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WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTE

DISTR.: LIMITED
DISTR.: LIMITEE

WHO/EPI/GAG/88/WP.11 Rev.1
ENGLISH ONLY

EPI Global Advisory Group Meeting
Abidjan, 17-21 October 1988

Expanded Programme on Immunization

PROGRAMMES FOR THE CONTROL OF VITAMIN A DEFICIENCY:

THE ROLE OF THE EPI IN

NEW INITIATIVES FOR THE 1990s

1. Introduction

Vitamin A deficiency is one of the "Gang of Four" most important types of malnutrition in the world, along with protein-energy malnutrition, iron and iodine deficiency disorders. The burden of over 2.5 million needlessly blind children over the past decade, and ten million children and adults annually with other evidence of vitamin A shortage, is concentrated on countries already facing a wide range of competing nutrition and health problems. If the three main micronutrient deficiencies were tackled comprehensively much of the global malnutrition would be resolved.

The major cause of vitamin A deficiency is prolonged inadequate dietary intake. Against a background of poverty and general malnutrition, recurrent infections are common precipitating factors, with measles emerging as an exceptionally severe threat to vitamin A status. In areas of Africa where measles is severe, rapid onset of potentially blinding vitamin A deficiency in early childhood can be regarded, to a large extent, as a vaccine preventable disease.

Preventing blindness in childhood has itself powerful emotional appeal. Recent evidence shows the equally sinister, and far more prevalent, results of poor vitamin A status leading to decreased resistance to infection and inevitably reduced chances of survival. The paradox is that for the last twenty years at least we have had the knowledge, the research base and most of the technical apparatus to deal with this disastrous condition. Control technologies are low cost and safe.

Since the 1984 World Health Assembly resolution to reduce vitamin A deficiency below a problem of public health significance within a decade, WHO has been the lead UN agency responsible for turning this vision into a reality. The EPI Global Advisory Group meeting in New Delhi in 1986 and Washington in 1987 recommended that the EPI should consider targeting young children in high risk areas, those at greatest risk of blindness and death due to preventable malnutrition. This papers reinforces the urgent need for new initiatives to finally control vitamin A deficiency in the 1990s.

2. EPI-linked Progress

The **International Vitamin A Consultative Group** (IVACG) meeting in Addis Ababa, December 1987, endorsed the potential contribution of immunization services to control strategies. The IVACG meeting also discussed the most efficient vitamin A dosing schedule for use with the EPI. A workshop on immunization services and vitamin A deficiency control strategies is planned for early 1989. Both the UN subcommittee on nutrition and the 41st World Health Assembly included resolutions strengthening determination to control vitamin A deficiency.

Countries which are known to have already **linked vitamin A supplementation** to the EPI include Malawi, Mauritania, Brazil, El Salvador, Guatemala and Indonesia. Headway was also made in 1988 at central and regional level in the coordination of control approaches between nutrition, blindness prevention and the EPI. **Country visits** were made to Malawi and Mali, both of which resulted in intensification of control strategies and decisions to prepare national policy documents.

Guidelines for the use of vitamin A supplements have been published in collaboration with UNICEF and IVACG, including detailed prevention and treatment schedules (1). An IVACG task force has also reported on the use of vitamin A in emergency and relief operations (2). A new recognition card for use in Africa, including photographs of eye lesions as well as treatment and prevention schedules, is now available.

A **training manual** for peripheral level field workers working in vitamin A deficiency control programmes, and a slide set to accompany courses, are under preparation.

Pump bottles for oral vitamin A solution have been produced in collaboration with the "Task Force for Sight and Life" in Basle and Hoffman-La Roche The pump bottle is intended for use with children under the age of 24 months, and ensures accurate delivery of a preset 100 000 IU vitamin A dose. The pump bottles are easier to use than capsules for young children, and the unit cost per dose should be less.

3. The EPI and New Initiatives

Using the EPI to distribute a micronutrient is a radically new departure for a programme which has focused on antigen delivery. But vitamin A supplementation makes sense as a sustained and cost-effective measure to enhance the overall goal of increased child survival. In countries with a serious public health problem of vitamin A deficiency, the EPI can contribute considerably to control of malnutrition and blindness in the critical years of early childhood in at least two distinct ways:

1. By providing a distribution mechanism for vitamin A supplements within the context of Primary Health Care.

2. Through measles immunization, thus eliminating the most important single cause of rapid deterioration of body vitamin A reserves, as well as potentially blinding corneal lesions in childhood.

The earliest recommended age for vitamin A supplementation within the EPI is six months. This is because severe effects of vitamin A deficiency are rare in the first few months of life, and the risks of toxicity are higher. The first EPI delivered dose of vitamin A (100 000 IU) should be as near to six months as possible, thus providing maximum protection against measles in the pre-immunization period. A dose of vitamin A at six months calls for another contact with the immunization services. Provided no high dose vitamin A supplement has been given within the previous month, children in high risk areas should also be given 100 000 IU vitamin A at nine months with measles immunization (Table 1).

The new pump bottles for vitamin A solution deliver a fixed dose of 100 000 IU vitamin A with each action of the mechanism. The pump bottle is intended for use with children under 24 months of age. Older children and adults should, if possible, be given high potency capsules. Using the pump bottle provides a more accurate 100 000 IU dose than attempting to count drops from opened capsules, and the cost should be less. There is no rationale for using injectable vitamin A within the EPI.

Table 1

**Vitamin A dosing schedule within the EPI:
in communities where vitamin A deficiency is a problem
of public health significance.**

Age of child	Vaccine	Vitamin A dose
birth or within 2 months of delivery	BCG and Polio	200 000 IU to mother
6 weeks	DPT 1 and Polio 1	
10 weeks	DPT 2 and Polio 2	
14 weeks	DPT 3 and Polio 3	
6 months		100 000 IU
9 months	measles	100 000 IU
1-5 years	any EPI or health services contact	200 000 IU every 3-6 months

From one year through five years, the preschool period of greatest risk, 200 000 IU vitamin A should be given every 3-6 months at any EPI booster dose contact or other health services visit. Periodic massive dosing with vitamin A will protect a child for up to six months against serious consequences of deficiency. Logistical constraints determine the interval of dosing. In emergency situations, or where refugee populations are severely malnourished, three monthly dosing intervals may be needed. Doses of vitamin A given should be recorded on the immunization record or on the child's growth chart.

Mothers at delivery, or during the next two months, should be given 200 000 IU vitamin A. This raises the concentration of vitamin A in breast milk and will therefore help protect the breastfed infant. Otherwise, doses of vitamin A in excess of 10 000 IU daily are not recommended for women in the childbearing age, in view of teratogenic risk to the young fetus. It is not therefore advisable that the EPI should deliver vitamin A supplements to women except around the time of delivery.

High potency vitamin A is safe when used as directed. There are rarely any adverse effects at the suggested dosage schedule. Any side effects which might occur, such as headache and vomiting, are transitory and do not require specific treatment.

Several types of specific activities can be envisaged as immediate EPI-linked objectives for 1989:

* **Monitoring and Surveillance.** Updating of the global reporting system for vitamin A deficiency, with integration of monitoring for xerophthalmia and vitamin A supplementation coverage into EPI coverage surveys on a trial basis.

* **Field testing of the vitamin A solution pump bottle.**

* **Completion and trials of training modules for peripheral level workers.**

* **Operational Research** to identify management and logistical problems involving existing control strategies.

* **Support for Country Proposals.** Two countries in the African region, Malawi and Mali, are in the process of completing planning documents. Several other countries are known to be looking for funding support for prepared plans - including Chad, Ethiopia, Mauritania and Zambia.

* **Implementation of Supplementation through the EPI** in at least two countries of Africa, two countries in Asia and one country in the Americas.

* **Assessment of vitamin A supplementation in emergency situations and refugee camps.** Focusing on the potential for using the EPI delivery mechanism both during mass coverage campaigns and sustained immunization programmes.

Other recommendations for research include:

a) Investigation of the effects of measles immunization coverage in reducing loss of sight in childhood.

b) Replication of studies on vitamin A supplementation for children with severe measles, comparing dose schedules.

c) Research into the development of slow release vitamin A supplementation preparations, which could be given at less frequent intervals.

4. Vitamin A, Infections and Survival

The role of vitamin A in vision is well recognized. The effects of vitamin A on cellular differentiation, growth, resistance to infection and ultimately survival undoubtedly involve larger populations. The immunoregulatory role of vitamin A is especially relevant for the EPI. Vitamin A deficiency results in reduced macrophage phagocytic activity, depressed cellular immunity and diminished serum antibody responses to antigens. In animal experiments, antibody responses are enhanced following vitamin A supplementation.

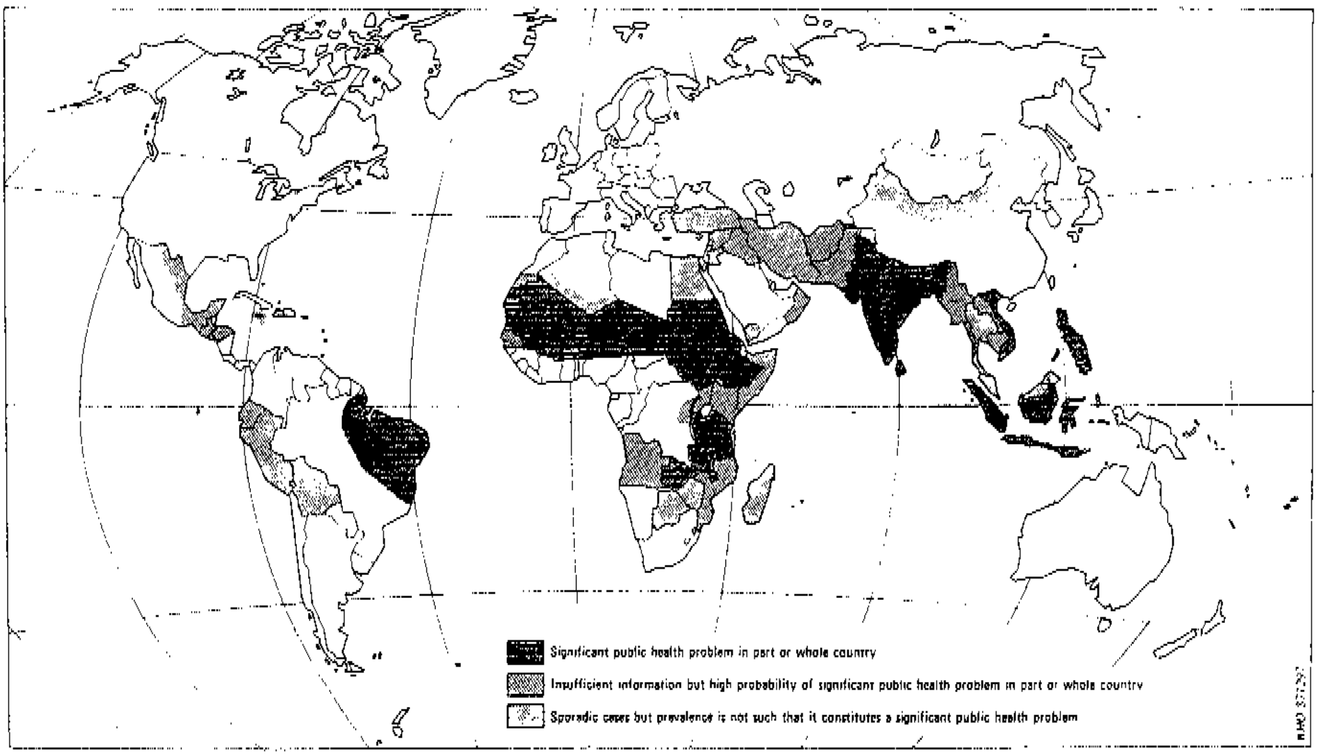
Only since 1983 has research in Indonesia focused attention on the overall importance of vitamin A status as a determinant of child survival. A longitudinal study in rural Java indicated that even children with mild eye signs of vitamin A deficiency had 2-3 fold increased risk of diarrhoea and respiratory disease, and were at least four times more likely to die than age-sex and neighbourhood matched controls

The only randomized controlled trial to date, again in Indonesia, showed that six monthly supplementation of mildly-moderately malnourished preschool-age children with high dose vitamin A (200 000 IU) was associated with a reduction in mortality by 20-30%. This study has been criticized on many grounds, including the higher initial prevalence of xerophthalmia and diarrhoea in control villages raising doubts about comparability, despite randomization. A controlled trial of the effects of vitamin A supplementation on child survival is due to start in Ghana in 1989.

5. Geographical Patterns of Deficiency

The severest effects of vitamin A deficiency have been recognized for many years in south east Asian countries with some of the world's largest populations. But an increasing number of African countries, 18 in the most recent WHO listing, are believed to have serious vitamin A deficiency (Figure 1 and Appendix 1).

Figure 1: Global distribution of Vitamin A deficiency



Epidemiological information for Asia is far more extensive than for any of the other regions. Bangladesh, Indonesia and Nepal have reported large national data sets based on randomized cluster sampling. In Africa, only Chad, Kenya, Malawi and Tanzania have reliable population-based data on the prevalence and severity of xerophthalmia. The overall extent of the vitamin A deficiency problem in Africa therefore needs further definition.

Table 2

Prevalence of xerophthalmia by population based surveys in Malawi, Chad, Bangladesh and Indonesia.

Country	Nightblindness %	Bitot's spots %	Active corneal lesions per 10 000	Corneal scars per 10 000
Malawi [1]	5.4	0.3	6.0	59.0
Chad [2]	(5)	0.4	6.2	49.0
Bangladesh [3]	3.6	0.9	5.9	25.2
Indonesia [4]	(6)	1.0	6.4	13.0

1. 1983, 5 436 children aged 0—71 months.
2. 1984, 1 626 children aged 0—59 months.
3. 1982—83, 18 660 children aged3—59 months.
4. 1978, 36 060 children aged 3—59 months.
5. Nightblindness not included in survey.
6. Nightblindness not reported separately.

Comparison of prevalence studies for preschool-age children in Malawi and Chad in Africa, and Bangladesh and Indonesia in south east Asia (Table 2) shows remarkably similar prevalence for potentially blinding active corneal lesions. The strikingly higher prevalence of corneal scarring in African countries is typical. The figures for corneal damage reflect the far greater impact of measles in Africa and, to a lesser extent, decreased post-blindness mortality so that children survive to be counted. Data on xerophthalmia undoubtedly underestimate the full extent of vitamin A deficiency disorders by ignoring the large population of affected individuals with dangerously low vitamin A reserves, but no eye signs.

Vitamin A deficiency is a clustered phenomenon with foci of disease in specific areas and in limited localities of the same village. Even in a country as relatively small as Malawi, there is considerable variation from one area to another. In a large country like Indonesia, incidence and prevalence may differ totally between regions.

Vitamin A deficiency is therefore a sensitive pointer to pockets of poverty and deprivation. Taking a broad indicator of the status of child survival, the under five mortality rate (U5-MR), 30% of the UNICEF rated countries with high or very high U5-MR (above 95 per 1 000) are also vitamin A deficient (Figure 2). Four out of the top five U5-MR countries - Afghanistan, Mali, Malawi and Ethiopia - have serious vitamin A deficiency. But Sri Lanka has a significant problem of vitamin A deficiency despite a low U5-MR, 46 per 1 000.

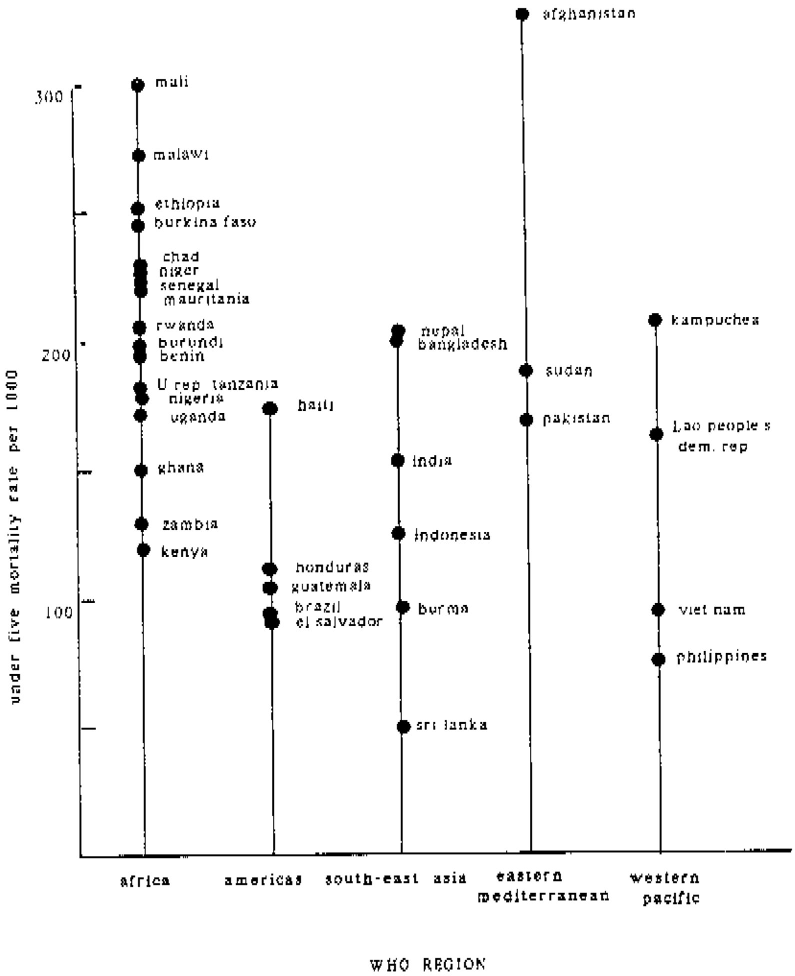


Figure 2: Under five year mortality rate in countries with severe vitamin A deficiency.

At country level, the localization of deficiency to limited regions is striking. This clustering effect within countries - northern Ghana, Nigeria and Burkina Faso, southern Malawi, the north east of Brazil in the Americas as examples - is a basis for conflicting reports where climatic and agricultural conditions vary widely within the same country. In other situations, vitamin A deficiency is concentrated in the slums around fast growing towns, in seasons of drought, famine or food shortage and in the growing populations of emergency settlements and refugee camps. National EPI programmes will need to decide the extent to which their own strategies should be adapted to regional and specific circumstances.

Dietary availability figures for grouped populations are notorious for concealing nutritional deficiencies in minority communities. But the most recent FAO estimates emphasize the low availability of dietary vitamin A for the Near East, Far East and Latin America regions. Higher estimates of average availability of vitamin A for Africa merely mask considerable inter-country variations. Availability of vitamin A is below 600 µg retinol equivalents (RE)/head/day for most seriously affected countries. As compared with requirements of 750 µg RE/head/day for adults, and 250-575 µg RE/head/day for children. The Near East and Latin America both shown encouraging upturns in vitamin A availability, reflected in the few countries from these regions with a currently severe problem.

Most disturbing are the trends for Africa and Asia in the period leading up to the 1980s. Deterioration in dietary availability of vitamin A in Africa is clear. Incremental availability in Asia is so poor that, even if maintained at the same rate, it would take well beyond the year 2 000 to catch up with requirements.

6. Assessing the Problem

Vitamin A concentrations in the liver, which contains over 90% of body reserves, are the most accurate indicator of vitamin A status (below 20 µg/g liver being associated with severe deficiency). Since direct measurement of liver concentrations is impossible in the public health setting, proxy techniques of variable validity are used. Serum vitamin A levels in particular reflect body vitamin A stores unreliably.

In practice, assessment of vitamin A deficiency is usually based on eye signs alone. It is important to realize that WHO criteria depend almost entirely on eye changes in a narrow age range of young children, aged 6 months to 6 years. Reported night blindness is only a sensitive indicator of vitamin A deficiency, for children old enough to be moving around by themselves, in areas where a local term for the condition exists. In many countries of Africa this is not the case. Night blindness prevalence cannot be included therefore among prevalence criteria, or for monitoring interventions in these situations.

The sequence to the development of potentially blinding corneal lesions need also not be linear. All combinations of retinal, conjunctival and corneal involvement may coexist and should, where possible, be reported in survey results. The combination of night blindness with conjunctival lesions, for example, points to the activity of Bitot's spots due to current vitamin A deficiency. But with rapid deterioration of vitamin A deficiency status, corneal destruction can develop in even a few hours without preceding retinal or conjunctival involvement.

Two new methods of assessing vitamin A status are promising. In **conjunctival impression cytology** a filter paper is applied to the bulbar conjunctiva, the adherent epithelial cells stained and examined microscopically. The underlying principle of the **relative dose response** is that when liver stores of vitamin A are normal, plasma retinol levels are little changed by low doses of vitamin A. When liver vitamin A is less than 20 µg/g liver, the relative dose response is greater than 20%.

7. Age and Sex as Determinants of Risk

Age is a most important epidemiological risk determinant of xerophthalmia. Xerophthalmia can occur at any age. But, as reflected in WHO diagnostic criteria, serious eye lesions are mostly found in preschool-age children with, in Asia, the age distribution peaking at 2-4 years. In Africa, the role of measles means that the distribution of associated corneal damage involves rather younger children.

Night blindness is often most prevalent in early school-age children. But a high proportion of Bitot's spots in older children in Africa are only evidence of previous vitamin A deficiency.

Sex, Pregnancy and Lactation. Non corneal xerophthalmia is generally more common among males than females. The reasons remain generally obscure, though in some cultures preference for feeding males the dietary "superfood" cereal, with little or no vitamin A content is probably responsible. Gender differences in corneal disease are not usually found, emphasizing that the aetiology is different.

Pregnant and lactating women are important target populations for programmes. Both pregnancy and lactation increase demand for vitamin A and in marginal states, precipitate deficiency. For the EPI, the procedural implications of risk factor weighting for age and sex is that programmes will find it most cost-effective to focus on preschool-age children, pregnant and lactating women. Inclusion of older children in broader programmes considerably increases the target population size, and the cost. Refugee camps, periods of exceptional drought or food shortage and urban slums are highly vulnerable situations where men and women of all ages may develop overt vitamin A deficiency.

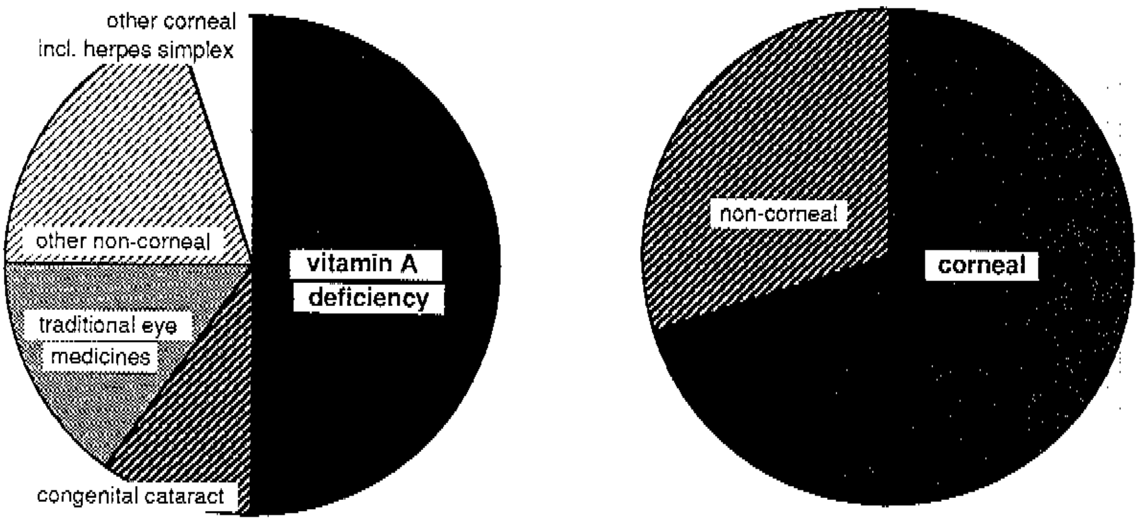
8. Measles and Blindness

In many developing countries vitamin A status is now recognized to be a critical determinant of outcome of measles infection. Measles also ranks as a potent precipitating illness leading to loss of sight in early childhood, especially in Africa and parts of Asia. A recent estimate is that measles immunization could prevent up to 50% of childhood blindness in Africa (Figure 3).

Corneal scarring has been estimated as responsible for 70% of blindness in children in African countries, the contribution of measles being considerable. Reviewing the position for Africa as a whole, Foster and Sommer concluded that 1-4% of African children with acute measles will develop corneal ulceration. In the United Republic of Tanzania as well as in Malawi, about 50% of children attending schools for the blind had a history of recent measles preceding the blinding episode. In the region of the Americas, over half of children with corneal scarring typical of xerophthalmia in El Salvador and 16% of children in Haiti were thought to have had measles preceding eye damage.

Severe vitamin A deficiency causes eye lesions indistinguishable from post measles involvement with corneal ulceration/keratomalacia leading to perforation and complete destruction of the corneal surface. In Indonesia, during a national survey of eye disease due to vitamin A deficiency, two thirds of all children with corneal lesions gave a history of preceding measles. Children with a history of measles were 11 times more likely to develop corneal xerophthalmia than normal controls.

Figure 3
Causes of bilateral childhood blindness in Tanzania



data from A Foster and A Sommer, 1986

Looking at the broader context of the relationship of vitamin A deficiency to mortality, a small sample-size Tanzanian study of children with measles admitted to hospital has shown reduced deaths in children under two years randomly allocated to receive large dose vitamin A supplement, as compared with routine treatment alone. Replication will be ethically difficult in view of the 1987 joint WHO/UNICEF recommendation that children with measles in high risk areas should be given vitamin A (3). Comparisons of varying dose schedules are one possibility.

Acute measles-induced decompensation of vitamin A status would account for the remarkably fast progression to corneal damage. Other infections also put pressure on vitamin A reserves, although less dramatically, It is the intensity, and not the mechanism, which is specific for measles. So far as eye damage is concerned, severe general malnutrition preceding measles is predictive of a higher incidence of potentially blinding lesions. The relative risk of eye involvement for primary and secondary measles cases remains to be established.

Measles immunization coverage is shown for all countries with a recognized serious problem of vitamin A deficiency in Figure 4 and Appendix 2. Already global measles coverage is 50%. In the African region, 9 of the 18 countries with a serious problem of vitamin A deficiency are reaching more than half of their target population. South east Asian countries with vitamin A deficiency lag behind with only 25% overall coverage.

A recognized disadvantage of the current vaccine is the necessity to delay immunization until the age of nine months. In the Machakos study in Kenya, 12% of children had measles between six and nine months. Many children therefore are being blinded due to measles before reaching the recommended age for immunization. Vitamin A supplementation through the EPI at six months will give some protection to these vulnerable children.

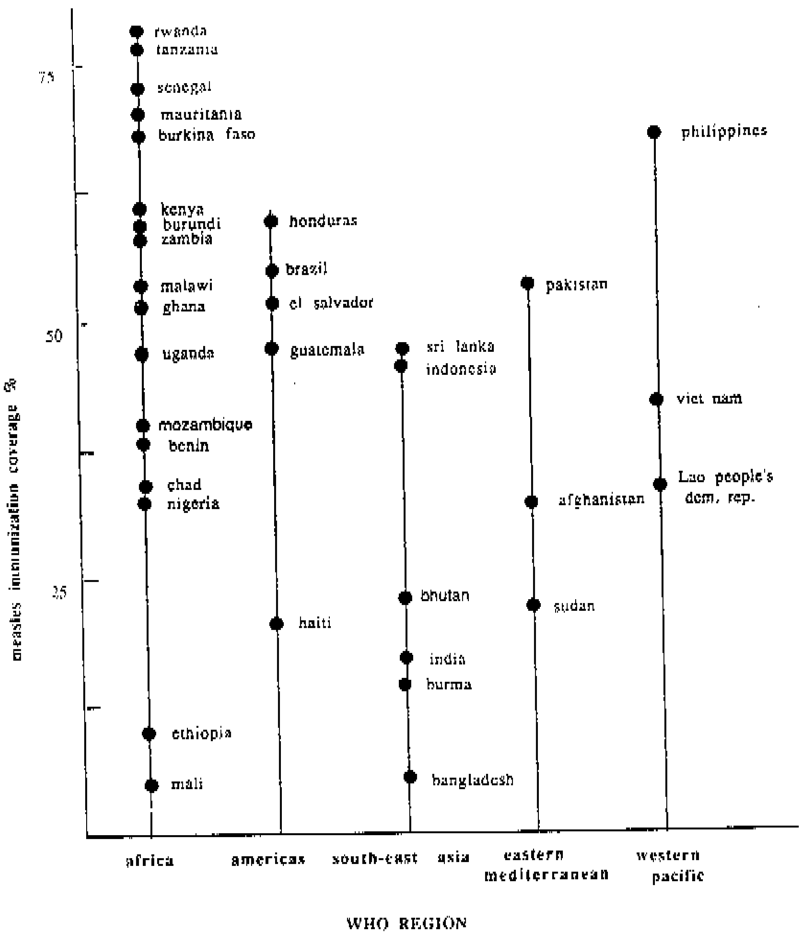


Figure 4: Measles immunization coverage in countries with severe vitamin A deficiency.

information available as of July 1988

9. Existing Programme Achievements and Constraints

Planning and Administration. The lack of nationally approved control policies is an obstacle to progress in many countries, in particular of Africa. Without detailed situation analysis, objectives, procedures and monitoring methods it is difficult to obtain resources - funding, manpower and vitamin A supplies. Countries with a severe vitamin A deficiency problem therefore need a country policy document, at the very least to ensure that priority is given to the issue. Since dealing with vitamin A deficiency is essentially an intersectoral problem, ministries of Agriculture and Education as well as Health and Nutrition should also be directly involved.

Currently only 12 out of 37 countries on the WHO listing have developed national programme strategies, or regional programmes approved at central level. Ethiopia, Malawi, Mali and Zambia should have completed policy documents by early 1989 (Appendix 2). Development and revision of policy guidelines is an opportunity to include objectives for the EPI, where periodic high dose supplementation is an intervention being used.

Range of interventions. The impact of periodic massive supplementation with vitamin A (200 000 IU) on reduction or elimination of xerophthalmic eye lesions is undisputed. The capacity of the liver to stock vitamin A providing a unique opportunity to protect against later deficiency. Massive supplementation with vitamin A gives immediate protection, at an individual cost for the vitamin A preparation of only a few US cents a year.

In the medium term, fortification of staple foods with vitamin A deficiency is effective, provided appropriate food vehicles exist and the cost is acceptable. Only the industrialized countries have sustained fortification measures, although Indonesia and the Philippines have carried out extensive work on fortification of monosodium glutamate (MSG). In Africa, fortification of cubes used to add taste to sauces is being considered. The longterm solutions to vitamin A deficiency include increased production and access to nutritious foods, better infant feeding habits and changed dietary behaviour.

Emergency situations and refugee camps. Emergency situations involving populations displaced by environmental disasters or war are special cases. Where vitamin A deficiency in the area is known or presumed, food shortage has been evident for a substantial period or there is obvious xerophthalmia, fortification of food aid provisions with vitamin A is essential. The Sudan in the 1984/85 emergency is one example where food supplementation with vitamin A did not occur, with resulting serious levels of xerophthalmia.

Distribution of high dose vitamin A supplements should also be an integral part of all emergency and relief operations, where there is a risk of vitamin A deficiency. Severely malnourished children, children with measles and other acute infections, lactating and pregnant women are priority groups. The potential contribution of the EPI in distributing vitamin A supplements to children from the age of six months or at the time of measles immunization is important.

Case Management. In terms of blindness prevention, treatment of eye lesions is a crucial component, with implications both for training of health workers and resources. For unless potentially blinding lesions are treated with high dose vitamin A, the many children inevitably not reached by even the most effective programmes will continue to lose their sight. The recommended WHO/UNICEF/IVACG treatment schedule is shown in Table 3. Supplies of high dose vitamin A should be available at all levels of the health care system in high risk areas.

Table 3

Treatment schedule for eye signs of vitamin A deficiency, active xerophthalmia

children one through five years old and adults[1]

Immediately on diagnosis	200 000 IU vitamin A orally
The following day	200 000 IU vitamin A orally
4 weeks later	200 000 IU vitamin A orally
Children under 1 year old, or who weigh less than 8 kg	100 000 IU vitamin A doses

1. Except for women in the childbearing age.

Vitamin A Supply. Worldwide, at least 28 countries are distributing high dose vitamin A (200 000 IU) either systematically or in sporadic programmes. UNICEF supplies nearly all vitamin A capsules (VAC) to countries. India, which manufactures its own vitamin A solution, being the major exception. Nearly 200 million vitamin A capsules were supplied by UNICEF in the years 1985-7 (Table 4). The striking feature is that 80% of UNICEF VAC went to only two countries, Bangladesh and Indonesia. The Africa region received less than 15% of the total. There have also been marked inequalities between countries of the same region, so that in 1985 Nigeria alone received 92% of the supply to central and west Africa.

Table 4

UNICEF supplies of vitamin A (200,000 IU capsules) in '000 1985-87.

	1985	1986	1987	% of overall distribution 1985-87
Bangladesh	42,040	44,160	22,200	55.8
Brazil	-	2,060	-	*
Burkina Faso	-	-	2	*
Chad	1,150	50	-	*
Ethiopia	1,094	292	6,329	4
Haiti	1,450	1,500	-	*
India[1]	-	750	-	*
Indonesia	22,811	7,194	18,400	24.9
Malawi	385	847	1,062	1.2
Mali	100	1,138	4	*
Mauritania	7	-	54	*
Nepal	915	600	985	1.3
Nigeria	6,000	-	-	3.1
Niger	230	-	-	*
Philippines	587	1,071	-	*
Sri Lanka	97	3	100	*
Sudan	2,512	2,712	52	2.7
Vietnam	687	207	60	*
Zambia	25	-	2290	1.2
	80,090	62,584	51,538	

1 India manufactures its own vitamin A solution

* less than 1%

Vitamin A stability. Vitamin A preparations are more stable than vaccines. A cold chain is not needed. Bottles of solution and capsules may be stored at ambient temperatures, but if possible below 30°C. In very hot climates, storage in cooled central stores is preferable. Bottles can be placed in a refrigerator, but should not be kept below 0°C. Bottle should be kept out of direct sunlight and heat. Vitamin A solution is liable to oxidation when exposed to air. Open pump bottles should be used within two months of opening, and capsule packs within six months. Information on stability of vitamin A preparations is summarized in Appendix 3.

References:

1. Vitamin A supplements. A guide to their use in the treatment and prevention of vitamin A deficiency and xerophthalmia. WHO/UNICEF/IVACG, WHO, 1988.

2. Guidelines for the use of vitamin A in emergency and relief operations. A report of the International Vitamin A Consultative Group, Washington, 1988.

3. Joint WHO/UNICEF statement on vitamin A for measles. Weekly epidemiological record, 1987 62: 133-134.

APPENDIX 1

Countries categorized by degree of public health significance of vitamin A deficiency, xeropthalmia, and nutritional blindness. WHO, January 1988.

WHO region	Category 1	Category 2	Category 3[1]
Africa	Benin Burkina Faso Chad Ethiopia Ghana Malawi Mali Mauritania Niger Nigeria United Republic of Tanzania Zambia	Angola Kenya Mozambique Uganda Rwanda Burundi	Algeria Botswana Lesotho Madagascar Senegal Zaire Zimbabwe
Americas	Brazil Haiti	El Salvador Guatemala Honduras	Bolivia Ecuador Jamaica Mexico Peru
South—East Asia	Bangladesh India Indonesai Nepal Sri Lanka	Burma Bhutan	Thailand
Europe			Turkey
Eastern Mediterranean	Sudan	Afghanistan Pakistan	Egypt Iran, Islamic Republic of Iraq Jordan Morocco Oman Somalia Syrian Arab Republic Yemen
Western Pacific	Philippines Viet Nam	Democratic Kampuchea Lao People's Democratic Republic	China Fiji Malaysia

[1] Category 1: Significant public health problem in part or whole of country.
Category 2: Insufficient information but high probability of signficant public health problem in part or whole of country.
Category 3: Sporadic cases but prevalence not such that it constitutes a significant public health problem.

Appendix 2

GLOBAL SITUATION — VITAMIN A DEFICIENCY

Country	Recognized public health problem *	Control Programme	Supplementation (1)	Measles coverage % (2)
African region				
Algeria	SPORADIC CASES	—	—	59
Angola	PROBABLE	NONE	—	...
Benin	YES	NONE	—	38
Botswana	SPORADIC CASES	—	—	91
Burkina Faso	YES	regional	YES	68
Burundi	PROBABLE	NONE	—	58
Cameroon	—	—	—	39
Cape Verde	—	—	—	59
Central African Rep.	—	—	—	30
Chad	YES	in drought	SPORADIC	33
Comoros	—	—	—	71
Congo	—	—	—	69
Cote d'Ivoire	—	—	—	85
Equatorial Guinea	—	—	—	12
Ethiopia	YES	planned	YES	10
Gabon	—	—	—	55
Gambia	—	—	—	82
Ghana	YES	SPORADIC	YES	51
Guinea	—	—	—	...
Guinea—Bissau	—	—	—	...
Kenya	PROBABLE	SPORADIC	YES	60
Lesotho	—	—	—	79
Liberia	—	—	—	36
Madagascar	SPORADIC CASES	—	—	10
Malawi	YES	YES: EPI link	YES	53
Mali	YES	planned	SPORADIC	5
Mauritania	YES	YES: EPI link	YES	69
Mauritius	—	—	—	75
Mozambique	YES	SPORADIC	YES	39
Niger	YES	YES	YES	...
Nigeria	YES	regional	YES	31
Rwanda	PROBABLE	NONE	—	78
Sao Tome	—	—	—	59
Senegal	SPORADIC CASES	—	—	70
Seychelles	—	—	—	95
Sierra Leone	—	—	—	50
South Africa	—	—	—	...
Swaziland	—	—	—	74
Tanzania	YES	YES	YES	76
Togo	—	—	—	48
Uganda	PROBABLE	in drought	YES	48
Zaire	SPORADIC CASES	—	—	39
Zambia	YES	planned	YES	58
Zimbabwe	SPORADIC CASES	—	—	77

Country	Recognized public health problem *	Control Programme	Supplementation (1)	Measles coverage % (2)
American Region				
Antigua and Barbuda	—	—	—	80
Argentina	—	—	—	87
Bahamas	—	.	—	83
Barbados	—	—	—	84
Bolivia	SPORADIC CASES	—	—	17
Brazil	YES	regional: EPI link	YES	55
Canada	—	—	—	...
Chile	—	—	—	91
Colombia	—	—	—	56
Costa Rica	—	—	—	55
Cuba	—	—	—	86
Dominica	—	—	—	97
Dominican Republic	—	—	—	24
Ecuador	SPORADIC CASES	—	—	49
El Salvador	PROBABLE	YES: EPI link	YES	51
Grenada	—	—	—	62
Guatemala	PROBABLE	YES: EPI link	YES	47
Guyana	—	—	—	42
Haiti	YES	YES	YES	21
Honduras	PROBABLE	NONE	—	60
Jamaica	SPORADIC CASES	—	—	36
Mexico	SPORADIC CASES	—	—	60
Nicaragua	—	—	—	61
Panama	—	—	—	73
Paraguay	—	—	—	46
Peru	SPORADIC CASES	—	—	41
St Christ. and Nevis	—	—	—	96
St Lucia	—	—	—	91
St Vincent & the Gren.	—	—	—	88
Suriname	—	—	—	78
Trinidad & Tobago	—	—	—	42
Uruguay	—	—	—	82
USA	—	—	—	82
Venezuela	—	—	—	48

Country	Recognized public health problem *	Control Programme	Supplementation (1)	Measles coverage % (2)
Eastern Mediterranean Region				
Afghanistan	PROBABLE	NONE	—	31
Bahrain	—	—	—	73
Cyprus	—	—	—	91
Democratic Yemen	SPORADIC CASES	—	—	35
Djibouti	—	—	—	61
Egypt	SPORADIC CASES	—	—	86
Iran	SPORADIC CASES	—	—	76
Iraq	SPORADIC CASES	—	—	69
Jordan	SPORADIC CASES	—	—	87
Kuwait	—	—	—	95
Lebanon	—	—	—	81
Libya	—	—	—	50
Morocco	SPORADIC	—	—	76
Oman	SPORADIC CASES	—	—	78
Pakistan	PROBABLE	SPORADIC	YES	53
Qatar	—	—	—	87
Saudi Arabia	—	—	—	80
Somalia	SPORADIC CASES	—	—	29
Sudan	YES	refugee camps	YES	22
Syrian Arab Republic	SPORADIC CASES	—	—	63
Tunisia	—	—	—	79
United Arab Emirates	—	—	—	56
UNRWA	—	—	—	100
Yemen	SPORADIC CASES	—	—	15

Country	Recognized public health problem *	Control Programme	Supplementation (1)	Measles coverage % (2)
European Region				
Albania	—	—	—	94
Austria	—	—	—	60
Belgium	—	—	—	90
Bulgaria	—	—	—	99
Czechoslovakia	—	—	—	98
Denmark	—	—	—	...
Finland	—	—	—	81
France	—	—	—	55
German Democrat. Rep.	—	—	—	98
German Federal Rep.	—	—	—	50
Greece	—	—	—	81
Hungary	—	—	—	99
Iceland	—	—	—	95
Ireland	—	—	—	63
Israel	—	—	—	88
Italy	—	—	—	21
Luxembourg	—	—	—	68
Malta	—	—	—	59
Monaco	—	—	—	...
Netherlands	—	—	—	96
Norway	—	—	—	87
Poland	—	—	—	94
Portugal	—	—	—	66
Romania	—	—	—	89
San Marino	—	—	—	...
Spain	—	—	—	83
Sweden	—	—	—	94
Switzerland	—	—	—	60
Turkey	SPORADIC CASES	—	—	50
United Kingdom	—	—	—	71
USSR	—	—	—	95
Yugoslavia	—	—	—	92
South East Asian Region				
Bangladesh	YES	YES	YES	6
Bhutan	PROBABLE	SPORADIC	YES	23
Burma	PROBABLE	NONE	—	14
DPR. Korea	—	—	—	35
India	YES	YES	YES	17
Indonesia	YES	YES: EPI link	YES	46
Maldives	—	—	—	9
Mongolia	—	—	—	61
Nepal	YES	YES	YES	...
Sri Lanka	YES	YES	YES	47
Thailand	SPORADIC CASES	—	—	34

Country	Recognized public health problem *	Control Programme	Supplementation (1)	Measles coverage % (2)
Western Pacific region				
Australia	—	—	—	68
Brunei Darussalam	—	—	—	100
China	—	—	—	77
Cook Islands	—	—	—	80
Democratic Kampuchea	PROBABLE	NONE	—	...
Fiji	SPORADIC CASES	—	—	61
Japan	—	—	—	73
Kiribati	—	—	—	7
Laos	PROBABLE	NONE	—	33
Malaysia	SPORADIC CASES	—	—	20
New Zealand	—		—	...
Papua New Guinea	—	—	—	27
Philippines	YES	YES	YES	68
Republic of Korea	—	—	—	89
Samoa	—	—	—	81
Singapore	—	—	—	94
Solomon Islands	—	—	—	37
Tonga	—	—	—	91
Vanuatu	—	—	—	25
Viet Nam	YES	NONE	SPORADIC	42

Based on reports received by the World Health Organization as of October 1988

* YES — vitamin A deficiency is a significant public health problem in part or whole of country.

PROBABLE — insufficient data but high probability of being a significant public health problem in part or whole of country.

SPORADIC CASES — prevalence is such that it does not constitute a significant public health problem.

(1) A national or regional programme exists to provide vitamin A supplementation.

(2) Measles immunization coverage as of July 1988.

— Reports indicate vitamin A deficiency has not been observed; or the category is not applicable.

... No information.

Appendix 3

Stability of vitamin A as retinol palmitate (unopened containers)

a) In oily solution:

storage temperature	% retinol retention after: 6 months	12 months	24 months
5°C	99	98	97
35°C	97	92	76
45°C	84	76	

b) In gelatine capsules:

23°C		97% at 31 months	
35°C	92	84	
45°C	85	79	

...