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Commentary

The great Vitamin A fiasco



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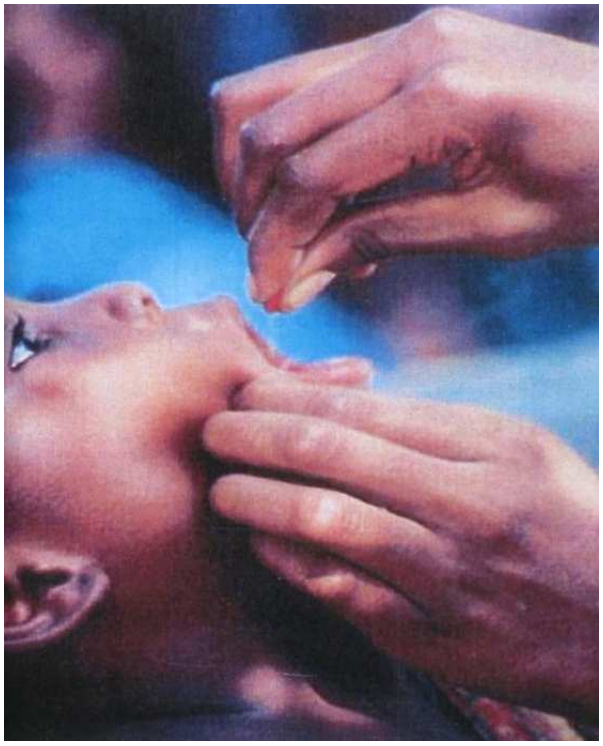
Introduction



This commentary challenges the wisdom and validity of the current practice of providing to children between 6 months and 5 years, regular supplements of massive medicinal doses of vitamin A. Every year, roughly half a billion capsules are made to be distributed and to be given to around 200 million children in over 100 'targeted' countries (1,2). One standard method of dosing of younger children is shown in the picture above, which appears on the cover of a United Nations Children's Fund (UNICEF) working paper issued in 2005 (1). In most cases, this medicinal dosing is now being done in countries and areas where the vitamin A deficiency diseases xerophthalmia and blinding keratomalacia are now rare, and any clinical signs of vitamin A deficiency are now uncommon.

'The international community', meaning influential public health policy-makers, recommends regular dosing with vitamin A capsules for a target of all children between the ages of 6 months and 5 years, in all countries where over 70 in 1,000 children die before the age of 5, 'as this is the internationally accepted proxy to indicate that vitamin A deficiency is a public health problem' (1). This figure is just above the 2008 global average of 65 deaths in 1,000 (3). Other countries are also included. A large proportion of the children who are receiving these massive doses

have no evidence of lack of vitamin A, let alone deficiency, and also are neither wasted nor stunted.

Since the early 1990s the 'agenda' for the global use of vitamin A supplements has been largely controlled by a relatively small coterie of academics, mostly based in the USA. This group has gained industry support, and remains allied with a number of senior people in United Nations agencies, and North American aid agencies (the donors who have largely footed the bill), and with big non-government organisations.

The vitamin A capsule programme, also known as VAC, was triggered by research findings published in the 1980s and 1990s apparently suggesting that correcting vitamin A deficiency would greatly reduce young child mortality in general. The pooled results of a number of intervention trials of variable size and quality suggested that capsules reduced mortality by something like 20-30 per cent, although some of these trials showed no significant effect. The research findings in turn triggered high-level international meetings. Vitamin A deficiency has become universally identified as one of the top global public health problems that can be solved. But this is not the primary purpose of the vitamin A capsule programme. Its rationale is that medicinal dosing with capsules reduces general child mortality.

Given that over 10 million children under the age of 5 die every year, a 20-30 per cent estimate translates into a potential of 2-3 million lives saveable a year – a staggering figure. A recent overview by the most influential academic expert in the field claims that the current global capsule programme is actually saving the lives of somewhat above 10 per cent of that figure, 350,000 children under the age of 5 every year, presumably by increasing resistance to infections (4).

The capsule programme has been massively scaled up in the 2000s. Between 1999 and 2004 the percentage of children in 103 targeted countries who received one dose of capsules a year increased from 50 to 68, and of two doses of capsules a year from 16 to 58, per cent (2,5).

This surge was partly in response to the United Nations Millennium Development Goal to reduce by two-thirds the rate of deaths of children under 5 between 1990 and 2015. UNICEF states: 'Vitamin A programming is a pre-requisite for achieving MDG#4' (1,2). Yet in 2009 a *Lancet* paper whose lead author was from UNICEF, stated that progress to the goal was 'grossly insufficient' other than in East Asia (China, notably), Latin America and the Caribbean, and also in high-income countries (3). Most of the countries making most progress have not implemented universal capsule distribution.

This commentary is concerned with the prevention of vitamin A deficiency, the prevention of childhood mortality and morbidity, and the protection of child health. In it, evidence is cited showing that the medicinal use of capsules does not work, in the ways that are claimed. To the contrary: the evidence, supported by many years of my own experience both in the field and in international policy-making committees, which is shared by many colleagues, is that the vitamin A programmes are ineffective. They use up precious human and material resources. Most of all, they impede other approaches to the prevention of vitamin A deficiency, best initiated at national and local level, which need much more support. These include breastfeeding, and the protection and development of healthy, affordable and appropriate food systems and supplies. Such approaches also protect against other diseases, are sustainable, enhance well-being, and have social, cultural, economic and environmental benefits.

So far the donors have remained willing to fund ever-increasing vitamin A capsule programmes, despite the growing period of time during which no evidence has emerged that these programmes are effective in the ways claimed. Indeed, the most recent and most powerful evidence, from a systematic review published in 2009 (6), and specifically from the biggest trial ever conducted whose results were disclosed in 2007 but are not yet published (7), is that capsules do not have a significant effect on mortality. There are signs that 'donor fatigue' is imminent. Once that happens, claims for the 'crucial necessity' for these programmes are likely to evaporate.

Vitamin A: Functions, sources, effects

Vitamin A is an essential micronutrient. It has many functions, one of which is to nourish eyesight. It is found in the form of retinol in a few animal foods. It is stored in the liver, and so the livers of animals, poultry and fish are very rich sources of retinol. Milk, other dairy products and eggs, are good sources.

Vitamin A is also in the form of carotenoids, which are pigments. Carotenoids (as 'retinol precursors'), are found in many colourful fruits in temperate and tropical countries, in a vast number of green leafy and other vegetables, and most orange and yellow vegetables and tubers. The carotenoid content of specific fruits, mangoes as an example, can vary by a factor of 10 or more (8). The outer leaves of leafy vegetables may contain 50 times the carotenoids of the inner leaves, because of the effect of sunlight (9). The richest sources of vitamin A (measured as retinol equivalents), are a number of tropical palm and other plant oils (10,11). Also most important for public health, breastmilk and in particular colostrum, contain substantial amounts of retinol.

The amount of vitamin A from food recommended in normal circumstances for children between 6-12 months is 600 international units a day; that for children between 4 and 5 years old is 900 international units a day. The massive-dose

medicinal twice-yearly supplements used to prevent deficiency are of 100,000 units for 6-12 month old babies, and 200,000 units for children between 1 and 5 years

The most conspicuous signs of prolonged vitamin A deficiency are inability to see well in darkness, and then the deficiency disease xerophthalmia, leading to keratomalacia. This shows as eye lesions initially visible only on close inspection which, if severe deficiency persists, will become irreversible, and cause impaired vision and eventually blindness. Children who go blind from keratomalacia often die (12).

1970s and 1980s: The story begins

In the 1970s, the academic and policy-making communities concerned with international public health nutrition became increasingly interested in vitamin A and its deficiency states, and in particular, serious vitamin A deficiency. This, leading to xerophthalmia, and then keratomalacia, and often blindness and death in young children, was rightly identified as a very serious public health problem in India and other South-East Asian countries, to a lesser extent elsewhere in Asia and in Africa, and to some extent within some Latin American countries. Many studies were launched to determine the extent of the problem. A seminal study, in which I participated, tested the efficacy of different control measures (13).

Initial consultations

The International Vitamin A Consultative Group (IVACG) was founded in 1975. This body was funded by the US government international aid agency USAID and operated within USAID policy parameters. UNICEF and WHO were also involved. (14). In due course the IVACG secretariat in Washington DC was supplied by the International Life Sciences Institute (ILSI). I was a founding member of IVACG. It met more or less annually, and in its early years in the 1970s and 1980s focused mainly on producing guidelines (15), and discussing and promoting research.

The UN Standing Committee on Nutrition (SCN – initially the ACC/SCN) is the body responsible for harmonisation of UN agency policies and programmes on food and nutrition policy. From its beginning in 1977, the SCN pushed for acceleration in policy, programme and advocacy areas, but the UN member agencies had too few staff and resources to have much influence on the control of vitamin A deficiencies. By the late 1980s, some non-government organisations began holding vitamin A and other working group meetings linked with the annual SCN meetings, summarising the year's field-level activities, enhancing agency coordination, and sharing

information about ongoing advocacy efforts. The UN agencies found these meetings useful, and working groups on vitamin A and a growing list of other issues became an integral part of SCN meetings.

First dramatic – and contested – findings

A very influential study conducted in Indonesia, published in the *Lancet* in 1986, concluded that children, even those without ocular signs of xerophthalmia, who received massive dose vitamin A supplements, had a 34 percent lower mortality from all causes than those not receiving the supplement (16).

With colleagues I responded (17), raising serious questions about this study. Randomisation was not done at the baseline. No placebos were used. The control children had more clinical signs of vitamin A deficiency and poorer growth. No causes of death were reported. The units of randomisation were villages, but the data were presented for children.

The Indonesian study was rapidly followed by a meeting hosted by the US National Research Council to set up guidelines for how follow up studies should be done (18). Eight randomised controlled trials were conducted. A meta-analysis published in 1993 showed that six found significant reductions in child mortality, and that two did not (19).

Most of these studies were conducted in Asian countries with high prevalence rates for xerophthalmia, much serious malnutrition, and also – highly significant – low measles immunisation rates. Two were conducted in Africa. One, co-ordinated from Harvard University and carried out in the Sudan (20) showed no difference in child deaths in those receiving vitamin A compared with controls. The second was the much quoted VAST (Vitamin A Supplement Trial) study in Ghana using a very large sample of village children. In 1993 the authors reported about 500 deaths in the control children compared to about 400 in the supplemented children – a statistically significant difference (21).

Again in the *Lancet* (22) I suggested that the statistical difference in deaths might disappear if measles mortality were excluded. The 'causes' of death in such studies are established by 'verbal autopsies' (a wonderful oxymoron) from family members, often many weeks after each child's death. It appeared entirely feasible, based on many years experience in the field in Africa, that many deaths recorded as due to respiratory infections, diarrhoea or fever (recorded as malaria) might in fact be measles deaths. Measles can cause all of these symptoms. Malaria can only be diagnosed by identifying plasmodia in blood. Measles is the only cause of childhood morbidity for which medicinal vitamin A supplements have been shown to reduce

the severity of illness and case fatality rates (23, 24). The most effective way to prevent measles is vaccination.

The question asked was: 'Could it be that the significant reduction in mortality rates in children receiving vitamin A supplements in these studies was due to a reduction in measles deaths?' This question has never been answered. Indeed, it has never been adequately addressed.

Early 1990s: 'Hidden hunger'

In the 1990s any doubts about the efficacy of medicinal vitamin A supplementation were swept aside. In 1990 the World Summit for Children, inspired by the then head of UNICEF James Grant, which was held at head of state level at the UN headquarters in New York, called for the elimination of vitamin A deficiency. David Alnwick, then of the UNICEF micronutrients programme, summarised the thinking behind such policy decisions as follows. 'Three micronutrients were "singled out" as deserving particular attention: vitamin A, iron and iodine. Although useful in prioritizing problems and drawing attention to the need for action, the identification of these particular micronutrients was somewhat arbitrary, based on an interpretation of data available at that time' (25).

The 'hidden hunger' concept

With the World Summit mandate, in 1991 USAID, WHO, FAO, UNICEF, the UN Development Programme (UNDP) and the World Bank, assembled for the Hidden Hunger Conference in Canada, convened by the Canadian International Development Agency (CIDA). At the conference, which I attended, it became clear that CIDA was likely to begin funding VAC programmes.

However, there was no agreement at this point that VAC would be the main approach. In 1992 the International Conference on Nutrition convened by FAO with WHO, which assembled in Rome after preparatory regional meetings, confirmed the Hidden Hunger conference position. A theme paper prepared by experts from the Indian National Institute of Nutrition stated: 'Currently, vitamin A deficiency is a serious public health problem in Africa, Southeast Asia and the Western Pacific' (26). The recommendation presented to the ICN's final meeting in Rome on the topic was: 'Ensure that sustainable food-based strategies are undertaken as first priority... Supplementation of intakes on a short-term basis with vitamin A... may be required to reinforce dietary approaches in severely deficient populations utilizing, where possible, primary health care services' (27).

At SCN meetings in this period, heated discussions were held on how vitamin A, iodine and iron programming should be coordinated and if possible even centralised. Vitamin A and iodine by then evidently had a strong research base, adequate programmatic experience, and growing public interest. It was clear that widespread donor interest and substantial funding were likely to emerge. In the field of international nutrition policy and programmes, that was – and is – a rarity. UN agencies vied to get their share, and would not agree that the SCN should take on the role of a central coordinator.

The UN system

The United Nations system was established after the Second World War as the most rational way where possible to preserve peace, increase understanding, and build a global family of nations. With all its faults, it is a system of international governance with some built-in accountability, I have worked as an advisor to a number of UN agencies for many years. Relevant agencies include the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), the UN Development Programme (UNDP), and, in the context specifically of aid to children in poor countries, the UN Children's Fund (UNICEF) and the World Food Programme (WFP). The heads of UNICEF and WFP are appointed by the US government. So is the head of the World Bank, which is also part of the UN system, as is the World Trade Organization.

An obvious problem with the UN system, as with separate national government departments, is that different UN agencies tend to have different and often competing or conflicting priorities. Uniquely, the UN system set up a co-ordinating body whose task has been to harmonise international nutrition policies. Founded in 1977, this UN System Standing Committee on Nutrition (SCN, originally known as the ACC-SCN) is still in existence, though at the time of writing it is in a state of disarray and out of funds.

Capsules 'a temporary measure'

Until well into the 1990s, textbooks, manuals, and vitamin A policy discussions, simply listed universal vitamin A capsule distribution as one of several programme options. It was not indicated as being superior unless speed of initiation was important. If sustainability was desired, it came last in lists.

Capsules 'short-term' and 'stop-gap'

For example, an SCN evaluation published in 1987 (28) laid out and compared the impact of the major alternatives. These were as follows. 1: Vitamin A capsules. 2: Fortification. 3: Horticultural and public health measures. All three resulted in improvements in serum retinol. But interventions 1 and 2 could do nothing more than improve vitamin A status. Intervention 3, however, could produce much wider benefits to health and nutrition, in addition to increasing intakes of carotenoids and improving vitamin A status.

Capsule distribution was acknowledged to be a short-term, stop-gap measure pending dietary improvements. The evaluation stated: 'It is important not to lose sight of the fact that this programme was conceived only as a temporary measure' (28). At the SCN meeting of which it was a product, several experts referred to supplementation as the 'short-term' solution. This view echoed that of a meeting of the IVACG held the previous year (29)

In this period, policy discussion divided vitamin A supplementation into two or three alternative approaches, one of which was the disease-targeted approach. When funds were scarce, in a country with a good primary health care system and an essential drugs programme, this could be a promising approach. This strategy might well have as much impact as a universal programme, at much lower cost, with much less need for its own personnel and infrastructure, and thus with a much greater chance of being sustainable.

Integration attempted in Africa...

Tanzania implemented the disease-based approach through its essential drugs programme in the early 1990s This was in addition to efforts to improve production and marketing of red palm oil, which is exceedingly rich in carotenoids, and to grow and sell tropical fruit seedlings from schools, which proved to be sustainable (30). The Tanzania Food and Nutrition Centre trained staff from every health facility in the country on how to implement this vitamin A supplement programme (for example, what dose to use for children with which diseases, and what record-keeping to use to prevent excessive dosing with multiple clinic visits).

Until the mid 1990s, governments usually attempted to integrate capsule delivery into primary health care delivery. Research in Tanzania around 1990 with iodised oil capsules showed that a more expensive, more vertical campaign style of delivery achieved dramatic reductions in capsule wastage, and increases in coverage rates (31). For iodised oil programmes this improves cost effectiveness.

These capsules were always seen as a stop-gap measure, to be phased out as universal salt iodisation was implemented. Concerned only about the potential for increased coverage, nearly all vitamin A capsule programmes also shifted to that approach, often combining capsule distribution with 'child health days' or other vaccination campaign efforts.

... and frustrated in Bangladesh

Beginning in the 1990s, supplementation programmes began to dominate all other means to improve vitamin A status. The coterie of people clustered in and around the International Vitamin A Consultative Group who were controlling the vitamin A 'agenda', often demeaned or brushed aside other approaches. Some UN and national aid agencies were complicit in this, and pharmaceutical giants stood to benefit financially.

Here is what this meant in Bangladesh. The Swedish International Development Cooperation Agency (Sida) had begun, through UNICEF, to support a universal capsule programme in Bangladesh in 1981. By 1989 it was clear that coverage rates were unlikely ever consistently to reach much above the 60 per cent level estimated to begin having a measurable impact on deficiency (32). Some 20 million 200,000 IU capsules 'disappeared' annually (33), and no research had been done to determine whether any of these were consumed by pregnant women. However, one evaluation found that, while 35 per cent of children in the target age group of 6 months to 6 years had received capsules, 26 per cent of infants under 6 months had received them (34). Coverage rates for infants under 6 months, who were not supposed to receive capsules at all, were nearly as high as for the target group in the rare measured cases.

Sida then explored alternative approaches, and tried to determine what relevant government agencies and other donors were doing to improve vitamin A status there. For the first of these, Sida chose to support a communication effort to increase both the supply and demand of foods rich in vitamin A. This was done by a local non-government organisation, Worldview International, on a district-by-district basis, starting with those known to have the highest levels of clinical signs of deficiency. Funded in some districts by Holland and Norway, a total of over 10 million people were reached (35).

However, both the Bangladeshi government, and the other donors, informed Sida that there were many other priorities in Bangladesh, and that at least vitamin A had the capsule programme on-going. In other words, as long as 'universal VAC' was covering about half the children, nothing more would be supported.

Capsule programmes a 'policy barrier'

In SCN working groups and other meetings, it was reported that universal capsule programmes thus appeared to be giving policy makers the feeling that nothing more was needed. This was thus acting as a 'policy barrier' to other effective and more sustainable food based approaches. Disease-targeted distribution would be less likely to lull policy makers into thinking that no complementary efforts were needed (36). At the 1993 IVACG meeting, a policy think-piece suggested a compromise solution (37). It was recommended that if donors agreed to fund short-term universal capsule distribution programmes, they should also ask for a complementary food-based programme. This might have needed to have been of equal cost, address long-term solutions, and be linked to a simple diet monitoring system (38). Monitoring was needed for checking to determine every few years which districts no longer needed universal capsule distribution. For a while this idea was acknowledged as an expression of a genuine policy concern (39).

The Beaton report

However, as from the early 1990s supplementation with massive medicinal doses of vitamin A became increasingly accepted as the main or even the only effective way to prevent deficiency, and also one of the most effective ways to save lives of children throughout higher child mortality countries.

The scientific basis for this change of policy is generally accepted to be a report published in 1993 (40). This reviewed the studies undertaken up to that time of the evident effects of supplementation on childhood mortality. It concluded: 'These studies together suggested that vitamin A supplementation resulted in an average reduction of 23 percent in mortality rates in children 6-60 months of age'.

The report, commissioned by CIDA, is usually known as the Beaton report, after its lead author. It was and still is interpreted in ways that had and still have the effect of vastly increasing the use of massive medicinal doses of vitamin A. This interpretation enhanced donor interest to provide increased funding for capsule use worldwide, not mainly to prevent xerophthalmia and keratomalacia, but as a 'magic bullet' claimed to have the potential greatly to reduce young child mortality rates throughout practically all higher-mortality countries.

The Beaton report continues to be used selectively. Thus, one of its key comments seems to have been studiously ignored. This says: 'We can offer no conclusion, based on the definitive mortality evidence, about the impact of vitamin A to be expected in

populations where there is evidence of depletion but not evidence that depletion is severe enough to produce clinical lesions in at least a small proportion of individuals' (40).

The report also specifically indicated that the impact it believed existed, was not due to the provision of a medicinal dose of vitamin A at one time, and that more gradual, sustainable approaches would be equally effective.

Capsules do not prevent major infections

What the Beaton report also said was that by contrast, and paradoxically, supplementation in the eight studies examined did not 'impact on incidence, duration or prevalence of diarrheal and respiratory infections'. The report did state that 'vitamin supplementation reduced the case fatality rates from measles' but was not able from the data to examine measles vaccination coverage.

The authors then stated their opinion that 'given the indisputable effect on mortality, there has to be an effect on severe morbidity'. Perhaps this way of thinking, so strongly expressed, has contributed to a lack of research on the link between morbidity and mortality.

The report also concluded that 'improvement of vitamin A status cannot be expected to impact on incidence, duration or prevalence of general diarrhoeal and respiratory illness as seen in the community'. It did state that 'vitamin A supplementation reduced the case fatality rates from measles' (40) but did not examine measles vaccination coverage, and whether this explained variance in the apparent impact of vitamin A supplementation on mortality.

Does the capsule programme really save many lives?

So if as claimed, the capsule programme does substantially reduce child mortality, it evidently does so without also reducing morbidity (with the exception of measles, most effectively prevented by vaccination). But how can this be possible? This is a conundrum that has not been resolved. Around half the annual deaths of children under 5 in the world are directly caused by infections – roughly 2 million from pneumonia, 2 million from diarrhoea, 1 million from malaria. Rates of death from these diseases are generally falling, but very slowly. Measles-related deaths have fallen rapidly in the last decade and are now around 200,000 a year.

When asked, capsule proponents cite findings which, they say, indicate that vitamin A supplementation may help the body deal better with severe infection, and suggest possible biological mechanisms. This is an issue of global importance. If policy

making designed to prevent and control vitamin A deficiency was really driven by science, this hypothesis surely would have been researched thoroughly, and consistently confirmed. To the contrary, concrete evidence for the hypothesis is quite thin.

No further placebo-controlled trials have been possible for ethical reasons. That no good studies, nor adequate evaluations, have been done on the effectiveness of national vitamin A capsule programmes, is deplorable.

Massive dosing may do some harm

Because the deaths of concern in children are not accidents, but nearly always preceded by morbidity, this spurred the conduct of studies designed to measure the impact of capsule programmes on morbidity, especially from diarrhoea and respiratory infections. I was involved in two such randomly controlled studies. Fairly consistently, these studies showed no reduction in the incidence of diarrhoea or respiratory infections in children receiving capsules.

Adverse effects on respiratory infections

To the contrary, some showed a statistically significant increase in respiratory infection incidence in the vitamin A compared with the control group. One of these, conducted in Indonesia, included 1407 preschool children. It was a randomised, placebo-controlled, double masked trial, published in 1996. The authors concluded: 'High dose vitamin A supplements increased the incidence of acute respiratory illnesses (ARI) by 8%, and acute lower respiratory illnesses (ALRI) by 39%'. They also concluded: 'These 'detrimental effects on acute lower respiratory illnesses were most marked in children with adequate nutritional status' (41).

A 2003 meta-analysis of the impact of capsule programmes on child morbidity from diarrhoea and respiratory infections (42) used 9 randomised control trials, including one in which I had been involved (43). It concluded that 'the combined results indicated that vitamin A supplementation has no consistent overall protective effect on the incidence of diarrhoea'. It also said that supplementation 'slightly increases the incidence of respiratory tract infections'. For this reason it concluded that: 'High dose vitamin A supplements are not recommended on a routine basis for all pre-school children, and should be offered only to individuals or populations with vitamin A deficiency' (43). These recommendations have been ignored.

Why do medicinal doses of supplements appear to worsen respiratory infections especially in healthy children? The authors, and others, provide a reasonable rationale. For example, the massive doses might cause immune dysregulation, due to massive non-physiological doses of the vitamin, especially in children with good vitamin A status. Some animal studies have shown that excess vitamin A depresses humoral and cellular immune responses. The findings that high doses of vitamin A, especially in well nourished children, have adverse impacts on respiratory infections, should surely be grounds for serious concern.

There has been no outcry, or even serious scientific collective discussion, focusing on this issue. The majority of children receiving medicinal doses of capsules are not malnourished. Can we be certain that capsule programmes are 'doing no harm' in many countries? The finding of adverse effects supports providing vitamin A supplements only to specially screened at-risk children, and perhaps with lower doses at more frequent intervals, not every 6 months. It also adds to arguments in favour of rapidly phasing out vitamin A capsule programmes in their current form.

Later 1990s and 2000s: Capsules 'the only game'

Just as there is big business and big science, there is big aid. International aid programmes are not driven simply by science. With any politically-influenced policy, evidence is part of the mix, but it may be interpreted recklessly. The main aid policy drivers are first of all, the national interests of the major bilateral donors, mainly governments of Northern countries. In the case of overseas development assistance, the biggest donor in absolute terms is, far and away, the USA, particularly thorough the US Agency for International Development (USAID). By federal law, USAID programmes, however beneficial to recipients, must further the interests of the USA, as interpreted by the US governments of the day.

The second driving force is industry, which in the case of food aid is the big agriculture and food companies, and in the case of VAC is Big Pharma – the giant pharmaceutical companies that manufacture synthetic nutrients. A third influence is culture. However sympathetic nationals of rich countries are with nationals of impoverished countries, without extensive field experience and residence in the community in such countries, they are unlikely to understand their needs.

Follow the money

Relevant UN agencies are also important, but the normative ones like WHO and FAO have little discretionary cash. Without gas in their tank in the form of money

and materials from donors and industry, there is not much they can do except set standards and hope governments and other powerful players will respond. Other players are academics and other experts. When – as in the case of vitamin A supplementation – their findings and views coincide with those of donors and industry, academics also can be decidedly influential.

Also, when a great deal of money is made available for specific international projects, those people in government, international agencies and academia who have been part of the policy thinking that has provided support for the projects, or who agree with this thinking, gain prestige, status, and funding. Further, donor money for 'development' generates jobs for people in non-governmental organisations, in government in the recipient countries, and in the field.

IVACG and the big agenda

By the 1990s the International Vitamin A Consultative Group had shifted its focus increasingly to include operations research, and discussion of policy and programme issues.

IVACG did much good work, especially in its earlier years. But it was undemocratic in its leadership, the same chair remained permanently in place, and in the last years of its existence some wags suggested calling it the International Vitamin A Capsule Group. This was because its leadership almost exclusively came to embrace the top-down, 'magic bullet' capsule approach. Food-based approaches and breastfeeding promotion became always marginal to its agenda.

The findings of studies showing the cost benefit and effectiveness of food-based approaches were either not accepted for presentation at IVACG meetings, or were given very little attention. Two examples were an evaluation showing that frequent consumption of green leaves by under-5s in an entire district could be doubled compared to a control district in the third year of a 3-year project, at a *per capita* cost of US $0.13 a year (44), and a randomised trial showing that common tropical fruits enhanced women's serum retinol as effectively as beta carotene supplements (45).

For several years at IVACG meetings the 'food based' agenda began to consist largely of providing high-profile attention to the work done by researchers at Wageningen University in the Netherlands (46). This research has been interpreted as meaning that any plant-based diets would be unlikely to protect people against vitamin A shortage and deficiency.

Later research showing that much higher absorption levels occurred if children were first de-wormed (47), was largely ignored. In international meetings it was announced

that universal vitamin A capsule supplementation should no longer be referred to as 'short term'.

In 2002, in a formal statement with the title of *The Annecy Accords*, IVACG declared that any diet-based approach was 'inadequate to normalise vitamin A status' (48).Those with longer experience and memories were reminded of the uncanny similarity between this claim, flying as it did in the face of all common sense and insight into human evolution, and previous claims that plant-based diets containing small amounts of animal food, the normal basis of most traditional cuisines throughout most of the world, were bound to be short of or deficient in protein.

The Micronutrient Forum

In 2006 IVACG was incorporated into the Micronutrient Forum, which focuses on several micronutrients. The IVACG chair, from Johns Hopkins University, remains the chair. Of the 13 members of the steering committee, 10 are from the USA, of whom four are from USAID and three from Johns Hopkins. Others are from Canada, Switzerland and Thailand. The Forum secretariat of six people are all from the USA, either from USAID or else the Academy for Educational Development, funded by USAID and more recently by the Gates Foundation. Given the statutes of USAID, it can be assumed that the Forum will not put any policies into practice in other countries that are seen not to be in the interests of the US State Department.

Two Micronutrient Forum meetings have been held, one in 2007 in Istanbul, and the second in 2009 in Beijing. The 'platinum' sponsors of the Beijing meeting included USAID and the International Life Sciences Institute. Its three 'gold' sponsors were the Gates Foundation, Coca-Cola, and Pepsi-Co. Within these meetings the sessions on vitamin A remain largely controlled by the same group who for so long controlled IVACG.

A pharaonic programme

As mentioned above, the criterion the lead UN agencies and their partners now use to decide which countries 'need' universal capsule supplementation, is not incidence of vitamin A depletion or deficiency. It is based on the 'proxy measure' of national average young child mortality rates somewhat above what is now the global average. This is irrespective of whether in these countries clinical signs of xerophthalmia are present nationally, regionally, or locally. The assumption behind this colossal programme is that supplementation with massive doses of vitamin A will greatly

reduce child mortality, including in populations with no clinical signs of deficiency. This assumption was not made by the authors of the Beaton report.

Once donors became excited and committed, the support for supplementation was ramped up, and the threshold for which mortality rate of under 5s 'required' universal vitamin A capsule programmes, was lowered by the UN agencies from 100 to 70 per 1,000, leading to continued programme expansion. The 2005 UNICEF working paper (1) says: 'Ensuring high and sustainable coverage with vitamin A supplements on a bi-annual basis in the 103 target countries covered by this report is critical not only for the elimination of deficiency, but also to accelerate progress towards reducing young child deaths and thus achieving MDG [Millennium Development Goal] 4'. Further, and therefore: 'In order to realize substantial gains in child survival, all children between the ages of six to 59 months in the target countries need to receive high dose vitamin A supplements every four to six months' (1).

Do capsules actually reduce mortality?

There is a lot riding on the vitamin A capsule programme. Does it deliver its main purpose, of sharply reducing child deaths? Should it be scaled up still further?

Currently, despite calls to do so, capsules are commonly not given to infants from birth to 6 months. While some research in Asia suggests benefit, a systematic review of randomised controlled trials published in 2009 in the *British Medical Journal* found no evidence of significant benefit at that age. Its conclusion was: 'There is thus no justification in initiating neonatal vitamin A supplementation as a public health intervention in developing countries for reducing infant mortality and morbidity' (6).

A more general recent finding is from the largest ever randomised controlled trial, on De-worming and Enhanced Vitamin A (DEVTA) (7).This included 1 million rural children above the age of 6 months in the state of Uttar Pradesh in north India. Half the children were given the usual massive medicinal doses of vitamin A, and half were not. There was no significant difference in the death rates between children who received the massive dose of vitamin A and those who did not. These results were disclosed at the 2007 Istanbul meeting of the Micronutrient Forum. Very remarkably, they still have not been published in a journal.

The presenter at Istanbul suggested that the results may be 'an extreme play of chance' (7). This is true for any statistically significant finding, by definition. At the meeting it was emphasised that taken together, results from all trials still showed a

protective effect, but at a much lower level. But the DEVTA trial is the biggest yet. Would a meta-analysis of the best designed trials, taken together, show any protective effect? Such an analysis has not yet been undertaken.

At the 2009 second Micronutrient Forum meeting in Beijing, the issue of actual effects of the vitamin A capsule programme on mortality was raised (49).Amy Rice of Johns Hopkins stated that it is too difficult to expect to measure the mortality impact of universal VAC programmes, and that there may not be much effect until a way is found to reach the 10-20 per cent who are unreached, where the problem is likely to cluster. Yet the average coverage rates in 2008 were 73 per cent for Africa and 65 per cent for South Asia. This is tantamount to saying that effects will never be known – a high proportion of the final fifth to tenth of children in low-income countries are inaccessible. Later in the meeting, delegates were even 'urged to focus on coverage' rather than investing in mortality or serum retinol assessments (49).

That there are no reliable data demonstrating the actual impact on mortality – or morbidity – of vitamin A programmes in the over 100 countries targeted for universal capsule distribution programmes (1,2) seems to me, and many others, to vitiate the programme.

Is the great game up?

Universal supplementation with medicinal doses of vitamin A has been one of the clearest examples of countries accepting an almost exclusively donor-imposed programme. The major exceptions are large countries with an independently developed vitamin A policy, with internal funding and highly competent personnel. Thus, Brazil implements relatively large-scale capsule distribution, but only in areas with proven clinical vitamin A deficiency. India provides vitamin A supplementation, but only to lowest-income populations participating in its huge Integrated Child Development Services programme. Even this has met with determined criticism from prominent local scientists (50-52).

Donor fatigue

However, despite the decades-long donor-driven effort on its behalf, many believe that the policy of universal capsule distribution cannot and will not be sustained. Coverage will rapidly decline, and hopefully be scaled down to areas of real clinical need, once the current major donors (CIDA, USAID, and UNICEF) tire of spending funds this way. Besides, knowledgeable people in national governments, the UN system and in aid organisations can read the evidence, which often includes that

derived from their own work. This commentary may also prove to be a step in the rational and ethical direction.

What do governments want?

Will national governments maintain capsule programmes when earmarked donor funds disappear? Running a national capsule programme requires a set of technical skills, some of which are difficult to obtain except by actually working on such programmes. Typical national capsule programmes are reckoned to cost around $US 3 million a year (53), which is not small change in an impoverished country.

There is also the question of whether, given a real choice, national governments see the sense of these programmes. Thus when a World Bank team examined vitamin A and iron public health issues in China for the World Bank in 2000, 40 low-income countries were receiving shipments of capsules through UNICEF. When explicitly asked if China would take over funding for this if the donor ended its support, officials in the Chinese ministry of health consulted among themselves and replied: 'Anyone who wants to come to China to do something beneficial for our children is welcome'. (Greiner T, personal communication). Asian elegance in delivering difficult messages is always impressive.

A 2009 report from the Micronutrient Initiative admits: 'Supplementation remains largely a push-driven rather than a demand-driven intervention' (5). A USAID-funded analysis published in 2007 (54) points out that funding for capsule distribution will be threatened when governments are 'allowed' themselves to make decisions about how donor funds are spent. Aid agencies are increasingly going in for 'general health basket' aid, in theory to be used as national governments wish. The analysis says: 'The trend may progress to donor funds applied to the overall government budget of countries, thus making health issues compete with other government ministries for support' (54).

This means that national governments will choose whether to spend non-earmarked money on vitamin A capsules, or alternatively on general primary health care, or other more general public health measures such as sanitation systems, sustainable rural livelihoods or primary education. Efforts are already being made to convince low-income governments to use 'general basket' donor funds to pay for capsule programmes (54).Will many governments, whose own expert advisors know that vitamin A deficiency is with exceptions now generally fairly rare, and who have understood the literature on the general inefficacy of the medicinal use of vitamin A, choose to spend scarce aid money on vitamin A capsules? Given the lack of evidence that in real life such programmes actually provide the promised reduction in young child mortality, this surely is unlikely.

Aid: For whom?

Donor-driven programmes, such as universal vitamin A capsule distribution, are rarely if ever 'gifts'. There is always a gradual siphoning-off of local funds to pay part of the costs for something a government often never really wanted in the first place. Worse yet, scarce human capital, in particular effective project managers, must be redirected from other high priority tasks, especially when big donors demand rapid returns on their investments. Worst of all, this kind of donor behaviour is so widespread and dominant in many of the poorest countries with the weakest technical and managerial capacity, that local technical staff and policy makers are unable to focus on, let alone develop, local high-priority approaches to address the underlying and basic causes of undernutrition.

Sometimes it suits governments to avoid thinking about the politics of undernutrition, including hunger, and instead to sign up to the notion that technical and quasi-medical interventions are all that is needed. With very many colleagues, I watch in dismay as the promotion of ready to use therapeutic food (RUTF) as an approach, not only to treat but also to prevent undernutrition, appears set to follow this same path as that of vitamin A.

Winners and losers

Most of those in the relatively small coterie of people in academia, UN agencies, government aid agencies and non-government organisations who continue to control the vitamin A agenda, have stood to gain in some way from their stance. Scientists and academics have enhanced their status and protected their turf in the research community. We all do this to some extent. Certain industries were in there, not unexpectedly, for profit. This backfired for a while in 1999 when two giant pharmaceutical companies had to pay out $US 725 million after a court ruling that throughout the 1990s they had colluded as a cartel to fix prices for synthetic vitamins, including vitamin A.

Aid is also political as well as commercial. Some high-up people in UN agencies, government aid agencies and non-government organisations have gained status, fame and power by their championing and control of top-down interventions which, they say, are preventing vitamin A deficiency and saving the lives of children on a vast scale.

Of course the administration of medicinal doses of capsules is effective in cases of clinically evident xerophthalmia, which remains a public health problem and even emergency in some locations in some lower-income countries. What is mistaken, and

reprehensible, are the claims made for vitamin A capsule programmes, and the indiscriminate scale of these programmes. Evidence for the numbers claimed was never conclusive, and is increasingly embarrassingly lacking as implementation has expanded.

Neglect of sustainable solutions

Worse yet is the neglect by the most powerful players in the great aid game of national, local and community-based programmes that give less-resourced governments and the affected communities themselves, a real chance of sustaining the prevention of vitamin A deficiency, sustaining food and nutrition security, and therefore gaining autonomy. To most big players, this is not an exciting approach.

The continuation of the promotion and use of massive dose vitamin A supplements is not a conspiracy. Conspirators usually hide both their agenda, and the identity of their co-conspirators. In 2010 it is indefensible that the huge vitamin A medicinal capsule programmes not only continue, but are being made even more colossal. Much of the nutrition world has simply failed to study and keep up with the evidence and the testimony of those with local knowledge or, if they have, seem to be unable or unwilling to challenge the status quo. It is as if some 'higher authority' must be right, even when evidence-based science shows that it is wrong. Now is the time for a concerted challenge to this authority.

How to shift a paradigm

There is a general context to the processes described in this commentary.

The concept of paradigm shifts, popularised in the recent best-selling book *The Tipping Point,* is set out more precisely by the philosopher of science Thomas Kuhn in his classic monograph *The Structure of Scientific Revolutions.* (55). A theory or system of ideas (a paradigm) that is evidently a powerful explanation of important matters, becomes adopted by the most powerful institutions – in the past, church and state, now in the case of public health, the scientific establishment, international donor organisations, and industry,. As all kinds of investments – intellectual, financial, ideological – are made in the theory, increasingly dogmatic claims are made, and anomalies are countered with increasingly implausible explanations. Evidence that contradicts the theory, and those advancing such evidence, are brushed off.

But eventually the stress of contradiction is so great, that an increasing number of influential people who are not fixated on the established paradigm speak out. Then, often as a result of some precipitating factor, confidence in the theory collapses, and its walls come tumbling down. The process is rather like that

causing successive economic booms and busts. In the case of vitamin A, the precipitating factor may well be withdrawal of 'free' supplies of capsules, as the evidence that capsule programmes don't work sinks in, and donor fatigue sets in. Without this support the vitamin A capsule supplementation programme will be seen to be what it is – a house of cards.

Conclusions

Evidence-based conclusions on vitamin A deficiency, the vitamin A capsule programme, and on the appropriate ways to prevent deficiency, protect children, and to sustain the health of less-resourced populations include the following:

Incidence: clinical deficiency is uncommon

Xerophthalmia, leading to blinding keratomalacia, remains a public health nutrition problem and even an emergency in some parts of some lower-income countries. However, most nutritionists, physicians and others with direct field experience have, over the last several years, almost universally expressed their certainty that serious xerophthalmia and resulting blindness is now very rare now compared with the estimates made in the 1970s. I personally have heard this strong statement from leaders in India, Bangladesh, the Philippines, Indonesia, Tanzania, Kenya, and other countries.

The paradigm is shifting

Since its beginning, I have been a player in and an observer of the process by which prevention of vitamin A deficiency has been transformed into a universal indiscriminate programme using medicinal doses of vitamin A capsules, claimed to be saving the lives of millions of young children. Over the years, with many colleagues in Asia, Africa and elsewhere, I have become increasingly dismayed by the march of events.

Previously, I was centrally engaged in the politics of protein and the alleged pandemic of protein deficiency. This led to a gross over-reaction from United Nations agencies and their partners. This in turn led in the mid 1970s to a 'paradigm shift': a sudden collapse of confidence in the global 'protein gap' hypothesis, discrediting food and nutrition policy-makers at the highest level. History is about to repeat itself, and for much the same reasons.

Time to end quick fixes

The capsule-driven academics and their colleagues outside the research community have buttressed their position by publicising research whose results seem to show that vitamin A deficiency cannot be prevented or controlled adequately by food-based and public health approaches. The implications of these research findings have been exaggerated to further support a policy already on shaky ground.

There is now no need for more research before conclusions are agreed and action taken. What is needed is dispassionate and independent review and evaluation of existing research findings. What is also needed is awareness of the historical and political events that account for the policies and programmes that remain fixated on the quick fix of non-physiological medicinal doses of vitamin A, and generally on quick fixes.

Such a review, facilitated at the appropriate levels within the relevant range of United Nations agencies and national government departments, supported by advice from open-minded scientists, will result in exposure of an ignominous error – the great vitamin A fiasco. As a result, the current indiscriminate and unjustified capsule programmes will be rapidly phased out.

Needed – support for sustainable actions

Fixation on these programmes has caused a policy barrier that has blocked, obscured or overlooked other approaches to prevention and control of vitamin A shortage or deficiency. These other approaches make evolutionary sense, and are biologically, socially, culturally, economically and environmentally appropriate. They are affordable and sustainable, and also provide further important health and other benefits.

They include early, exclusive, and continued breastfeeding, as now defined by WHO; protection against pathogenic infection and infestation; support of community and kitchen gardens; and the promotion of increased production and consumption of local plant and other foods, including those that grow wild, that are good sources of vitamin A.

Such approaches also promote family and community life, provide employment and strengthen local economies, prevent other diseases, and promote well-being. They are – or should be – part of integrated primary health care programmes. Significantly, they also enable impoverished countries to become less dependent.

They should become first priorities, at Secretary-General and head of state levels, of the range of relevant United Nations agencies and of national government departments responsible for justice, employment, agriculture, food security and rural development, as well as for health. They already have the support of many health professionals with field experience, and of international, national and local non-government, civil society and citizens' organisations and groups committed to the maintenance and protection of human rights and entitlements.

Nutrition science – a problem

All public health problems, including those of public health nutrition, have different types of cause. These may be immediate, underlying, or basic (56). To express the same concept a different way, public health problems have biological, behavioural, social, cultural, economic, political and environmental dimensions (57). This does not mean that they are impossibly complex. Sometimes an effective solution will be conceptually very simple, drink-driving laws being an example. But it does mean that consideration needs to be given to all main aspects of public health problems – and opportunities – before rational policies can be a basis for effective actions. It also means that the right approaches will vary according to circumstances. The right approach to legislation to encourage breastfeeding in Australia and in Arabia, as one obvious example, will be different.

Malnutrition has many causes

These points may seem all too obvious, but they point up a strange, troublesome development in international food and nutrition policies and programmes since the 1939-1945 war and the establishment of the United Nations system. This actually goes deeper, to the discovery of the separate biochemical functions of macronutrients and micronutrients, beginning in the 1840s and continuing until recent decades and indeed now. By definition, all nutrients and some of their constituents are essential (unless alcohol is counted). Humans need them, and without them suffer and, eventually, die. As a result, and partly because of the chronological coincidence with the discovery of the functions and effects of microbes, and then of antimicrobial drugs, there is a general tendency to approach deficiency diseases, and even general malnutrition, almost as if these are sort-of infectious diseases, that can be 'conquered' by medicalised or quasi-medical public health interventions.

Malnutrition, in the sense of population undernutrition or even hunger, obviously has many causes. Which one is most relevant depends on circumstances, resources, what is possible, and how urgent the issues are. With 'classic' exceptions such as goitre and shipboard scurvy, anybody suffering from a specific deficiency disease is unlikely to be deficient in just one or a few nutrients. Thus, any child or adult who is seriously short of vitamin A, or showing or suffering signs

of clinical deficiency, is with very unusual exceptions bound to be seriously short of other nutrients, very likely to be generally malnourished, quite probably infected or infested, likely to be chronically hungry, and almost certainly suffering from social, economic and other forms of deprivation.

These points are crucial. While a quasi-medical approach to micronutrient deficiency is of course essential in cases of acute deficiency and actual disease, such an intervention unless part of an integrated programme will not treat other deficiencies or address their underlying and basic causes.

Recommendations

Here are the most important recommendations, based on a solid body of evidence, and backed by the real-life experience of researchers and other health professionals in the field. This commentary does not discuss treatment of deficiency.

Prevention: plant oils are sustainable

The sustainable and safe approach to prevention in areas and locations where vitamin A deficiency is still a public health problem, is the use of red palm and other plant oils that are exceedingly rich in vitamin A (measured as retinol equivalents). The trees and other sources of such oils may be native to or established in countries and locations where xerophthalmia is present or has been endemic. National and state governments should support and scale up the production or importation of these oils, and make clear why they are doing so. They should also educate local clinicians, community leaders, and parents in their use, in clinical settings and also at home when preparing meals. The sustained benefits of these initiatives will be most evident when they involve government departments of agriculture, employment and rural development, as well as of health.

Measles: the right to vaccination

Universal measles immunisation is of great importance for children. Indeed, children have a right to be immunised (58). Measles immunisation has proved to be very effective in reducing child mortality, including that associated with vitamin A deficiency.

Freedom from infestation: a key factor

Children in tropical countries who are short of or deficient in vitamin A – and other nutrients – are very likely to be infected with micro-organisms that cause diarrhoeal and other diseases, depress nutritional status, and increase vulnerability to further infection. They also are very likely to be infested with worms and other parasites. These also depress nutritional status, and some cause anaemia.

The significance of helminthic infestation tends to be overlooked by investigators based in high-income temperate countries. De-worming of children who are most exposed to infestation, because of poor sanitation, unsafe water and other factors, may well be more effective than nutritional supplementation as a preventive measure. Better yet is sound sanitation, safe water, and adequate basic primary health care systems.

Breastfeeding is the best protection

The essential way to prevent shortage and deficiency of vitamin A – and also of a range of nutrients and protective factors – in infants and young children, is breastfeeding. Humans are evolved so that breastmilk is normally a more than adequate source of vitamin A, and colostrum, which is richer in vitamin A than breastmilk, is a natural vitamin A booster.

A major reason for vitamin A deficiency during and since the second half of the last century, has been a reduction of breastfeeding. Government-led policies and actions, including legislation, involving all actors, that result in a higher proportion of mothers breastfeeding exclusively for 6 months, and continuing to feed breastmilk to their children for 24 months or longer, will correspondingly reduce shortage or deficiency of vitamin A. This will also protect against other forms of malnutrition, and infections which in turn increase vulnerability to malnutrition.

Because colostrum and breastmilk comes from the mother, it is rational to ensure that women of childbearing age in locations where clinical deficiency among children is a problem, have adequate vitamin A stores. This is best done by ensuring food supplies high in carotenoids and, when readily available and affordable, animal foods high in retinol. Good practice in these locations is also to see that family carers include red palm and other oils rich in vitamin A in their food supplies and cooking, or if necessary by supplementation with such oils.

Plant-based food systems are best

Most policy documents on vitamin A deficiency emphasise the value of the small number of animal foods that are fair, good or rich sources of retinol. These include cow's and other animal milks, dairy produce, eggs, and liver from animals including poultry and fish. The main stated reason for this emphasis is that retinol from animal foods is much better absorbed than carotenoids from plant foods. But such foods are often scarce and expensive in low-income countries. Where they are locally available and affordable, their inclusion as part of culturally appropriate diets can be encouraged.

Within countries where vitamin A deficiency remains an issue, governments at all levels, from national to local, need to support and encourage food systems that include leafy vegetables, fruits and other plant foods that are good, rich or very rich sources of carotene. Some of these, such as mangoes, yellow sweet potatoes, carrots, some palm and other tree fruits, and red palm and other plant oils, are well known and commonly available. The abundance of plants rich in carotenoids varies from country to country. Many of these tend to be overlooked in expert reports, especially when they are tropical foods not known in temperate countries where reports tend to be written and food composition tables compiled. Indeed, some exceedingly rich sources of carotene such as palm and other fruits, tend to be overlooked even in the countries where they are native or established, one reason being that they often grow wild, and even when cultivated do not feature in international or national food composition tables.

Promotion and support for home, school, and community gardening is important, These approaches also have many other benefits. They are family- and self-reliant approaches. They are local, and often culturally appropriate and environmentally beneficial. They contribute to reducing chronic disease. They are sustainable.

Diets that include an abundance of vegetables and fruits, both cultivated and wild, contribute very significantly to good nutrition, including vitamin A status. Animal foods and other plant foods, especially when fresh, are also nourishing. Such diets also protect against various diseases and contribute to well-being, something capsules cannot do. The antioxidants in these foods reduce the negative impact of free radicals which contribute so importantly to chronic disease including cancer and heart disease. These chronic conditions are now the leading causes of mortality in Northern countries, and now in most Southern countries, and even in some sub-Saharan African countries.

The mainstream policy

These recommendations are not new. They follow the position developed after many consultations and meetings throughout the world, finally by all member states at the end of the December 1992 UN International Conference on Nutrition in its *Declaration and Plan of Action* (59). This followed the position as presented to the final ICN meeting, cited above (27). The purpose of the finally agreed document was – and remains – to inform and guide food and nutrition policies throughout the world. The statement on vitamin A (and also iodine and iron) as pledged by all member states is as follows:

'Implement the most appropriate combination of the following measures: improved food availability, food preservation, food and nutrition education and training, dietary diversification, food fortification, supplementation and pertinent public-health measures such as primary health care, promotion of breast-feeding and safe drinking-water... Ensure that sustainable food-based strategies are given first priority particularly for populations deficient in vitamin A and iron, favouring locally available foods and taking into account local food habits. Supplementation of intakes on a short-term basis with vitamin A, iodine and iron may be required to reinforce dietary approaches in severely deficient populations utilizing, where possible, primary health care services... Supplementation should be progressively phased out as soon as micronutrient-rich food-based strategies enable adequate consumption of micronutrients'.

Events of the last 20 years confirm the wisdom of this statement.

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Key terms

Vitamin A, vitamin A (sources), retinol, carotenoids, vitamin A deficiency (prevention), vitamin A supplements (medicinal use), Vitamin A capsule programme (VAC), International Vitamin A Consultative Group (IVACG), Micronutrient Forum and vitamin A, US Agency for International Development and vitamin A (USAID), United Nations System Standing Committee on Nutrition (SCN), food and nutrition aid policy, breastfeeding, breastmilk, colostrum, bioavailability of carotenoids, plant-based food systems, United Nations public health nutrition policies and actions, national government public health nutrition policies and actions.

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WN commentaries are subject to internal review by members of the editorial team. This commentary was reviewed by Barrie Margetts and Geoffrey Cannon, and also by Ted Greiner. Geoffrey Cannon edited the submitted version, and drafted the boxed text for revision and approval by the author.

MCL states: Dr. Ted Greiner, a close friend, colleague and former student of mine, contributed very importantly to this commentary. He and I have discussed the issues in this commentary for many years. Over a period of several weeks we exchanged views. He provided important insights, and also shared with me relevant research and policy -related experiences he had while working in Sweden, and also in the field in Tanzania, Zimbabwe, Bangladesh and elsewhere. I have incorporated, with references, many of these. I am very grateful to him for his time, interest and assistance. In the process of editing, Geoffrey Cannon made valuable suggestions for changes and additions, many of which I accepted.

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I am a founding member of the World Alliance for Breastfeeding Action (WABA). I have no conflicts of interest.

Request

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