, and the Carter Center Task Force for Child Survival and Development. PAMM receives support from the United States Agency for International Development, the United Nations Children's Fund, the MI, and the World Bank. PAMM supports the goal of eliminating micronutrient malnutrition through collaboration with the International Agricultural Center and Wageningen Agricultural University in the Netherlands; countries that have participated in PAMM training or workshops (36 countries as of 1994); and multilateral, bilateral, and nongovernmental agencies.

The ***United Nations Children's Fund*** (UNICEF) is mandated by the United Nations General Assembly to advocate for the protection of the children's rights, to help meet their basic needs and to expand their opportunities to reach their full potential. UNICEF insists that the survival, protection and development of children are universal development imperatives that are integral to human progress. UNICEF mobilizes political will and material resources to help countries, particularly developing countries, ensure a "first call for children" and to build their capacity to form appropriate policies and deliver services for children and their families.

Requests for copies of this manual and other inquiries or comments can be directed to MI or PAMM.

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## MONITORING VITAMIN A PROGRAMS

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