

Do vitamin A deficiency and undernutrition still matter?



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Children grow and develop well when they have access to affordable, diverse, nutrient-rich food, appropriate maternal and child care, adequate health services and a healthy environment including safe water, sanitation and good hygiene.

Children can become undernourished – therefore failing to grow and thrive – for a variety of reasons. The immediate causes of undernutrition are:

- **inadequate dietary intake**, whether as a result of poor maternal diet before, during and after pregnancy, sub-optimal breastfeeding, inadequate complementary foods during weaning or insufficient nutrient-rich foods during early childhood
- **disease**, including parasitic infections, diarrhoeal disease, or other infections such as measles.

Underlying these causes are factors such as household food insecurity (due to poverty or other reasons), inadequate care and feeding practices, unhealthy household environments and inadequate health services.¹ How these factors inter-relate with each other is shown on page 64.

Being undernourished for a long time can lead to stunting. In addition to its most obvious effects on stature (height), stunting has implications for the health and development of children, including their ability to learn. It can also lead to an increased risk of chronic diseases, such as heart disease or diabetes, in adulthood.

Although stunting is declining, the rate



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Having enough nutrient-rich food to eat prevents stunting, blindness, and death in young children

of decline is too slow. There are now major global initiatives in place to improve the nutritional status of young children – the group most vulnerable to undernutrition and in whom the effects of undernutrition are greatest.

Two of the main initiatives are the

Scaling Up Nutrition (SUN) movement and the 1,000 Days Partnership, which focuses on the period of that encompasses pregnancy and the first two years of the child's life. These initiatives have similar aims. Broadly, these are:

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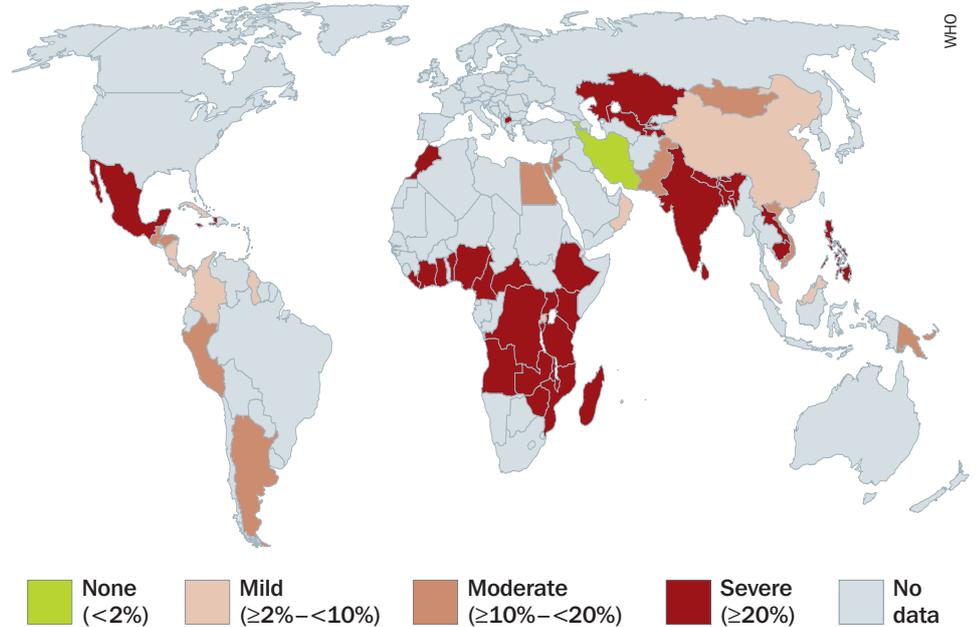
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- to improve women's nutrition before, during and after pregnancy to promote intrauterine growth and improve the quality of breast milk
- to promote and support exclusive breastfeeding for the first 6 months of a child's life followed by continued breastfeeding together with the introduction of safe and appropriate complementary feeding for the next

- 18 months and beyond
- to ensure children get the vitamins and minerals they need, whether through better dietary choices, food fortification or micronutrient supplementation
- to treat malnutrition with appropriate nutritional interventions.

Improving the availability of affordable, nutritious foods requires a broad approach, encompassing all the farmers,

Figure 1. Global extent of vitamin A deficiency as defined by prevalence of serum retinol <0.70 µmol/l in preschool children³



Volume 26 | Issue 84
*Supporting VISION 2020:
The Right to Sight*



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ISSN 0953-6833

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businesses, institutions and processes (such as supply chains) which produce, process and make foods available to communities.

Vitamin A deficiency remains a problem

Most children who suffer from malnutrition and stunting are deficient in many micronutrients, such as the B vitamins, vitamin D, iron, iodine and zinc. Stunted children are also usually deficient in vitamin A, which places them at increased risk of blindness and death.

- **Blindness.** Vitamin A deficiency can result in xerophthalmia ('dry eyes'), which in its most severe forms results in irreversible blindness (pages 66–67). Xerophthalmia, in the form of night blindness, and low levels of retinol (the form of vitamin A found in the blood), are both indicators of vitamin A deficiency.
- **Death.** In children, the link between vitamin A deficiency and death is so strong that mortality rates in children under 5 years are now taken to be a 'surrogate' indicator of vitamin A deficiency. Vitamin A deficiency is considered to be a public health issue in countries with mortality rates in children under 5 years of ≥ 50 deaths per 1,000 live births. In sub-Saharan Africa, 40 countries have mortality rates in under-5s above this level; of these, 37 have mortality rates that are twice as high (over 100 deaths per 1,000).²

Although great strides have been made to address vitamin A deficiency in children, it is clear from these data

that there are still many countries where vitamin A deficiency remains a problem. Worldwide, in populations at risk of vitamin A deficiency, one in three preschool-aged children is thought to be deficient in vitamin A with the greatest burden in Africa and Southeast Asia (Figure 1).³

In the short term, vitamin A supplementation is the most effective way to reduce vitamin A deficiency and child mortality (see page 70). Doing something about vitamin A deficiency on its own, however,



Sight and Life

Providing mothers and carers with the knowledge and skills to prepare nutrient-rich foods can reduce undernutrition and vitamin A deficiency, but sometimes more is needed

will not deal with the larger problem of undernutrition and deficiency of other micronutrients essential for growth, health and educational development. This is why, in this issue of the *Community*

Eye Health Journal, we suggest that vitamin A deficiency must be addressed – not just with supplementation – but also by working with mothers to address the immediate and underlying causes of chronic undernutrition. This will

improve their children's health and diet and therefore also their general nutrition. In particular, we should encourage improved hand washing practices and work with families to overcome customs associated with inadequate complementary or weaning foods.

Vitamin A supplementation – a specific, targeted intervention delivered by health workers – remains an important and effective strategy for reducing vitamin A deficiency. Many countries are achieving high coverage, but even in

these countries, many infants and children living in poor, rural communities are not being reached. This issue discusses some of the ways in which coverage can be improved and highlights the successes achieved in Burkina Faso.

As eye care professionals, we can do a lot to inform and educate communities about nutrition in general and how families can improve the diet of young children, thereby also preventing them from becoming vitamin A deficient. This issue gives some practical examples of what you can do either in the clinic or during outreach and includes advice on how to manage a child with xerophthalmia and what urgent action is needed to reduce the risk of blindness and death.

Chronic undernutrition affects communities, not just individuals. It is therefore important to remember that when we see a child with xerophthalmia, there are likely to be many more children affected by the condition in his or her community. Many of these children, although vitamin A deficient, will not show the eye signs.

Vitamin A deficiency and undernutrition still matter. As eye health workers, we have a responsibility to do what we can, and also to alert those responsible for child health if we suspect that a particular community is suffering from chronic undernutrition – as they are likely to be vitamin A deficient too.

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- 3 World Health Organization (WHO). Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A deficiency. Geneva, Switzerland: WHO; 2009. Available at: http://whqlibdoc.who.int/publications/2009/9789241598019_eng.pdf

Further reading

The Food and Agriculture Organization of the United Nations. <http://www.fao.org/about/what-we-do/so1/en/> Scaling Up Nutrition. <http://scalingupnutrition.org> 1,000 Days Partnership. www.thousanddays.org The Road to Good Nutrition. Basel, Switzerland: Karger; 2013. www.sightandlife.org/news/news-details/article/Book-launch-The-Road-to-Good-Nutrition-at-20th-International-Congress-of-Nutrition.html

Understanding undernutrition

For children to have adequate micronutrient intake, including vitamin A, all of the following should be in place.

- 1 Nutrient-rich foods must be available to the family.** Sufficient nutrient-rich foods must be available where the family can buy them, and must be affordable.
- 2 Children must consume enough nutrient-rich foods.** Children must be given enough nutrient-rich food to eat. Food must be prepared in such a way that the nutrients are preserved and easily absorbed. For most foods, this means not overcooking them. For good vitamin A absorption, there must also be enough fat in the diet.
- 3 Children must be free from disease and infection.** Measles, intestinal worms, diarrhoea and other infections all reduce the absorption – and increase the loss – of many micronutrients, including vitamin A.

What can go wrong?

1 Nutrient-rich foods are not available or affordable.

If this is the case, children will not get adequate amounts of micronutrients, including vitamin A, even if parents prepare the foods correctly and the children are free of disease. There may be several underlying causes:

- the foods may be seasonal
- markets may be far or transport is a problem
- the family may not own land so cannot grow their own crops
- some foods, such as meat and other animal products, are not affordable for poorer families.

2 Nutrient-rich foods are not given to children, are not given in the correct way, and/or children do not want to eat these foods.

This can be due to a combination of factors, including social and/or cultural norms and beliefs, poverty and lack of knowledge. Here are some examples:

- mothers may not know which foods are healthy for their young children
- mothers may stop breastfeeding early and give complementary foods low in nutrients
- nutrient-rich foods may be overcooked
- dark green leafy vegetables (high in vitamin A) are not cooked in such a way that children will eat them
- there may be local customs about what to feed children who are sick, e.g. porridge instead of vegetables
- local customs may stop mothers giving

children certain foods; e.g. a belief that eggs cause children to become thieves

- if there is not enough food for the family, the more nutritious food may be given to the head of the household.

3 Children suffer from disease and infection.

Disease and infection can:

- reduce the body's ability to absorb nutrients from food
- increase the body's demand for nutrients
- increase the loss of nutrients from the body.

Absorption is reduced by:

- gastrointestinal tract infections, diarrhoea and intestinal worms
- chronic undernutrition itself.

Demand is increased by:

- repeated episodes of infection with fever
- measles infection. Vitamin A is needed to repair cells damaged in the skin, lungs, gut, mouth, conjunctiva and middle ear. In children with inadequate vitamin A intake, measles infection can very quickly deplete the body's vitamin A stores (in the liver), leading to blindness, hearing impairment and death.

Loss is increased by:

- diarrhoea: micronutrients are lost from the gut.
- measles: retinol is lost in the urine or from the gut.

Underlying causes

There are a range of underlying causes of undernutrition, as shown in Figure 1:

- food insecurity at household level
- lack of knowledge about good health, hygiene and child feeding practices
- lack of sanitation and water, leading to an unhealthy household environment
- inadequate health services, including low coverage of measles immunisation programmes and a lack of primary care.

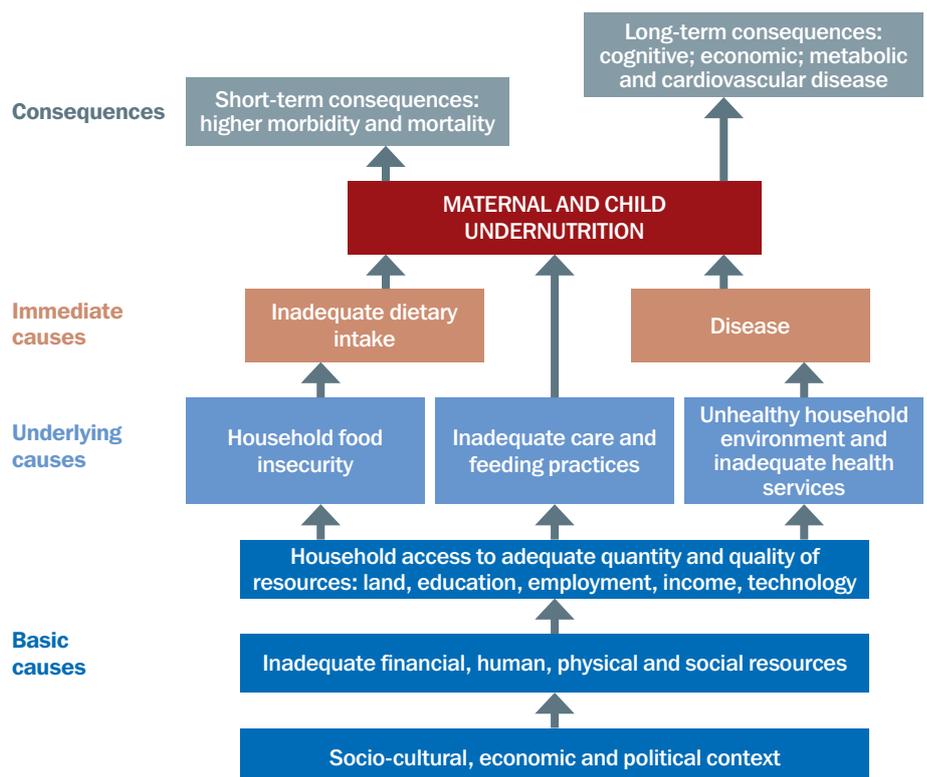
These causes are themselves the result of more basic causes, e.g. a lack of access to resources including income, education, land, and technology. The social, cultural, economic and political context people find themselves in also plays a role.

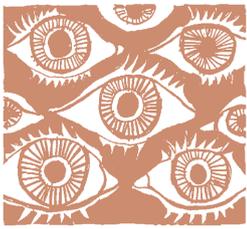
Although these causes are difficult to address, as eye care providers we can do much to address misconceptions and improve knowledge about nutrition among parents and in communities (see pages 72–73). We can promote good hygiene practices, measles immunisation and deworming and encourage parents to give their children a diet that is nutritious and rich in micronutrients, including vitamin A.

Reference

UNICEF. Improving Child Nutrition. New York, United Nation's Children's Fund (UNICEF), 2013. http://www.unicef.org/publications/index_68661.html

Figure 1. Conceptual framework of the determinants of child undernutrition¹





VITAMIN A

What is vitamin A and why do we need it?



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Vitamin A, along with other vitamins, minerals and other compounds, is an essential micronutrient. This means that our bodies cannot manufacture it and therefore it has to be included in our diet.

Vitamin A from food is stored in the liver until required by the body and is bound to protein before being transported to where it is needed.

Vitamin A is essential for many physiological processes, including maintaining the integrity and function of all surface tissues (epithelia): for example, the skin, the lining of the respiratory tract, the gut, the bladder, the inner ear and the eye. Vitamin A supports the daily replacement of skin cells and ensures that tissues such as the conjunctiva are able to produce mucous and provide a barrier to infection. Vitamin A is also essential for vision under conditions of poor lighting, for maintaining a healthy immune system, for growth and development and for reproduction. Vitamin A supports many systems in the body. For this reason, vitamin A deficiency is now referred to as vitamin A deficiency disorders. For simplicity, however, we will continue to use the older term vitamin A deficiency (VAD).

One of the main consequences of VAD is an increased risk of severe infection. Infection increases the body's demand for vitamin A and so the deficiency gets worse. Children can therefore become involved in a vicious



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Vitamin A, whether from plant or animal sources, is essential for health

cycle of deficiency and infection, which is why vitamin A deficiency is such an important cause of child mortality.

Sources of vitamin A

There are two main sources of vitamin A: animal sources and plant sources. All the sources of vitamin A need some fat in the diet to aid absorption.

In animal sources, vitamin A is found as retinol, the 'active' form of vitamin A. Liver, including fish liver, is a very good source. Other animal sources are egg yolk (not the white) and dairy products such as milk (including human breast milk), cheese and butter. Meat, from the animal's muscles, is not a good source.

Plant sources contain vitamin A in the form of carotenoids which have to be converted during digestion into retinol before the body can use it. Carotenoids are the pigments that give plants their green colour and some fruits and vegetables their red or orange colour.

Plant sources of vitamin A include: mangos, papaya, many of the squashes, carrots, sweet potatoes and maize (but not the white varieties). Other good sources of vitamin A are red palm oil and biruti palm oil. (Note: if these oils are boiled to remove their colour the vitamin A is destroyed.)

Some fruits and vegetables are easier to digest than others, and it has been shown that dark green leafy vegetables such as spinach or amaranth are harder to digest. Mashing these vegetables up after cooking makes them easier to digest. When mashed they can be added to staples, which also makes them easier to disguise – children the world over do not like green vegetables!

It is important that all sources of vitamin A are not overcooked, as this can reduce the vitamin A content. Ultraviolet light can also reduce the vitamin A content of food, so drying of fruits such as mangos should not be done in direct sunlight (see page 73).

Diets that rely heavily on local carbohydrates, such as rice, fufu, ugali, cassava, millet and sorghum, are very low in vitamin A, unless vitamin A-rich foods are added.

How much vitamin A does a child need?

Because children are growing, they need a relatively high intake of vitamin A; about half as much as an adult. Another reason for the relatively high intake is because children are prone to infection which increases the metabolic rate and hence the rate at which they use vitamin A.

Breast milk contains enough vitamin A for children up to six months of age, but after that complementary foods (the foods given in addition to breast milk) should include small amounts of vitamin A-rich foods.

For a young child, a balanced diet that is rich in vitamin A should include helpings of at least 2–3 vitamin A-rich fruits and vegetables a day, plus a little bit of fat to aid absorption.

Young children are totally dependent on their mother or other carers for their diet, and so it is vital that mothers and carers of young children know what constitutes a healthy diet for their child.

With thanks to Temina Mkumbwa, Christina Nyhus Dhillon, Heather Katcher, and Jessica Blankenship.

Food sources of vitamin A

Fruits and vegetables

- Dark green leafy vegetables, for example amaranth (red or green), spinach and chard
- Orange-fleshed sweet potatoes
- Carrots
- Squashes/pumpkins
- Yellow maize
- Mangoes
- Papayas

Animal sources

- Liver, eggs, milk (including breast milk)

Oils

- Red palm oil or biruti palm oil



The eye signs of vitamin A deficiency



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It is vitally important to realise that many children who are vitamin A deficient will **not** have the eye signs, known as xerophthalmia (dry eye). This means that children with the eye signs are only the ‘tip of the iceberg’ – there will be many other children in the community who are vitamin A deficient but who have completely normal eyes and vision. This is why community approaches to control are so vitally important (page 69–70).

The different eye signs of vitamin A deficiency (VAD) in children, as graded by the WHO, are:

- Night blindness (XN)
- Conjunctival xerosis (X1A)
- Bitot’s spots (X1B)
- Corneal xerosis (X2)
- Corneal ulcer covering less than 1/3 of the cornea (X3A)
- Corneal ulcer covering at least 1/3 of the cornea, defined as keratomalacia (X3B)
- Corneal scarring (XS)

It is very important to realise that children do **not** first develop night blindness, then Bitot’s spots and then corneal ulcers. Some eye signs reflect long-standing VAD, whereas other eye signs reflect severe, acute, sudden-onset VAD. A child who is vitamin A deficient, but who does not have any of the eye signs of long-standing deficiency, may develop one of the severe eye signs, such as corneal ulcers, as a result of infection or diarrhoea.

Children with **any** of the eye signs of VAD are at high risk of dying. One of the first studies in Indonesia showed that children with night blindness were almost



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Picture drawn by a child to illustrate night blindness

three times more likely to die as those from the same community without night blindness, and children with both night blindness and Bitot’s spots were almost nine times more likely to die.¹ A study from Bangladesh showed that almost two-thirds of children with the most severe form of xerophthalmia – known as keratomalacia (a corneal ulcer affecting more than a third of the cornea) – had died within a few months.²

Long-standing VAD is most prevalent in children aged 3–6 years (with night blindness, children as young as 2 years old can be affected). Acute VAD is most prevalent among children aged 1–4 years (see Table 1). To prevent blindness and child mortality from VAD, interventions must therefore be targeted at pre-school-aged children.

Signs of chronic, long-standing VAD

NOTE: To examine the eye, use a bright torch in natural light.

Night blindness

This can affect children as well as pregnant and lactating women and is one of the more common manifestations of deficiency. If VAD is prevalent in the community then there are often local names for it. It is useful to find out what these terms are so they can be used when asking about night blindness. It is more difficult to find out if a child has night blindness, as children do not complain. Mothers need to be asked whether they have noticed that their child behaves differently after the sun goes down or when they are in a dark room. The child will become less active, and may be fearful of moving around. Night blindness tends to affect women who are pregnant or lactating, and children aged 2–6 years.

Conjunctival xerosis

This presents as dryness of the conjunctiva (Figure 1) and is another sign of long-standing deficiency. It can be quite difficult to detect and is therefore not a very reliable sign.

Figure 1. Conjunctival xerosis. Note the slight wrinkling of the temporal conjunctiva



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Table 1. World Health Organization (WHO) classification of vitamin A deficiency and the age groups most affected

Grade of xerophthalmia		Peak age group (years)	Type of deficiency	Risk of death
XN	Night blindness	2–6; adult women	Long standing. Not blinding	+
X1A	Conjunctival xerosis	3–6	Long standing. Not blinding	+
X1B	Bitot’s spot	3–6	Long standing. Not blinding	+
X2	Corneal xerosis	1–4	Acute deficiency. Can be blinding	++
X3A	Corneal ulcer/ < 1/3 cornea	1–4	Severe acute deficiency. Blinding	+++
X3B	Corneal ulcer/keratomalacia ≥ 1/3	1–4	Severe acute deficiency. Blinding	++++
XS	Corneal scarring (from X3)	>2	Consequence of corneal ulceration	+/-
XF	Xerophthalmic fundus	Adults	Long standing. Not blinding. Rare	-

Bitot's spots

Bitot's spots (Figure 2) are characteristic of VAD and are not caused by any other condition. The slightly elevated, white foamy lesion is usually seen on the bulbar conjunctiva near the limbus, at the three o'clock or nine o'clock positions. Bitot's spots are more common on the temporal side. The white deposit consists of keratin, which the conjunctiva starts to produce because the deficiency has led to 'squamous metaplasia' with the cells in the conjunctiva becoming more like skin than a mucous membrane. To a certain extent the white foamy material can be wiped away from the surface of the conjunctiva, but does not disappear completely, even after the vitamin A deficiency has been treated. Hence, this sign does not necessarily mean that the child is currently vitamin A deficient. Bitot's spots usually appear in children aged 3–6 years. Bitot's spots that do not respond to vitamin A treatment are more common in school-aged children.

Figure 2. Bitot's spots at the temporal limbus



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Signs of acute, sudden-onset VAD

Acute, sudden-onset VAD leads to potentially blinding eye signs and is associated with a very high mortality rate in children.

Corneal xerosis

This is drying of the cornea (Figure 3) and is a sign of sudden, acute deficiency. The cornea becomes dry because glands in the conjunctiva no longer function normally. This leads to loss of tears and also loss of mucous, which acts as a 'wetting agent'. The lack of mucous together with lack of tears not only leads to the dry appearance but also increases the risk of infection.

Figure 3. Corneal xerosis

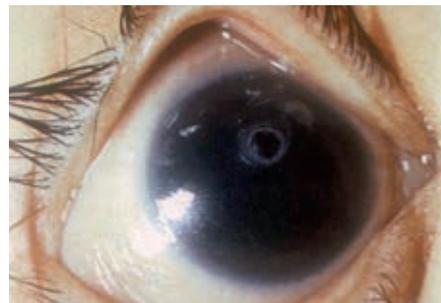


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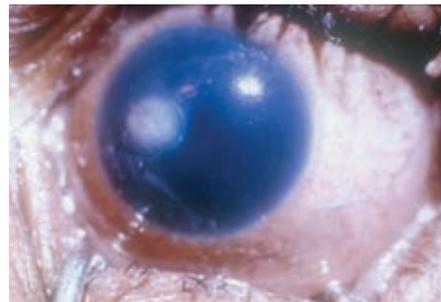
Corneal ulcer

If the acute deficiency is not reversed as a matter of urgency, the cornea can become ulcerated and melt away. The ulcer may have the appearance of a small, punched-out area in the cornea (Figure 4, top image), or the ulcer may have a more fluffy appearance (Figure 4, lower picture). In the absence of secondary infection, the eye can look surprisingly white, as in both images in Figure 4; however, secondary infection of the ulcer is common, leading to an acutely inflamed eye (Figure 5).

Figure 4. Corneal ulceration (X3a) without secondary infection



Allen Foster



Alfred Sommer

Figure 5. Corneal ulceration (X3a) with secondary infection



Allen Foster

Keratomalacia

The most severe form of xerophthalmia is keratomalacia (Figure 6), in which more than one-third of the cornea is affected. The cornea may become oedematous and thickened, and then melt away. This occurs because the structure of the collagen in the cornea is affected by a process known as necrosis. The cornea can be destroyed in just a few days. Children with keratomalacia are often malnourished, but children who previously appeared relatively healthy can also develop keratomalacia following measles infection or episodes of diarrhoea; this is

usually because they were vitamin A deficient and the measles infection resulted in depletion of their vitamin A stores. If you are not sure whether the child you are seeing has keratomalacia, ask about recent illness, particularly measles.

Figure 6. Keratomalacia



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The end result of corneal ulceration

The end result of corneal ulceration and keratomalacia is corneal scarring (Figure 7), staphylomas (forward bulging of a badly damaged cornea) or phthisis bulbi (an eye that has shrivelled up), depending on the extent of the pathology in the cornea. Most of the eye signs of VAD are symmetrical and bilateral, and so can lead to blindness.

Figure 7. Corneal scarring



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If a child is found to have the eye signs of VAD, spend time talking to his or her mother or carer. Ask the mother about the food the child is given, and how often he/she is fed. Ask specifically about foods which are rich in vitamin A. Ask if the child has been ill recently, or had diarrhoea. Explain that the child is at risk of infection and that they need more than one dose of vitamin A to treat the problem, as is described on page 68. Remember that other young children in the family and the community are also likely to be at risk.

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How to manage children with the eye signs of vitamin A deficiency



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The principles of managing children with the eye signs of vitamin A deficiency (VAD) – xerophthalmia – are:

- 1 correct the deficiency
- 2 manage the eye manifestations.

The initial focus should always be on correcting the VAD as children with any signs of xerophthalmia are at an increased risk of dying.

Correcting the deficiency

Children with any of the features of xerophthalmia should be assumed to be markedly vitamin A deficient, with low stores of retinol in their livers. They need multiple doses of vitamin A to restore their serum levels and to boost their liver stores.

The recommended treatment for a child with any of the eye signs of VAD is shown in Table 1. Explain to the child's mother that three doses are needed. Watch the child being given the first dose to make sure he/she takes it, and give the mother the other doses for the next day and two weeks later. If the child is very sick and cannot swallow, intramuscular preparations are available. In cases of acute deficiency with ocular manifestations, parenteral/intramuscular injection of 50,000 international units of **water soluble** vitamin A is very useful, giving immediate improvement both in the ocular and systemic conditions.

Managing the eye manifestations

Corneal ulceration

Disentangling different causes of corneal ulcers in children (Table 2) can be challenging, as they can be due to a variety of causes, such as bacterial or fungal infections, herpes simplex

Table 1. Recommended treatment of children with any of the eye signs of vitamin A deficiency

Age of the child	Dose of vitamin A (IU)	Frequency
<6 months	50,000	Day 1, day 2 and day 14
6-12 months	100,000	Day 1, day 2 and day 14
>12 months	200,000	Day 1, day 2 and day 14

IU = International units of retinyl palmitate

infection, the use of harmful traditional eye remedies or some forms of trauma (e.g. burns from acid or hot fluids) as well as VAD. In the case of ulcers from VAD the diagnosis can be more difficult. There may be secondary infection, which makes the eyes red and painful with discharge, and the mother may have used harmful traditional eye remedies which can alter the appearance of the ulcer.

Take a careful history and examine the eyes carefully. **If in doubt, give high-dose vitamin A as well as other treatment.**

Corneal scarring

If a child has bilateral, dense central corneal scars, an optical iridectomy (surgical removal of a small segment of peripheral iris through a small incision at the limbus) can dramatically improve the visual function (Figure 1).

This is usually only indicated, however, if both eyes are blind and there is a wide enough area of clear peripheral cornea. The operation is quick and easy and

usually has no complications.

One of the main challenges of corneal grafting in children with corneal scarring is that the chance of rejection is extremely high.¹ The scars are vascularised and the cornea will have lost its 'immune privilege'. Corneal grafting in these children also requires healthy young donor corneas, highly experienced corneal surgeons, parents who understand and will be compliant with instilling eye drops after surgery (possibly for months), and who will bring their child back for regular follow-up for months after surgery, as well as ophthalmologists who understand visual development in children.

As most children with corneal scars will be amblyopic (because the visual system did not develop normally), parents need to understand that visual acuity may be poor after a graft or iridectomy; however, the child's overall visual function may improve. Children in whom surgery is not possible should be referred for rehabilitation.

Staphyloma and phthisis bulbi

Staphyloma (forward bulging of a badly damaged cornea) is often very uncomfortable or painful. If the child has a painful staphyloma the eye should be removed. Phthisical eyes (eyes that have shriveled up after severe eye disease) can be very disfiguring, and removing the eye and replacing it with an artificial eye can improve the appearance.

Reference

- 1 Vajpayee RB, Vanathi M, Tandon R, et al. Keratoplasty for keratomalacia in preschool children. *Br J Ophthalmol.* 2003;87(5):538-542.

Figure 1. Optical iridectomy for central corneal scarring



Clare Gilbert

Table 2. Differentiating between vitamin A deficiency and other causes of corneal ulceration

Likely cause	From the history	From examination
Vitamin A deficiency more likely if ...	<ul style="list-style-type: none"> • Recent illness such as measles, diarrhoea or other illness associated with fever • No medication of any kind has been put in the eye(s) • No history of eye injury • Child not adequately breastfed • The mother is poor and malnourished herself 	<ul style="list-style-type: none"> • Bilateral ulceration • The ulcer has a punched-out appearance, or may even be full thickness with protrusion of the iris
Other causes more likely if ...	<ul style="list-style-type: none"> • History of trauma or hot fluid or acid getting into the eyes 	<ul style="list-style-type: none"> • Only one eye is affected and the other eye is entirely normal



Public health programmes for vitamin A deficiency control



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Since the early 1980s, when it was first realised that children with the eye signs of vitamin A deficiency (VAD) had a higher mortality rate than children in the same communities who did not have these signs, there have been many large-scale, community-based trials to assess whether improving the vitamin A status of young children improves child health and survival. Many of the trials involved intermittent supplementation with high-dose vitamin A, but food-based interventions such as food fortification have also been assessed.

Findings from the large number of randomised controlled trials of supplementation of children aged 6–59 months have been pooled, showing that intermittent supplementation with high-dose vitamin A has a major impact on child mortality in communities of children at risk of VAD. When all the results are combined, the mortality rate of the children given supplements was 24% lower than that of the children not given supplements. Some of these trials also showed a reduction in diarrhoea, measles, night blindness and other signs of xerophthalmia. (The results of trials of children under the age of 6 months, and of newborn infants and mothers, are less clear). Analysis of randomised controlled trials of vitamin A-fortified foods showed significant impacts on serum retinol concentration and haemoglobin levels.¹

The results of all these trials have led to global initiatives (see pages 61 and 62) to control VAD in children. There has been progress in many countries, but further action is needed to increase the number of countries implementing programmes to address VAD.

Food-based strategies

Food-based strategies are a long-term approach to controlling VAD.

Fortification of staple foods

In some countries, where industrial and



Melanie Suter

A mother in Zambia adds multi-micronutrient powder to her daughter's porridge

commercial infrastructure is adequate, fortification of food staples like flour, sugar, oil or condiments with pre-formed vitamin A (retinol) can be a very cost-effective way of reducing VAD. To be successful, the fortified food must be eaten by those at risk of VAD (young children and mothers) on a regular basis. To increase acceptability, the appearance, shelf-life and costs of the fortified and non-fortified food should be comparable. Fortification programmes demonstrate that with high coverage and adequate fortificant levels, food fortification can improve vitamin A status, and thus have a positive health impact.

Multi-micronutrient powders

Home fortification with multi-micronutrient powders (MNPs) has been successfully used in some countries and is being adopted by others. Mothers are taught how to add sachets of micronutrient powder to their child's food and how often this should be done, depending on the nutritional value of the local staple used to prepare the food (e.g. maize or rice porridge). Additional information on hygiene, health, nutrition, and child development is provided as an

integral part of this approach and, depending on the programme, the micronutrient powders can be purchased or are distributed for free. Home fortification has been used with success in refugee camps, emergency situations, in child health and nutrition programmes, and in school feeding programmes.² It is foreseen that, in coming years, large-scale interventions will be initiated to reach even more children and other target groups, including children and adolescents in schools.

Selective breeding and biofortification

Increasing intakes of vitamin A through selective breeding and biofortification of staples, such as orange-fleshed sweet potatoes or orange maize, can be another approach. Compared with food fortification, however, biofortification may not be as effective. The form of vitamin A used in food fortification is more effective than plant sources at improving vitamin A status. Health education might also be required to reassure

mothers that the more orange foods are healthy and not harmful.

Dietary diversification and improvement

Dietary diversification and improvement, including ensuring regular access to foods that are naturally rich in vitamin A, is also important in the long run.

For example, some countries are emphasising feeding programmes for preschool-aged children. Encouraging exclusive breastfeeding is another important strategy, as breast milk is a very important source of vitamin A. Breastfeeding is an important means of reducing VAD among infants and young children.

Showing people how to grow plants rich in vitamin A throughout the year, and how to store and cook them, is the most sustainable long-term food-based approach.

Even in areas where water and land are scarce, using innovative approaches to home gardening can give adequate yields for a family. If a family can also keep chickens then this improves their protein intake, and egg yolk is also an excellent source of vitamin A.

Continues overleaf ➤

Vitamin A supplementation

Vitamin A supplementation (page 71), when implemented on a very large scale, is a fast and cost-effective intervention to improve the vitamin A status of populations.

Vitamin A supplementation guidelines for the prevention of VAD recommend that high-dose supplements should be given to children aged 6–59 months in settings where VAD is a public health problem. In areas where VAD is a **severe** public health problem, **low-dose** vitamin A supplements are also recommended for pregnant women.

The 2011 World Health Organization (WHO) guidelines on vitamin A supplementation focus on preventive supplementation. They also contain guidelines for treatment of clinical cases of xerophthalmia and measles, and information about repeated high-dose vitamin A supplementation.

The best way of increasing coverage is to make sure that vitamin A supplementation is an integral part of child health services. For example, The Integrated Management of Childhood Illness programme which is used as the basis for services for under 5-year-olds in many countries in Africa, emphasises vitamin A supplementation. Coverage can also be increased by including supplementation during national immunisation campaigns.

Impact of VAD control programmes

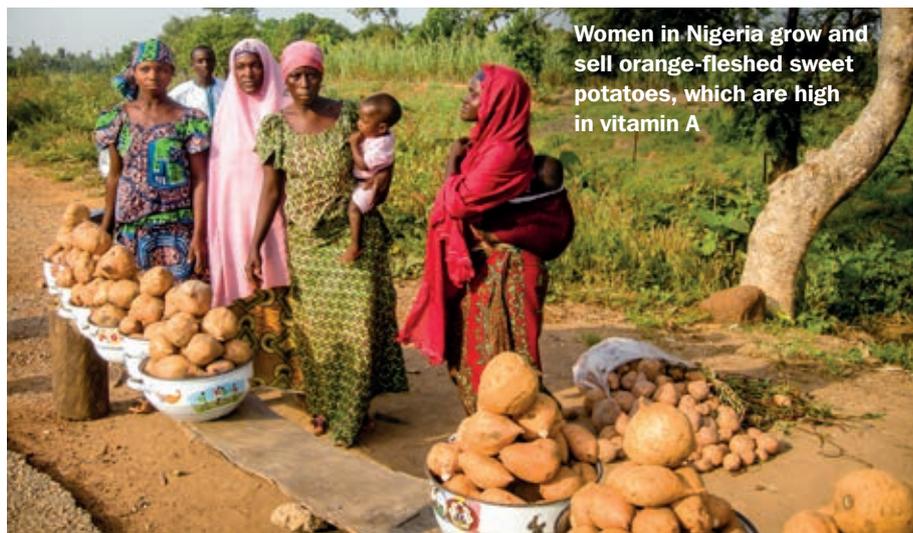
Vitamin A supplementation is very cost-effective. Capsules cost just a few cents and the potential of vitamin A supplementation to reduce the risk of blindness, infectious disease and mortality is high.

In 2008, WHO estimated that, since 1998 (when it and its partners started to deliver supplements through national immunisation days), 1.25 million VAD-related deaths had been prevented.

In 2008, the Copenhagen Consensus ranked the combined intervention of vitamin A and zinc supplementation as the world's best development investment. In 2010, the World Bank estimated that vitamin A supplements would have the highest cost-effectiveness of all mass nutrition interventions.

Increased awareness and availability of epidemiological information have enabled several countries to make sustained efforts to combat VAD through a combination of fortifying commonly consumed foods, providing supplements and, sometimes, dietary diversification.

Many countries have been successful in addressing VAD and are no longer considered to have a serious public health problem. In some countries, VAD has now virtually disappeared, for example in



Women in Nigeria grow and sell orange-fleshed sweet potatoes, which are high in vitamin A

Seniti David

Guatemala and Nicaragua. This has been the result of combined interventions, including fortification, supplementation and home gardening.

Conclusion

The success of public health programmes for controlling VAD depend on the commitment, ownership and responsibility of governments, civil society and industry combined with advocacy and assistance from international agencies.

The ultimate aim should be that all children have a nutritious diet that includes foods rich in vitamin A. This can only be achieved through long-term development in agriculture and all the systems and processing required to ensure foods of high quality are available to all sectors of the population.

References

- 1 Mayo-Wilson E, Imdad A, Herzer K, Yakoob MY, Bhutta ZA. Vitamin A supplements for preventing mortality, illness, and blindness in children aged under 5: systematic review and meta-analysis. *BMJ*. 2011 Aug 25;343:d5094. doi: 10.1136/bmj.d5094.
- 2 Haider BA, Bhutta ZA. Neonatal vitamin A supplementation for the prevention of mortality and morbidity in term neonates in developing countries. *Cochrane Database Syst Rev*. 2011 Oct 5;(10):CD006980. doi: 10.1002/14651858.CD006980.pub2.

Further reading

- 1 Sight and Life 2013. Home fortification with micronutrient powders (MNP). www.sightandlife.org/news/news-details/article/Home-Fortification-with-Micronutrient-Powders-MNP.html
- 2 WHO/UNICEF/IVACG Taskforce. Vitamin A supplements: a guide to their use in the treatment and prevention of vitamin A deficiency and xerophthalmia. Second edition. Geneva, Switzerland: WHO, 1997.
- 3 World Health Organization (WHO). Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A Deficiency. Geneva, Switzerland: WHO, 2009.

Case study: Burkina Faso

Burkina Faso initiated supplementation in 1986 after a survey showed that vitamin A deficiency was a major public health problem. Since then the country has used several different approaches.

- 1 Vitamin A supplementation has been integrated into national immunisation days, along with polio vaccination, in 1999; this improved coverage to over 90%. Since 2011, the country has held two 'Vitamin A+ Days' a year, during which supplements are given alongside other essential child survival interventions.
- 2 Increased consumption of vitamin A-rich foods is being promoted through school and community gardening programmes and nutrition education, with an emphasis on orange-fleshed sweet potatoes.
- 3 Dietary diversification is promoted through an enhanced homestead food production programme to improve year-round availability of a range of vitamin A-rich foods. Women

learn to grow vitamin A-rich vegetable crops and raise chickens (for eggs) and goats (for milk).

- 4 Vitamin A-fortified foods are being produced through public-private partnerships with government ministries and commercial producers. Cooking oil produced in Burkina Faso is now fortified with vitamin A; 71% of the oil consumed in the country is now fortified with vitamin A.

The decline in child mortality from 184/1,000 to 129/1,000 during the last decade is one indication that these interventions have been effectively implemented.

A national survey to assess current levels of VAD will be conducted in 2014 in order to better inform vitamin A programme strategy.

Written by Jean Celestine Somda, Laura Barrett, and Fanny Yago-Wienne (Helen Keller International, Burkina Faso), and Heather Katcher and Jessica Blankenship (Helen Keller International, Africa Regional Office).

Vitamin A supplementation: who, when and how

The majority of countries where vitamin A deficiency (VAD) is known to be a severe public health problem have policies supporting the distribution of vitamin A. This article provides guidelines for vitamin A supplementation in children and women and discusses when it is safe to phase out supplementation.

Vitamin A supplements for young children aged 6–59 months

The World Health Organization (WHO) recommends that all children aged 6–59 months should receive supplements if they live in a community where VAD is a public health problem. These are communities where the prevalence of night blindness is $\geq 1\%$ in children aged 24–59 months, or where the prevalence of VAD is $\geq 20\%$ in infants and children aged 6–59 months.

The suggested vitamin A supplementation scheme for prevention of deficiency in children aged 6–59 months in areas where VAD is a severe public health problem is shown in Table 1.

Vitamin A supplements for newborns and children aged 1–5 months

Vitamin A supplementation of newborns and children aged 1–5 months is not yet recommended by WHO. Exclusive breastfeeding of infants is encouraged for the first six months of life, to help achieve optimal growth, development and health.

Vitamin A supplements for pregnant women are not routinely recommended

Although women are highly susceptible to



High-dose vitamin A in oral liquid form is given to a child

VAD during pregnancy, vitamin A supplementation during pregnancy is not recommended, as high-dose vitamin A from supplements may cause harm to the developing baby. Instead, pregnant women are encouraged to meet their increased requirements by eating enough vitamin A-rich foods (see pages 65 and 72); this is unlikely to harm the developing foetus.

The **only** circumstance in which vitamin A supplementation during pregnancy may be considered is when women live in an area where VAD is a **severe public health problem** (i.e. $\geq 5\%$ of pregnant women in that area have night blindness). It is very

important to note that far lower doses are needed for pregnant women than for children, and doses need to be given on a more frequent basis (see Table 2).

Vitamin A supplements for women who have recently given birth are not routinely recommended

Giving high-dose vitamin A to women immediately after delivery is also not recommended by the WHO (2011 Guidelines).

When to phase out vitamin A supplements

WHO and the United Nations Children's Fund (UNICEF) recommend phasing out vitamin A supplementation when VAD is no longer a public health problem. This means there must be clear evidence that the prevalence of night blindness or reduced serum retinol levels are well below the minimum public health thresholds for an extended period of time and, at the same time, that mortality rates in under-5s are in long-term decline.

Further reading

World Health Organization guidelines on vitamin A supplementation (2011). Visit www.who.int/nutrition/publications/vitamins_minerals/en/index.html

Safety

Pregnant women

Vitamin A supplements are not routinely recommended for pregnant women unless there is a severe public health problem. The far lower doses recommended in Table 2 are safe. Higher doses are contra-indicated because of uncertain effects on the unborn child.

Children

Vitamin A supplementation reduces child morbidity and mortality and is recommended for infants and children 6–59 months when VAD is a public health problem. Vitamin A supplements given to children will not cause any significant side effects when the recommended age-specific vitamin A dose is administered. Trials of vitamin A supplementation of infants and children aged 6–59 months have found uncommon, transient, and mild adverse symptoms (irritability, headache, fever, diarrhoea, nausea and vomiting). The impact of high-dose vitamin A supplements on preventing blindness and mortality, however, far outweigh these rare and transient side effects.

Table 1. High-dose vitamin A supplementation to prevent deficiency in children aged 6–59 months

Target age group	Oral dose	Frequency	Route of administration
6–11 months	100,000 IU	Once	Oral liquid, oil-based preparation of retinyl palmitate or retinyl acetate
12–59 months	200,000 IU	Every 4–6 months	Oral liquid, oil-based preparation of retinyl palmitate or retinyl acetate

Table 2. Low-dose vitamin A supplementation to prevent deficiency in pregnant women (Note: ONLY in areas where vitamin A deficiency is a severe public health problem)

Target group	Oral dose	Frequency	Route of administration	Duration
Pregnant women	Up to 10,000 IU vitamin A	Daily dose	Oral liquid, oil-based preparation of retinyl palmitate or retinyl acetate	A minimum of 12 weeks during pregnancy, until delivery
	OR Up to 25,000 IU vitamin A	Weekly dose		



Vitamin A deficiency: what eye health workers can do



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Work with colleagues

Talk to the nurses and staff who work in maternal and child health clinics nearby. Ask what they know about vitamin A deficiency (VAD) and whether they are aware that it can lead to blindness. Encourage them to pass this information on to parents and to check that all children who are eligible receive their supplements at the correct time. Find out whether they are aware of – or involved in – any preventive vitamin A supplementation programmes.

Talk to colleagues in the paediatric ward of your hospital to make sure they have adequate supplies of high-dose vitamin A to treat children with severe diarrhoea, malnutrition and measles (as shown in Table 1, page 68), as these children are at high risk of VAD and blindness.

Change your own practices

Consider making it routine practice to make a note in the medical records when each child last had a dose of vitamin A, and whether he or she has been immunised against measles. Do this for **all** children aged under 5 years who present to the clinic, regardless of the reason they present. If needed, talk to the child's parent or carer about the importance of immunisation and vitamin A supplementation.

If health talks are part of routine practice in the eye clinic or during outreach, include a 'How to keep your child's eyes healthy' session for parents and carers. This could include the importance of measles immunisation and vitamin A supplementation to prevent corneal scarring, as well as regular and routine face washing to prevent trachoma.

If you find a child with suspected VAD, talk to someone involved in a preventive supplementation programme – they may need to act on this information as there are likely to be other children in the community who are vitamin A deficient.

Talk to families

First, find out about:

- which vitamin A-rich foods are sold in the local market at different times of the year
- local customs that might stop mothers giving their children vitamin A-rich foods

Figure 1. Examples of vitamin A-rich fruits and vegetables. Young children need 2–3 helpings of such foods per day.



- local customs concerning the diet given to children when they are sick
- words in the local language for night blindness.

Get as many of the following as possible to show to parents:

- vitamin A capsules
- vitamin A and/or multi-micronutrient powders (MNPs) (see page 69)
- locally available fortified foods
- photographs or real examples of foods rich in vitamin A (eggs, orange sweet potatoes, mangoes).

Discuss with families:

- the special needs of young children and pregnant and breastfeeding mothers for vitamin A-rich foods. Explain the risks of not eating enough vitamin A-rich foods
- which vitamin A-rich foods are available to them (this will depend on what can be grown or purchased in the area and the cost of these foods)
- which vitamin A-rich foods young children like and which are affordable
- any reasons why available vitamin A rich foods might not be eaten.

Ask the following questions:

- Have the parents ever noticed that their young child does not walk around or play after the sun has gone down, or when they are in a dark place? This may be 'night blindness' (use the local term if available) due to VAD (page 66). If the child has night blindness, ensure that he/she receives high-dose vitamin A supplementation (Table 1, page 68).
- Did the mother ever have night blindness during pregnancy or while she was breastfeeding? If so then she is likely to be deficient.

Encourage families to try available vitamin A-rich foods and to add a little oil to the food to aid absorption.

If vitamin A-rich foods are not available in the community, recommend that families grow foods such as dark green leafy vegetables or orange-fleshed sweet potatoes. If they do not own much land, point out that some vitamin A-rich foods, such as squashes, can be grown so they climb over the roofs of homes, using virtually no land.

Show families how to prepare foods in ways that children like. For example:

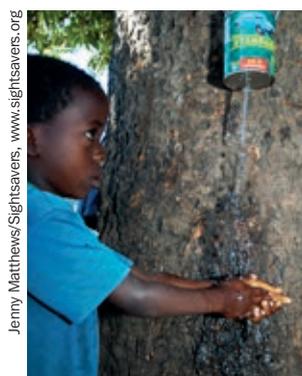
- chop and mash green leaves with oil-rich food (e.g. groundnuts) and staple starches
- mash carrots or orange-fleshed sweet potatoes.

Advice for different ages

Children younger than 6 months

Mothers should be encouraged to:

- start breastfeeding within 1 hour of giving birth. This ensures that their baby receives colostrum, which is an excellent source of vitamin A.
- Colostrum is full of nutrients, including vitamin A and other compounds, such as immunoglobulins, that help prevent infection
- exclusively breastfeed their baby until he/she is 6 months old and continue breastfeeding for at least 2 years, as breast milk is a very important source of vitamin A. Tell the mother: 'There are important nutrients in breast milk including vitamin A, which help to keep your baby healthy and prevent measles and diarrhoea.'
- eat plenty of vitamin A rich foods themselves to ensure that their breast milk provides their infant with enough vitamin A as well as meeting their own health needs.



Jenny Matthews/Sightsavers, www.sightsavers.org

Hand washing

adopted fortification have made it mandatory that staple foods are fortified.

In addition to staple foods fortified with vitamin A, home fortification using MNPs are an excellent way to increase the amount of vitamin A that young children eat. This approach is particularly useful if vitamin A-rich foods are not available in the community and complementary foods are poor in vitamin A (page 67).

Hygiene

Help families to practice good hygiene and sanitation.

Because infections, especially diarrhoea, play an important role in under-nutrition and VAD, health workers should ensure that families understand the importance of clean water and hygienic practices for good health.

Proper disposal of human and animal waste (including faeces) should be promoted as well as clean and safe preparation of foods. Mothers and carers should wash their hands with soap before preparing any food, and after defecating or cleaning a child after defecation. If water is scarce, show them how to make a very small hole in a tin



Show parents examples of locally available fortified foods. Pictured here are fortified sugar (left) and fortified cooking oil

© Global Alliance on Improved Nutrition (GAIN)

and how to wash their hands and the hands of their children using very little water.

Good hygiene practices will also reduce the transmission of intestinal worms, which contribute to undernutrition in general.

Other ways to reduce vitamin A deficiency

If families have many children who are born close together, the mother's ability to breastfeed each one for long enough is reduced. Encourage families to use family planning methods to space their children at least 2 years apart.¹

Sick children need even more nutritious foods than children who are well. Encourage mothers to feed children healthy foods – including those rich in vitamin A (see Figure 1 and the panel on page 65) – during periods of illness and/or diarrhoea.

Reference

- 1 World Health Organization (WHO). Report of a WHO technical consultation on birth spacing. WHO: Geneva, Switzerland; 2005.

Children aged 6 to 12 months

Mothers should be encouraged to continue to breastfeed and to feed their baby complementary foods that are rich in vitamin A. Even small children will eat these foods if they are given in small, frequent amounts, and are mashed up (perhaps mixed with expressed breast milk) to make them more appealing.

Children aged around 9 months

Mothers should be encouraged to have their child immunised against measles. Measles is a very important cause of severe vitamin A deficiency which can lead to damage to their child's eyes. If their child is too sick, or they are unable to visit the clinic at 9 months, then the child can be taken to the clinic for immunisation as soon as he or she is well enough.

Fortified foods

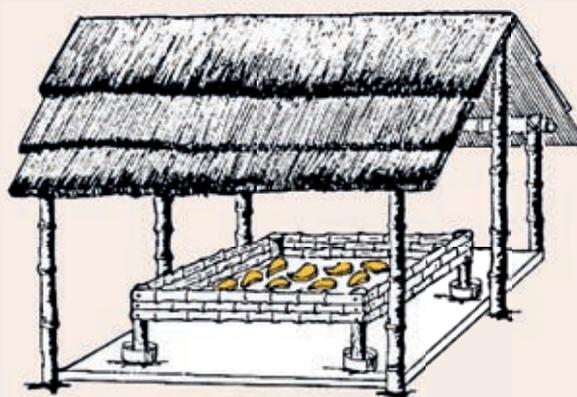
Encourage people to eat or cook with foods fortified with vitamin A if they are available, as this can help to prevent VAD.

Foods that are commonly fortified with vitamin A include vegetable oil, margarine, flour and sugar. Most countries that have

Shade drying

Shade drying requires full air circulation. It should not be undertaken inside conventional buildings but in a purpose-built open-sided shed for shade drying. Most foods to be dried (e.g. mangoes, sweet potatoes and carrots) are sliced, as sliced food generally dries faster. The slices should be only about 1 cm thick so that they dry thoroughly and quickly. Leafy vegetables, such as amaranth, are dried whole because they are thin. The food should be placed on mats or trays, well off the ground in order to avoid contamination from dust or soil (see Figure 1). Turn over the slices daily to ensure that the food dries quickly. To store well, the slices should be quite dry. Fruits, however, need only be dried until they are leathery, as their higher sugar content acts as a preservative.

Figure 1. Placing the drying rack on a pedestal standing in a container of water prevents crawling insects from reaching the food



Source: Food and Agriculture Organisation of the United Nations. Home Garden Technology Leaflet 18. Processing, Preservation and Storage. Visit <http://www.fao.org/docrep/003/x3996e/x3996e42.htm>



The new On-Line Foundation Formative Assessment

This new online assessment is mostly for first year trainees. It is available 24/7 and candidates can use books or search engines to answer the 84 questions (336 options) in up to 20 minutes each. A compulsory "confidence indicator" which rewards those justifiably confident of their knowledge.

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Subjects

A General Medicine related to Ophthalmology
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International Medical Ethics and Good Practice
Epidemiology and Statistics
Genetics

B Ophthalmic pathology and intraocular tumours
Intraocular inflammation and uveitis
Retina and vitreous

C Trauma, external disease and cornea
Glaucoma
Lens and cataract

D Anatomy of the Eye, the Orbit and related structures
Embryology and Development
Neuro-Anatomy
Principles of General Physiology
Vision, Ocular Physiology, Biochemistry, Cell Biology
Pathology and Micro-biology

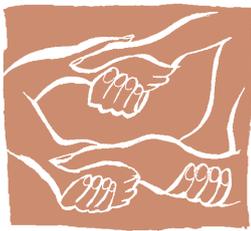
E Pharmacology
Optics and Refraction
Basic design, construction and use of instruments
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Keep on operating: how to deal with power cuts

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It is that time of year again: rains have come and gone, it is dry, and it seems the electricity generating industry is coming to another crisis. We are 90 minutes into our main operating list and doing well. Unexpectedly, the music from the radio cuts, and so do the lights from the microscopes. In the sudden silence we realise there is another power cut and the hospital generator is not working. Do we tell the people waiting to come back another day?

Finishing the present operation

Our first priority is to finish the present operation. A good halogen torch (or other bright, focused light), held by a nurse, may help; however, we have found the following two options even more useful.

1 Uninterruptible power supply (UPS).

A UPS (Figure 1), similar to that used for a desktop computer, allows our two microscopes another 30 minutes or so of power so we can conclude the present operation with illumination of better quality than a torch.

2 Inverter. The inverter is connected to the mains and charges a lead acid battery connected to it (Figure 2). As soon as the mains power cuts, power from the battery – direct current (DC) – flows through the inverter, and becomes 220v alternating current (AC). It can now power a microscope requiring AC current.

Continuing an operating list

In a setting where patients have travelled long distances, often at high cost, cancelling an operating list due to a power failure is something to avoid if at all possible. If the hospital generator is not reliable, we strongly recommend that you invest in one of the following.

1 A small generator. A small petrol generator, such as the one in Figure 4, should be adequate to run your microscope. If you are buying one specifically for this purpose, it is important to know the total amount of electricity needed by the microscope, vitrector and any other equipment using a small amount of electricity, then you can be sure the generator will produce enough.

2 A 12v battery. We have a microscope that has the option of running on 220v AC or 12v DC. A 12v battery (Figure 3) can last for several hours, providing

Figure 1. UPS, front and rear views showing power outlets



Brian Savage

Figure 3. 12v 7amp-hour battery for direct current



Brian Savage

enough power to finish the present operation and to perform additional operations. Alternatives include the battery from the car you arrived in, or a specially-purchased dry cell battery similar to that found in many UPS devices. We have completed many operating lists using this method, but **only** when we have two or more charged batteries available (suitable UPS batteries cost around US \$30).

We have had no significant problems using our basic Scan Optics microscope with either the generator or the 12v battery for a list lasting several hours.

Sterilisation

Problem solved? Well, not quite: the nurses have run out of sterile instruments, which they usually sterilise during the list in autoclaves requiring large quantities of electricity. Our batteries and alternators cannot provide this load. We have developed two different approaches to providing sterile instruments during a power cut.

1 Use pre-packed, pre-sterilised instruments, just as one uses pre-sterilised drapes. This requires advance planning and

Figure 5. Cylinder-mounted gas burner with domestic pressure cooker



Brian Savage

Figure 2. Inverter, attached to lead acid battery (chargeable by solar or mains electricity)



Brian Savage

Figure 4. Small petrol generator



Brian Savage

having several operating sets that can be pre-sterilised and double-wrapped in sterile drapes. Provided the packs remain dry, they can be kept for up to 1 week.

2 Use a domestic pressure cooker (costing around US \$70) on top of a gas burner that screws into the top of a gas cylinder (Figure 5). The burner gives quick and effective heat and using a pressure cooker is better and quicker than boiling instruments in a pan. The gas burner with cylinder is readily available locally for around US \$100.

These suggestions do not work for all situations. If you have a sophisticated microscope, then a standard UPS will not have the power to give a consistent,

steady illumination. Also, you may not have sufficient operating instruments to pre-pack and sterilise.

However, if you want your operating to go well through a period of power shortage, and are prepared to plan for this in advance, you might like to give these suggestions a try. It is possible to continue operating during a power cut and the equipment to enable this is usually available locally.

How to measure and record blood pressure



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This article will explain how to measure and record blood pressure using a **sphygmomanometer** (Figure 1). There are many other types of machines for recording blood pressure, such as electronic devices, but these may not be readily available. They can also be difficult to maintain and therefore may give inaccurate readings.

What is blood pressure?

Blood pressure is the force of blood against the walls of the arteries. Blood pressure is recorded as two numbers, the **systolic** pressure (the pressure when the heart beats) over the **diastolic** pressure (the pressure when the heart relaxes between beats).

We record this with the **systolic pressure first (on the top)** and the **diastolic pressure second (below)**. For example, if the systolic pressure is 120 mmHg (millimetres of mercury) and the diastolic pressure is 80 mmHg, we would describe the blood pressure as '120 over 80', written 120/80.

All patients must be assessed for fitness before they undergo surgery. As part of this assessment, it is important to measure and record the patient's blood pressure. There are two reasons for this:

- 1 It provides an initial recording (a 'baseline'). If the blood pressure falls suddenly below this baseline after surgery, we are alerted to the fact that the patient may be experiencing complications.
- 2 It allows us to confirm that the patient is fit enough to undergo surgery. A high blood pressure reading, or indeed a very low blood pressure reading, could suggest that the patient has other medical problems, e.g. an undiagnosed heart condition. He or she may need further medical tests and possibly medication to stabilise the blood pressure before undergoing surgery.

When measuring a patient's blood pressure, the nurse should be aware of factors that can affect the reading and possibly give a false reading, which could lead to unnecessary medical investigations. These factors include:

- blood pressure cuff is too small or is placed over clothing

Figure 2. The arm is supported on a level surface. The cuff is around the upper arm and the stethoscope is over the brachial artery, in the bend of the elbow



Elmien Wolvaardt, Ellison

- the patient has recently exercised
- the patient is cold or otherwise uncomfortable (e.g., they may need to use the toilet first)
- the patient has consumed alcohol or caffeine less than 30 minutes before the reading
- the patient is anxious or stressed
- the patient is talking during the procedure.

Blood pressure may vary according to whether the patient is lying down, sitting or standing. It is normally recorded with the patient sitting.

You will need

- sphygmomanometer
- blood pressure cuffs: small, medium, large
- stethoscope
- chair
- patient's care notes or observation chart
- alcohol wipe

Preparation

- Ask whether the patient needs the toilet.
- Ask the patient to sit down. The patient should have rested for 3–5 minutes before starting the procedure.
- Wash and dry your hands.
- Explain to the patient what you are going to do. This will help reduce their anxiety.
- Explain the sensation of the cuff tightening on their arm and reassure them that this is safe.

Figure 1. Sphygmomanometer (wall-mounted)



Elmien Wolvaardt, Ellison

Method

- Ask the patient to loosen any tight clothing or remove long-sleeved garments so that it is possible to access the upper arm. Do not use an arm that may have a medical problem.
- Place the cuff around the upper arm and secure.
- Connect the cuff tubing to the sphygmomanometer tubing and secure.
- Rest the patient's arm on a surface that is level with their arm.
- Place the stethoscope over the brachial artery (in the bend of the elbow) and listen to the pulse (Figure 2).
- Pump up the cuff slowly and listen for when the pulse disappears. This is an indication to stop inflating the cuff.
- Start to deflate the cuff very slowly whilst watching the mercury level in the sphygmomanometer.
- Note the sphygmomanometer reading (the number the mercury has reached) when the pulse reappears: record this as the systolic pressure.
- Deflate the cuff further until the pulse disappears: record this reading as the diastolic pressure.
- Record these two measurements, first the systolic and then the diastolic (e.g., 120/80), in the patient's notes or chart.
- Tell the patient the blood pressure reading.
- Disinfect the stethoscope drum and ear pieces with the alcohol wipe.
- Wash and dry your hands.
- Report an extremely low or high reading to the clinically qualified person in charge of the patient's care.

Verifying the calibration of a manual one-position keratometer



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A keratometer, also known as an ophthalmometer, is a diagnostic instrument for measuring the curvature of the anterior surface of the cornea, which is used to assess the amount and axis of astigmatism. A very popular and reliable type of manual, one-position keratometer (commonly known as a Bausch and Lomb-type keratometer) is shown in Figure 1. Although this type of keratometer rarely goes out of calibration, it should be checked for accuracy at least once a year.

Procedure

To verify the accuracy of the keratometer you need a set of standard spheres, which many manufacturers include with the keratometer. Such a set typically includes three highly polished steel balls of known curvatures (for instance, 40.50, 42.50, and 44.75 diopters) and a magnetised mounting device that attaches to the headrest of the keratometer (Figure 1).

Adjust the eyepiece

Do not omit this step. If you do not adjust the eyepiece, you may think that your keratometer is out of adjustment when it may not be.

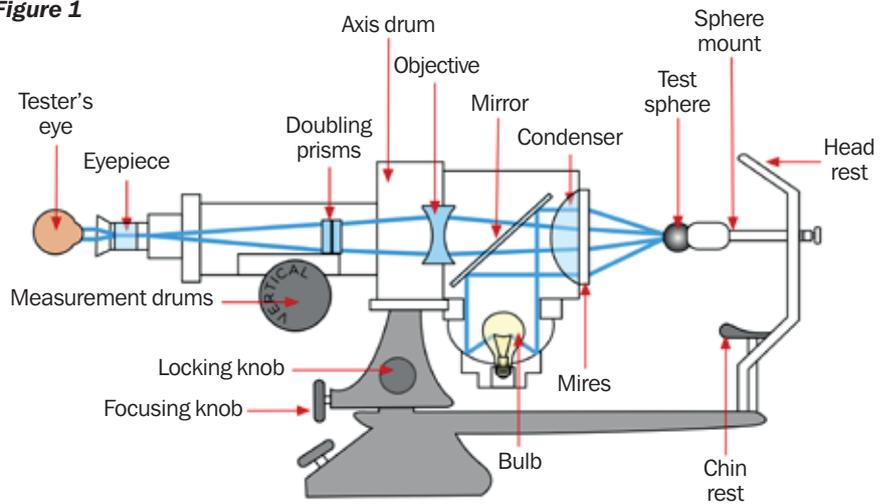
- 1 Place a sheet of white paper over the back of the keratometer. The white background will better highlight the crosshairs when viewed through the eyepiece.
- 2 Turn on the instrument.
- 3 Rotate the eyepiece fully counter-clockwise. You will notice that the crosshairs will become blurred, and thus inhibit accommodation.
- 4 While keeping both eyes open, turn the eyepiece in the clockwise (plus) direction until the crosshairs come into sharp focus, then stop. The keratometer has now been adjusted for your refractive error.

NOTE: Do not move the eyepiece back and forth in the plus and minus directions; only approach the point of focus from the plus direction.

Mount the test sphere

- 1 Secure the sphere mount to one side of the keratometer's headrest.
- 2 Place a test sphere (for example, the 42.50 diopter sphere) on the magnetic mount.

Figure 1



- 3 Rotate the mount towards the keratometer so that the test sphere is where a patient's eye would normally be positioned.

NOTE: If the sphere has a dull appearance it may not sufficiently reflect the mires, making measurements difficult. If it is dull, use a soft cotton cloth to polish its surface.

Focus the mires

- 1 When looking through the eyepiece, you will observe three circles, each with a plus (+) sign to its left and to its right, and a minus (-) sign on top and below. The bottom right-hand circle should have the crosshair in the centre and may appear doubled (Figure 2a).
- 2 Using the focusing knob, bring the bottom right circle into focus as a single image (Figure 2b).
- 3 Lock the instrument into place using the locking knob. This will ensure that the instrument does not rotate during the measurement process.

Measure the test sphere

NOTE: since the test spheres are completely spherical, there is no need to

rotate the axis drum on the top of the unit so that the plus (+) signs of the adjacent circles are on the same plane, as would be required when assessing a real eye.

- 1 Turn the horizontal measuring drum and bring the tips of the plus signs together until they are superimposed (Figure 2c) and note the reading on the horizontal measuring drum (Figure 3a).
- 2 Turn the vertical measuring drum and bring the minus signs of the circles above one another together until they are superimposed (Figure 2d) and note the reading on the vertical measuring drum (Figure 3b).

If both the readings on the horizontal and vertical measuring drums match the diopter value of the sphere (plus or minus an eighth of a diopter), then the keratometer is accurate. If you have other spheres, you can repeat the procedure to confirm the calibration.

If you find the keratometer to be out of calibration, the instrument should be calibrated by a professional ophthalmic equipment technician.

Figure 2

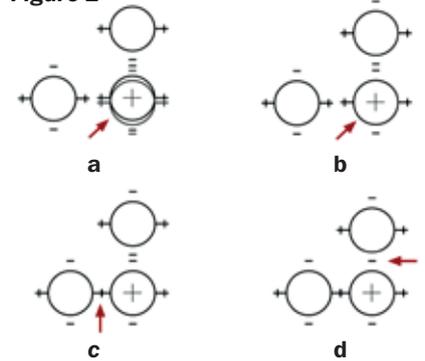
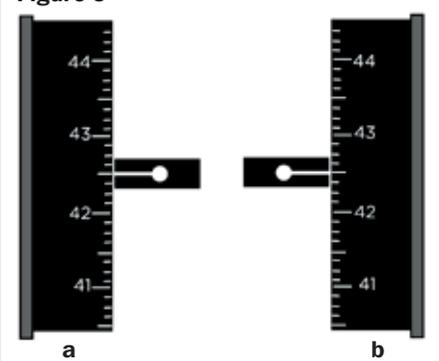


Figure 3



We have ‘a very good chance’ of eliminating blinding trachoma by 2020

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Former US President Jimmy Carter, speaking at the 15th anniversary of Pfizer’s donation of Zithromax® in New York on 5th November 2013, said: "With the help of Pfizer, we are trying to eliminate blinding trachoma from the face of the earth by 2020. I think we have a very good chance of reaching this goal."

During the past 15 years, Pfizer – through the International Trachoma Initiative (ITI) – has donated more than 340 million doses of Zithromax® to 28 countries in Africa and Asia.

After years of untreated trachoma infection, the eyelids turn inward and the eyelashes scrape the cornea with every blink, causing pain and gradual loss of vision from scarring of the cornea. An estimated 320 million people worldwide are at risk of contracting trachoma.

Mark Rosenberg, Director of the Task Force for Global Health, which includes the ITI programme, said: "Many of those at risk are children and their mothers living in the poorest villages in the world with inadequate clean water and sanitation, but trachoma can be prevented, treated and eliminated."

Pfizer and the International Coalition for Trachoma Control (ICTC), which includes the Carter Center and ITI, support the Global Alliance for the Elimination of Trachoma by the year 2020 (GET 2020), an initiative led by the World Health Organization (WHO). This interna-



William Vazquez for Pfizer

Former President Jimmy Carter (left) with Pfizer CEO Ian Read and Pfizer Senior Director of Social Investments Kimberly Lewis at an event to mark the 15th anniversary of Pfizer’s donation of Zithromax(R) to combat trichoma

tional alliance for elimination of blindness from trachoma implements the SAFE strategy, approved by the WHO, to prevent and treat trachoma. SAFE stands for: Surgery for the inturned eyelashes (trichiasis); Antibiotics to treat active infection; promotion of Facial cleanliness; and Environmental improvements, including better water supply and latrines to reduce the spread of disease by flies.

President Carter said Pfizer’s donation of Zithromax® was "momentous in trachoma control", and added that it allowed the Carter Center and other international nongovernmental organizations to "get the medicine into the villages and

demonstrate the world can end blinding trachoma". He continued: "Millions of people worldwide will be spared the injustice, indignity and pain of their eyelashes scratching and scarring their eyes."

Pfizer CEO Ian Read said Jimmy Carter’s support is key to the success of trachoma elimination, and Carter concluded: "Once people in a village know what needs to be done to get rid of trachoma, they are much more eager than any of us in this room to see it done."

For 2014, the Trachoma Expert Committee of ITI has approved 63 million doses of Zithromax® for treatment of trachoma in 23 countries.

Approaching elimination: Mali’s post-endemic surveillance strategy

In Mali, the prevalence of trachoma in 43 out of the originally 51 trachoma endemic districts is low enough so that mass drug administration (MDA) at the district level is no longer warranted. The National Blindness Prevention Programme in Mali began piloting an innovative post-endemic surveillance protocol in 2011 to assess whether high-prevalence pockets of active infection exist within districts that are eligible to stop district-level MDA. The assessment is integrated into surgical camps led by teams of surgeons that come from the capital and travel to areas where trachoma is endemic.

Post-endemic surveillance is conducted in districts where the prevalence of follicular trachoma (TF) is

≤ 10% in children aged 1–9 years.

The surveillance method involves selecting two or four villages in each area in which to do a more detailed investigation. If the population in the area is less than 200,000, two villages are chosen, and if it is between 200,000 and 400,000, four villages are chosen.

In each village, 50 children under the age of 10 are examined for TF.

- If < 5% of children examined have TF, only the children with TF, their families, and surrounding neighbours are treated with antibiotics (azithromax).
- If 5–9.9% of the children have TF, then the entire village is treated.

- If ≥10% of the children have TF, then the entire health district/area is treated.

To date, this post-endemic surveillance strategy has been implemented in 19 districts, and will be scaled up dramatically as Mali approaches the elimination date of 2015. It is seen as a cost-efficient strategy since it integrates surgical camps and active infection surveillance. Having strong and cost-efficient surveillance mechanisms in place to detect areas with a high prevalence of trachoma is critical to reaching full trachoma elimination.

With thanks to Sanoussi Bamani, Seydou Goita, Yaya Kamissoko, Sadi Moussa, Sidi Coulibaly, Aryn W Mosher, and Emily Toubali.



Test your knowledge and understanding

This page is designed to test your understanding of the concepts covered in this issue and to give you an opportunity to reflect on what you have learnt. The multiple true/false questions were produced in collaboration with the International Council of Ophthalmology (ICO) and the Diagnose This quiz is provided courtesy of the Ophthalmic News and Education (ONE®) Network of the American Academy of Ophthalmology.

1. Think about undernutrition and vitamin A deficiency		True	False
a	Both disease and infection contribute to undernutrition and stunting.	<input type="checkbox"/>	<input type="checkbox"/>
b	The children who actually show the eye signs of vitamin A deficiency should be our main concern.	<input type="checkbox"/>	<input type="checkbox"/>
c	Children with vitamin A deficiency may go blind, but are not at increased risk of death.	<input type="checkbox"/>	<input type="checkbox"/>
d	Even if a family has enough vitamin A-rich foods, children may still be deficient.	<input type="checkbox"/>	<input type="checkbox"/>
2. Think about the sources of vitamin A		True	False
a	Meat and liver are both good animal sources of vitamin A.	<input type="checkbox"/>	<input type="checkbox"/>
b	Sunlight can destroy vitamin A.	<input type="checkbox"/>	<input type="checkbox"/>
c	For children younger than 12 months, breast milk alone provides enough vitamin A.	<input type="checkbox"/>	<input type="checkbox"/>
d	Adding fat to the diet aids absorption of vitamin A.	<input type="checkbox"/>	<input type="checkbox"/>
3. Think about the eye signs of vitamin A deficiency		True	False
a	Children usually develop night blindness first and only later develop corneal ulcers.	<input type="checkbox"/>	<input type="checkbox"/>
b	Children with Bitot's spots are not necessarily vitamin A deficient.	<input type="checkbox"/>	<input type="checkbox"/>
c	The eye signs of vitamin A deficiency are usually bilateral (in both eyes).	<input type="checkbox"/>	<input type="checkbox"/>
d	Children with night blindness tend to become more active at night.	<input type="checkbox"/>	<input type="checkbox"/>

ANSWERS

1. a. True, b. False, c. True, d. True. Vitamin A deficiency usually affects whole communities, not just individuals. If some children have the eye signs, many more have vitamin A deficiency. c. False. There is a very strong link between vitamin A deficiency and death. d. True. Customs and local beliefs might prevent parents from giving children the right foods, particularly if they are ill. 2. a. False. Liver is a good source, but meat (the muscle) is not a good source. b. True, c. False. From 6 months, children need both breast milk and vitamin A-rich foods. d. True. 3. a. False. A child who is vitamin A deficient, but who does not have any of the eye signs, may develop corneal ulcers when infection or diarrhoea depletes the liver stores of vitamin A, causing acute deficiency. b. True, c. True. d. False. Mothers describe their children as becoming less active at night.

Time to reflect

1 How relevant to your day-to-day work was the material covered in this issue of the *Community Eye Health Journal*?
Extremely relevant, relevant, neither relevant nor irrelevant, irrelevant, extremely irrelevant (circle as appropriate)

2 How much of what you read in this issue was new to you?
 Please give a percentage:

3 As a result of reading this issue, will you be changing your practice/teaching/leadership/policies/management?
Yes/No (circle as appropriate)

4 If 'Yes', give examples of planned changes in the space provided, or in your own continued professional development (CPD) diary.

Diagnose This quiz

A patient presents with a dilated pupil, depicted in the figure; 45 minutes after instillation of 1% pilocarpine, it remains unchanged. What is the most likely diagnosis?



- Tonic (Adie) pupil
- Pharmacologic dilation
- Horner syndrome
- Third cranial nerve palsy

ANSWER

The figure depicts a dilated pupil that was unaffected by 1% pilocarpine. The 1% pilocarpine test distinguishes all causes of pathological pupillary dilation from pharmacologic dilation. Generally a pharmacologically dilated pupil will not constrict to 1% pilocarpine, whereas tonic pupils, third nerve palsy pupils, and Horner syndrome pupils will constrict. Horner syndrome also causes miosis in the affected eye. With dilute pilocarpine (e.g., 0.1%), a tonic pupil will demonstrate denervation supersensitivity and constriction.

Pharmacologic dilation.

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Visit www.cehjournal.org to complete the questions on this page online.

News



Eye banks develop a global alliance

The new Global Alliance of Eye Bank Associations aims to share knowledge and expertise, best practice guidelines, and information on scientific meetings and educational events. It also aims to establish a worldwide register of eye banks and develop global coding that will improve the traceability of donor materials. The Global Alliance of Eye Bank Associations is formed of the Eye Bank Association of America, the European Eye Bank Association, the Association of Eye Banks of Asia, the Eye Banks Association of Australia and New Zealand, the Pan American Association of Eye Banks and the Eye Banks Association of India.

If you work for an eye bank that is not currently a member of one of these associations, then the Global Alliance would like to hear from you. Please contact the Project Officer, Heather Machin.

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 Fax: +61 3 9929 8711
 Visit www.gaeba.org

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 Email: admin@cehjournal.org

Meetings

The 44th National Congress of the Ophthalmological Society of South Africa takes place in Drakensberg, South Africa, from 13–16 March 2014. Visit www.ossa2014.co.za

The World Ophthalmology Congress (WOC2014) takes place in Tokyo, Japan, from 2–6 April 2014. Visit www.woc2014.org for details.

The Africa Ophthalmology Forum (AOF) will be awarding a support grant of US \$500 each to 20 young sub-Saharan ophthalmologists attending WOC2014. Preference will be given to those who are making presentations and going to the WOC for the first time. Contact Henry Nkumbe, AOF General Secretary, by 15 December 2013: Nkumbe@gmx.net

Courses

Tell us about your course. Please write to: The Editor: Community Eye Health Journal, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK.
 Email: editor@cehjournal.org

London School of Hygiene and Tropical Medicine, London, UK MSc Public Health for Eye Care
 Starting September 2014. To apply, visit www.lshtm.ac.uk/study/masters/mscphec.html

Short courses in 2014

- Planning for VISION2020 (April)
 - NEW COURSE: Research Methods for Eye Health Professionals (June)
 - Tropical Ophthalmology (June)
- www.lshtm.ac.uk/study/cpd/short-courses.html

German Jordanian University, Amman, Jordan Professional Diploma in Vision Rehabilitation (4 months, US \$1,040) and MSc in Vision Rehabilitation (2 years, US \$4,800) open to optometrists, therapists, educators and rehabilitation workers. For more information, visit <http://tinyurl.com/rehabcourse>. Email: vtc@gju.edu.jo

Lions Medical Training Centre, Nairobi, Kenya Small Incision Cataract Surgery, for ophthalmologists wishing to upgrade from ECCE (6 weeks, US\$1,000 for tuition). Write to: The Training Coordinator, Lions Medical Training Centre, Lions SightFirst Eye Hospital, PO Box 66576-00800, Nairobi, Kenya. Tel: +254 20 418 32 39.

Kilimanjaro Centre for Community Ophthalmology International Epidemiology of Vision Loss in Africa, 20–23 January 2014, Cape Town, South Africa. Please contact Genes Mng'anga at genes@kcco.net and/or genestz@yahoo.com. Visit www.kcco.net

Online courses

Aurosiksha
 Free short online courses for eye care professionals to help them maintain skills and continue their professional development from Lions Aravind Institute of Community Ophthalmology (LAICO), India. Visit www.aurosiksha.org

ORBIS CyberSight
 Free courses on strabismus, cataract, paediatric ophthalmology, neuro-ophthalmology and the cornea are currently available. Registration is free. Visit www.cybersight.org

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Next issue

The next issue of the *Community Eye Health Journal* is called **Improving cataract services**

Heiko Philiprin