Policy Brief

Informing Salt Iodization Policies in Lebanon to Ensure Optimal Iodine Nutrition

K2P Policy Briefs bring together global research evidence, local evidence and context-specific knowledge to inform deliberations about health policies and programmes. It is prepared by synthesising and contextualizing the best available evidence about the problem and viable solutions through the involvement of content experts, policymakers and stakeholders.

Policy Brief Summary

+ Included

Description of a health system problem

Viable options for addressing this problem

Strategies for implementing these options

× Not Included

Does not make **recommendations**

1866 AUB American University of Beirut الجامعة الأميركية في بيروت
Faculty of Health Sciences
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K2P Policy Brief

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Faculty of Health Sciences
Center for Research on Population and Health | CRPH

IODINE global network
formerly ICCIDD Global Network

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Contents

Key Messages

الرسائل الأساسية

ما هي المشكلة؟

يعاني سكان لبنان بشكل عام من نقص في مادة اليود (*Iodine*) الذي هو عنصر غذائي ضروري. ويؤثر عدم توافره بكمية كافية في الغذاء على جميع الفئات العمرية ما يؤدي الى آثار صحية ضارة. وعلى الرغم من أن القانون رقم 178 لسنة 2011 (2011/178) يفرض تدعيم الملح بمادة اليود في لبنان، إلا أن تطبيق هذا القانون يبقى ضعيفاً، إلى جانب ضعف آليات التقييم والرقابة، الأمر الذي يؤدي إلى هذه المشكلة الصحية الحيوية.

ما الذي نعرفه حول ثلاثة عناصر يتم اعتمادها في المقاربات لمعالجة هذه المشكلة؟

العنصر الأول> تعديل أو استبدال قانون رقم 2011/178. ومن التوضيحات المقترحة في هذا السياق:

(1) إنشاء لجنة وطنية متعددة القطاعات مع واجبات ومسؤوليات محددة للأعضاء، و(2) توضيح تفاصيل مادة اليود المستخدمة في التدعيم كمّاً ونوعاً، (3) وإعادة النظر بعد، سنتين أو ثلاث من بدء التنفيذ، في ما إذا كانت هناك حاجة لإضافة اليود الى الملح المستخدم في التصنيع الغذائي .

- هناك الكثير من الأدلة الدامغة من دراسات علمية فردية تؤكد فوائد تدعيم الملح باليود من جهة وفوائد التشريعات التي تلزم إضافة اليود من جهة أخرى. لهذا فإن الصعوبة في تنفيذ التشريعات تبقى عاملًا رئيسياً يحدّ من التقدم.

العنصر الثاني> دعم جهود تنفيذ السياسات العالمية لإضافة اليود الى الملح من خلال ضمان وجود ما يلزم من المعايير والبنية التحتيّة والقدرات. ويمكن ضمان ذلك من خلال: (1 دعم الصناعة لضمان البنية التحتية الكافية وتطوير أو شراء المعدات المناسبة لمعالجة الملح باليود وتعبئته وتوضيبه، و(2) تدريب المدراء والموظّفين العاملين في قطاع الملح؛ و(3) تطبيق استراتيجية خاصة للتواصل في ما يختص بقطاع الملح؛ و(4) توفيق متطلّبات مواصفات الملح المعدّة من قبل مؤسسة القاييس والمواصفات اللبنانية (LIBNOR) مع المعايير العالمية والبيّنات المحلية، وجعل هذا المعيار إلزامي وإدراجه ضمن بنود الشروط المسبقة لتنفيذ القرارات التطبيقية.

- بالرّغم من عدم توثيق مراجعات منهجية تثني على جهود ضمّ الجهات المصنّعة للملح في برامج تطبيق تدعيم الملح بمادة اليود، إلا أنّ العديد من تجارب البلدان الأخرى كشفت أن الجهود المستمرة في تنفيذ إضافة اليود إلى الملح بالإضافة الى التعاون مع الشركات المصنعة للملح بضمّها الى برامج تطبيق تدعيم الملح بمادة اليود، أدّت إلى تقدم كبير وملموس في هذا الأمر.
- شدّدت أدلةٌ من دراسات علمية فردية، على أهمية عمليات الإنتاج والتعبئة والتغليف المناسبة والصحيحة وذلك بهدف تعزيز كفاءة برامج معالجة الملح باليود.

العنصر الثالث> مراقبة وتقييم تطبيق القانون من خلال:

(1) إجراء تحليل لهيكلية صناعة الملح بشكل عام ولمعرفة أين يجب تشديد المراقبة؛ و(2) رصد معدّلات اليود في الملح عند الإنتاج وعند البيع بالتجزئة، وعند المستهلكين، من خلال بناء نظام فعّال لجمع البينات بشكل دوري.

- يهدف نظام المراقبة والتقييم إلى التأكّد من تحقيق الأهداف المطلوبة على صعيد التغذية.

ما هي الجوانب التي يجب أخذها بعين الاعتبار عند التطبيق العملي؟

لعلّ أبرز العوائق التي يجب أخذها بعين الاعتبار هي على الصعيد الجهات المنتجة وعلى الصعيد الإداري الحكومي هي:

- إنّ تدعيم الملح بمادة اليود بالشكل السليم يفرض تكاليف إضافية على الجهات المنتجة حيث يتطلب هذا الأمر شراء معدّات خاصة، وصيانتها، إلى جانب شراء اليود، وتكلفة عملية التدعيم باليود، ثم التوضيب، وإجراءات ضبط الجودة على الصعيد الداخلي. وقد تتفاقم هذه المشكلة مع ممارسات إستيراد غير قانونية للملح الغير مدعّم باليود عبر الحدود اللبنانية أو تسرب ملحِ ذات تكلفة أقل وغير معالج باليود في الأسواق من قبل منتجين منافسين.
- مستوى الإلتزام السياسي والمالي لضمان سلامة آليات تنفيذ القانون، خاصة في ظل وجود عدد كبير من الأولويات للسياسات العامة الصحية. كما لا بد من الحرص على وجود القدرات البشرية والفنية/التقنية، والمؤسّساتية اللازمة لضمان تنفيذ القوانين والتشريعات واستدامة البرنامج الوطني.

Key Messages

What's the problem?

The overall problem is the existence of iodine deficiency among the Lebanese population. This is critical given that iodine is an essential nutrient and its deficiency can affect people of all age groups and yield detrimental health effects. Although a law (178/2011) that mandates salt fortification is in place in Lebanon, weak implementation of the law as well as the poor evaluation and monitoring systems have led to this critical health issue.

What do we know about three elements of an approach to addressing the problem?

Element 1› Amend or replace law 178/2011. Suggested clarifications include 1) establishing a multi-sector national committee with defined duties and responsibilities for members, 2) clarifying the form and amount of iodine used in fortification and 3) Considering after 2-3 years of implementation whether there is a need to fortify the salt used in food processing. There is compelling evidence from single studies on the benefits of universal salt iodization and its mandatory implementation through appropriate legislations. Difficulty in enforcing legislation remains a key factor limiting progress.

Element 2› Strengthen the implementation of universal salt iodization by ensuring adequate standards, infrastructure and capacity. This can be established by 1) supporting the industry to ensure adequate infrastructure and upgrade or purchase suitable equipment for the salt iodization and packaging, 2) training salt industry managers and employees, 3) implementing a communication strategy with the salt industry, 4) aligning the requirements of the Lebanese Standards Institution (LIBNOR) standard on salt with international and local evidence, making it mandatory and including it as a requisite in implementation decrees, and 5) building consumer awareness regarding the adequate use and storage of iodized salt

⇢ Although no systematic reviews were retrieved, the experience of other countries revealed that continuous efforts in implementing universal salt iodization along with the cooperation of the salt manufacturers have led to considerable progress in salt iodization.

- The evidence from several single studies highlighted the importance of establishing proper production and packaging processes to enhance the efficiency of salt iodization programs.

Element 3› Monitor and evaluate the implementation of the law by 1) conducting a salt situation analysis to identify the structure of the overall salt industry and where monitoring may be needed and 2) by monitoring salt iodine content at the production, retail and consumer levels by building an efficient system for routine data collection.

- Monitoring and evaluating systems help ascertain the achievement of the nutritional goals of the implementation.

What implementation considerations need to be kept in mind?

The most significant barriers to implementation are likely at the producer and government levels:

- Proper iodization of salt would entail additional costs for producers for purchasing the iodization equipment, the maintenance, the iodine supply, the iodization process, and the packaging and internal quality control. These could be compounded by the illegal importation of non-iodized salt through Lebanese borders or the leakage of less expensive non-iodized salt into retail markets by competing producers.
- The political and financial commitment of the government to ensure implementation and enforcement of the law given the multitude of health policy priorities in addition to the human, technical and institutional capacity to enforce regulations and sustain the national program.

Content

K2P Policy Brief

The Problem

Iodine deficiency among the Lebanese population was found in different studies about urinary mineral status conducted between 1960 and 2014. This is critical given that iodine is an essential nutrient needed for cognitive, neurological, mental, and psychomotor development in children and for the regulation of the body's metabolism. The current salt iodization program in Lebanon does not seem to guarantee adequate iodine intake and consequently normal iodine status in the population. This is likely due to the weak implementation of law 178/2011 on fortification of salt with iodine by salt producers as well as the poor evaluation and monitoring systems.

Size of the Problem

Background Information

Iodine is an essential nutrient needed for cognitive, neurological, mental, and psychomotor development in children [1] and for the regulation of the body's metabolism. Iodine deficiency affects people of all age groups [2] and yields detrimental health effects known, collectively as "Iodine Deficiency Disorders" (IDD). While some IDD are mild or moderate resulting from sub-optimal iodine intake, other consequences such as goiter or cretinism, occur in cases of chronic severe iodine deficiency [3].

Iodization of salt was first introduced in 1920 in the USA and in Switzerland [4] and consequently adopted by more than 120 countries all over the world [5]. This strategy was recognized as the most cost-effective and sustainable intervention to reduce iodine deficiency [6] because salt acceptability as a condiment is set in almost all populations and its intake is assumed to be constant unlike other types of food or even water [7]. Other methods to increase iodine intake include iodized water, iodized bread or milk, and iodized oil supplements by injection or by mouth (especially in remote areas)[7].

Iodization programs have contributed to worldwide progress in reducing iodine deficiency [8]. International reports have shown a beneficial effect of iodine fortification, more specifically Universal Salt Iodization (USI), in reducing the

Background to Policy Brief

A K2P Policy Brief brings together global research evidence, local evidence and context-specific knowledge to inform deliberations about health policies and programs. It is prepared by synthesizing and contextualizing the best available evidence about the problem and viable solutions and options through the involvement of content experts, policymakers and stakeholders.

The preparation of the Policy Brief involved the following steps:

1) *Selecting a priority topic according to K2P criteria*
2) *Selecting a working team who deliberates to develop an outline for the policy brief and oversee the litmus testing phase.*
3) *Developing and refining the outline, particularly the framing of the problem and the viable options*
4) *Litmus testing by conducting one to one interviews with up to 15 selected policymakers and stakeholders to frame the problem and make sure all aspects are addressed.*
5) *Identifying, appraising and synthesizing relevant research evidence about the problem, options, and implementation considerations*
6) *Drafting the brief in such a way as to present concisely and in accessible language the global and local research evidence.*
7) *Undergoing merit review*
8) *Finalizing the Policy Brief based on the input of merit reviewers, translating into Arabic, validating translation, and disseminating through policy dialogues and other mechanisms.*

prevalence of IDD all over the world. A recent World Health Organization (WHO) systematic analysis (2014) [9] confirmed the large effect of iodized salt has had on reducing goiter, cretinism and improving overall intelligence and mental development.

The WHO, United Nations Children's Fund (UNICEF) and the Iodine Global Network (IGN) therefore recommend USI as a reasonable, safe, and cost-effective strategy that guarantees sufficient iodine intake [5]. In fact, a 1986 study estimated that the costs of diagnosis and treatment of IDD could be cut from 8 USD/inhabitant/day to 8 cent/inhabitant/year, if salt iodization is implemented [10]. Direct economic benefits are expected in response to salt iodization; according to the World Bank, each US dollar spent on preventive strategies to reduce IDD would yield a gain of 28-30 USD [11]. For the developing world, the benefit to cost ratio of salt iodization was estimated at 70:1 [12]. Additionally, the cost of salt iodization per child per year varies between 0.02 and 0.05 USD while the cost of one disability-adjusted life year (DALY) is estimated to be around 35 USD [6].

Despite these efforts and the evidence in support of USI, 1.5-2 billion people in the world are not reached by adequately iodized salt and have insufficient iodine intake [6] while many countries still are classified as having IDD. The IGN currently classifies 26 countries with iodine deficiency [8] and globally, 29.8% of children (246 million) aged from 6 to 12 years have insufficient iodine intake [13].

The Eastern Mediterranean Region (EMR) is not immune from IDD. In 1987 and due to high rates of endemic goiter and iodine deficiency reported from countries of the region, IDD was officially recognized as a regional public health problem [4]. Since that time, many countries have implemented USI programs, and by 2002, 52% of households in the EMR were estimated to consume adequately iodized salt. Since then, programs have progressed while others have faltered [14].

The assessment of IDD in Lebanon started in the early 1960s when cases of goiter in villages were reported. Incidence of goiter among the Lebanese population was reported to range from 15% to 68.5% depending on the age, geographical location (coastal vs non-coastal), and socio-economic status [15] of the sample population. Although Lebanon is located on the Mediterranean Sea, the Lebanese diet, especially in mountain areas, is poor in fish and seaweeds [16-18], the main food sources of iodine [19]. The Lebanese diet also traditionally contains significant amounts of active goitrogens [16] (like cabbage, turnips, rutabagas, peach, pear, strawberry, spinach, carrot) that are known to inhibit absorption and uptake of iodine. To our knowledge, the iodine content in Lebanon's soil has never been assessed, although its concentration in soil is expected to be low as is the case all over the world. These combined factors had

led to low intake of dietary iodine, leading to a high prevalence of goiter and low urinary iodine concentration until action was taken in the 1990s.

The first national IDD assessment in Lebanon was conducted in 1993 and showed that the prevalence of goiter was 25.7%. No national updates have since been reported. Figure 1 describes chronological evidence related to iodine in Lebanon.

In Lebanon, in response to reports revealing the presence of endemic goiter, a law requiring salt iodization was set in 1971. However, due to internal conflicts and wars, the implementation only started in 1995 with support from UNICEF. Two large scale studies that have been conducted since that time on children post-implementation showed inconsistent results. While much as 90% of Lebanese households have been reported to consume "adequately" iodized salt in studies carried out in 1996 [20] and 2004 [21], more recent data suggests that the coverage has declined. This has been further corroborated by a sharp decrease in iodine status of the population, as reflected by a median urinary iodine concentration between 1997 (94.5 µg/l) and 2014 (66.0 µg/l) when optimal levels are between 100 and 199 µg/l. This finding highlights gaps in the salt iodization program that are likely due to the weak implementation of the law by salt producers as well as the frail evaluation and monitoring systems. In 2011, a revised legislation (178/2011) modifying the amount of iodine (from 10 to 200 mg/kg of iodine in 1971 to 60 to 80 mg/kg of either KI or KIO3 in 2011) and requiring the addition of fluoride to table salt was passed in Lebanon (Law 178/2011) and its implementation decrees were issued in June 2014 in the national gazette. In fact, the new salt iodization law aimed to tackle both iodine and fluoride fortification of salt at the same time. However, the inclusion of fluoridation has led to some ambiguity and confusion in the law, hindering progress. The Lebanese Standards Institution (LIBNOR), a public institution attached to the Ministry of Industry, also published in 2007 a standard on food grade salt.

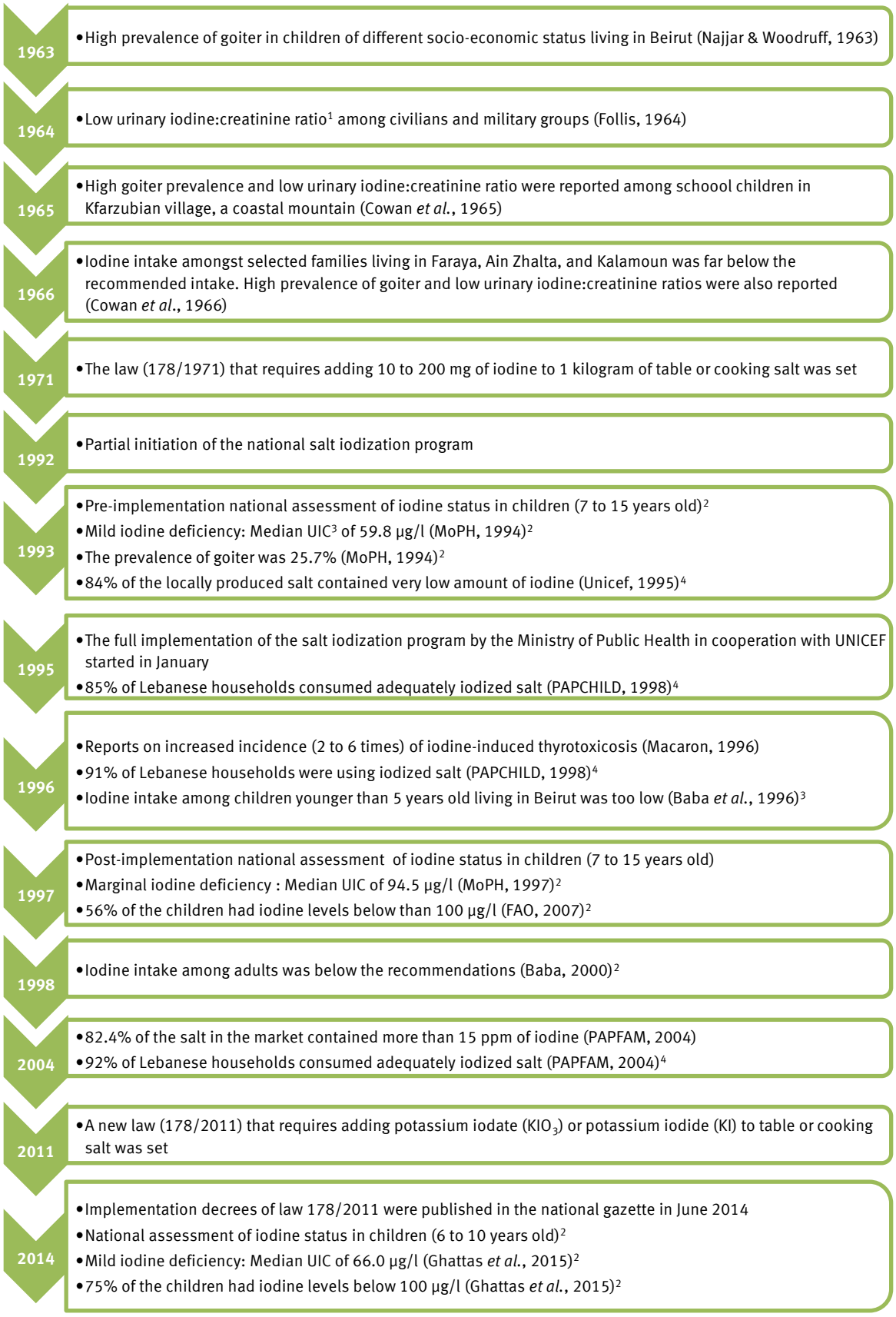

Figure 1- **Summary of evidence-Iodine in Lebanon**

Underlying Causes

The underlying factors of the problem are described below. The main barriers to successful implementation of USI has been the presence of loopholes in law 178/2011 and the lack of clarity among salt producers as to whether the law is in effect or not. Other barriers include the infrastructure and capacity of salt producers.

Consumption of coarse salt

The law does not cover coarse salt available in the market or traditionally produced by solar evaporation of seawater that is usually consumed by populations of lower socio-economic status (SES). In fact, several studies have reported a higher prevalence of iodine deficiency among populations of lower SES [22-24] by consuming non-iodized (coarse) salt [25, 26].

The law in its current form covers neither coarse salt nor industrial salt

Industrial salt

When salt intake is assessed, salt in processed food should be taken into account and it is considered the main provider of salt/sodium [27-29]. However, the Lebanese law does not cover the "industrial" salt used in processed foods (like meat, bread, cheese, etc.). In fact, amongst Lebanese children, sodium and iodine appear to have different food sources (not table salt) since a very poor correlation ($R2 = 0.039$; P-value <0.0001) was found between urinary excretion of sodium and iodine [22].

Definition and quantities

The first and second articles of the law state that iodine should be added to table and cooking salt as either potassium iodide (KI) or potassium iodate (KIO_3). However, within the same law, Article 7 specifies that iodine should be added as KIO_3 in an amount that ranges between 60 and 80 mg per kilogram of salt. It is not clear whether the quantity (reported in milligrams per kilogram which is equivalent to ppm) refers to the amount of iodine (I) or the amount of one of the two molecules (KI or KIO_3). Thus, different interpretations of this guidance would lead to different concentrations of iodine in the salt, depending on the form of iodine that is added to the salt, as shown in the example below:

Addition of 60 ppm as	1 kilogram of salt would contain
Iodine	60 mg of iodine
Potassium iodide	45.9 mg of iodine
Potassium iodate	35.6 mg of iodine

Method of iodization

Three methods and technologies are available for salt iodization: dripping, dry mixing, and spray mixing with higher quality reported for the latter two [30]. The current law is not clear on what methods to use for salt iodization. Lebanese manufacturers have used a combination of methods including the internationally approved techniques [31, 32] and self-invented ones. The self-invented techniques used by manufacturers are due to lack of training, expertise, and facilities leading to inconsistent iodine content in salt.

Methods of Iodization include dripping, dry mixing, and spray mixing with higher quality reported for the latter two

Packaging

The law also requires that iodized salt is wrapped in no more than 1-kilogram packs. Thus salt sold in larger quantities to other food manufacturers as an ingredient or to retailers who repackage the salt into 1-kilogram packs, is not subject to the law. Since the law does not specify whether salt iodization is the responsibility of the producer (salt manufacturers) or the retailer/re-packer, none of the parties are being held accountable.

Responsibility, monitoring, and compliance

The law does not clearly state the parties/ministries involved in the implementation or the monitoring process (from supplying iodine to measuring iodine content in the final product). Eventually, the absence of a clear monitoring system has opened the door to a lack of compliance [33, 34]. In a 2015 market study of twenty-five refined salt samples, 56% of the samples contained less than 15 ppm and 68% contained less than 35.6 ppm of KOI3[22]. Only 24% were adequately iodized (assuming that 60 to 80 ppm is the amount of KIO3 in salt). In the same context, the MoPH collected 38 samples from the Lebanese market and only one sample was considered adequately iodized. These findings are indicative of deficiencies in the salt production process as well as in the monitoring by the Ministry of Economy and Trade that was reported by salt producers to regularly

assess salt samples without reporting any deficiencies in the iodine content of salt [34].

Actual status of the law

The actual status of the law is also poorly understood. In addition to iodine fortification, the 178/2011 law included the addition of fluoride to salt, and manufacturers were given one year (end of 2012) to implement the new requirements. In response to the manufacturers' request, the time limit was extended to 2014 during which debates between health experts on the fortification of salt with fluoride took place. While implementation decrees were only published in June 2014, the status of the law in regard to salt iodization does not seem to be clear to salt producers. Informal ministerial discussions were reported to have agreed on the suspension of the fortification of salt with fluoride causing confusion as to whether the salt iodization component of the law was also put on hold, leading to non-compliance with the law.

Infrastructure and capacity of salt producers

In 1995 as the full implementation of the salt iodization program was taking place, funding agencies assisted with the costs of equipment for iodization of salt and provided iodine supply for 5 years. Since then, salt producers have not invested in renewing equipment for iodization of salt. There also has been no capacity building of their skills on the most updated international guidelines for salt iodization.

Elements of a comprehensive approach to address the problem

This section below provides an analysis of three elements to be considered for addressing the iodine deficiency problem in Lebanon, with particular emphasis on the law and its implementation. Most of the retrieved reviews were clinical in nature, assessing the effectiveness of iodine fortification on IDD or the prevalence of iodine deficiency rather than assessing the effectiveness and challenges in implementing USI as reported by Timmer in 2012 "A wealth of experience, materials and lessons learned exist [on USI] but are often not accessible to peers in other countries. A community of practice and more systematic documentation of lessons and experiences can provide a solution to this" [35].

Element 1

Amend or replace law 178/2011

Element 2

Strengthen the implementation of a USI law by ensuring adequate standards, infrastructure and capacity.

Element 3

Monitor and evaluate the implementation of the law

Elements

Policy Elements and Implementation Considerations

Element 1

Amend or replace law 178/2011

Law 178/2011 requires clarification, through its amendment or the drafting of a new law given the information gaps presented above. The suggested clarifications are to:

- **Element 1.1.** Establish a national USI/IDD coalition - Implementing and monitoring bodies

The legislation should clearly state the roles and responsibilities of the different stakeholders engaged in the implementation of the USI program (including but not limited to the responsibilities of salt producers, distributers, importers) and its monitoring (including the specific activities for internal and external monitoring of iodine in salt at the production sites [36]). In order to ensure the sustained elimination of IDD, the WHO recommends the creation of a multi-sector national IDD committee responsible for all aspects of the IDD program [36]. Members should include government officials, international health agencies, salt producers, researchers and consumer representatives, each with defined duties and responsibilities. As an example, a National Coalition for Sustained Optimal Iodine intake has played a significant role in the progress achieved towards the sustainable elimination of IDD in India [37]. Its most significant contribution has been to provide a platform for a regular dialogue among the partners and act as a high-level advocacy channel. The coalition ensures that sensitive tasks are pursued collectively rather than by individual stakeholders, thus minimizing the risks and optimizing expected gains [37]. At the state level, ineffective USI is seen in regions where coalitions are poorly functioning or where coordination between partners is missing [38].

- **Element 1.2.** Clarify the form and amount of iodine used in fortification

The law stipulates that both forms of iodine, potassium iodate and potassium iodide can be used to iodize salt. Potassium iodate is preferred given its higher stability, which has programmatic implications on effectiveness and cost [36]. The law should clarify the quantity for each of the two forms of iodine or limit the choices and require the use of one specific form (preferably KIO3).

The WHO, in its 2014 guidelines, suggests the following concentrations for the fortification of food-grade salt with iodine[39]:

Estimated salt consumption, g/day[a]	Average amount of iodine to add, mg/kg salt (RNI* + losses)[b]
3	65
4	49
5[c]	39

SUMMARY

Element 1
Amend or replace law 178/2011

Element 2
Strengthen the implementation of a USI law by ensuring adequate standards, infrastructure and capacity.

Element 3
Monitor and evaluate the implementation of the law

Estimated salt consumption, g/day[a]	Average amount of iodine to add, mg/kg salt (RNI* + losses)[b]
6	33
7	28
8	24
9	22
10	20
11	18
12	16
13	15
14	14

a. This includes table salt as well as salt from processed food

b. This is calculated based on the mean recommended nutrient intake of 150 µg iodine/day + 30% losses from production to household level before consumption, and a 92% iodine bioavailability.

* RNI: recommended nutrient intake

⇢ **Element 1.3.** Consider after 2-3 years of implementation whether there is a need to extend the fortification of salt to salt used in food processing..

The WHO recommends the fortification of all edible food-grade salt. This extends to all salt used in the household and food processing as well as for animal consumption [39]. A review of USI progress throughout the world between 2000 and 2009 revealed that adequate iodine nutrition was most likely to be achieved in countries that adopted a USI strategy on the entire supply of food-grade salt (including household salt and salt used in industrially manufactured foods) [40]. Given changing salt consumption patterns and an increase in the consumption of processed foods (which contribute around 67% of the average salt intake in Lebanon– from both local and imported products) [41], legislation should extend to include the salt content of industrialized processed foods [9].

Appropriate legislations provide the framework within which national salt iodization programs function. Given that law 178/2011 already exists and there is significant evidence for the benefits of USI and its mandatory nature, there is a need to ensure the absence of issues in the law in order to harness these benefits.

Table 1 **Key findings from systematic reviews and single studies**

Category of finding	Element 1
Benefits	While no systematic reviews were identified, compelling evidence from single studies and country experiences on enacting such legislations was retrieved. Numerous single studies reported eliminating iodine deficiency within 1 year of legislation in South Africa [42], 2 years in Lesotho [43] and 7 years in Iran [44, 45]. A study in In Lesotho found that, whereas iodization of table salts alone did not eliminate iodine deficiency, legislation on universal salt iodization of food-grade salt and other salt intended for human and animal consumption eliminated iodine deficiency as a public health problem within 2 years after its implementation [43] A literature review found that the compulsory use of iodized salt in processed foods in all of selected food segments, enacted in 4 of the 27 EU member states and in 13 countries of the UN CEE/CIS region*, contributed to successful elimination of iodine deficiency [46]. According to the UNICEF global database, 55 out of 117 developing countries have enacted legislations for mandatory universal salt iodization which appear to be effective. The data show that those countries with legislation had a larger increase in household consumption of iodized salt than those without legislation.[5] Of 20 European and North American countries with effective iodine legislations, most countries with mandatory iodization have achieved adequate iodine status while only half of those with voluntary iodization did [47]. In fact, voluntary iodization or focusing on household salt alone was found to be less likely conducive for success [40]. Universal salt iodization mandated by law can be a more equitable strategy since it reaches most of the population, and is likely to be more sustainable since it can be readily monitored, allowing adjustments in the level of fortification [48] The importance of legislation clarifying the form and amount of iodine used in fortification is supported by the findings from numerous studies whereby the effectiveness of salt-iodization programs to deliver adequate amounts of iodine at the consumer level largely depended on the stability of iodine, [43, 49-52] Several studies conducted on more than 20 food products containing salt fortified with potassium iodate or potassium iodide did not find adverse effects on food quality. However, a

Category of finding	Element 1
	very limited number of adverse effects on product quality and appearance was observed at high iodine content. [9, 46]
Potential harms	Implementation of USI may lead to excessive urinary iodine concentrations [53-55] and increase in the risk of iodine-induced hyperthyroidism (IIH) in vulnerable people [43, 56] requiring effective monitoring and evaluation systems [57]. In almost all iodine fortification programs, early stage implementation results in outbreaks of IIH and mainly affects older adults with long-standing thyroid nodules [58].
Cost and/ or cost effectiveness in relation to the status quo	There are direct economic benefits for salt iodization; according to the World Bank, each US dollar spent on preventive strategies to reduce IDD would yield a gain of 28 US dollars (USD) [11]. For the developing world, the benefit to cost ratio of salt iodization was estimated at 70:1 [12]. Additionally, the cost of salt iodization per child per year varies between 0.02 and 0.05 USD while the cost of one disability-adjusted life year (DALY) is estimated to be around 35 USD [6].
Uncertainty regarding benefits and potential harms (so monitoring and evaluation could be warranted if the approach element were pursued)	Although no large-scale investigations have been conducted to assess the relation between iodine fortification and iodine-induced thyroiditis, cases have been reported to be aggravated or even induced by increasing iodine intake [58]. The WHO/UNICEF/ICCIDD have stated that a USI program with adequate salt iodine levels and good population coverage can meet the increased iodine requirements of pregnant women (50% increase in requirements compared to non-pregnancy). This may be at the expense of school-aged children who would have more-than-adequate and excessive intakes [59]. Conversely, some studies have reported that the increased needs of iodine during pregnancy toned to be covered by oral supplementation [60] since salt iodization only meets basic recommended intake for children which is lower than requirements of pregnancy. In Poland, a pharmacotherapy of 150 mcg/d is given to support extra needs during pregnancy and breastfeeding [61].
Key elements of the approach if it was tried elsewhere	The success of salt iodization depends on the situation (such as policy and infrastructure) in each country, however, certain key elements of successful salt iodization programs are: - Mandatory salt iodization and ensuing availability of adequately iodized salt - Ensuring political commitment - Forming partnerships and coalitions including

Category of finding	Element 1
	the multi-sector national IDD committee
	A WHO report [53] clearly states that the difficulty in enforcing legislation is a key factor limiting the progress of USI.
Stakeholders' views and experiences	We could not find any studies reporting on stakeholders' views and experiences

* Central and Eastern Europe and the Commonwealth of Independent States

Element 2

Strengthen the implementation of a USI law by ensuring adequate standards, infrastructure and capacity

This element promotes effective implementation of a USI law.

Setting a clear straight forward law and having political commitment are pre-requisite to effective program implementation [38]. Implementation requires the full involvement of the salt industry as well as training at all levels in management, salt technology, laboratory methods and communication [36]. The Indian experience showed that enhancement of adequately iodized salt coverage is reported when salt industries improved production process [38] highlighting the key role of the production in the success.

⇢ **Element 2.1.** Support the industry to ensure adequate infrastructure and upgrade or purchase suitable equipment for the salt iodization and packaging

In the 1990s, UNICEF shared the costs of equipment with the producers and provided iodine supply over 5 years. The current available equipment in factories was reported not to meet the requirements for proper iodization in Lebanon.

It is critical to ensure a strong infrastructure for iodization and packaging of all human and livestock salt, as well as support the infrastructure with quality assurance measures[62]. A key requirement for the production of accurately iodized salt is the presence of a functional internal quality control program operating concurrently with the iodization process. This can further be enhanced in the presence of written quality control plans, availability of equipment and reagents and record-keeping [63] .

Adequate packaging and storage space are other important factors to retain the iodine content in salt and enhance the efficiency of salt iodization programs. "Laminate of low-density polyethylene" or "woven high-density polyethylene" bags with continuous film inserts have been recommended as effective, low-cost packaging methods for iodized salt. [64] In addition, the storage of salt in a dry place and clean airtight plastic containers as well as

avoiding excess exposure to heat and sunlight could help reduce post-production loss of iodine at retailer and consumer levels. [51]

⇢ **Element 2.2.** Training of salt industry managers and employees

Training of those involved in the day-to-day production of iodized salt is necessary to ensure proper implementation [36, 65]. Staff at production lines needs to be constantly trained and their skills standardized on standard operating procedures (the method of choice to fortify the salt with iodine and adequately measuring iodine concentration using validated quantitative and qualitative methods).[63] The most commonly used quantitative method for determining the iodine concentration in salt is titration. Ideally, salt producers should have the capacity to use titration method to routinely check the accuracy of salt iodization onsite.[62]

⇢ **Element 2.3.** Complement the implementation with a communication strategy

Communication messages should target the salt industry including producers, distributors, food processors, retailers and others in order to ensure effective implementation. Messages to be highlighted include the importance of iodine, its health benefits, the detrimental consequences of iodine deficiency and excess; and emphasize their critical contribution to implementation of USI [66]. Misconceptions that could present barriers to their acceptance of iodized salt need to be addressed as well [66].

⇢ **Element 2.4.** Align the requirements of the Lebanese Standards Institution (LIBNOR) standard on salt with international and local evidence, make it mandatory and include it as a requisite in implementation decrees.

LIBNOR standards are voluntary in nature unless a decree is issued to make them mandatory and are reviewed every 5 years. The standard specifies several criteria such as: the types of salt covered, the quality control, the packaging and storage [67]. In regard to the amount of iodine, the standard refers to the quantity specified by the responsible entity, the Ministry of Public Health.

⇢ **Element 2.5.** Build consumer awareness regarding the adequate use and storage of iodized salt

Specific and appropriate communication strategies are vital to raise consumer awareness about appropriate use and storage of iodized salt. Given the high volatility of iodine, the general population should be made aware that placing the iodized salt container above the oven or adding salt during cooking will lead to the loss of the iodine.

Table 2 **Key findings** from systematic reviews and single studies

Category of finding	**Element 2**
Benefits	While no systematic reviews were identified, the experience from other countries revealed that continuous efforts in implementing USI along with the cooperation of the salt manufacturers have led to considerable progress in salt iodization [38] The evidence from several single studies highlighted the importance of ensuring proper production and packaging process to enhance effectiveness of salt iodization program: The results from one study indicated that controlling moisture content in iodized salt during the course of manufacturing and distribution by improved processing, packaging, and storage is critical to the stability of the added iodine. [64] Specifically, packaging salt in low-density polyethylene bags was found to significantly decrease iodine losses, with the iodine content remaining relatively stable for six months to one year. [64] Another report suggested the loss of iodine from salt packaged in good quality small polyethylene bags to be less than 10% over an period of 18-month, irrespective of climatic conditions and texture of salt [62]
Potential harms	Consumer and food producers demand for non-iodized salt – such as coarse salt – can push local stores and food shops to supply such a product; this circumstance must be taken into account when developing programs or deploying implementation and should be addressed through information and communication efforts targeting specific audiences [9].
Cost and/ or cost effectiveness in relation to the status quo	Iodine is considered among the cheapest fortificants, costing less than USD 0.02 per year [58]. Despite this fact, the additional cost of iodine needs to be subsidized and should not be added to initial price in order to limit the risk of increased iodine deficiency among low SES populations [68, 69]. At a national level, fortification of salt with 20 to 40 ppm of potassium iodate costs around USD 45,625 per year for a country of 10 million people [58]; thus, a fortification of 60 to 80 ppm in a country of 5 million people equates to around USD 57,031.
Uncertainty regarding benefits and potential harms (so monitoring and	The use of appropriate packages for iodized salt would increase the cost and thus the price of locally produced refined salt; potentially triggering the consumption of coarse salt or illegally imported salt also available in the market [70].

Category of finding	Element 2
evaluation could be warranted if the approach element were pursued)	
Key elements of the approach if it was tried elsewhere	Effective implementation of a multi-sectoral program requires coordination of various stakeholders [38]. Interagency collaboration is important for program planning and vital for program implementation [71].
Stakeholders' views and experiences	Committee members in general understand and agree on the importance of the elimination of IDD. A factory owner in Palestine mentioned that assuring proper iodization is a "moral responsibility" of the manufacturers [72].

Element 3

Monitor and evaluate the implementation of the law

- **Element 3.1.** Conduct a salt situation analysis

The proposed multi-sectoral national IDD committee needs to conduct a salt situation analysis to identify the structure of the overall salt industry and where monitoring may be needed. Information is needed on sources of salt production, sources of imported salt and the distribution of salt within the country [73].

- **Element 3.2.** Monitor salt iodine content at the production, retail and consumer levels by building an efficient system for routine data collection
  - At the *production level*, monitor the salt iodization process and salt iodine content by adopting quality assurance measures.
    - A routine internal monitoring system, which relies on rapid salt test kits
    - An external monitoring system already exists. It is led by the Ministry of Industry and the Customs Authorities in collaboration with the Industrial Research Institute (IRI). The IRI reported measuring iodine and giving results as KIO3.
    - Internal and external monitoring have to take place at both factories and packers levels if the two procedures are separate (this first has to be clarified by the law) [36].

Lebanon has only four main manufacturers that produce around 89.7% [48] of salts consumed in Lebanon, facilitating monitoring [71] and achieving the goal of USI [58].

- *At port entry for imported salt*. In Lebanon, imported salt may be ready for human consumption and iodized, or may require processing to be consumed by humans and then iodized.
  - Food inspection officers of the Customs Authority and the Ministry of Economy and Trade need to take samples and send them to the relevant laboratories (such as the Industrial Research Institute) for testing to ensure that imported salt contains the same amount of iodine required by the Lebanese legislation.
  - Inspection for conformity has to take place before imported salt packets enter the country.
  - Capacity building of food control and enforcement personnel may be needed in order to track and distinguish iodized from non-iodized salt [66].
- *At the retail level*. Iodine concentration in salt is not constant; it is expected to observe a decrease in iodine content of salt between the production and the retailer levels [51].
  - Monitoring is necessary to assess the availability of counterfeit salt or salt not meeting standards [36].
  - The Consumer Protection Directorate under the authority of the Ministry of Economy and Trade or non-governmental organizations representing consumers such as Consumers Lebanon can assist in monitoring and be a powerful tool to pressure companies [66].
- *At the consumer level*. Packaging of iodized salt, its transportation and storage at retail before reaching consumers' plates might be responsible for inadequate iodine content at consumer level (especially under certain climatic conditions) [49]. The lack of monitoring of salt transported by road has challenged the good implementation of the salt iodization program in India [38]. This uncontrolled transportation is reported to have worsened the coverage of adequately iodized salt [38].
- *At household level*, monitoring should cover
  - The assessment of iodized salt: the type of salt used, the quantity of daily salt intake as well as the method and conditions of storage have to be assessed in order to assure adequate delivery of health and technical messages and convenient coverage of iodized salt (44).
  - The proportion of households using iodized salt adequate to meeting iodine requirements,
  - The assessment of iodine status through population-based

median urinary iodine concentration of school-aged children (12 – 16 years) one year post-implementation followed by every 5 years [36].

Annex 1 presents suggested criteria for measuring success at various monitoring stages for salt iodization programs.

Additional targeted interventions may need to be considered for vulnerable populations. Where USI has been in place for at least 2 years and the salt is adequately iodized, the needs of women of childbearing age and pregnant women are likely to be met by their diet. However, iodized salt may not provide the requirements of children during complementary feeding (unless foods are iodine-fortified) as nutrition guidelines discourage the addition of salt to home-prepared food. In such instances, and when pregnant women are unable to meet their requirements, iodine supplements may be considered [60].

Populations consuming mainly coarse salt or salt by evaporation of seawater will also need to be identified and offered adapted interventions.

Table 3 **Key findings from systematic reviews and primary studies**

Category of finding	**Element 3**
Benefits	Monitoring and evaluating systems help ascertain the achievement of the nutritional goals of the implementation [58]
Potential harms	No potential harms were identified for the monitoring and evaluation of the implementation phase.
Cost and/ or cost effectiveness in relation to the status quo	The estimated cost of household monitoring is less than USD 10,000 per year (O. Dary, personal communication, 2004) [58]
Uncertainty regarding benefits and potential harms (so monitoring and evaluation could be warranted if the approach element were pursued)	The sensitivity of the indicator must be taken into consideration. Hence, change in iodine status in response to salt iodization, using goiter as an indicator, takes up to 2 years. Whereas, urinary iodine concentration is a more sensitive indicator that increases a few weeks after increasing iodine intake [58].
Key elements of the approach if it was tried elsewhere	Monitoring at different levels was found to yield paramount benefits in all conditions; - At the production level, where internal and external monitoring have to take place (41). - At port entry level, where the tracking system should be strong enough to identify iodized from non-iodized salt (68). - At the retail level, to further inspect and detect any

Category of finding	Element 3
	unconformity (41). - At the consumer level, to assess iodine losses during transportation and make sure that initial iodine amounts account for these intangible losses (43), (70).
Stakeholders' views and experiences	We could not find any studies reporting on stakeholders' views and experiences.

Implementation considerations

Experiences of other countries reveal barriers in the implementation of USI, its monitoring and evaluation; these are likely to be encountered in Lebanon as well. Several reports have highlighted the lessons learnt from these contexts. Key barriers and counter strategies are presented in the table below.

	Barriers	Counterstrategies
Consumer	In Lebanon, salt price was reported to double when iodization took place in the mid-1990s. In 1993, a kilogram of iodized salt cost between 0.5 and 0.9 USD while the price of non-iodized salt ranged between 0.25 and 0.5 USD (34).	More subsidization of cost by the government so that the subsidized rate encourages a wider proportion of the population to consume iodized salt rather than non-iodized [71]. This might create external dependency causing impediments in the program sustainability
	Any further increase in the cost of iodized salt may lead to an increase in the proportion of the population consuming non-iodized salt (such as coarse salt or salt by evaporation of seawater or illegally imported salt).	There is no need to promote consumption of iodized salt if it is mandatory and well regulated. Surveillance should identify high- risk populations including pockets of poverty, and monitor salt supply in their regions [74].
Producer	Several disincentives among producers are presented below [71] Low demand for iodized salt by the food industry	Initiate collaboration with the salt industry as early as possible – at planning/ratification phase as part of the multi-sector national IDD committee – as it improves producers' level of knowledge of iodine deficiency and encourages a sense of ownership for the program among them [66, 71]. Salt producers should ensure that only iodized salt is provided to the food industry (*Unpublished report by Timmer, A and Gorstein, J. Iodine nutrition and USI: Implications of the changing landscape*).
	Worries about changes in quality and appearance of the product. For example, Lebanese dairy producers are likely to worry about the yellowish color of yogurt and strained yoghurt obtained from adding iodine.	The Lebanese Standards Institution (LIBNOR) requires that the ingredients of any processed food meet the standards established for each ingredient including food grade salt (table salt and salt used in processed foods) [67]. Reassure producers that fortification of salt used for processed foods has

	Barriers	Counterstrategies
		been shown to have a very limited number of adverse reactions on product quality and appearance observed at high iodine content and when using potassium iodate [9, 46].
	Additional costs for iodization equipment, maintenance, the iodine supply, the iodization process, the packaging and internal quality control. These in turn could lead to an increase in price of iodized salt between 1 and 24% [75], increasing the share of population consuming non-iodized salt. Lebanese producers have reported that an increase from 60 – current practice – to 80 mg of iodine (assuming that these are the levels mentioned in the law) to every kilogram of salt would lead to their inability to compete with the market given the current price of 50-60 dollars per ton of salt (Al Akhbar).	Request IGN technical support [71]. Exempt salt producers from paying taxes [71]. Make the importation and procurement of KIO3 exempt from taxes. Offer producers of iodized salt a national seal of recognition to incorporate in their salt packaging and to use as part of their marketing strategy [71].
	Leakage of inexpensive bulk industrial salt (non-iodized) into retail markets and households by producers [66].	Ensure the law applies to all salt (human and animal consumption, industrial or imported, refined and coarse salt – produced outside the formal sector
	The illegal importation of non-iodized salt through the Lebanese borders.	Ensure proper monitoring at the borders
	Iodine producers typically sell shipments of 1 MT minimum, which is beyond the practical need and financial carrying capacity of the very small producers, rendering them vulnerable to intermediary traders with the expected markups from each transaction [40].	Develop sustainable and predictable procurement supply of iodine premix (rising and variable cost, cost recovery systems, legacy of donor dependence) (*Unpublished report by Timmer, A and Gorstein, J. Iodine nutrition and USI: Implications of the changing landscape*).
	Shortage in iodine supply [40].	
Health Sector	There are on-going initiatives in Lebanon to reduce the excess sodium in bread and processed foods. There are concerns about a drop in iodine intake with lower	Iodine experts report no conflict between salt reduction and consumption of iodized salt as the amount of iodine in salt can be increased as salt intake decreases

	Barriers	Counterstrategies
	addition of salt to processed foods.	[57, 76].
Government	Lack of understanding, awareness and commitment among key gatekeepers (public, private, civic, and academic sectors) (*Unpublished report by Timmer, A and Gorstein, J. Iodine nutrition and USI: Implications of the changing landscape*).	Ensure intensive education and lobbying of politicians and other opinion leaders of all levels [60] Maintain iodine nutrition on the agenda by renewing commitment to support oversight and implementation of program (*Unpublished report by Timmer, A and Gorstein, J. Iodine nutrition and USI: Implications of the changing landscape*).
	Political and financial commitment of the government to ensure implementation and enforcement of the law given the multitude of health policy priorities.	Improve the awareness of government authorities of the consequences of iodine deficiency and the benefits of consuming iodized salt [71]. Strengthen national coordination among all relevant stakeholders (*Unpublished report by Timmer, A and Gorstein, J. Iodine nutrition and USI: Implications of the changing landscape*). National budgeting
	The human, technical and institutional capacity to enforce regulations and sustain the national program.	Engage international organizations (IGN) to assist the government in the implementation and enforcement processes. Build capacity at the government level Long term contracts Reinforcing the monitoring of salt at ports of entry
	The capacity to enforce salt legislation at border sites facilitating the entry of non-iodized salt [71].	Transfer responsibility for monitoring local program implementation to local governments or subnational committees [71].
International Organizations	Continuous financial support to sustain the national program may constitute a burden.	Phasing out of donor contributions of iodine supply and parts of iodization equipment. The government can cover costs in a transition process before salt producers absorb all costs with minimal increase in cost of retail salt [5, 71].

Next Steps

Next Steps

The aim of this policy brief is to foster dialogue informed by the best available evidence. The intention is not to advocate specific policy options/elements or close off discussion. Further actions will flow from the deliberations that the policy brief is intended to inform. These may include:

- Deliberation amongst policymakers and stakeholders regarding the policy elements described in this policy brief.
- Refining elements, for example by incorporating, removing or modifying some components

Annexes

Annexes

Annex I. Suggested criteria for measuring success at various monitoring stages for salt iodization program (40)

Level	Indicators	Goals
Household	Proportion of households using adequately iodized salt	›90%
	The percentage of household salt with an iodine content according to government standards as determined by RTK and by titration in a sub-sample	›90%
Population	Median urinary iodine concentration in the general population	100–199 g/l
	Median urinary iodine concentration in pregnant women	150–249 g/l
	Proportion of the population having urinary iodine below 100µg/l	‹50%
	Proportion of the population having urinary iodine below 50µg/l	‹20%
	Total Goiter Rate (TGR) in school-age children	‹5%
Retail (production or importation)	Proportion of salt for human consumption must be iodized according to government standards for iodine content as determined by titration	95%
Program	1. Presence of a national multi-sector coalition responsible to the government for the national program for the elimination of IDD with the following characteristics: • National stature; • All concerned sectors, including the salt industry, represented, with defined roles and responsibilities; • Convenes at least twice yearly. 2. Demonstration of political commitment as reflected by: • Inclusion of IDD in the national budget (either as specific program funds or through inclusion in existing program funds) particularly with regard to procurement and distribution of KI03.	8 out of 10

Level	Indicators	Goals
	3. Enactment of legislation and supportive regulations on universal salt iodization, which establishes a routine mechanism for external quality assurance. 4. Establishment of methods for assessment of progress in the elimination of IDD as reflected by: • Reporting on national program progress every three years. 5. Access to laboratories as defined by: • Laboratories able to provide accurate data on salt and urinary iodine levels and thyroid function. 6. Establishment of a program of education and social mobilization as defined by: • Inclusion of information on the importance of iodine and the use of iodized salt, within educational curricula. 7. Routine availability of data on salt iodine content as defined by: • Availability at the factory level at least monthly, and at the household level at least every five years. 8. Routine availability of population-based data on urinary iodine every five years. 9. Demonstration of ongoing cooperation from the salt industry as reflected by: • Maintenance of quality control measures and absorption of the cost of iodate/iodide. Presence of a national database for recording of results of regular monitoring procedures, which include population-based household coverage and urinary iodine (with other indicators of iodine status and thyroid function included as available).	

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