2C: LESSONS FROM THE GLOBAL ELIMINATION OF IODINE DEFICIENCY AS A CAUSE OF BRAIN DAMAGE

Basil S Hetzel

The global picture

Iodine deficiency, with consequent hypothyroidism, is now recognised to be the most common preventable cause of brain damage in the world today. In 1999 The World Health Organisation (WHO) estimated that there were 2.2 billion people at risk, from 130 countries. Eight of the most populous countries (Bangladesh, Brazil, China, India, Indonesia, Nigeria, Pakistan and the Russian Federation), which make up 54% of the world's population, have a significant risk of iodine deficiency disorders (IDD).

The last decades of the 20th century witnessed a global program proceeding with remarkable momentum aimed at the elimination of iodine deficiency as a cause of brain damage by the year 2000, with use of iodized salt as the major technology. This measure, effective in industrialised countries, has only in the last decade been shown to be effective in many developing countries, where universal iodization of all salt for human and animal consumption (USI) has now been adopted with the support of appropriate legislation.

However, much more than salt technology is involved in these successful programs.

The International Council for Control of Iodine Deficiency Disorders (ICCIDD), an international NGO, formally recognised by the Director General of WHO and the Executive Director of UNICEF at the time of inauguration in Kathmandu in 1986, has played a significant role in the development of these national programs. The ICCIDD now comprises an international multidisciplinary network of 500 professionals from 92 countries, with a majority from developing countries.

From its foundation the ICCIDD accepted technical assistance to national programs as the first priority. This led to a close working relationship with the leading agencies, WHO and UNICEF, and governments of countries with significant public health problems with iodine deficiency (usually with Ministries of Health, but also involving the salt industry). In addition the specialised agencies Program Against Micronutrient Malnutrition (PAMM), Emory University, and Micronutrient Initiative (MI), Canada, have played an important supporting role.

The development and progress of this massive program will now be described with special reference to the role of the ICCIDD.

The scientific base

An adequate scientific base was provided by the demonstration in a controlled trial that iodine deficiency caused foetal brain damage and that prevention could be achieved by correction of the deficiency before pregnancy. This finding was further supported by studies in animal models. The recognition of these effects on the foetal brain led to the change in the concept of the problem of iodine deficiency from that of goitre to that of iodine deficiency disorders (IDD).

IDD refer to all the effects of iodine deficiency on growth and development in a human or animal population, which can be prevented by correction of the iodine deficiency. These effects include goitre, stillbirths, neonatal and other types of hypothyroidism, but the most important effect is that of foetal brain damage.

It was also pointed out in 1983 that available effective technology with iodized salt and iodized oil made possible the eradication (elimination) of IDD within a decade.

The development of a global program

The basis for a global program was presented in a Report to the United Nations (UN) System made at the request of the UN Subcommittee of Nutrition (SCN).

The Report included a review of the scientific evidence, a model for a national program and then a proposal to establish an NGO – the International Council for Control of Iodine Deficiency Disorders (ICCIDD). This proposal was approved by the SCN in 1985.

A Global Action Plan for the elimination of IDD was developed by the ICCIDD which proposed actions at global, regional and national levels to achieve elimination of IDD as a cause of brain damage by the year 2000. In 1990 this plan was endorsed by the SCN and the year 2000 goal was also endorsed by the World Health Assembly (WHA) and the Executive Board of UNICEF. The WHA Resolution also called for elimination of IDD by the year 2000.

The endorsement of the Global Action Plan was followed by the adoption of the goal of elimination of IDD by the World Summit for Children at a special meeting at the UN, New York (September 30, 1990). This meeting was attended by 71 Heads of State who signed a Declaration providing new goals for improved health and education for all children throughout the world. This Declaration was subsequently signed by representatives of 88 other national governments. Such a Resolution was unprecedented and has provided very important political support for national IDD programs throughout the world. This Resolution led in due course to the establishment of an informal global partnership, which has been all important to the progress achieved since 1990. (Table 1)

Table 1: GLOBAL PARTNERSHIP FOR ELIMINATION OF IDD

- **People of affected countries**
- **Governments of affected countries**
- **The salt industry of affected countries**
- **The International Agencies: WHO; UNICEF; World Bank**
- **The Bilateral Agencies: Australia; Canada; Netherlands;**
- **The International Council for Control of Iodine Deficiency Disorders**
- **Micronutrient Initiative; PAMM**
- **Kiwanis International**

The role of the ICCIDD in the development of country programs

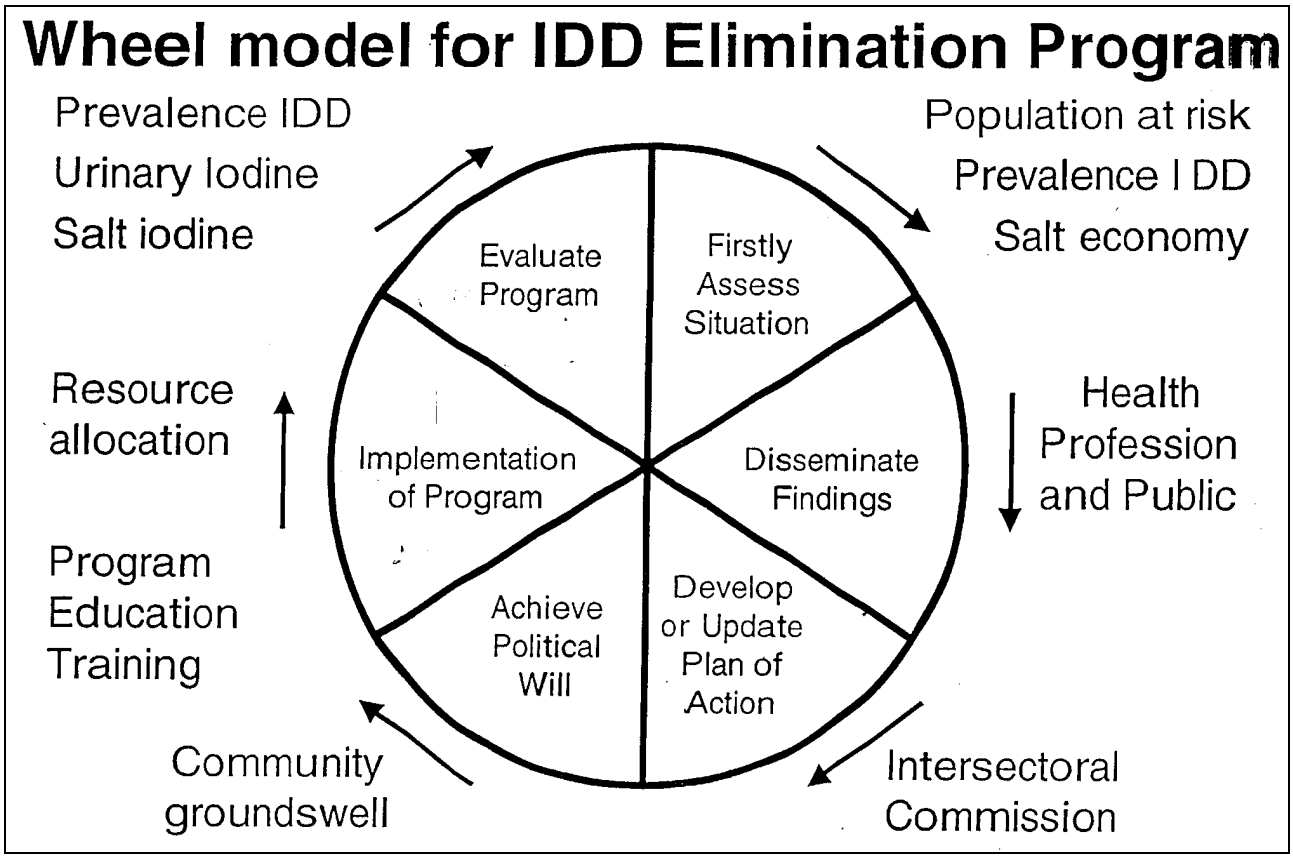
In addition to political support, a significant factor in the development of national programs has been a series of Regional Meetings held by the ICCIDD with the support of WHO and UNICEF. These meetings have been attended by representatives of the Ministries of Health and other important sectors such as the salt industry in each National Program.

These meetings took place in Yaoundé (Cameroon) 1987; in Delhi (India) 1989; in Dar es Salaam (Tanzania) 1990; in Tashkent (former USSR) 1991; in Brussels (Belgium) 1992; Alexandria (Egypt) 1993, Quito (Ecuador) 1994; Dhaka (Bangladesh) 1995; Harare (Zimbabwe) 1996; Munich (Germany) 1997 and Beijing (China) 1998.

It is through these Regional Meetings that a limited number of experts within the ICCIDD network and other agencies have been able to communicate with many countries at country level. This has subsequently developed further with consultancies and further contacts designed to identify obstacles to progress and remove them. The appointment of ICCIDD Regional Coordinators (WHO Regions) has been most important in further facilitating contact with countries.

Progress has been spectacular in Africa. At the first African Regional Meeting (Yaounde, Cameroon) in 1987, only 22 countries were represented, in 1996, 45 countries were represented including Zaire, Angola, Mozambique and Eritrea in spite of the recent or present occurrence of civil war. At these Regional Meetings a model for a National Program has been developed to show its multisectoral nature and the relation between the different elements. (Fig. 1)

Figure 1



The expertise required includes epidemiological methods, laboratory techniques (salt iodine and urine iodine measurement), the establishment and maintenance of laboratories, advice regarding planning and communication, management, iodized salt and other iodine technologies. The ICCIDD multidisciplinary network has been able to provide advice on all these aspects.

The preferred iodine technology on the grounds of effectiveness and cost is universal salt iodization (USI). This means that all salt for human and animal consumption should be iodized, which requires legislation. Such a measure was recommended by WHO/UNICEF in 1993 and has been adopted by the great majority of countries with an IDD public health problem including the highly populous countries China, India, Indonesia, and Nigeria.

China has made remarkable progress as reported to an International Workshop in Beijing (5,6 October 1998) held by the ICCIDD, with the Ministry of Health and the Ministry of Light Industry. A comprehensive Report was presented which indicated a mean fall in goitre rate in all 31 Provinces from 20.4% in 1995 to 10.9% in 1997 and 8.8% in 1999 (Table 2). (Total Goitre Rate (TGR) [children aged 8-10 years]). There was an increase in quality rates of iodized salt (more than 20 mg iodine/kilo) at household level from 39.9% (1995) to 81.1% (1997) and 88.9% (1999).

Table 2: THE PEOPLE'S REPUBLIC OF CHINA

China has made great progress towards the elimination of IDD and is the only country in the world where the National Monitoring Survey has taken place every two years applying the WHO/UNICEF/ICCIDD criteria. The following table demonstrates the main results of monitoring indicators:

National Monitoring Results in 1995, 1997 and 1999

Indicators	1995	1997	1999
(1) The proportion of households consuming iodized salt			
20 mg/kg (%)	**39.9**	**81.1**	**88.9**
20-60 mg/kg (%)	**29.7**	**69.0**	**80.6**
median iodine level mg/kg (%)	**16.2**	**37.0**	**42.3**
(2) Urinary iodine level in children aged 8-10			
median(ug/L)	**164.8**	**330.2**	**306.0**
< 50ug/L(%)	**13.3**	**3.5**	**3.3**
Number provinces with median <100ug/L	**3**	**1**	**1**
(3) Total goitre rate (TGR) (%)			
Palpation	**20.4**	**10.9**	**8.8**
ultrasonography	**-**	**9.6**	**8.0**
Grade II	**2.1**	**0.5**	**0.3**
(4) The production of iodized salt (10,000 Tons)	**539**	**620**	**753**

Notable features were the high level of political support, the success of health education of children about IDD and the successful international cooperation. Continuing problems included lack of awareness in remote provinces such as Tibet and Xinjiang, the availability of non-iodized salt in some provinces and the illegal availability of capsules of iodine through schools and health services.

Recently a special program has been launched for Tibet with support of A$2 million from Australia (AusAID) and WHO. Significant progress has also been reported by Indonesia with a mean fall in total goitre rate in 27 provinces from 27.7% (1990) to 9.8% (1996,1998).

A Report on overall progress throughout the world indicated that by 1999 105 (81%) of the 130 countries affected by IDD have national programs in place with an intersectoral national body. Of these 98 (75%) have legislation in place and 95 (73%) are monitoring salt quality. In a report from UNICEF (2000) over 90% of people in 28 developing countries use adequately iodized salt. In an additional 36 countries more than half the population is protected from IDD by using iodized salt. But there are still 36 countries with less than half the population using iodized salt. This is a further challenge to the global partnership.

The challenge of sustainability

The challenge now being faced by countries in relation to the success of USI is the issue of sustainability. It is well known that past success has been followed by failure due to a variety of factors. In Guatemala and Colombia in South America the failure was due to political changes and social upheaval, in the former USSR countries to lack of concern about sustainability following initial success. More recently in Brazil the Federal Government has relinquished responsibility for salt iodization to the salt industry as part of a policy of downsizing, which threatens sustainability.

A Resolution was passed by the 1996 World Health Assembly pointing out the need for monitoring and evaluation in order to ensure sustainability of programs and the availability of the ICCIDD to assist.

The criteria for elimination of IDD as a cause of brain damage have already been determined by a Joint WHO/UNICEF/ICCIDD Working Group (1994) (2,1). Particular emphasis is laid on salt iodine and urine iodine levels. Salt iodine should be in the range of 20-40 mg per kilo and urine iodine in the range of 100-200 µg/litre. The need for monitoring is urgent in order to ensure that this range is maintained. The higher level should not be greater than 200 µg/litre in order to minimise iodine induced hyperthyroidism (IIH) and the lower level (100 µg/litre) is essential to ensure the prevention of fetal brain damage during pregnancy and prevention of damage to the infant brain particularly during the first two years of life when the brain is developing so rapidly.

The term “Partnership Evaluation” has been adopted by the ICCIDD in order to describe the process of independent monitoring and review of other aspects of the National Program by the ICCIDD. A number of these evaluations have been carried out at the request of governments in collaboration with UNICEF and WHO and national government representatives.

Conclusion

The remarkable progress in the elimination of IDD has depended on a number of factors – political support, the availability of salt technology and advances in laboratory methods.

In addition it has become clear that an NGO with committed relevant multidisciplinary expertise can be an important factor in the initiation, maintenance, evaluation and sustainability of national programs.

There are substantial obstacles to effective collaboration between the major international agencies. A number of staff from the Agencies have commented on the fact that the ICCIDD is able to facilitate cooperation which would not otherwise be achieved.

Ensuring continuity of core funding for the ICCIDD is a constant challenge. Yet there has been general agreement that the ICCIDD has made a significant difference to the development of national programs throughout the world.

Our experience indicates that the international NGO model can indeed be effective in assisting a global program, in making it initially effective and in making it sustainable. We hope this experience will assist the establishment of other NGOs in order to assist implementation of other global programs in nutrition or other areas of public health.

Discussion notes

- Goitre occurred throughout Australia up to the Second World War. It was found in hilly and mountainous areas including the Great Dividing Range and the Adelaide Hills. Full details are available from the WHO publication “Endemic Goitre” (1960). Other hilly areas included Canberra, where iodised bread was first used in Australia. Clinical cretinism (inborn hypothyroidism) has never been reported, in keeping with a less severe iodine deficiency in Australia. The problem was most severe in Tasmania, where iodised bread was used in the 1960s, following the satisfactory Canberra experience and the limitations of iodine tablet administration in Tasmanian schools.
- In the 1960s the occurrence of iodine in milk was demonstrated due to the use of iodophores (disinfectants) in the dairy industry. The increase in iodine intake associated with iodophores led to a mild epidemic of iodine-induced hyperthyroidism (Stanbury and Hetzel, 1980).
- Australia now relies on iodised salt rather than iodised bread to prevent IDD. Since most people consume salt, it makes it a very convenient vehicle for mass iodine supplementation. This can pose two potential problems. First, one of the theories about the causes of hypertension is that it is related to the consumption of sodium chloride (common salt) above the naturally occurring levels, so that encouraging added salt consumption may inadvertently promote high blood pressure. Second, some patients are advised by their doctors to restrict salt consumption, which may lead to iodine deficiency. There is now evidence of mild iodine deficiency in pregnant women in Sydney and in Tasmania, as well as mild iodine deficiency in Tasmanian children.
- Sustainable prevention of IDD in Australia is still not completely satisfactory. At present, only one sixth of the salt consumed is iodised and it is purely voluntary, as in many other western countries, although Canada has had mandatory salt iodisation for many years. A good case can be argued for mandatory iodisation of salt in Australia in order to prevent foetal brain damage from iodine deficiency in pregnancy. It is also essential to provide adequate iodine intake for mothers and children, at least until the age of adolescence, since recent evidence indicates that even mild iodine deficiency

has some effect on foetal brain function and in children. When salt intake is contra-indicated, iodine might be supplied as supplements to vitamin capsules.

- The question has been raised as to whether in areas of endemic goitre something could be done to replenish iodine in the soil, although this would pose considerable logistic problems.

Further reading

1. Hetzel BS (1989)
   The Story of Iodine Deficiency: An International Challenge in Nutrition. OUP Oxford and New Delhi.

2. Hetzel BS (1996)
   Iodine Deficiency: A Global Problem
   Med J. Aust 165: 28-29 (1 July 1996)

3. WHO/UNICEF/ICCIDD (1999)
   Progress towards the Elimination of
   Iodine Deficiency Disorders (IDD)
   WHO/NHD/99.4