technical manual no. 3

A PRACTICAL GUIDE TO THE CORRECTION OF IODINE DEFICIENCY

International Council for Control of Iodine Deficiency Disorders

World Health Organisation
A PRACTICAL GUIDE TO THE CORRECTION OF IODINE DEFICIENCY

by

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Additional copies of this Guide can be obtained by writing to the nearest office of the World Health Organisation (WHO), the United Nations Children's Fund (UNICEF) or the International Council for Control of Iodine Deficiency Disorders (ICCIDD). Some addresses of these organisations are given in Chapter 6: Resources. Publication of this Guide was supported by the Netherlands Ministry for Development Cooperation, UNICEF and the Department of Medicine, University of Virginia, Charlottesville, USA.
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About one billion people live in iodine-deficient regions of the world, most of them in developing countries. Iodine deficiency damages human health in several ways, most importantly by interfering with normal development of the brain. Some of the consequences of iodine deficiency are not reversible once they occur, but all can be completely prevented by easily available techniques of iodine supplementation. Thus, health planners and international agencies are increasingly recognizing that the elimination of iodine deficiency is an attainable goal with important benefits for many people.

The target of this Guide is the non-expert with an interest in preventing the consequences of iodine deficiency. The chapters summarize the major consequences of iodine deficiency, the means for its correction, and the key elements in control programs. The final section lists sources for further information and help. We have tried to keep this volume short, focussed, nontechnical and practical. This Guide will serve as an introduction to technical manuals, currently in preparation, on iodized salt, iodized oil, iodine-deficiency disorders assessment, laboratory techniques, and social mobilization.

The organization and presentation of this Guide have benefited enormously from the patient advice and criticism of many colleagues in the International Council for the Control of Iodine Deficiency Disorders (ICCIDD), particularly P. Bourdoux, G. Clugston, F. Delange, E. Dulberg, P. Greaves, B. Hetzel, F. Kavishe, V. Mannar, C. Pandav and J. Stanbury. Many others have contributed in a broader way by sharing their extensive experience in iodine control programs over several decades and by shaping the approaches to iodine deficiency that we have described in this guide. We thank M.D. Havron, Hirke Jeeninga, M. Rivadeneira, Romsai Suwanik, J.B. Stanbury, P. Subramanian, and the Thailand Ministry of Health for some of the illustrations. The remaining illustrations are from our files. Additionally, we thank Dr. J. P. Greaves of UNICEF, and Drs. A. Pradilla and G. A. Clugston of the World Health Organization, on behalf of their respective organizations, for endorsing this guide. Staffmembers at the International Agricultural Center, Wageningen, The Netherlands, have been especially helpful in criticizing the draft and arranging details of publication and distribution. Finally, we gratefully acknowledge the financial support and services provided by the Netherlands Ministry for Development Cooperation, UNICEF, and the Department of Medicine, University of Virginia.

October, 1989

Charlottesville, VA, USA
Wageningen, The Netherlands

John T. Dunn
Frits van der Haar
CHAPTER 1. IODINE DEFICIENCY AND ITS IMPORTANCE

A. The need for iodine

Iodine is a chemical element. Calcium, oxygen, nitrogen, and sodium are other examples of elements, but iodine is much rarer. Humans need iodine to make thyroid hormones. These hormones are produced by the thyroid gland, a butterfly-shaped structure in the front part of the neck consisting of two "lobes" on either side of the windpipe connected by a narrow bridge called the isthmus. After manufacture in the thyroid gland, thyroid hormones travel in the blood and control many chemical processes in different parts of the body. These hormones are essential for normal development and function of the brain and nervous system, and for maintenance of body heat and energy (see Scheme A).

Scheme A

Relationships among pituitary, thyroid and other tissues. The thyroid secretes thyroid hormones in the blood, which affect chemical reactions in muscles, liver, heart, and kidneys, and are also necessary for maturation of the developing brain. Thyroid hormones also act on the pituitary gland, which releases its hormone, called thyroid stimulating hormone (TSH), which in turn stimulates the thyroid. When blood levels of thyroid hormones fall, the pituitary produces more TSH to make the thyroid work harder.
B. The consequences of iodine deficiency

When people do not have enough iodine, they cannot make enough thyroid hormone. This deficiency of iodine has several important health consequences that together are called "iodine deficiency disorders," or IDD. These consequences are as follows:

1. Goiter (see Figures 1-2, page 21)

The term "goiter" means a thyroid gland that is bigger than normal. People with iodine deficiency have goiters because they do not make enough thyroid hormone. The pituitary, a small control gland in the brain, detects the low thyroid hormone levels in the blood, and makes more of its controlling hormone, called "thyroid stimulating hormone" (TSH), which makes the thyroid work harder to produce more thyroid hormone. This increased TSH stimulation is a normal adaptation but it produces a goiter, particularly if stimulation becomes chronic because of continued iodine deficiency. The goiter is a sign that the body is trying to compensate for a lack of iodine. Other causes of goiter exist, but increased TSH stimulation is responsible for the goiters in areas of iodine deficiency.

The position of the thyroid in the neck is shown in the drawing below.
Sometimes goiters compress the windpipe and produce choking. They can also interfere with swallowing. In other cases the goiter may not give its owner symptoms, but it is still an indication of iodine deficiency and may be accompanied by more serious manifestations.

2. Hypothyroidism

This word means that the body does not receive enough thyroid hormone. Hypothyroidism is detected by low levels of thyroid hormones in the blood. Hypothyroidism produces sluggishness, sleepiness, dry skin, cold intolerance, and constipation. In very young children, it produces not only these features but also mental and growth retardation, because the thyroid hormones are essential for normal development of the brain and nervous system. Sometimes the mental retardation is very severe, at other times it is mild and may not be recognized unless specifically looked for. Hypothyroidism in newborns is particularly serious, because the mental retardation it produces cannot be corrected - it is permanent. This condition is called neonatal hypothyroidism.

3. Cretinism (see Figures 3-5, pages 21-22)

This term refers to the very severe consequences of hypothyroidism occurring during fetal or neonatal life. Cretins have severe irreversible mental retardation. In addition they may have several other signs, including deaf mutism, short stature, and retarded development of the musculoskeletal system. Some cretins also have goiter and obvious hypothyroidism, but others do not.

Frequently iodine deficiency produces intellectual or developmental retardation that is not severe enough to be classified as cretinism. The term "subcretin" is used by some writers to describe these conditions. A better, but longer, term might be "iodine deficiency developmental retardation." We regard subcretinism as the result of hypothyroidism, described above.

4. Reproductive failure

Women in severely iodine deficient areas have more miscarriages, stillbirths, and other problems of pregnancy and reproduction than do iodine-sufficient women. It is difficult to estimate how often these complications occur, but they are probably much more frequent than generally realized. Continued miscarriages and fetal wastage decrease the fertility of a population and endanger the health of women.

5. Childhood mortality

Iodine deficiency kills children. Their defenses against infections and other nutritional problems are lower than those of children in iodine-sufficient areas. For example, when iodine was given to pregnant women in Zaire, their newborn children had a higher birth weight and a doubled survival rate when compared with children of
mothers who had not received iodine. In Papua New Guinea, children of mothers who received iodine during pregnancy had a 20% better chance of surviving to the age of 15 than did those whose mothers did not receive iodine.

6. Socioeconomic retardation

Iodine deficiency affects the socioeconomic development of a community in two ways. First, the people are mentally slower and less vigorous. They are harder to educate and harder to motivate, and thus they are less productive in their work. Also, iodine deficiency produces more handicapped individuals who depend on others for their care, thus diverting community resources. Secondly, in most of these areas agriculture is the most important economic activity, and domestic animals suffer from iodine deficiency in much the same way that people do. Thus, domestic animals will be smaller and produce less meat, eggs, and wool. They also have more abortions and are frequently sterile.

A dramatic example of the effects of iodine deficiency and its correction is presented by the information in the Scheme below. The data were obtained in Jixian, a small rural village in Heilongjiang Province, China, studied before (1978) and eight years after (1986) the introduction of effective iodine supplementation.

---

Scheme B

**EFFECTS OF IODINE DEFICIENCY CONTROL IN JIXIAN VILLAGE, CHINA**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Goiter prevalence</td>
<td>80%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Cretinism prevalence</td>
<td>11%</td>
<td>None new</td>
</tr>
<tr>
<td>School ranking (of 14 schools in district)</td>
<td>14th</td>
<td>3rd</td>
</tr>
<tr>
<td>School failure rate</td>
<td>&gt; 50%</td>
<td>2%</td>
</tr>
<tr>
<td>Value of farm production (Yuan)</td>
<td>19,000</td>
<td>180,000</td>
</tr>
<tr>
<td>Per capita income (Yuan)</td>
<td>43</td>
<td>550</td>
</tr>
</tbody>
</table>

---

C. Geographical distribution of iodine deficiency

Iodine occurs in fairly constant amounts in ocean water but is distributed very unevenly in the earth's crust. Inland regions far from the ocean have the greatest risk of iodine deficiency. Some of the most severe iodine deficiency occurs in relatively young mountainous areas, such as in the Alps, Andes, and Himalayas, where iodine in
the soil has been washed away by rain and glaciers. However, iodine deficiency is not confined to high mountains, and also occurs in large parts of Central Africa, Central Asia, and Europe. It has also been associated with areas exposed to frequent flooding and in large river deltas such as those of the Ganges, Yellow River, and Rhine. The accompanying map shows areas of the world where iodine deficiency occurs. This map is only a summary of current knowledge. Undoubtedly, many other areas in the world, particularly in Africa, have iodine deficiency that has not been adequately recognized. A current estimate is that one billion people are at risk for iodine deficiency, with 710 million in Asia, 60 million in Latin America, 227 million in Africa, and 20-30 million in Europe. Of these, at least 200 to 300 million have goiter or another demonstrable consequence of iodine deficiency, and at least six million are cretins.

*Worldmap to show areas of recent or continuing iodine deficiency. Many other areas, particularly in Africa and the Middle East, probably have iodine deficiency but have not yet been surveyed adequately.*
D. Summary

Over 12% of the world's population lives in iodine deficient areas. Iodine deficiency frequently causes permanent brain damage and mental retardation in children, reproductive failure, decreased child survival, goiter, and socioeconomic stagnation. Iodine deficiency is important because of its widespread prevalence and its destructive effects on human and animal health. Proper supplementation with iodine completely prevents these consequences.
CHAPTER 2. DETECTION OF IODINE DEFICIENCY

A. Background

The first question to ask is whether iodine deficiency exists in a particular region or population, and if so, how severe it is. Usually some previous information will be available. For example, travellers or local health workers may have noted that many people from a certain area have visible goiter. Often the likelihood of iodine deficiency in a given region can be predicted from knowledge of its geographical location. For example, iodine deficiency should be suspected in an area surrounded by other iodine deficient regions, or in inland areas, especially those with high mountains.

Goiter is usually the most obvious sign of iodine deficiency, but brain damage, mental retardation, miscarriages, and child mortality are more serious consequences. It is, therefore, important to document the goiter prevalence in a population to determine whether these more serious consequences are likely to be present. In almost all areas, goiter occurring in a large fraction (more than 10%) of the population will result from iodine deficiency rather than some other cause.

The two most valuable means for assessing the severity of iodine deficiency in a given area are:

- the prevalence of goiter, and
- the urinary excretion of iodine.

Details for measuring goiter prevalence and urinary iodine levels are described in the technical manuals, "Survey and Assessment Technique" and "Laboratory Testing for Iodine Deficiency," currently being prepared. The general principles will be discussed here briefly.

B. Goiter surveys (see Figure 6, page 22)

For examination of children or adults, the examiner stands or sits facing the subject, places his two thumbs on either side of the subject’s windpipe several centimeters below the notch of the thyroid cartilage (the "Adam’s apple") and rolls his thumbs gently over the thyroid, which lies next to the windpipe. This technique is called "palpation."

The very first decision should be whether or not the subject has a goiter. If each lobe of the thyroid is smaller than the part of the subject’s thumb beyond the last joint (the "terminal phalanx"), the thyroid is classified as Grade 0, no goiter. If each
lobe is larger than the terminal phalanx of the subject's thumb, he or she has goiter.

Next, the goiter size needs to be defined (see Scheme C). To do this, the subject's head is tilted back and the examiner tries to see the goiter. If it cannot be seen but was palpable, the goiter is classified as Grade 1A. If the goiter can be seen as well as palpated, the subject's head is returned to a normal position, looking straight ahead. If the goiter can be seen only with the head tilted back, it is called Grade 1B. If it can be seen with the subject looking straight ahead, it is called Grade 2. If it is quite large and can easily be seen from a distance of about 10 meters, it is called Grade 3. Grades 2 and 3 are collectively called visible goiter. These two plus Grades 1A and 1B are total goiter.

Scheme C

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No goiter</td>
</tr>
<tr>
<td>1A</td>
<td>Thyroid lobes larger than ends of thumbs</td>
</tr>
<tr>
<td>1B</td>
<td>Thyroid enlarged, visible with head tilted back</td>
</tr>
<tr>
<td>2</td>
<td>Thyroid enlarged, visible with neck in normal position</td>
</tr>
<tr>
<td>3</td>
<td>Thyroid greatly enlarged, visible from about 10 meters</td>
</tr>
</tbody>
</table>

This classification system has been endorsed by the World Health Organization and ICCIDD. Its uniform use among different observers allows comparison of the severity of goiter among different regions and at different times. It can be easily applied in the field and requires no specialized equipment. The examiners need not be medical professionals, but they should be trained and initially supervised by other examiners with experience to obtain uniformity of results. Small goiters may pose a problem of correct classification, particularly when the observer is inexperienced and must decide between Grades 0 and 1A, or between 1A and 1B.

C. Urinary iodine

Almost all iodine in the body is eventually excreted in the urine. Thus measurement of iodine in the urine provides a good index of the iodine taken in. Since the absolute minimum daily iodine requirement is about 50 μg, a urinary iodine level of less than 50 μg per day means iodine deficiency. In fact, some degree of iodine deficiency may exist even when the urinary iodine excretion is as high as 100 μg per day. When the mean daily urinary iodine excretion in an area is less than 25 μg, cretinism will frequently be found in the population.
In the field it is almost impossible to collect all the urine passed by a subject during a 24 hour period. Instead, examiners must rely on casual urine samples, which are more easy to obtain. Two general approaches have been used to relate the iodine content of a casual urine sample to the 24 hour value. One approach relates urinary iodine to urinary creatinine, a chemical substance which the body excretes daily in fairly constant amounts. Thus, one can measure both the iodine and creatinine in a casual urine sample, and express the result as a ratio, \( \frac{\mu g \text{ iodine}}{\text{gram creatinine}} \). The other approach is to simply measure the concentration of iodine in the urine, as \( \mu g \text{ iodine per 100 ml urine} \). While subjects will vary in the concentration of their urine, depending on how much liquid they have been drinking, this variation will tend to even out among samples from many subjects. For this reason we recommend that samples be obtained from at least 40 subjects to determine the mean concentration of urinary iodine in a given region. Most experts prefer the expression of urinary iodine in this latter method (as a concentration), because it is simpler and has usually proven more reliable than relating it to creatinine.

The details of the laboratory procedure for measuring iodine in urine are given in the technical manual "Laboratory Testing for Iodine Deficiency" being prepared for this series. Briefly, the change in color of a chemical called ceric ammonium sulfate by another chemical, arsenious acid, is accelerated by iodine, which acts as a catalyst. The rate of this color change depends upon the amount of iodine present; it can be measured in an instrument called a colorimeter, and the amount of iodine in the urine can be calculated by comparison with standard solutions of known iodine content. The analysis must be carried out in a laboratory. A manual method requires a heating bath (oil or sand), or a furnace for ashing, a colorimeter to measure color change, and special chemical reagents, such as ceric ammonium sulfate, arsenious acid, and sulfuric acid. The equipment is frequently available in routine chemistry laboratories. One experienced technician can perform about 20-50 analyses per day, including standards for comparison. The approximate cost for equipping such a lab is about US $3,500, with annual costs of about $800 for glassware, etc., $1,000 for chemicals, and $150 for records, maintenance, etc. based on figures gathered in India in 1989. These estimates do not include labor costs.

The same chemical reaction can be carried out with automated equipment. The estimated cost is from $20,000-40,000 for the instrument, depending on whether it is fully or partially automated. Currently the source is Technicon, Ltd., Church Lane, Swords, County Dublin, Ireland; tel. #353-1-407-571. In an experienced laboratory in Brussels (Dr. P. Bourdoux) about 40-50 samples can be processed per day at a cost of US $3.00 for reagents and maintenance per sample, and $5.00 when labor costs are included. Analytical grade reagents guaranteed free of iodine or iodine-containing compounds should be obtained from a reputable chemical house.

Under proper circumstances measurement of the urinary iodine is a reliable and effective test. However, setting up the assay for urinary iodines de novo is not simple, and some time is required to adapt the procedures and have the method working smoothly. For initial surveys, we recommend collecting the samples and
sending them to an appropriate reference laboratory. At least 10 or 15 such reference laboratories exist globally, with some on each continent. Information about their locations and accessibility can be obtained from ICCIDD (see Chapter 6). The usual cost for doing these determinations will range from US $5-10 per analysis. Urine samples (2-5 ml) can be collected in the field, stored without refrigeration, and sent directly to the assay laboratory. If a country decides to launch a large scale IDD program, its directors can decide whether it is more practical to set up its own laboratory, using either the manual or automated method, or to contract with a reference laboratory on a more permanent basis.

D. Other clinical and laboratory data

The goiter surveys and urinary iodine determinations are the simplest and most valuable means of assessing iodine deficiency in a population. Additional information can sometimes be obtained from casual observation of cretinism or widespread mental retardation. Occasionally, further laboratory investigations are obtained for research purposes or in conjunction with other evaluations. While these tests can be valuable, they are expensive and difficult to obtain and are not usually necessary in a general evaluation.

1. Laboratory tests related to thyroid hormones

Laboratory methods exist for measuring blood levels of the major thyroid hormones, thyroxine and triiodothyronine, and the hormone stimulating the thyroid, TSH (thyroid stimulating hormone). These are standard laboratory procedures, usually by radioimmunoassay techniques. While giving an accurate assessment, they have the serious disadvantages of being expensive, being generally unavailable in many developing countries, and requiring the collection of blood samples, which are generally unpopular in poorer communities harboring IDD. Examples of cost are US $10.00 for the serum thyroxine, $25.00 for the serum triiodothyronine, and $30.00 for the serum TSH in the United States in 1989; however, these tests can be performed at a much lower cost when done in bulk in a research lab.

2. Neonatal screening

Approximately one of every 4,000 newborns in areas without iodine deficiency is hypothyroid, usually because the fetal thyroid gland fails to develop normally. Blood taken from the umbilical cord or collected by heel prick within the first several days of life can be placed on filter paper, sent to a reference laboratory, and measured for content of either thyroxine or TSH. If the results suggest hypothyroidism, the infant is followed up rapidly with appropriate further tests, and if a diagnosis of hypothyroidism is confirmed, the child is started on thyroid hormone medication promptly. This treatment prevents some or all of the adverse effects of hypothyroidism on the developing brain. These screening programs are in virtually universal use in Europe, Japan, and North America.
Similar screening programs have been advocated for some areas of the developing world as well, but frequently they will not be an effective use of scarce health money. In areas of iodine deficiency the tests will suggest high prevalences of neonatal hypothyroidism, frequently up to 10%. It is usually difficult to locate these newborns and costly to treat them. Also, it is frequently difficult to obtain samples that are truly representative of the population, because many births are at home and unrecorded, transportation of samples is cumbersome, and technology for measurement is not routinely available. Thus, the main application for neonatal screening in iodine deficient areas will be only for epidemiologic monitoring. Occasionally, documenting neonatal hypothyroidism is useful for advocacy purposes, because such measurement directly reflects the risk that iodine deficiency imposes on normal brain development. However, this risk can be estimated by knowing urinary iodine levels and the prevalence of goiter, without resorting to neonatal screening.

3. Radioiodine uptake

This test is widely used in industrialized countries to measure the avidity of the thyroid for iodine. In areas of iodine deficiency the thyroidal uptake of a small dose of radioiodine will be quite high. However, the test requires sophisticated technology and rarely provides information that will alter the general assessment of iodine deficiency obtained by simpler approaches.

4. Ultrasonography

The examination for thyroid size can be difficult, as already emphasized. Ultrasonography, a means of obtaining an image of the thyroid size by ultrasound wave, can provide a more accurate assessment of thyroid size. However, it requires a trained operator, expensive equipment, and is not often practical for routine use in surveys.

E. Organization of surveys

The initial strategy will depend on the size, location and other special circumstances of the region to be surveyed, and the degree of information already available about it. An effective way to begin is to form a team of one or more IDD experts to make an initial assessment over a brief period, perhaps a week or two. They can rapidly determine the existing situation about iodine availability, go to several key areas and survey for goiter prevalence, collect urine samples for iodine assays to be done in a reference laboratory, and obtain general information about salt production, distribution, and consumption. Such a consultation can provide an immediate recommendation about how to proceed further in the IDD assessment.

The major approaches to a more detailed survey of goiter prevalence are:
- through mobile teams of one or more trained examiners moving throughout the region; or

- through the primary health care system in the region.

The first method will usually provide more accurate information because the examiners are more experienced, and the survey may be completed more quickly and efficiently. The second method will be less expensive and will increase the awareness and involvement of the primary health care system in IDD.

Usually it will be impossible and unnecessary to examine every member of the population, and instead, representative samples will be selected. Schoolchildren are a convenient group because they congregate in one place and are representative of the current state of iodine deficiency, whereas goiter may persist in older subjects even after iodine deficiency has been corrected. Typically, one examiner can assess the thyroids of one or two children every minute (see Figure 7, page 22), and his assessment of each child can be recorded by a teacher, clerk, or other assistant, so that within one or two hours he can have a clear idea of the goiter prevalence in the school. Casual urine samples can be collected from perhaps every tenth child, a small amount (2-5 ml) stored in plastic tubes with a few drops toluene as a preservative, and later transported to the reference laboratory for iodine analysis. On visiting the schools the examiners can also give short talks to the teachers and students about iodine deficiency and the importance of its correction, thus paving the way for further educational campaigns.

Schools to be examined must be selected carefully. They should, in general, be representative of the region, but chosen with a preference for those in the poorer and more remote villages. In some regions, less than half the children and very few girls attend school. These areas may have more severe iodine deficiency because their communication with the outside world is less. In such cases an effort should be made to assess other members of the community, perhaps at special gatherings, in mothers and child clinics or the market place, or by household surveys. If the survey is to be carried out within the primary health care system, it can still be done in schools, with health workers doing the examinations for goiter. In addition, surveys can be carried out in maternity clinics and other outpatient health programs.

It is highly desirable to collect data on both goiter prevalence and urinary iodine levels during surveys. As described above, the goiter surveys can be inaccurate, particularly if done by inexperienced examiners and if the goiters are not large. The value of urinary iodine determinations can be limited by the use of casual samples, and by differences in urine concentration. For these reasons, the combination of goiter surveys and urinary iodine determinations is usually necessary for a proper assessment of the IDD problem in a community.
F. Severity of the IDD endemia

Data from the goiter prevalence surveys and urinary iodine determinations can be used to assess the severity of the IDD and the urgency of its correction. In general, a high goiter prevalence and low mean urinary iodine level indicate severe IDD. As stated above, we recommend that both goiter prevalence and urinary iodine levels be obtained for assessment. Occasionally a high prevalence of visible goiter (> 10%) is sufficient information to justify intervention with iodine supplementation, but confirmation with data on urinary iodine levels is always desirable.

The accompanying Scheme shows three stages of severity, I, II, and III, with typical values for their urinary iodine levels and total goiter prevalences. In the more severe stages, the goiters will be both more prevalent and larger.

### Scheme D

<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical Features</th>
<th>Typical goiter prevalence</th>
<th>Median urinary iodine</th>
<th>Need for Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goiter</td>
<td>Hypothyroidism</td>
<td>Cretinism</td>
<td>µg l/dl</td>
</tr>
<tr>
<td>I Mild</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>10-30%</td>
</tr>
<tr>
<td>II Moderate</td>
<td>++</td>
<td>+</td>
<td>0</td>
<td>20-50</td>
</tr>
<tr>
<td>III Severe</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>30-100</td>
</tr>
</tbody>
</table>

0 = absent; +, ++ and +++ = present, with +++ being most severe.

In Stage I, iodine deficiency is definitely present, but it is usually not accompanied by hypothyroidism or cretinism. It is important to correct Stage I IDD, but other health priorities may be considered more important. In Stage II the mean urinary iodine level is lower, goiters are more prevalent and larger, some degree of hypothyroidism is present, and the need for correction is more urgent. In Stage III, with low urinary iodine levels, the goiters are even larger and more prevalent, hypothyroidism and also cretinism occur, and correction of the iodine deficiency is an emergency, because children in such a region are at significant risk for permanent mental and physical retardation.
G. Summary

Surveys for goiter prevalence in school-age children and the measurement of iodine in the urine are the best practical means for assessing iodine deficiency in a community. Goiter surveys are simple and rapid, but require some training of the examiner to be reliable. Schoolchildren are a convenient test group because they are easily accessible, reflect the current status of iodine nutrition, and are a major priority group for prompt correction of iodine deficiency. Urinary iodine determinations require sophisticated technology that is available in many reference laboratories, but is not easy to set up. However, this laboratory confirmation of the goiter prevalence data is highly desirable in any proper survey. Other laboratory procedures can provide additional information but are usually not recommended because of their increased costs and the difficulty of carrying them out, particularly in the areas where iodine deficiency is most prevalent.
Figure 1: Goiters in children (courtesy of Romsai Suwanik and Thailand Ministry of Health)

Figure 2: Goiter in adult Tanzanian woman

Figure 3: Cretin in Equador (courtesy of J.B. Stanbury)

Figure 4: Cretin in Zaire (courtesy of J.B. Stanbury)
Figure 5: Cretin in China

Figure 6: Palpation for thyroid size

Figure 7: Goiter survey in school (courtesy of Hinke Jeeninga)

Figure 8: Goiter in cow (courtesy of M. Rivadeneira)
CHAPTER 3. PLANNING AN IDD CONTROL PROGRAM

A. Initial organization

Once the presence of iodine deficiency is established, a program to deal with it must be developed. The primary responsibility for developing an approach will almost always be with the government, usually at the national level but occasionally regionally in large countries with wide geographical or cultural variations. The governmental agency responsible for nutrition or public health should have a major role in planning and executing the program. Depending on the institutional structure in a particular country or region, this will usually be the Division of Nutrition or Division of Public Health in the Ministry of Health, at least to provide the scientific and public health background for the program. However, it is imperative to involve other interested groups at an early stage in planning the program. Salt iodization will usually be the major intervention in most programs, and introducing iodized salt requires full participation of many groups concerned with salt production, marketing, and consumption.

The following are typical groups to consider. Their appropriateness and importance will vary among countries, depending on local characteristics.

1. Other components of the Ministry of Health (in addition to the Nutrition Division)
   a. Division of Child and Maternal Welfare
   b. Division of Primary Health Care
   c. Regional and Rural Health Centers
   d. Division of Epidemiology and Health Statistics
   e. Division of Laboratories
   f. Division of Health Publications, Education, and Communications

2. Other Ministries
   a. Ministry of Commerce, because it may regulate the salt trade.
   b. Ministry of Mining, because it may regulate salt production and be responsible for monitoring laws requiring salt iodization.
   c. Ministry of Transportation, because its regulations affect movement of
salt to iodization centers and its subsequent distribution.

d. Ministry of Education, for training and educating teachers, students, parents, and communities about the importance of IDD and its correction. This Ministry can help in selection of schools for surveys and facilitation of the survey program. Often the universities are under this Ministry and can contribute their expertise to various parts of an IDD program.

e. Ministry of Agriculture, because domestic animals also are impaired by iodine deficiency (see Figure 8, page 22), and therefore, farm productivity is lowered. Programs of rural assistance in this Ministry should include the prevention of iodine deficiency.

f. Ministry of Justice, because it is responsible for framing and enforcing legislation, especially on salt iodization.

g. Ministry of Local Governments, because in many countries health and other services are decentralized, and technical information needs to be provided locally by the central government.

3. Local governments

Iodine deficiency may be much more extensive in one region than another. In such cases, the local government should become involved and its relevant subdivisions should take responsibility for local IDD control.

4. Other interest groups

a. Physicians, nurses, and other health personnel, particularly at the local level, and their professional organizations.

b. Professional schools - the importance of iodine deficiency and its correction should be discussed and emphasized in the education of physicians, nurses, nutritionists, regional health workers, school teachers, agronomists, veterinarians, and students of other relevant disciplines.

c. Non-governmental civic groups, such as mothers’ clubs, religious organizations, groups devoted to general social welfare and development, consumers’ unions and associations, and local and national media, including newspapers, radio, and television.

5. International organizations

In most developing countries, United Nations (UN) agencies such as the World Health Organization (WHO) and United Nations Children’s Fund (UNICEF) actively support health projects. They have access to international technical and
financial resources and can help enormously in planning, developing and funding programs.

6. Target communities

A frequently overlooked interest group is the iodine deficient community itself. Many IDD programs in the past have made the serious mistake of omitting the affected community from the planning process. The community needs to be actively involved from the earliest stages. Failure to obtain this involvement has frequently led to misunderstanding about both the problem and the benefits of its solution, and resistance or, at best, passive acceptance has resulted. Indeed, target population demand for solving the IDD problem can be the most important factor in achieving sustained correction of iodine deficiency.

B. Situation analysis

A "situation analysis" is the first step in planning a program. It is frequently best initiated in a workshop, involving the groups listed above, and moderated by an experienced planner (not necessarily an IDD professional). This initial planning workshop should limit itself to formulating the policy decisions that determine the overall approach to IDD control. After formulation of the policy it is more efficient that separate task forces address the implications of the agreed policy by setting the priorities for the various sectors. Detailed planning for measures correcting the iodine deficiency can come later, once the policy has been accepted.

Participation and agreement are key concepts for a situation analysis, since their application creates commitment towards the activities that must be undertaken to control the IDD problem. The following are questions that always need to be addressed; additional questions will also occur, depending on local circumstances, and can become incorporated into the analysis:

1. What is the extent and severity of the iodine deficiency?

The available information should be reviewed. Is iodine deficiency concentrated in only one area of the country, such as an inland area? If present throughout, does it vary in severity from one region to another? Answers to these questions will come chiefly from surveys for goiter prevalence and urinary iodine levels. This information will also determine the severity of the problem, and hence the urgency of intervention.

2. Are there special factors which influence the IDD and its severity?

Some areas contain environmental "goitrogens," i.e., chemical or other factors that interfere with thyroid hormone production. Examples of goitrogens are found in cassava, millet, and other dietary staples. When goitrogens are present in areas
of iodine deficiency, the manifestations of IDD are worse. Also, other nutritional factors such as protein-energy malnutrition and vitamin A deficiency may worsen the manifestations of IDD in a population.

3. **What health services are available for implementation of an iodine-deficiency control program?**

For example, is there a strong primary health care system? Should correction of iodine deficiency be combined with other programs such as the expanded program on immunization (EPI)?

4. **What are the possibilities for prevention of iodine deficiency?**

As will be described more extensively in Chapter 4, iodized salt is usually the most satisfactory means of intervention. However, when it cannot be implemented quickly and when the iodine deficiency is severe, more immediate measures such as iodized oil may be necessary. The implications of intervening with either iodized salt or iodized oil need consideration in the situation analysis.

a. **Salt** - Features of the salt trade must be analyzed before a strategy for salt iodization can be developed. The following are pertinent questions:

1) What are the sources of salt? Does it come from within the country or is it imported?

2) Is access to salt deposits limited or widely available? For example, in some countries small deposits of salt are scattered over many remote areas, making it difficult to control iodization effectively, while in other countries salt production is limited to a few places, frequently on the coast, that can be easily regulated.

3) What are the existing networks of salt trade and distribution, and how will they be altered by iodization?

4) What is the quality of the salt preferred for consumption, and how is the salt packaged and priced?

5) What is the average salt consumption per capita, and what are the habits of domestic salt storage and use? Is the same salt also used for domestic animals?

6) What is the current price of salt, and will it be changed by introducing iodization? Will subsidies or other support be needed during the initial period of iodization?

7) What is the structure of the salt industry? Do several large companies produce it all, or are there many small producers? In the case of the latter, would
cooperatives for iodization be feasible?

b. Other methods of iodine supplementation - Iodized salt will usually be the preferred form of prophylaxis. Since iodization of salt will almost always change existing commercial patterns, it will receive most of the attention when the situation analysis considers intervention. However, occasionally it is not feasible to introduce iodized salt quickly, and more immediate measures are necessary. In such a case iodine must be introduced by some other mass means, such as iodization of drinking water or by giving it individually to subjects at risk, by iodized oil either orally or intramuscularly, or in the form of Lugol's solution (a liquid form of concentrated iodine). Technical aspects of these interventions are described in Chapter 4, and in more detail in the forthcoming technical manuals. However, in the situation analysis, particularly if prevention by means other than salt iodization is necessary, the following questions are pertinent:

1) If iodized oil is to be used, should it be administered orally or by injection? The intramuscular route is effective for a longer period of time and guidelines for its use are better established, but oral iodized oil is much easier to administer. The accessibility of the target regions would be a major factor in this choice.

2) If injected oil is to be used, are there proper safeguards against reutilization of needles, for proper disposal of syringes, and for proper injection technique?

3) Is iodization of drinking water feasible? Is there an adequate central water supply and can it be satisfactorily regulated?

4) Are there responsible people available for guaranteeing frequent administration of Lugol's iodine solution to make this a practical approach for a given region?

5) What resources are required and available? For example, is there a strong primary health care system? If so, its workers can be involved in implementing the program, to promote the use of iodized salt or to administer the iodized oil.

C. The National Council for the Control of Iodine Deficiency Disorders (NCCIDD)

Formation of such a council is useful for coordinating the IDD control effort. Initiative for its formation will usually come from the Ministry of Health, at least in the early stages, but it may be more effective to have the chairmanship in the Ministry of National Planning and Development, or its equivalent. The council must
be broad enough to represent most interested parties but small enough to ensure workable meetings. Since development of a program requires the participation of many different components from both the government and private sectors, full representation for the viewpoints of different interest groups is essential. For example, a law mandating salt iodization will have profound effects on the salt trade. These consequences need to be recognized, discussed, and dealt with, or the cooperation of the salt industry will be lost. Also, inclusion of the other groups provides a wide forum for dissemination of information and interest in IDD and its solution. Again, we stress the importance of including representatives from the iodine-deficient community itself.

The major roles of the NCCIDD are leadership, coordination, and advocacy. The council will seek agreement on policy issues, such as timing of the various measures, allocating resources, and setting priorities. The Council can appoint task forces of technical experts to deal with individual aspects of the program, in relation to the appropriate specialized governmental agency. Examples of topics for such task forces are epidemiology, salt, communication, education, IDD assessment, and the feasibility of specific interventions such as iodized oil, if they are to be considered. A task force on salt might include representatives of the salt producers, the salt transportation network, consumers, the governmental ministry regulating salt production and marketing, and experts in technical aspects of salt iodization, among others. A task force on education and communication might include representatives of the media, teachers, professional communicators, and the ministry of education. Obviously the creation and make-up of these task forces will vary depending on circumstances within a given country. The recommendations of such task forces will be received by the NCCIDD, which will use them to define the overall IDD strategy.

In addition to defining policy, the NCCIDD will monitor its implementation. It will serve as a clearing house for information from the different implementing groups and task forces, monitor their progress, and alter the policy as necessary. The NCCIDD must also ensure the continuation of the program once it is underway, and guard against its subsequent relapse.

The role of the NCCIDD in advocacy is crucial. Its broad representation places it in a pivotal position to alert all sectors, particularly the politicians, to the importance of IDD control, and it should use this position to secure and maintain an effective well-planned program. Clearly, the NCCIDD must have the political support of the national government to be fully effective.

D. Development of a plan

The situation analysis will establish the severity of the IDD and thus the relative urgency of its correction, and will also identify constraints that affect the choice of iodine supplementation method. Such factors will shape the best plan for
IDD control. The answers to all the questions posed in the situation analysis will never be exactly the same from one country to another, and the factors in plan development will vary accordingly. Rather than provide an exhaustive blueprint to cover every possible situation, we present several examples to show how the answers to these questions can be used in developing an appropriate plan.

Example 1 - A is a small country with low national income, many severe health problems, and mild IDD. It produces its own salt, and the market is dominated by two large companies on the coast which transport salt inland, where the IDD is concentrated. Recommendation - In this situation, correction of IDD is important but is outranked by other health priorities. The best approach would be an iodized salt program, and this may be easy to carry out because it requires regulation of only two large producers.

Example 2 - B is a country with severe iodine deficiency in all its regions and cretinism is frequent. It has many inland salt deposits from which small producers carry the salt on primitive roads for sale at local fairs. Most people eat coarse block salt, which they share with their animals; refined salt is much more expensive. Recommendation - The IDD is severe, and control of salt marketing will not be easy. The best approach is iodized oil for the most severe areas, while also planning an iodized salt program. The ultimate solution should still be iodized salt, but several years at least will be required to overcome the complexities of the salt trade and to introduce iodization successfully. The government will need to make the cost of iodized salt competitive with the non-iodized product. This will require initial subsidies, imaginative marketing, and massive educational efforts to create a demand for iodine. Iodized oil will be necessary until iodized salt successfully covers the country, and in some remote areas permanent reliance on periodic administrations of iodized oil may be necessary.

Example 3 - C is a small country that imports all its salt. In fact, most salt enters as contraband, and political conditions make the introduction of a successful iodization program unlikely. However, the country is relatively affluent, transportation is good, and most children attend school. The IDD is Stage II, moderate severity. Recommendation - Iodized salt is not currently practical. Oral iodized oil would be one solution, since periodic re-administration is not difficult. Another possibility would be administration of Lugol’s iodine, perhaps every two to four weeks to the susceptible population, to be given by responsible people such as teachers, community health workers, or occasionally even by parents. Iodization of water should also be considered.

Example 4 - D is a small mountainous country dominated by a large neighbor which supplies most of the salt, supposedly in the iodized form. Delays are long between production of iodized salt in the supplier country and its actual consumption. Iodine deficiency is severe throughout most of the country, but particularly in the remote mountainous areas, which are inaccessible for much of the year. Recommendation - Repeat iodization of salt at points of entry into the
country is one possibility. However, if effective distribution of iodized salt will be difficult to achieve, a program of iodized oil injection in the remote areas is appropriate, and will probably need to be repeated every four to five years.

Example 5 - E is a region of a country with moderate iodine deficiency. The region is fairly affluent and most of the population urban, but for political reasons iodized salt has not been successful. The IDD is mild to moderate. Recommendation - Iodization of water may be a practical measure, since most of the community is urban. With the community relatively affluent and sophisticated, an intensive educational campaign may create sufficient demand to overcome the political deterrents to iodized salt.

E. Legislation and its enforcement

Introduction of salt iodization frequently requires legislation and enforcement to make it effective. First, the government must be convinced that iodine deficiency is important and that iodized salt is the preferred corrective measure (which it usually will be). Then a law should be drafted. While specifics of the law may vary with the characteristics of an individual country, the following will usually be important components:

1. All salt for human and animal consumption in the country should be iodized. Animals should be specifically included because they also suffer from iodine deficiency and because non-iodized salt for animals, particularly when it is cheaper, will inevitably be used by humans. Making iodized salt mandatory for the whole country is usually wise, because otherwise it is difficult to prevent the flow of non-iodized salt into iodine-deficient areas within the same country.

2. The law should clearly designate one governmental unit as responsible for IDD control. It is desirable to have an IDD Control Unit with its own budget and an established position within the governmental hierarchy. Several organizational schemes are possible (see Chapter 5), but strong coordination is necessary between the Ministry of Health, which is involved with the health consequences of IDD, and the ministry responsible for regulating salt production, marketing, and consumption.

3. While the law should decree salt iodization, it should leave the technical specifications (i.e., the form of iodine, the level of fortification, the types of packaging and labelling) to be formulated by the IDD Control Unit through enabling regulations. If the law is too rigid, it will become difficult to introduce appropriate subsequent modifications, e.g., to accommodate changes in consumption patterns.

4. It is valuable for the law to establish a NCCIDD, at least as an advisory board to the IDD Control Unit within the government. General guidelines for membership can be decreed, although its exact composition may vary greatly with
the circumstances of a particular country.

5. The laws should require periodic reporting by the IDD Control Unit to appropriate governmental agencies, such as to the Planning Commission, or jointly to the Ministries of Health and Mining, etc.

6. The law should specify enforcement procedures and penalties for noncompliance.

F. Financing

IDD control costs money. Expenses for the following components must be addressed:

1. Operation of the IDD Control Unit

The Unit must have a separate governmental budget sufficient to carry out its mission. It will usually require outlay for personnel in the Ministry of Health and/or the ministry responsible for salt regulation. The Unit must have an appropriate priority for obtaining the services of other governmental support units, such as laboratories, health inspectors, and rural health workers. Monitoring of the program must be adequately provided for.

2. Costs for iodized salt

Iodization will increase the cost of salt. This increase must be borne by someone, perhaps the consumer eventually, but it is unwise to shift this entire burden to consumers initially. They will usually be resentful and seek ways to resist the law, making the program unsuccessful. It is more reasonable to phase in the increased cost by a system of decreasing government subsidies over several years rather than initially passing the whole cost to the consumer. Consumer resistance can be counter-balanced to some degree by an aggressive education program, which should always be part of any IDD Control Program.

The government will need to make a financial investment in IDD control. This can take several forms, and will depend on the particular situation in a given country. One method is initial subsidies or tax incentives to salt producers. Another is donation of iodine and iodization equipment. International organizations will frequently help with the initial start-up of a program, particularly if presented with a reasonable plan for its self-sufficiency within several years. However, a clear demonstration of governmental responsibility for the effort is required.

Costs for other interventions, chiefly iodized oil, will need to be borne by the
government. International organizations have frequently provided partial support for reasonable programs of iodized oil intervention.

G. Summary

The initial organization of an IDD Control Program will almost always come from a component of the government, frequently the Ministry of Health. A NCCIDD (National Council for the Control of Iodine Deficiency Disorders) should be formed at an early stage. Its membership should represent the groups associated with all the essential components of the control program, including several divisions in the Ministry of Health, the ministries responsible for salt production and trade and for education, local government organizations, non-governmental health personnel, professional schools, non-governmental civic groups, and most importantly, the iodine-deficient communities themselves. A situation analysis should consider the location and severity of the iodine deficiency and the factors affecting the choice of intervention measures, particularly the salt trade. Based on this analysis, a plan for IDD control can be developed that is appropriate for the specific conditions in a given country. Legislation for salt iodization and provision of adequate financing for IDD control must be obtained. Several examples of recommended approaches, based on particular circumstances in a country, are presented to illustrate these points.
CHAPTER 4. METHODS OF IODINE SUPPLEMENTATION

Once it is established that iodine supplementation is necessary, we must then decide the best way to provide it. This chapter considers the available methods for introducing iodine into a deficient area, and some of the factors that influence the choice among them. The technical manuals currently in preparation will give specific details about iodized salt and iodized oil.

(The nomenclature for iodine is sanctioned more by general use than chemical logic. The term "iodine" usually refers to the chemical element in a general sense without specifying its chemical form, but it is also used to denote the form $I_2$. For the purpose of this Guide, we define a substance as "iodized" when iodine is added in any form. Occasionally salt or another vehicle will be described as "iodated" when potassium iodate ($KIO_3$) is added, or as "iodinated" when iodine ($I_2$) is added.)

A. Salt

1. Rationale and appeal

Salt is an ideal vehicle for addition of a micronutrient such as iodine. Everyone needs salt, usually in fairly constant daily amounts. In many rural communities of the developing world, salt may be the only commodity introduced from the outside. The sources of salt are usually limited, making them susceptible to control for addition of iodine. The techniques for iodization are simple and well established. Particularly when salt is already being refined for human consumption, iodization adds very little to its total cost. The added iodine does not affect the appearance or taste of salt and is usually well accepted by the consumer.

An approach to salt iodization must begin by considering the sources, marketing, distribution and utilization of salt, and the cultural habits associated with its use. Salt is usually obtained from salt mines or by evaporation in the sun from seawater or inland salt lakes. To introduce iodine, salt must be intercepted at some stage in its path to the consumer, usually at the site of production. The quality of salt in the world varies greatly, from crude irregular lumps with many impurities to pure, white, crystalline granules.

The following conditions will affect strategies for salt iodization:

a. Source of salt - Is the salt imported? Is the major production from solar evaporation of seawater, are there inland salt lakes or rock salt mines? Where are the major production centers located?
b. **Quality of salt** - Are there many impurities mixed with the salt, or is it pure (greater than 99%) sodium chloride?

c. **Distribution** - Is there an easily accessible distribution system, or do people travel many miles over difficult routes to obtain salt? Is distribution through central channels, or are there many networks, some of them involving contraband? How easy and how complete will it be to intercept salt for iodization, given existing distribution pathways?

d. **Storage** - Is the salt consumed within several weeks or months after it leaves the production site, or does it sit in warehouses, stores, and kitchens for many months?

e. **Packaging** - Does current packing material protect from heat and moisture? Is salt packaged in large or small quantities?

f. **Consumer preference** - Is salt purchased in crude blocks, or in large packages? Is the same salt consumed by both humans and domestic animals? Is fine crystalline salt preferred over coarser varieties, and are the consumers, particularly the poorer rural ones, willing to pay for refining? Are there preferences for local salt, even if it is not as pure?

From the answers to these questions, it will be relatively simple and cheap to introduce iodization into the salt trade when the product is already highly refined, comes from only a few production sites, and has extensive distribution networks. It will be more difficult when there are many sources of salt, all relatively accessible to small producers who then travel by primitive means to sell it in local communities.

2. **Techniques for iodization**

At the simplest level, a predetermined amount of iodine can be added to an appropriate amount of salt and mixed by hand. This procedure is tedious, and does not give even distribution of iodine within the salt. However, it requires no machinery and has been used in remote villages, particularly in Thailand. To be effective it requires proper instruction and supervision, frequent checks on the completeness of mixing, and adequate supplies of iodine. Occasionally this method is attractive as a pilot project to demonstrate the feasibility of salt iodization on a limited scale.

Most salt is iodized mechanically. The salt is moved on a conveyor belt and iodine is introduced at an appropriate point in a predetermined amount. Several techniques are in use:

a. **Dry-mixing process**, in which potassium iodate or iodide is introduced by a screw conveyor onto a conveyor belt carrying the salt. This procedure is successful only with powdered salt.
b. **Drip-feed addition**, typically used for salt crystals. A liquid solution of iodine (potassium iodide or iodate) is dripped at a constant rate from a bottle suspended above the salt that is moving on conveyor belts.

c. **Spray method** - The salt on the conveyor belt is iodized by a fine spray of iodate or iodide solution at a predetermined pressure (see Figure 9, page 43).

d. **Submersion process** - A saturated solution of salt and iodine are placed in contact, then the salt is dried, leaving it iodized.

Of these processes, the spray and dry-mix are more successful with dry powdered salt, but the drip feed and submersion processes are cheaper in capital and operating costs, and therefore, cheaper for the consumer.

3. **Chemical form of iodine and supplementation level**

Two chemical forms of iodine, potassium iodide (KI) and potassium iodate (KIO₃), are commonly used for salt iodization. Potassium iodide is cheaper but less stable. It is satisfactory only with highly purified salt in dry, temperate climates when the salt will be consumed within several months of production. Potassium iodate is much more stable and resistant to evaporation. Iodate, rather than iodide, must be used with impure salt, when the salt is exposed to excessive heat and humidity, or when storage and transportation impose long delays before consumption.

The amount of iodine added to salt depends on the average amount of salt consumed per capita by the target population. The desired daily consumption of iodine is at least 150 μg. Average per capita salt consumption per day may be taken as 10 grams, but there are wide fluctuations relating to heat, exercise, customs, and economy, so that the range may be from 2 g or less to 20 g. Allowance also needs to be made for losses of iodine from imperfect packaging or during storage. Thus, as a general rule an appropriate fortification level is about one part iodine per 20,000-40,000 parts salt (this can also be expressed as 25-50 parts per million (ppm), as 25-50 mg iodine per kg salt, or 25-50 gm iodine per metric ton salt). This amount can be varied up or down depending on the intake factors described above.

Most of the world’s iodine is obtained as a byproduct of the natural gas industry. Japan is the major producing country. Some also comes from Chilean nitrate deposits.

4. **Costs of iodization**

These include the following:
a. **Cost of the chemical** - Potassium iodate currently costs about US $30.00 per kilogram (1988). For an iodine range of 15-40 parts per million, the additional cost would be US $0.75-$2.00 per ton of salt.

b. **Processing costs** - Labor and supervision usually range from US $2.00-$4.50 per ton. Other processing costs per ton are maintenance and spare parts, $0.20-$0.50; power and fuel, $0.19-$0.40; and laboratory chemicals $0.05-$0.10. Thus, the total overall processing cost per ton is US $2.35-$5.50.

c. **Packing costs** - Polyethylene lining of containers for iodized salt is strongly recommended in warm humid climates. The additional cost of packing with this material is about US $4.00-$5.00 per ton. Although expensive, such packaging is usually cost effective. The iodized salt retains its iodine in the journey from producer to consumer rather than losing it by evaporation; this in turn permits the addition of smaller amounts of iodine to the salt during iodization, thus lowering the outlay for iodine.

d. **Amortization** - The capital costs for iodization equipment are usually written off over a period of 5-10 years. This amortization cost is estimated at US $0.50-$2.50 per ton of iodized salt.

e. **Administration** - Costs range from US $0.60-$1.50 per ton.

From the above figures, the average cost of iodization per ton of salt is US $7.50 (range $3.95-12.50), or with packing, $11.50 (range $7.95-16.50). These figures represent a cost of $0.004-0.016 per kilogram or $0.02-0.06 per capita per year. Since the retail price of crystalline salt is usually in the range of US $0.25-$1.00 per kilogram, the cost of iodization represents 2-20% the retail price of the salt.

The accompanying table (see page 37) shows the cost for a small iodization plant, developed in India, with a capacity of 4,000 tons per year. This would supply sufficient salt for approximately one million people at a cost per person per year of about US $0.047. In this example, the cost for iodizing one ton salt is $11.69, but a larger plant can decrease the cost per ton. The plant and housing cost approximately US $89,000, with the major expense ($72,000) being suitable housing for the plant. These costs are for the iodization itself, and do not include additional expenses associated with packaging, special distribution, storage, or monitoring.

Detailed plans for spray mixing or submersion plants are available from UNICEF, ROSCA, New Delhi, India (address in Chapter 6). Plans for the submersion process can be obtained from the Central Salt and Marine Chemicals Research Institute, Bhaonagas, Gujarat, India. Several small plants have been adapted to specific needs in Latin America, including dual fortification with iodine and fluoride (details from PAHO, WHO Regional Office for Americas, address in Chapter 6).
TYPICAL COST OF SALT IODIZATION

Capacity: 1 ton/hour, 4000 tons/year

<table>
<thead>
<tr>
<th>Capital cost:</th>
<th>US $</th>
</tr>
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<tbody>
<tr>
<td>Plant alone</td>
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</tr>
<tr>
<td>Installation</td>
<td>2,500</td>
</tr>
<tr>
<td>Other equipment</td>
<td>3,500</td>
</tr>
<tr>
<td>Laboratory and chemicals</td>
<td>750</td>
</tr>
<tr>
<td>Housing for plant</td>
<td>72,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating costs:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Iodate 200 kg @ US $30/kg</td>
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</tr>
<tr>
<td>Labor</td>
<td>33,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1,430</td>
</tr>
<tr>
<td>Power/fuel</td>
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<tr>
<td>Overhead</td>
<td>750</td>
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<tr>
<td>Depreciation</td>
<td>3,580</td>
</tr>
</tbody>
</table>

B. Iodized oil

A well known chemical reaction can add iodine to vegetable oils. The most widely used preparation, Lipiodol, is 38% iodine by weight, so 1 ml contains 480 mg of iodine. A single intramuscular injection of 0.5-1.0 ml protects from iodine deficiency for three to five years. A single oral administration will usually provide satisfactory iodine stores for one to two years. The chief use of iodized oil is for areas where prompt correction of iodine deficiency is urgent and iodized salt is not available. The major limitation of iodized oil programs, when compared to those for iodized salt, is that direct contact must be made with each subject who will receive the iodized oil, whereas proper iodization of salt assures that every person eating the salt will receive sufficient iodine.

1. Iodized oil by injection (see Figure 10, page 43)

Iodized oil is injected by syringe and needle into the muscles of the buttocks, for small children, or of the upper arm, for older children and adults. The usual dose is 1 ml (480 mg of iodine) for subjects one year and older and 0.5 ml for age 0-1 year. The iodine is released slowly from its injection site into the blood, then circulates to the thyroid, which concentrates it and produces thyroid hormones from it. Some of the iodine is also stored in body fat. Several factors are responsible for its sustained duration of effect: the high dose of iodine, the slow
release from the muscle, the recycling of iodine by the thyroid, and perhaps its storage in fat.

There are two principal ways of conducting iodized oil injection programs. In one, the iodized oil is distributed through the primary health care system to regional health areas, and local health personnel give the prescribed injections to the targeted communities. The other common approach is to organize small teams that travel within a given region for the chief purpose of giving the iodized oil injections. Sometimes these two approaches can be combined, by carrying out several other health interventions such as immunizations at the same time as iodized oil injections.

Nepal provides an example of an iodine injection program. In districts targeted for iodized oil administration, two-person injection teams are recruited for a one-year period. These persons are native to the district and familiar with its geography, language, and customs. The teams fan out from a central headquarters on circuits often lasting two weeks, during which they visit as many villages and dwellings as possible. The following year new teams are recruited and new districts injected. Over two million people have received iodized oil in Nepal since the late 1970's as part of this program. Another example is Zaire, where mobile teams of five persons could give 100,000 injections per year, or about 500 per day, allowing coverage of 1.5 million people in five years with three such teams.

The injectors are usually not physicians, and need to be trained only in administering the injections, sterile precautions, and proper handling and disposal of materials, particularly needles. The iodized oil is stable and does not require refrigeration. The necessary supplies include the iodized oil itself, which usually comes in 10 ml vials, the syringes, needles, and alcohol and cotton for skin sterilization. injections are not very painful, and produce no significant complications when properly administered.

2. Oral iodized oil (see Figures 11-12, page 43)

When given by mouth, iodized oil is absorbed from the gut into the circulation. Some then goes directly to the thyroid, some probably is stored in fat, and the rest is excreted. The body does not use oral oil as efficiently as it does the injected oil because none is stored in muscle. The world's experience with oral iodized oil is more limited than with the injected material, and precise guidelines for its optimal dose and duration of effect are not well established. At present we suggest that a dose of 1 ml (480 mg iodine) will provide adequate iodine for one to two years after a single administration. Some preliminary studies suggest that smaller doses may be equally effective, at least for a year. While this duration is shorter than that with injection, the oral administration avoids the need for syringes, needles, and sterile techniques, and can be administered by responsible persons without medical training. Capsules of iodized oil containing approximately 200 mg iodine are available and can be administered directly. Another approach is to draw the oil into a syringe, and place 1 ml (or some other predetermined amount) onto
the subject’s tongue by discharge through the syringe barrel. Since the syringe does not come into direct contact with the subject, it can be reused for many doses.

3. Sources of iodized oil

Currently the major international source is Laboratoire Guerbet, 16-24 rue Jean-Chapte l, 93601 Aulney-sous-Bois Cedex, France. The material, marketed as Lipiodol Ultrafluid, is iodinated poppyseed oil containing 38% iodine or 480 mg per cc. Another commercial source is the Fourth Pharmaceutical Factory, 24 Wen-Ming Road, Wuchang, Wuhan, People’s Republic of China. Its material is soybean or walnut oil in capsules containing 200 mg iodine, or as a liquid containing 24-28% iodine. Its efficacy has been reported in China, but it has not been tested extensively in other countries or reported in the world technical literature. In mid-1989, several efforts were underway to develop other sources of iodized oil, particularly for oral use. If these are successful they may provide a cheaper product than that currently available from Guerbet.

4. Cost of iodized oil program (mid 1989)

Each 200 mg capsule costs about US $0.10. A 10 ml vial of iodized oil costs about $2.75. Guerbet is planning soon to market a different preparation of iodized oil that will reduce the current cost by about one-third. A 5 ml plastic sterilizable syringe costs US $0.18, and a box of 12 needles costs $0.50. Other costs such as personnel, transportation, and training need to be added. In most circumstances the personnel costs for an injection program will be considerably higher than those for oral administration, since greater technical skill is required.

C. Iodized water (see Figure 13, page 44)

Iodine added directly to drinking water can correct iodine deficiency. In the simplest form of this approach, a measured amount of iodine, usually as a concentrated solution of I₂, KI, or KIO₃, is added directly to drinking water in a jar, in an amount appropriate for achieving a daily intake of at least 150 µg iodine. The iodine solution is prepared locally and distributed in dropper bottles to schools and to household heads; approximately 8 million people are being covered by this approach in northern Thailand.

Iodization is also achieved through a public water supply by diverting a small amount of the water through a canister containing crystals of iodine and then reintroducing this iodized water into the main water flow. The amount of iodized water reintroduced can be controlled by pressure differential to achieve any iodine level required. The apparatus is relatively simple. This technique requires a central water supply and occasional technical supervision to see that the proper amount of iodine is introduced, but the system can run largely unattended for one or more years. It will not be applicable to most rural communities. This technique has the advantage of supplying an appropriate amount of iodine each day rather than the
large doses received with a single administration of iodized oil. Also, the iodine can
purify the water from most forms of bacterial contamination if I\textsubscript{2} (but not KI or
KIO\textsubscript{3}) is used. Commercial instruments are available (Hydrodine, Inc., 935
Northeast 95th Street, Miami Shores, FL 33138, USA). In an application of this
technique in Sicily, the cost of iodization was estimated at approximately US $0.04
per person per year in 1985.

Another technique is the constant release of iodide into well water from a silicon polymer, needing replacement about once a year. This method may
be useful in communities with central wells. The estimated cost of this program is
about US $0.10 per person per year (details can be obtained from Fondation
Rhone-Poulenc Sante, 20 Avenue R. Aron 92165, Paris, France).

D. Lugol's iodine

Subjects can receive oral iodine directly in the form of Lugol's solution
(5 g I\textsubscript{2} plus 10 g KI per 100 ml, or 6 mg iodine per drop). Lugol's solution is
commonly found even in small rural hospitals in developing countries. Its chief
medical application is as an antiseptic. In contrast to iodized oil, Lugol's iodine is
stored in the body only by thyroid recycling. Accordingly, its duration of effect will
be considerably shorter than that of iodized oil, and repeated applications are
required. Precise guidelines for the optimal dose and duration of effect are not
available, although studies to supply this information are being developed. An
appropriate dose would be the equivalent of one drop of Lugol's solution (6 mg
iodine) every 30 days. Because of certain effects of large amounts of iodine on the
thyroid, a better approach might be administration of a diluted sample, containing
approximately 1 mg iodine, every seven days. The great advantages of Lugol's
iodine are its wide availability and low cost. Also, it provides a supply of iodine
that is closer to physiologic needs than the one-time large doses received from
iodized oil. However, effective use of Lugol's iodine requires responsible people to
distribute it and to see that the correct dose is given at the proper intervals. A
small program using Lugol's iodine has been successful in Bolivia, with teachers and
even heads of households, after proper instruction, in charge of its administration.

E. Factors in choosing an iodization method

We have already described some of the advantages and disadvantages
of each method. Some additional points are as follows:

1. Iodized salt provides a constant daily ration of iodine that can be
achieved without direct contact with each target subject. Salt is a particularly
satisfactory vehicle because its sources are limited and it is an essential nutrient. In
most situations iodized salt should be the long-range objective of any iodine
supplementation program.
2. The major alternative to iodized salt is iodized oil. Its use requires direct contact with each target subject, so it is more difficult to administer on a mass basis. However, a program of iodized oil can be implemented very quickly, and can bypass the delays involved with introducing iodine into salt marketing. Iodized oil is best considered as an emergency measure and one to "buy time" while seeking effective iodization of salt. Occasionally, the problems with salt iodization will be so massive that cyclical administration of iodized oil may be a semipermanent approach.

3. In comparing the cost of salt iodization with that of iodized oil programs, it should be remembered that only the target subject receives iodized oil whereas iodized salt will also reach (but not harm) many people who do not actually need additional iodine. Therefore, the calculation of cost per beneficiary needs to reflect this difference.

4. Injections of iodized oil provide longer coverage than oral administration for a given dose. However, injections require more technical skill for administration and the need for syringes, needles, and sterilization increase the cost. They also carry the risk of improper disposal of equipment, particularly syringes and needles, with consequent risk of transmission of AIDS, hepatitis, and other viruses.

5. Administration of iodine by Lugol’s solution should be remembered as a technique that can be applied almost instantly at little cost for basic supplies. It has the important disadvantage of requiring frequent application. Also, the optimal dose and its duration of effect have not been established. However the rough guidelines given above will provide temporary coverage while organizing more complicated schemes of iodization such as with salt or iodized oil.

F. Summary

Iodization of salt is the preferred approach for supplementation in iodine deficient populations. Salt is a dietary necessity whose sources are usually limited and therefore easily controlled, and the technology for iodization is simple. The cost of iodization is usually US $0.02-0.06 per person per year. The successful implementation of an iodization program may take several years or longer, because it involves changes in the salt trade. However, salt iodization should still be the ultimate goal for correction of iodine deficiency. Iodized oil can be given either by injection or orally, with a single administration providing adequate iodine for three to five years (injected) or about two years (oral). The cost of iodized oil per person per year protection is usually US $0.10-0.25. The disadvantage of iodized oil is that it requires direct individual contact with each subject. Its advantage is that programs can begin almost immediately without the delays associated with salt iodization. Its major use is in areas where the iodine deficiency is severe and alternate means of iodine supplementation will not be available for at least one or two years. Other approaches include iodization of drinking water and frequent administration of Lugol’s iodine.
Figure 9: Salt iodization plant. Potassium iodate solution is sprayed onto salt moving on conveyer belt from right to left. Iodized salt is bagged, in the left foreground (courtesy of P. Subramanian)

Figure 10: Injection of iodized oil

Figure 11: Iodized oil administrated orally from syringe barrel

Figure 12: Distribution of capsule of iodized oil for oral use (courtesy of M.D. Havron)
Figure 13: Student drops concentrated solution of potassium iodate into school drinking water every day (courtesy of Thailand Ministry of Health)

"IODISED SALT" not only gives you Super Taste but also helps to improve memory power. Prevents & cures goiter disease. It increases your strength & health. Hence stick on the IODISED salt and consume only IODISED salt.

Figure 14: Posters at IDD campaign booth at rural fair, where IDD program workers survey for goiter, administer iodized oil, distribute iodized salt, and teach about IDD and its control

Figure 15: A notice enclosed in iodized salt packages to emphasize the benefits of iodization

Figure 16: Children parade with homemade posters attacking iodine deficiency and its consequences
CHAPTER 5. PROGRAM OPERATION

A. Introduction

Each country is different in the severity and distribution of its iodine deficiency and in the factors that govern the choice of treatment strategy. Therefore, the structure and operation of the control program should be tailored to the actual conditions in a particular country. Some features influencing the control plan have already been described in Chapter 3. To reiterate, the important factors in structuring the program are: (1) the severity of the IDD and its location; (2) the decision about intervention modality; (3) the structure of the primary health care system; (4) the structure of the salt trade; and (5) any special political or social features, such as cooperatives.

In almost all circumstances the long range aim should be effective iodization of salt. If it cannot be implemented successfully within one or two years, and if the IDD is severe, temporary alternative measures should be instituted. The usual alternative is iodized oil, given either orally or by injection. However, this temporary measure should not be used as an excuse to delay the development of a salt iodization program.

B. Administrative structure

The organization of an IDD control program must be adapted to the customs and political realities of a given country. The accompanying figure presents an example of one organizational scheme, but many others are possible. We strongly recommend that the following components be considered:

1. Creation of a NCCIDD

The National Council for the Control of Iodine Deficiency Disorders should adequately represent the appropriate groups mentioned in Chapter 3, particularly members of the target community. The NCCIDD is the forum for policy making, direction, and coordinating the various groups involved in IDD control. Also, the NCCIDD should oversee evaluation and advocacy for effective sustained IDD control. Again, it is important to note that it requires the political support of the national government for the NCCIDD to be fully effective.

2. A dedicated IDD Control Unit

A separate IDD Control Unit responsible for implementation is recommended. This Unit is frequently located within the Ministry of Health and its Division of Nutrition. Since salt iodization is usually the preferred long-range control measure, the Unit must be closely related to the ministry responsible for salt, and occasionally may be more appropriately placed in that ministry than in
Health. A fulltime director should be appointed. He/she will frequently be a physician, but this is not necessary as long as there is access to appropriate medical advice. The director must have good managerial skills, be an effective advocate for IDD control, and be able to deal successfully with politicians, medical personnel, target communities, the salt industry, and other interested parties.

Typical organizational scheme for an IDD Control Program. The IDD Control Unit with its major divisions and functions are shown in the lower portion. The Unit is directly responsible to one of the following, shown by numbered arrows: (1) the NCCIDD, (2) the Ministry of Health; (3) the Ministry of Planning; (4) another ministry, usually mining or commerce. All of these ministries, plus other groups mentioned in the text, have representation in the NCCIDD, which can be either executive or advisory.
Depending on the size of the IDD problem, personnel should be assigned to the following areas:

a. **Epidemiology** - Responsibilities include: assessing the distribution and severity of IDD; collecting information to aid the choice of preventive measures; choosing the prophylactic methods; carrying out direct interventions such as iodized oil; monitoring the biological effects, including planning and evaluation of periodic surveys for goiter and urinary iodine; overseeing laboratory tests and goiter prevalence surveys; and tabulating and analyzing results.

b. **Iodized salt** - Responsibilities include: analyzing salt quantity, production, packing, pricing, marketing, and consumption patterns; identifying problems associated with introduction of iodization into salt processing and trade, and developing solutions to these problems; interacting effectively with each component of the chain from production to consumption of salt; and overseeing the monitoring and reporting of iodine levels in the salt.

c. **Education and communication** - Responsibilities include developing methods for informing all interest groups, and particularly the affected communities, about the importance of IDD and its correction (further details are given below).

These are the major responsibilities within an IDD Control Unit. Some can be carried out by the same individual, if the program is small, although the necessary skills demand training in several different areas. A common mistake in many programs has been to entrust the nonmedical components, such as salt iodization and communication, solely to physicians, who are not professionally trained in these areas.

The relationship of the IDD Control Unit to other governmental organizations can take several forms:

1) As a separate component within the Ministry of Health, or possibly within the Division of Nutrition of the Ministry of Health.

2) As a unit of the Ministry of Mines or Commerce, whichever is responsible for salt.

3) As an independent governmental agency, with representation from several ministries, and answerable to an overall governing organization, such as a National Planning Commission.

4) As a unit answerable directly to the National Council for the Control of Iodine Deficiency Disorders.

Local political and financial considerations will dictate the most effective organizational framework for the IDD Control Unit. The most important point is
that it must have sufficient independence, authority, and financial resources to effectively carry out its mission to control IDD.

C. Budget

The national or regional budget should designate specific funds for the IDD Control Unit. These funds must be adequate for carrying out the Unit's program within the time specified. If the funds are discretionary or are not specified within a larger unit's budget, the program may be cut off financially. In addition to specific support for personnel and supplementation costs, provision should be made for monitoring and evaluation.

International organizations may offer help in initial funding for IDD programs, particularly for specific intervention measures. However, the long range objective must be to make the IDD Control Unit an integral item in the national or regional governmental budget, and not dependent on outside funds.

D. Education and communication (see Figures 14-16, page 44)

This is one of the most important (and most neglected) components of an IDD control program. Many programs in the past have introduced iodine supplementation measures without educating the target group or other involved parties to the importance of IDD and its correction. Such unexplained interventions may meet with indifference or resistance and frequently are not sustained. An aggressive campaign to make all interested parties aware of IDD and its correction should be a cornerstone of an IDD control program.

Education should be at all levels, including the following:

1. Politicians and decision makers

They need to be convinced of the importance of IDD and its correction, both for humans and animals. They should also realize that the technology for IDD control is straightforward and easily applied, and that an aggressive campaign with appropriate political and financial support has a high probability of success, with great political credit for its supporters. Short personal contacts, movies or slide shows, or summary brochures may be the most effective means for communicating with this group.

2. Health workers

The understanding and support of this group is essential for an effective program, because they will be involved in teaching and counseling the target population and in monitoring the effects of the program. Most health workers will be responsive to a convincing message about IDD control. This educational effort
can take several forms, including pamphlets, technical books, the introduction of material on IDD into curricula of medical and nursing schools, and regional health meetings.

Health workers are involved with health care delivery or assessment, particularly at the village levels, and include not only public health personnel, physicians, and nurses but also others such as midwives, traditional healers, and food inspectors. Their education is particularly important when they are involved with a direct intervention such as iodized oil. They need, of course, specific instructions about the administration technique itself, but in addition they should be taught the justification for the chosen method of iodine supplementation, the procedures for its correct implementation, the risks of inappropriate use, its anticipated effect on communities as well as on individuals, and any groups to be excluded from supplementation. Health workers should have adequate opportunity for communication with the IDD Control Unit; this can occasionally be facilitated by recruiting an established well-informed medical leader for close collaboration between the Unit and health sector workers.

3. Workers in the salt trade

Iodization of salt is usually the ultimate goal in an IDD control program, and the cooperation of the salt industry is essential to its success. Traditionally, the prevention of disease is rarely a special concern of a profit-oriented sector such as the salt trade. The challenge is to convince "ordinary" workers such as porters, foremen, truck drivers, laboratory analysts, storemen, retailers, shop keepers, etc., that their contributions to the quality of iodized salt have a direct effect on the well being of mothers and children in their country. The same message should also reach managers and supervisors in the salt industry.

4. Citizen groups

Many groups fall into this category. Examples are civic and religious leaders, radio, television and newspapers, school teachers, civic groups such as mothers' clubs, organizations and charitable foundations, and international agencies. Materials may include brochures, articles for radio, television, and newspaper, videos, and slide shows, all aimed at a level appropriate for the particular target audience.

5. The iodine-deficient community

This is the most important group for education. A community that understands how iodine deficiency threatens it, and how easily it can be corrected, will not only cooperate with preventive measures but will demand them. In this way the affected community can be the most powerful advocacy group, insisting that its political leaders correct iodine deficiency. The education methods need to be adapted to the community's customs, sophistication and level of understanding. Examples will be given in the technical manual on communication, now in
preparation. Most methods will involve oral communication through schools, village leaders, local health workers, radio, videos, slide shows, posters, health fairs, and similar channels. For example, in Ecuador and Peru schoolchildren and other members of the target community are encouraged to develop and perform short plays or skits promoting the benefits of iodine supplementation. The performances are videotaped and played back to a highly attentive local audience, creating great interest in the correction of iodine deficiency. In Bolivia workers from the IDD Control program regularly set up booths and loudspeakers at regional fairs, dispensing information, iodized salt and iodized oil, and carrying out goiter examinations; they also help with childhood immunizations when these have not yet been administered, showing how one public health program can assist another.

E. Assessment, monitoring and evaluation

Once the IDD control program is in operation, periodic evaluation of its biological effects is mandatory. Chapter 2 described the techniques for goiter survey and urinary iodine determination. A reasonable period for a repeat survey is three years after the introduction of the iodization program. It is highly desirable to re-examine subjects in the same schools or villages used for the initial assessment. A network of "sentinel communities," carefully selected to be representative of the iodine-deficient population, can be very valuable for periodic reassessment by goiter survey and urinary iodine measurement.

It is also essential to monitor the iodine content of the salt. One component of this will be quality checks in the iodization plants and regular review of their records by the IDD Control Unit. Also, regional public health workers should routinely collect salt samples from the marketplace and homes, and send them to a central or regional laboratory for analysis of iodine content. The techniques for measurement of iodine in salt will be described in detail in an accompanying technical manual and are much simpler than the determination of iodine in the urine. They can be performed in laboratories at the sites of salt production and are also easily done in small regional laboratories. Simple kits and dropper bottles are available that even allow instant field-testing of salt for iodine content. Their use has allowed health inspectors in Thailand, China, Mexico, and Bangladesh, among others, to conduct on-the-spot monitoring in stores and homes, and to start an immediate investigation when the iodine content was not satisfactory. A significant deviation from the prescribed iodine level in salt should immediately alert the IDD Control Unit to the need for further investigation of the causative factors.

We strongly emphasize that monitoring and evaluation of the effects of implementation are crucial to the long range success of an IDD control program. There are many examples of countries with initially successful programs that later failed for lack of proper long range surveillance. The danger is readily understandable. Initially, a program generates excitement and publicity, but once it is successful, the iodization is taken for granted, and vigilance is relaxed and later disappears. The operational program must include clear safeguards for continued
monitoring on a permanent basis. The functions of the IDD Control Unit must be maintained intact, with an appropriate budget, to ensure permanent success of the IDD control program.

F. Summary

The basic administrative component of an IDD control program is the IDD Control Unit, with subprograms in epidemiology, iodized salt, and education. This Control Unit is usually located in the Ministry of Health, the Ministry of Planning, the Ministry of Mining or Commerce, or other appropriate governmental organizations, and receives policy direction from the National Council for the Control of Iodine Deficiency Disorders (NCCIDD). The IDD Control Unit must have specific designated funds for its operation. Education and communication are integral components of the program, and should have as targets politicians and decision makers, health workers, workers in the salt trade, non-medical citizens, and most importantly, the iodine-deficient community itself. A successful program must provide adequate surveillance of the biological impact of iodization, by periodic surveys of goiter and urinary iodines, and by constant monitoring of the iodine level in iodized salt. Failure to provide for adequate long term monitoring has caused many initially successful programs to fail.
CHAPTER 6. RESOURCES

This chapter lists opportunities for obtaining information and help on iodine deficiency.

A. International organizations

1. The International Council for the Control of Iodine Deficiency Disorders

This nonprofit international organization exists to eliminate iodine deficiency disorders in the world. Its members include physicians, public health workers, salt specialists, economists, communication experts, nutritionists, and others. Its Board includes representatives from these disciplines and from UNICEF, the World Health Organization, and the World Bank. Its activities are: (a) to acquire and disseminate knowledge about IDD; (b) to aid and promote advocacy for IDD control at all levels; and (c) to provide technical consultation and advice on all aspects of IDD. It operates through a Board of 32 persons, including an Executive Committee, four officers, and regional coordinators for Africa (including two subregional coordinators), the Americas, Europe, the Middle East, South Central Asia, and the Western Pacific. The Executive Committee, Regional Coordinators, and other Board members are listed at the end of this Guide. Further information can be obtained from any of these individuals.

2. The United Nations Children's Fund

UNICEF has offices in the capital cities of most developing countries. It has a strong interest in the correction of iodine deficiency, particularly because of its effects on the survival and development of children, and has provided extensive support in many countries worldwide. It has been especially valuable in organizational, educational, and communication aspects of IDD programs, and has provided salt iodization equipment in many countries. UNICEF is prepared to consider cooperation with governments in all aspects of the development and implementation of their IDD control programs, and an approach for support is best made to the UNICEF representation in the country concerned. Addresses for the New York headquarters and regional offices are given below:

UNICEF House
3 United Nations Plaza
New York, NY 10017, USA

UNICEF West and Central Africa Regional Office
Boite Postale 443
Abidjan 04, Ivory Coast
3. **World Health Organization**

This organization has a longstanding familiarity with IDD, and has been very active in its assessment and control. It is particularly active in the medical and technical aspects. It has country representatives in almost all developing countries, and they can be contacted for advice about IDD control. Addresses for the Geneva headquarters and regional offices are as follows:

**Nutrition Unit**
**Family Health Division**
**World Health Organization**
1211 Geneva 27, Switzerland

**Regional Nutrition Advisor**
**WHO/AFRO**
P. O. Box 6
Brazzaville, Republic of Congo

**Asesor Regional en Nutrition**
**PAHO/WHO**
525 23rd Street, N.W.
Washington, D.C. 20037, USA
Regional Adviser in Nutrition  
World Health House  
Mahatma Gandhi Road, Indraprastha Estate  
New Delhi 110 002, India

Regional Nutritional Adviser, WHO/EMRO  
P. O. Box 1517  
Alexandria, Egypt

WHO/WPRO  
United Nations Avenue  
P. O. Box 2932  
Manilla 2801, Philippines

Regional Nutrition Adviser, WHO/EURO  
8 Scherfigsvej  
DK-2100 Copenhagen, Denmark

4. World Bank

This organization operates many programs worldwide. The major focus is on financing of development programs and studies of socio-economic aspects. The address for the headquarters is: The World Bank, Population, Health and Nutrition Division, Population and Human Resources Department, 1818 H Street, N.W., Washington, D.C. 20433, USA

5. Bilateral programs

A number of countries maintain bilateral programs of assistance for less developed countries. These vary in countries, programs of interest, and amount budgeted. Some that have shown interest in IDD programs are listed as follows; others known to provide aid for other projects in a particular country might properly be approached through their country missions for aid in an IDD program:

Australia  
AIDAB  
G.P.O. Box 887  
Canberra A.C.T., Australia 2601

Canada  
Canadian International Development Agency (CIDA)  
200 Promenade du Portage  
Hull, Quebec  
K1A 0G4, Canada
Denmark
Ministry of Foreign Affairs
Q. Asiatisk
TLADS
DK 1448 Copenhagen, Denmark

Germany
Health, Nutrition and Population Department
Dag-Hammarskjold-Weg 1-2
Postfach 5180
D-6236 Eschborn 1, Federal Republic of Germany

Italy
Department of Development Cooperation
Ministry of Foreign Affairs
00100 Rome, Italy

Netherlands
Coordinator of Food and Nutrition
Ministry of Foreign Affairs
Bureau DST/Pl(a), P. O. Box 20061
2500 EB The Hague, Netherlands

Norway
Nutritional Consultant
C/O HEFA, Royal Norwegian Ministry
of Development Cooperation
P. O. Box 8142,
N 033 Oslo 1, Norway

Sweden
Director, Health Division
Swedish International Development Authority (SIDA)
S-105 25 Stockholm, Sweden

United Kingdom
The Secretary
Overseas Development Association
1 Stag Place
London SW1 5DH, England

USA
Director of Nutrition
USAID, Department of State
23 and C Streets, N.W.
Washington, D.C. 20001, USA
6. Others

Many nongovernmental organizations provide aid for developing countries. Each organization will typically have its own priorities for countries of interest and targets for aid. An iodine deficiency control program can relate to child and maternal health, nutrition, immunization, child survival, socioeconomic development, and agricultural improvement, among others. The following is a list of some organizations that have been either active in IDD control in the past or might be in the future. We emphasize that this list is only partial and in no way attempts to be complete.

Save the Children
54 Wilton Road
Westport, CT 06880, USA

Program for Appropriate Technology in Health (PATH)
4 Nickerson Street
Seattle, WA 98109, USA

Health Unit
OXFAM
274 Banbury Road
Oxford OX2 7DZ, England

B. Publications

1. Recent books


emphasis on Latin America, and concrete guidelines for goiter surveys, research and training, salt iodination programs, iodized oil use, planning, surveillance, and technical conduct of programs, and the functions of governmental and international institutions.


g. Strategies for Combating Endemic Goitre, by C. H. Thilly, P. Bourdoux, P. Contempre, B. Swennen, 1988; published as issue #175-176 of Children in the Tropics, available from International Children's Centre, Chateau de Longchamp, Bois de Boulogne, 75016, Paris, France. Also available in French - A general review of IDD control with emphasis on preventive measures, analysis of several national or regional programs, and comments on cost/efficiency.

2. Periodicals

a. IDD Newsletter - Published by ICCIDD quarterly since mid-1985. Obtainable from ICCIDD, C/O J. T. Dunn, editor, Box 511, University of Virginia Health Sciences Center, Charlottesville, VA 22908, USA, mailed free of charge, also distributed in bulk through UNICEF and WHO. Each issue, usually 12 or 16 pages, contains news of IDD from different countries and regions, abstracts from published and unpublished scientific and medical literature, and articles on prophylaxis and other aspects of IDD control programs.

b. Others - Reports on IDD are scattered through a number of scientific
publications, including those dealing with nutrition, geographical medicine, public health, and endocrinology.

C. Audiovisuals

1. Other literature

ICCIDD attempts to keep samples of literature used in IDD programs from throughout the world, including educational brochures, pamphlets, posters, and video cassettes. For further information, write J. T. Dunn, Secretary, ICCIDD or Ms. Nilima Chawla (E-9/20 Vasant Vihar, New Delhi 110 057, India). UNICEF and WHO have been active in developing communication programs for a number of countries, and their offices can be contacted for examples.

The Program in Endemic Goiter (PEG) has a Documentation Center to help people working in the field in obtaining relevant journal papers relevant to IDD. Contact PEG course (Dr. Pierre Bourdoux, Head of Radioimmunology Unit, Free University of Brussels, Hopital Saint Pierre, Rue Haute 322, B-1000 Brussels, Belgium).

2. Slide series

The foundation Teaching Aids at Low Cost (TALC) has developed a series of 24 slides with an accompanying teacher's manual on "Goitre and Cretinism" - A description of the symptoms, signs and medical management of endemic goiter and cretinism. The package is also excellent as a tool for self-learning. Details about ordering and prices from: TALC, PO Box 49, St Albans, Herts AL1 4AX, UK.

3. Films and video cassettes
   b. Barren Harvest, describes environmental degradation and IDD in Northern India, available from INTACH (Indian National Trust for Art and Cultural Heritage), 136 Golf Links, New Delhi, India.
J. B. Stanbury (Chairman)
43 Circuit Road
Chestnut Hill, MA 02167, USA

V. Ramalingaswami (Vice Chairman)
Indian Council of Medical Research
Ansari Nagar
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N. Kochupillai (India)
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