



Strahlenschutzkommission

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Use of Iodine Tablets for Thyroid Blocking in the Event of a Nuclear Emergency with Release of Radioactive Iodine

Recommendation by the
German Commission on Radiological Protection

Adopted at the 294th session of the German Commission on Radiological Protection,
26 April 2018, amended at the 298th session of the German Commission on Radiological
Protection, 6 February 2019

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**Verwendung von Jodtabletten zur Jodblockade der Schilddrüse bei einem
Notfall mit Freisetzung von radioaktivem Jod**

Empfehlung der Strahlenschutzkommission

This translation is for informational purposes only, and is not a substitute for the official statement. The original version of the statement, published on www.ssk.de, is the only definitive and official version.

Foreword

Based on experiences of the reactor accident in Fukushima and the current guideline of the World Health Organisation (WHO) on Iodine Thyroid Blocking, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) requested the Commission on Radiological Protection (SSK) to review and, if applicable, to update the information leaflets last published in 2011 on the “Use of Iodine Tablets for Iodine Thyroid Blocking in the Event of a Nuclear Accident” (so-called iodine information leaflets).

The iodine information leaflets were revised by the working group “Medical Emergency Management” of the committees “Radiation Protection in Medicine” and “Emergency Management” of the Commission on Radiological Protection resulting in the present recommendation. The following persons were members of the working group:

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Overall, the review showed only a marginal need for revision of content, both in the information leaflet for physicians and pharmacists as well as in the information sheet for the general public. However, the information leaflets were edited and supplemented with the objective to improve comprehensibility and to provide more extended information on the protection concept.

Bonn, April 2018

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1 Recommendation and background

Based on experiences of the reactor accident in Fukushima and the current guideline of the World Health Organisation (WHO) on Iodine Thyroid Blocking 2017, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) requested the Commission on Radiological Protection (SSK) to review and, if applicable, to update the information leaflets on the “Use of Iodine Tablets for Iodine Thyroid Blocking in the Event of a Nuclear Accident” (so-called iodine information leaflets) last published in 2011.

Overall, the review showed only a marginal need for revision of content both in the information leaflet for physicians and pharmacists as well as in the information sheet for the general public. However, the information leaflets have been edited and supplemented with the objective to improve comprehensibility and to provide more comprehensive information on the protection concept.

The objective of iodine thyroid blocking by intake of high doses of stable iodine at levels 100 to 1000 times higher than the daily dietary intake is primarily to prevent radiation-induced thyroid cancer in highly vulnerable groups of the general public (foetuses, children and adolescents). Pregnant and breastfeeding women also belong to the group of highly vulnerable persons.

In the past, Germany was considered a country with distinct regional dietary iodine deficiency. Due to the implementation of iodised table salt, this situation has improved significantly in Germany since 1989. However, current studies show that, according to the criteria of the World Health Organisation (WHO), slight iodine deficiency still exists, which is no longer due to regional aspects, but to diet. Therefore, iodine thyroid blocking in Germany is of higher importance than in countries with an adequate supply of iodine.

The SSK recommendation indicates that persons above the age of 45 years are not to be administered potassium iodide tablets for iodine thyroid blocking (hereinafter referred to as iodine tablets). The reason is that with increasing age, the risk of side effects such as the triggering of hyperthyroidism in an iodine deficient goiter is higher than the minor risk of developing thyroid cancer due to an accident-caused exposure to radioactive iodine. For the time being, the SSK recommends to retain the age limit of 45 years as orientation value since thyroid status has not yet changed as markedly due to the improved iodine supply among older persons than among younger persons. The mentioned age limit does not apply to workers of a nuclear facility during an emergency or directly thereafter.

As a rule, the single intake of tablets with an adequate amount of stable iodine is sufficient. The iodine leaflets of 2011 already referred to exceptions to this rule. If nothing else, the course of the reactor accident of Fukushima showed that radioactive iodine can be released repeatedly over a period of days. In the event of recurrent or prolonged release of iodine or if radioactive iodine is released more than a few hours after intake of tablets, the SSK recommends to repeat the intake of iodine tablets.

The current recommendations newly contain references to further early protective actions such as sheltering, evacuation and restrictions on consuming contaminated food and drinking water have been adopted in the current recommendation. The use of simple respiratory masks (FFP3-masks) is not recommended, as they do not provide sufficient protection to serve as a substitute for iodine thyroid blocking.

Authorities competent for planning iodine thyroid blocking are strongly recommended to provide the iodine information leaflets and information on iodine thyroid blocking to physicians and pharmacists in potential distribution areas in advance – e. g. by references to

the website www.jodblockade.de. It is recommended further to address the subject of iodine thyroid blocking as part of medical education.

In addition, the SSK recommends the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety to initiate the harmonisation of the action iodine thyroid blocking in Europe.

2 Information leaflet for physicians, pharmacists and the professional community

Preliminary remarks

The competent authorities for civil protection stockpile potassium iodide tablets for distribution to the public in a nuclear or other radiological emergency provided they have not already been pre-distributed. The current leaflet is intended to inform physicians, pharmacists and the professional public about key issues associated with iodine thyroid blocking. A separate information leaflet for the general public will be referred to in this context.

Iodine tablets provide no protection against external radiation or against the effects of radioactive substances other than iodine that were absorbed by the body.

What is the principle of thyroid iodine thyroid blocking?

The fission products originating from nuclear reactors in operation include various radioactive isotopes of iodine, which are exceptional due to the biological character of iodine namely its uptake by the thyroid and its binding to hormone precursors during biosynthesis of thyroid hormones. At the temperatures present in nuclear reactors, iodine has a gaseous state; it is therefore expected that in an emergency, under unfavourable circumstances, radioactive iodine will be released into the air. Most of this radioactive iodine will be deposited on the ground and on vegetation and may be ingested by humans with contaminated food, especially milk. Volatile radioactive iodine may also be inhaled from the air and absorbed by the lungs.

After absorption by the lungs or resorption in the stomach, radioactive iodine behaves in exactly the same way as stable iodine. It is transported in blood plasma and temporarily accumulated in the salivary glands and the gastric mucosa. Iodine is primarily taken up by the thyroid by means of the so-called sodium-iodide symporter (NIS) and stored there for a relatively long period (biological half-life of approximately 80 days). The uptake and storage depends on thyroid function; in the case of normal thyroid function, it depends in particular on the dietary supply of iodine (normally 100 microgram to 200 microgram daily).

The thyroidal uptake of radioactive iodine can be effectively blocked, if shortly before or during its uptake, a large quantity of stable (non-radioactive) iodine is ingested at high single doses (approximately 100 to 1000 times the normal daily nutritional intake, between 12.5 mg and 100 mg of iodine depending on age, see Table 1). According to current findings, "iodine thyroid blocking" resulting hereby is achieved by a massive increase in the iodine plasma level, which leads to significantly reduced transportation of radioactive iodine into the thyroid cell via NIS by means of a mechanism not yet clarified. The iodine still circulating in the blood plasma, but not stored by the thyroid, is quickly eliminated via the kidneys with a biological half-life of a few hours. For this reason, the effectiveness of iodine thyroid blocking rapidly decreases after intake of iodine tablets; this must be taken into account in the event of recurrent or prolonged release of radioactive iodine.

Effects of radioactive iodine on the thyroid: What is the objective of iodine thyroid blocking and for whom is it of particular concern?

If very large quantities of radioactive iodine are taken up by the thyroid e. g. of workers in a damaged nuclear plant, the radiation emitted can lead to death of substantial proportions of thyroid tissue resulting in hypothyroidism weeks or months later.

Radioactive iodine can be transported in the air over long distances so that smaller quantities can be inhaled by the population. Besides uptake via inhalation, radioactive iodine can also be taken up by the thyroid via the food chain and in particular via contaminated milk. In these cases, the radiation dose is generally too small to cause hypothyroidism by cell death. However, radiation may cause mutations in surviving cells possibly leading to thyroid cancer. Foetuses after the third month of pregnancy as well as children and adolescents up to the age of 18 are particularly vulnerable in this respect.

The primary objective of iodine thyroid blocking is to prevent radiation-induced thyroid carcinomas in foetuses, children and adolescents of the affected population. The protection of pregnant and breastfeeding women is a priority too, in order to protect the foetuses or infants via the mother.

For workers at a nuclear facility involved in actions during or directly after an emergency, iodine tablets can also serve to prevent hypothyroidism.

What is the relevance of nutritional iodine deficiency in connection with iodine thyroid blocking?

In the past, Germany was considered a country with distinct regional dietary iodine deficiency. With the introduction of iodised table salt, this situation has improved significantly in Germany since 1989. However, current studies show that, according to the criteria of the World Health Organisation (WHO), slight iodine deficiency still exists, which is no longer due to regional aspects, but to diet. In case of nutritional iodine deficiency, the thyroid is "hungry for iodine" and takes up more radioactive iodine released in a nuclear emergency than with adequate iodine supply. As a result, iodine thyroid blocking in Germany is of greater importance than in iodine sufficient countries.

Are there groups in the population less vulnerable to radioactive iodine?

The relative risk of developing thyroid cancer after radiation exposure is significantly less for persons older than 45 years of age than for children and adolescents (<18 years of age). As to whether elder adults can develop radiation-induced thyroid carcinomas at all – and if so, then with a significantly lower probability – has been subject of scientific debate for a long time. It is considered certain that, in adults, there is a long latency period of 30 to 40 years before manifestation of such a cancer. Based on current life expectancy, this means that only a small percentage of the few affected persons in the group above <45 years will develop thyroid cancer, if at all.

On the other hand, persistent slight iodine deficiency in Germany results in a higher frequency of benign thyroid disease in terms of nodules in the population, particularly among older persons (25 % to 40 % of persons, who are older than 45 years of age compared to 10 % to 15 % of persons, who are 45 years of age or younger). Approximately one third of these nodules in older adults are functionally autonomous meaning that if elevated quantities of iodine are taken up, as in the case of iodine thyroid blocking, there may be a risk for causing possibly severe hyperthyroidism, which should not be neglected.

Consequently, in terms of a benefit-risk evaluation and the situation of persistent slight iodine deficiency in Germany, it is indicated that the recommendation valid to date not to perform iodine thyroid blocking in persons older than 45 years of age is quite reasonable and still applies regarding protective actions in civil protection.

Workers highly exposed to radioiodine (e. g. in nuclear facilities involved in actions during or directly after emergencies) should receive iodine tablets regardless of their age in order to prevent damage of thyroid tissue.

Are there measures additional to iodine tablets to protect oneself?

The instruction to take iodine tablets is only one of a number of protective actions taken by the competent civil protection authority and other authorities competent for civil defence. To prevent uptake of radioactive iodine from air inhaled, the authority may also recommend sheltering with the windows and doors closed until the “radioactive plume” has passed by. Timely evacuation can be more effective in this respect; especially before radioactive iodine is released. It may be necessary to combine these actions with iodine thyroid blocking. Monitoring and withdrawal of contaminated food and drinking water by the authorities is particularly effective to prevent the uptake of larger quantities of radioactive iodine. Monitoring and withdrawal of contaminated milk is particularly crucial in this respect.

When is iodine thyroid blocking indicated?

To request iodine thyroid blocking will be considered by the competent authorities only if, based on the radiological situation, a significant release of radioactive iodine has to be expected. As the risk of a radiation-induced thyroid cancer is definitely elevated in foetuses, children and adolescents, the protection of children, adolescents, pregnant and breastfeeding women will therefore be a priority of this protective action.

The release of radioactive iodine at a scale that justifies iodine thyroid blocking for the population is normally detected in time. Therefore, an advance warning period of hours to days can be assumed during which the authorities can take protective actions based on the assessment of the radiological situation and further information. The valid intervention reference levels of the Radiological Bases for Decisions (SSK 2014)¹ are taken into account in the decision regarding protective actions. It is necessary to inform the population that it is useless and even harmful to undertake iodine thyroid blocking on their own initiative, i. e. without instruction by the competent authorities.

The highly-dosed iodine tablets intended for iodine thyroid blocking may only be taken in case of release of radioactive iodine. They are not suited to supplement dietary iodine deficiency. They also do not constitute a “radiation protection substance” universally effective against any kind of radiation damage; they are only effective on the thyroid.

Iodine blocking is not indicated for patients whose thyroid has been totally removed surgically. This does not apply to patients whose thyroid has only been partially removed.

How does iodine thyroid blocking function depend on the time of intake of the tablets and of the release of radioactive iodine?

As the uptake curve of the thyroid is initially very steep, iodine thyroid blocking is most effective (95%) if stable iodine is present shortly before the radioactive iodine is resorbed by

¹ SSK 2014: Strahlenschutzkommission (SSK). Basic Radiological Principles for Decisions on Measures for the Protection of the Population against Incidents involving Releases of Radionuclides Recommendation of the German Commission of Radiological Protection. Adopted at the 268th meeting of the Radiation Protection Commission on 13/14 February 2014. [urn:nbn:de:101:1-201412088183](https://nbn-resolving.org/urn:nbn:de:101:1-201412088183)

the body. However, administering stable iodine within the first hours following the resorption of radioactive iodine also still reduces uptake (administration of iodine after two hours – reduction of radioactive iodine thyroid uptake by 60% to 80%, administration of iodine after eight hours – reduction of thyroid uptake by 20% to 40%). On the contrary, administration of stable iodide more than 24 hours *after* completed inhalation or ingestion does no longer provide any protective effect on the uptake of radioiodine, as the retention period of radioiodine in the thyroid is even extended after that time. This is why iodine tablets should not be taken after that time any longer. If iodine tablets are taken too early, that is, more than 24 hours *before* radioactive iodine is resorbed, repeated stable iodine administration is necessary at best less than 2 hours before.

Is iodine thyroid blocking allowed and indicated for pregnant and breastfeeding women?

Thyroid blocking recommended by the competent authorities should be implemented in pregnant women, irrespective of their age, in order to protect the foetus.

The thyroid of the foetus takes up iodine starting from about the twelfth week of pregnancy. From the sixth month there is significant storage of iodine in the foetal thyroid. Thyroid blocking is therefore also necessary for the older foetus; this is achieved via administration of stable iodine to the pregnant woman – without the need for special adaptation of the dosage.

During lactation, iodine is secreted into the mother's milk in quantities that vary individually. Since this does not ensure sufficient iodine thyroid blocking for the breastfed child, newborns and infants should also be given iodine tablets (see dosing schedule, Table 1).

Women treated with high doses of iodine during pregnancy and lactation should be instructed to inform their midwife and paediatrician about this, so that they pay special attention to possible hypothyroidism in the newborn.

What dosage of iodine tablets is to be taken?

As well as the timing of administration, the quantity of stable iodine is crucial for blocking thyroidal uptake of radioactive iodine. Since it is important that the blocking is as complete as possible, a high plasma concentration of stable iodide is required. In adults this is achieved by a single 130 mg dose of potassium iodide.

Reducing the dosage does not reduce potential side effects and does not result in any additional substantial reduction of radiation dose to the thyroid.

Tab 1: Dosing schedule for 65 mg potassium iodide tablets

Age group	65-mg potassium iodide tablets	One-day dose in mg potassium iodide	One-day dose in mg iodine
< 1 month	$\frac{1}{4}$	16.25	12.5
1 to 36 months	$\frac{1}{2}$	32.5	25
3 - 12 years	1	65	50
13 -45 years	2	130	100

(For tablets with a different potassium iodide content please consult the respective dosage instructions.)

Pregnant and breastfeeding women should receive the same dose of stable iodine as individuals in the age group 13 to 45 years. The same applies to patients whose thyroid has been partially removed.

Wherever possible, potassium iodide should not be taken on an empty stomach due to its potential irritation of the gastric mucosa. The tablets can be swallowed or dissolved in liquid. Administration of the adequate proportion of a tablet to infants and children can be facilitated by dissolving it in a drink, such as water or tea. However, the solution is not stable and must be drunk immediately.

Iodine tablets should only be taken on the instructions of the competent authorities. These will specify which groups of individuals are to take the tablets.

Can it be necessary to repeat intake of iodine tablets?

In principle, a single administration of iodine tablets is sufficient. Depending on the radiological situation, the competent authorities may request repeated administration of iodine tablets e. g. in cases of prolonged or repeated release of radioactive iodine, more than 24 hours after the last administration of iodine tablets. The protective effect of iodine correlates inversely with the period of time between the intake of the tablets and the absorption of the radioactive iodine. Effectiveness declines to 80% after 48 hours, to 50% after 72 hours and to only 10% if the tablets were taken 96 hours before the absorption of radioactive iodine.

In the case of pregnant and breastfeeding women and newborns, other actions should be taken by the competent authority to ensure that a second administration of iodine tablets is not required.

What are the health risks of iodine thyroid blocking?

Individuals with a known hypersensitivity to iodine (very rare conditions such as genuine iodine allergy, dermatitis herpetiformis [Dühring's disease], iododerma tuberosum, hypocomplementemic vasculitis, myotonia congenita) must not take iodine tablets. Occasionally iodine tablets may also cause skin rashes, tissue oedema, sore throat, tearing eyes, rhinitis, swelling of the salivary glands or fever.

Very rarely signs of hypersensitivity to iodine ("genuine" iodine allergy), e. g. iodine rhinitis or iodine exanthema may develop. The possibility of iodine intolerance should not be overestimated. Iodine resorption can be inhibited by irrigating the stomach with a starch solution (30 g per 1 litre, until the blue colour disappears) or with 1% to 3% sodium thiosulphate solution. To accelerate excretion, administration of Glauber's salt and forced diuresis are recommended. A possible cardiovascular shock as well as fluid and electrolyte imbalances are to be treated in the normal manner.

In pre-existing thyroid disorders, even if asymptomatic until then (especially in the case of nodular goitre with functional autonomy), hyperthyroidism may be induced within weeks or months of iodine intake.

Contrary, especially newborns and infants may develop hypothyroidism if administered higher iodine doses. Therefore, children in this age group, who have taken iodine tablets for thyroid blocking, should be examined by a paediatrician for possible iodine-induced hypothyroidism.

A healthy adult thyroid gland has regulatory mechanisms to tolerate an overload of iodine without a harmful increase in the production of thyroid hormones (the so-called Wolff-Chaikoff effect). However, this protective effect can be disrupted (so-called escape

phenomenon) in goiters with autonomous nodules due to prolonged dietary iodine deficiency or as a result of autoimmune processes in thyroids that appear to be normal, e. g. in early stages of Grave's disease. In consequence, following distribution of iodine tablets for thyroid blocking to larger populations, a higher incidence of hyperthyroidism is to be expected even without existing pronounced clinical symptoms of thyrotoxicosis .

When is iodine thyroid blocking contraindicated?

Contraindications occasionally referred to in the literature, although unsubstantiated, are coronary insufficiency and tuberculosis in its various forms. Both pregnancy/lactation and hypothyroidism/thyroiditis are also mentioned, but these are no contraindications.

Iodine must not be administered in cases of known "genuine" iodine allergy. This is very rare and must not be confused with an intolerance reaction or an allergy to X-ray contrast agents, which is usually not caused by small amounts of free iodide in the agent but by organically bound iodine of the contrast material.

Under no circumstances iodine should be administered to patients with the very rare conditions of dermatitis herpetiformis (Duhning's disease), iododerma tuberosum, hypocomplementemic vasculitis or myotonia congenita.

Wherever possible, patients undergoing treatment for hyperthyroidism should consult their attending physician before taking iodine tablets. After the nuclear emergency, all hyperthyroid patients – whether under treatment or not – should be monitored medically by hormone analyses at short-term intervals.

Can other medications be used for thyroid blocking?

A number of monovalent anions (such as perchlorate or thiocyanate) competitively inhibit thyroidal uptake of iodine by the sodium iodide symporter (NIS) due to their anion volume very similar to iodide. Therapeutically, this mechanism is used when sodium or potassium perchlorate is administered to treat hyperthyroidism. In Germany, Irenat^R is a commercially available preparation of sodium perchlorate. It is also used successfully in nuclear medicine to block undesired thyroidal uptake of free radioactive iodide from some radiopharmaceuticals.

Due to the substantial risk of side effects, sodium or potassium perchlorate, is a second choice pharmaceutical for thyroid blocking and should only be used for rare contraindications of potassium iodide. Frequent side effects of perchlorate include skin rash, swelling of the lymph nodes, fever and decrease in the number of leucocytes. Agranulocytosis, aplastic anemia, icterus and nephrotic syndrome are observed more seldom.

Taking perchlorate during pregnancy is not recommended as sufficient experiences with respect to a potential risk to the foetus are lacking. If treatment with perchlorate is unavoidable while breastfeeding, the baby should be weaned.

The following dosages of sodium perchlorate are recommended for thyroid blocking, which must, wherever possible, be taken a few hours before the absorption of radioactive iodine:

Adults: single dose of 600 mg – 1 000 mg (= 30 – 50 drops of Irenat^R)

Children: single dose of 300 mg – 600 mg (= 15 – 30 drops of Irenat^R) per m² body surface area.

In the case of recurrent or prolonged release of radioiodine as well as when release occurs more than a few hours after the pharmaceutical has been taken, repeated perchlorate administration is necessary after 24 hours , under certain circumstances, analogous to iodine thyroid blocking.

3 Information leaflet for the general public

A nuclear accident involving the release of radioactive iodine

Under unfavourable circumstances, accidents in nuclear facilities, especially in nuclear power plants, may result in the release of radioactive substances, including radioactive iodine.

Radioactive iodine has the same chemical and biological properties as the iodine that occurs naturally in food and is therefore stored in the thyroid gland in the same way as normal, non-radioactive iodine. This storage mechanism of the thyroid distinguishes iodine from other substances. Taking iodine tablets with a high iodine content (approximately 100 to 1000 times the daily dietary intake) as a countermeasure can prevent radioactive iodine from being taken up by the thyroid. This method is known as “iodine thyroid blocking” (referred to in the following as iodine blocking).

How does radioactive iodine enter the body?

Like other substances in the human environment, radioactive iodine can mainly enter the body in two ways:

- with the air via the respiratory system,
- with food and drink via the stomach and digestive system.

Absorption via intact skin is usually so insignificant that it has not to be taken into account. Intake of radioactive iodine with water or food can be considerable – e. g. if milk is drunk from cows whose feed was contaminated.

How do iodine tablets function?

To function normally, the thyroid gland needs small amounts of iodine, which are usually absorbed with food. This is why the use of iodised table salt or low-dose iodine tablets (0.1 mg to 0.2 mg) is recommended to prevent iodine deficiency disorders. However, these low-dose tablets are not suited for iodine blocking.

For iodine blocking, only tablets containing a significantly higher dose of iodine as provided for a nuclear emergency are suitable, since they block radioactive iodine from being taken up by the thyroid. The excess iodine is quickly excreted from the body.

How can I protect myself in addition to the use of iodine tablets?

The absorption of radioactive iodine by inhaled air can be significantly reduced by staying indoors with windows and doors closed. Timely evacuation can be more effective in this respect; ideally before radioactive iodine is released. It may be necessary to combine these actions with iodine blocking. To prevent ingestion of larger quantities of radioactive iodine, the most effective way is not to consume possibly contaminated freshly harvested leafy vegetables or other food and drinks (e. g. milk), until officially approved within the radioactivity limits.

The competent authority decides about the implementation of the protective actions taking into account the radiological situation and the corresponding recommendations of the German

Commission on Radiological Protection e¹. Pay attention to the official information; comply with their instructions and conduct recommendations.

Why and when is the preventive intake of iodine tablets necessary?

It must be emphasised that iodine tablets are supposed to only provide protection shortly before or after thyroidal uptake of radioactive iodine through inhalation; protection is most effective when the iodine tablets are taken shortly before the potential inhalation of radioactive iodine. Taking the tablets too early (more than 24 hours before the inhalation of radioactive iodine) or too late (at the very most eight hours after inhaling radioactive iodine) may impair the protective effect for the thyroid. Taking iodine tablets later than 24 hours after the absorption of radioactive iodine does no longer provide any protection; indeed, it will then do more harm than benefit.

Iodine tablets do not protect against other radioactive substances.

Where and when can iodine tablets be obtained when needed?

The competent authorities maintain adequate stocks and store iodine tablets to be distributed immediate to the affected population for iodine thyroid blocking as planned in case of emergency, provided they have not already been pre-distributed under certain conditions.

The distribution of iodine tablets is a precautionary action and does not mean that the tablets should be taken immediately. If it is actually necessary to take the tablets, the competent authorities will expressly request the affected population – e. g. via radio, TV or loudspeaker announcements – to do so.

Pharmaceuticals identical to the tablets stocked by the authorities should be available without prescription in pharmacies.

Whether it is necessary to take of iodine tablets can only be decided by the competent authorities on the basis of all the information available to them and an expert assessment of the radiological situation. Therefore, the tablets should never be taken at one's own initiative or fears.

Caution: Highly-dosed iodine tablets containing different amounts of potassium iodide can be ordered from abroad via the Internet. These do not represent approved pharmaceuticals; their use is discouraged.

What are the effects of iodine tablets and how are they used?

Iodine tablets block the uptake of radioactive iodine, thereby blocking its storage (so-called iodine thyroid blocking), if taken at the recommended dosage and time. This type of iodine tablets is not suitable for supplementing dietary iodine deficiency. However, in an emergency, they can be taken in addition to the far lower dosed iodine tablets, used to treat dietary iodine deficiency.

¹ SSK 2014: Strahlenschutzkommission (SSK). Basic Radiological Principles for Decisions on Measures for the Protection of the Population against Incidents involving Releases of Radionuclides Recommendation of the German Commission of Radiological Protection. Adopted at the 268th meeting of the Radiation Protection Commission on 13/14 February 2014. [urn:nbn:de:101:1-201412088183](https://nbn-resolving.org/urn:nbn:de:101:1-201412088183)

The primary objective of iodine thyroid blocking is to prevent radiation-induced thyroid cancer in fetuses, children and adolescents. Priority should also be given to protect pregnant and breastfeeding women in order to protect the fetuses or infants via the mother.

Iodine blocking is not necessary for patients whose thyroid has been completely removed by surgery. This does not apply to patients whose thyroid has only been partially removed.

What is the dosage of iodine tablets and how are they used?

Tab. 1: Dosage schema for 65 mg potassium iodide tablets

Age group	65-mg potassium iodide tablets
Birth to 1 month	$\frac{1}{4}$
1 to 3 years	$\frac{1}{2}$
3 years to 12 years	1
Above 12 years to 45 years	2

(For tablets with a different potassium iodide content please consult the respective dosage instructions.)

Children older than 12 years and adults take 2 tablets once. Children from 3 years to 12 years old take 1 tablet once. Infants from one month to 3 years of age take a single dose of $\frac{1}{2}$ tablet. Neonates up to the 1 month of life take a single dose of $\frac{1}{4}$ tablet.

Pregnant and breastfeeding women receive the same iodine dose as the age group older than 12 years to 45 years. The same applies to operated patients after partial removal of the thyroid.

Wherever possible, iodine tablets should not be taken on an empty stomach. The tablets can be swallowed or be dissolved in liquids. To facilitate administration of the adequate dose to infants and children, the tablets can be dissolved in a drink, such as water or tea. However, the solution is not stable and must be drunk immediately.

Iodine tablets should only be taken when instructed by the competent authorities. Their instructions will specify which groups of individuals are to take the tablets.

Is it possible that iodine tablets may have to be taken again?

In principle, a single administration of iodine tablets is sufficient. Additional tablets should only be taken if recommended by the competent authorities. If, by mistake, iodine tablets were taken too early, that is, more than 24 hours before absorption of radioactive iodine, administration has to be repeated. The protective effect of iodine tablets decreases the longer the period of time between the intake of the tablets and the absorption of radioactive iodine: to 80 % if radioactive iodine is inhaled after 48 hours, to 50 % after 72 hours and to only 10 % if the tablets were taken 96 hours before the inhalation of radioiodine.

For pregnant and breastfeeding women and newborns, other actions should be taken by the competent authorities to ensure that a second administration of iodine tablets is not required.

Should iodine tablets be taken by pregnant and breastfeeding women?

Regardless of age, pregnant and breastfeeding women should perform iodine thyroid blocking as recommended by the authorities to protect the unborn and the infant, respectively. Iodine

tablets taken by pregnant women also protect the unborn child via iodine available in the circulation of the mother. In spite of the transfer of stable iodine through the milk, the breast-fed child should be given the recommended dose of stable iodine (Tab. 1). The mothers should inform their midwife and the paediatrician about iodine thyroid blocking performed so that especial attention to this fact is paid when mandatory thyroid screening of the infant is performed.

What are the intolerances and risks of iodine tablets?

Iodine tablets must not be taken by persons who have the following confirmed diagnoses:

- known genuine hypersensitivity to iodine (this is very rare and should not be confused with the less infrequent allergy to X-ray contrast agents),
- very rare diseases (Dermatitis herpetiformis Duhring, an immunologically caused blistering skin disease and hypocomplementaemic vasculitis, an allergy associated disease of small blood vessel walls).

In rare cases, taking iodine tablets may also cause allergic reactions such as skin rashes, oedema, sore throat, tearing eyes, rhinitis, swelling of the salivary glands, fever or other similar symptoms.

Persons who have been diagnosed with hyperthyroidism should consult their physician before taking iodine tablets. In patients with goiter or thyroid nodules, there is an increased risk that iodine tablets may induce overactivity of the thyroid (hyperthyroidism). Therefore, such persons should consult a physician shortly after taking the tablets.

A physician should also be consulted if symptoms indicating an overactive thyroid develop between one week and three months after taking the tablets. Such symptoms include restlessness, accelerated pulse, weight loss or constant diarrhoea.

Should persons over the age of 45 take iodine tablets?

For two reasons including people over the age of 45 years into the protective action iodine thyroid blocking (stocking, distribution of the tablets) is not recommended:

1. Nodules and resulting metabolic disorders of the thyroid become more common with increasing age. Such a functional autonomy of the thyroid common in patients with thyroid nodules increases the risk of side effects from iodine thyroid blocking.
2. The risk of thyroid cancer caused by exposure to radiation declines greatly with increasing age.

What are the possible side effects of iodine tablets?

Irritation of the stomach lining can occur, especially if the iodine tablets are taken on an empty stomach. If symptoms persist a physician should be consulted.

What do iodine tablets not protect against?

Iodine tablets provide no protection against radiation from outside the body, or against the effects of radioactive substances other than radioiodine, which may be absorbed into the body.

Urgent request:

- In an emergency, pay attention to official loudspeaker announcements, the news and notifications on regional radio and television stations as well as official warnings issued via mobile devices via an app or the Internet.
- In your interest, comply with the notifications, recommendations and instructions of the competent authorities, as they hold all information related to the radiological situation necessary to assess the situation and implement appropriate protective actions.

Note:

Like all medicines, the tablets should be stored protected from light and moisture and kept out of the reach of children.

Iodine tablets should be taken only upon the specific instructions of the competent authorities. Taking the tablets too soon or too late may result in insufficient protection of the thyroid. In addition, the risks and side effects listed above must be observed.

4 References

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