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Detoxify or Die: Natural Radiation Protection Therapies for Coping With the Fallout of the Fukushima Nuclear Meltdown

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> *Foot-dragging in recognizing obvious problems and the resultant delays in preventing exposure and mitigating the effects lies at the door of nuclear power advocates more interested in preserving the status quo than in helping millions of innocent people who are suffering through no fault of their own*. - Nesterenko, A. V., Nesterenko, V. B. and Yablokov, *Chernobyl: Consequences of the Catastrophe for People and the Environment*.

© AP/NTV Smoke ascends from the Fukushima Dai-ichi nuclear plant's Unit 3 on Monday 14 after a second hydrogen explosion.

We have had conflicting reports from mainstream news sources regarding the nuclear emergency in Fukushima, Japan. Some say that it is not nearly as bad as the Chernobyl catastrophe, others say that it will be much worse than Chernobyl. What are we to make of this? Who can we trust?

With the current state of affairs, I think it is reasonable enough to expect and prepare for the worst, hope for the best and take what comes. It is with this state of mind that I set out to review the available literature about accessible and alternative therapies in case of nuclear disasters as well as data about the Chernobyl catastrophe. What I found was shocking enough but know that there is also well-documented essential knowledge that can protect you and your loved ones.

This article includes an overview of the publication *Chernobyl: Consequences of the Catastrophe for People and the Environment* which appeared in *Annals of the New York Academy* (2009). The authors - Alexey V. Nesterenko (Institute of Radiation Safety (BELRAD), Belarus) and Alexey V.

Yablokov (Russian Academy of Sciences) along with Vassily B. Nesterenko - synthesized information from several thousand cited scientific papers and other materials, including successful and widely available natural therapies that worked. There are also other numerous studies about alternative effective treatments in case of radiation. It will give you a clear idea of what to expect and what you can do in case of a nuclear disaster in Japan.

This is a matter that concerns all of us as no country in the world is capable of providing complete protection from radiation for those living in affected areas and from eating locally grown foods that are contaminated with radiation.

A Lesson from History or What to Expect: The Chernobyl Catastrophe

We have to look only as far back to Chernobyl to understand why we are having so many conflicting reports and little information about what is happening in Japan.

In the last days of spring and the beginning of summer of 1986, radioactivity was released from the Chernobyl power plant and fell upon hundreds of millions of people. The resulting levels of radionuclides were **hundreds of times higher than that from the Hiroshima atomic bomb.**

The normal lives of tens of millions were destroyed. Today, more than 6 million people live on land with dangerous levels of contamination. More than 20 years after the catastrophe, due to the natural migration of radionuclides, the dangerous consequences in these areas have not decreased, but have actually increased and will continue to do so for many years to come.

Authorities typically provided the least possible financial means for detoxification therapies and disaster control while they denied the facts and documented data concerning dangerous levels of radiation among the population, in foods and the environment.

Sound familiar? This attitude has been the norm rather than the exception.

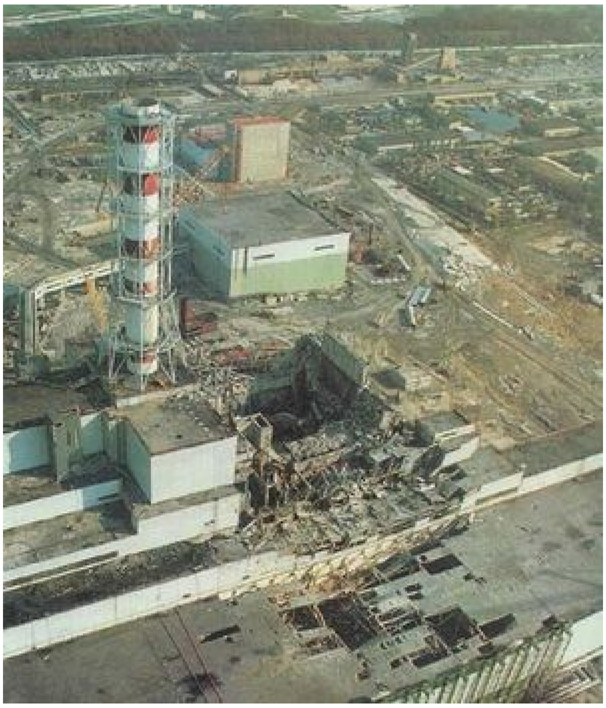
As a result of the catastrophe, **40% of Europe was contaminated with dangerous radioactivity**. Asia and North America were also exposed to significant amounts of radioactive fallout. According to Yablokov et al., the claim by the International Atomic Energy Agency (IAEA), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and several other groups that the Chernobyl radioactive fallout added "only" 2% to the natural radioactive background ignores several facts:

> "First, many territories continue to have dangerously high levels of radiation. Second, high levels of radiation were spread far and wide in the first weeks after the catastrophe. Third, there will be decades of chronic, low-level contamination after the catastrophe. Fourth, every increase in nuclear radiation has an effect on both somatic [body] and reproductive cells of all living things."

Another important lesson from the Chernobyl experience is that experts and organizations tied to the nuclear industry have dismissed and ignored the consequences of the catastrophe. It was only after 8 or 9 years from the catastrophe that the medical authorities began to finally admit the universal increase in cataracts among the population. The same occurred with thyroid cancer, leukemia and organic central nervous system disorders.

In addition to that, it is known that the percentage of food products with radioactive contamination in excess of official permissible levels did not decrease for 14 years after the 1986 Chernobyl catastrophe. On the contrary, this percentage began to increase in 1996. In spite of official secrecy, the full picture of Chernobyl food contamination in countries as far away as the United States has finally begun to emerge:

> "Many people suffer from continuing chronic low-dose radiation 23 years after the catastrophe, owing primarily to consumption of radioactively contaminated food. An important consideration is the fact that given an identical diet, a child's radiation exposure is three- to fivefold higher than that of an adult. Since more than 90% of the radiation burden nowadays is due to Caesium-137, which has a half-life of about 30 years, contaminated areas will continue to be dangerously radioactive for roughly the next three centuries.
>
> "When children have the same menu as adults, they get up to five times higher dose burdens from locally produced foodstuffs because of their lower weight and more active processes of metabolism. Children living in rural villages have a dose burden five to six times higher than city children of the same age.
>
> "Daily exposure to small amounts of radionuclides (mostly Cs-137) is virtually unavoidable as they get into the body with food (up to 94%), with drinking water (up to 5%), and through the air (about 1%). Accumulation of radionuclides in the body is dangerous, primarily for children, and for those living in the contaminated territories where there are high levels of Cs-137 in local foodstuffs. The incorporation of radionuclides is now the primary cause of the deterioration of public health in the contaminated territories.
>
> "Experience has shown that existing official radioactive monitoring systems are inadequate (not only in the countries of the Former Soviet Union). Generally, the systems cover territories selectively, do not measure each person, and often conceal important facts when releasing information. The common factor among all governments is to minimize spending for which they are not directly responsible, such as the Chernobyl meltdown, which occurred 23 years ago. Thus officials are not eager to obtain objective data of radioactive contamination of communities, individuals, or food.
>
> "We have to take responsibility not only for our own health, but for the health of future generations of humans, plants, and animals, which can be harmed by mutations resulting from exposure to even the smallest amount of radioactive contamination.
> [Nesterenko, A. V., Nesterenko, V. B. and Yablokov]



Chernobyl Disaster

All people living in territories heavily contaminated by Chernobyl fallout continue to be exposed to low doses of chronic radiation. Without special equipment to identify levels of environmental contamination, it is impossible to know what radionuclide levels are in our food and water or have been incorporated into our bodies.

The radioactive elements Caesium-137 (Cs-137), Strontium-90 (Sr-90), Plutonium (Pu), and Americium (Am) released in Chernobyl concentrate in the roots of plants and it is now known that they will continue to be mobilized for decades, even up to several hundreds of years into the future. Agricultural products have contained - and will continue to contain - radioactivity in all of the Northern Hemisphere countries contaminated by Chernobyl.

The level of radionuclide incorporation in our bodies varies according to each organ. In Chernobyl the most affected organs (from autopsies) were the thyroid gland, the adrenal glands, the pancreas, the thymus, the skeletal muscle, the spleen, the heart and the liver (in decreasing order).

The thyroid gland is the most affected since radioactive iodine (Iodine-131) binds to it, making supplemental non-radioactive iodine a key therapy in the case of nuclear radiation. The natural iodine will bind to the thyroid, blocking the radioactive iodine from binding to it. The affliction of the adrenals is worthy of attention, since **there were many "new" diseases that emerged after the Chernobyl disaster whose symptoms resemble those of adrenal fatigue**.

The total Chernobyl death toll for the period from 1987 to 2004 has reached nearly 417,000 in other parts of Europe, Asia, and Africa, and nearly 170,000 in North America, accounting for **nearly 824,000 deaths worldwide**. This number of Chernobyl victims will continue to increase for several generations.

A Note on Radiation

Radiation poisoning damages organ tissues by excessive exposure to ionizing radiation. Ionizing radiation consists of particles or electromagnetic waves that are energetic enough to detach electrons from atoms or molecules, thus ionizing them. Direct ionization from the effects of single particles or single photons produces free radicals, which are atoms or molecules containing unpaired electrons, and which tend to be especially chemically reactive due to their electronic structure.

This means that they become chemically unstable and highly reactive ions as free radicals are formed. These unstable metabolic by-products strive to stabilize by 'stealing' a replacement electron from any neighboring molecule, leaving even more damaged molecules in their wake. **This is how free radicals in our bodies are produced and cause inflammation**, a process that is best known as oxidative stress, oxidative damage or lipid peroxidation. Oxidation can even cause debilitating changes to your DNA. **This is why anti-oxidants are so important**. Antioxidants help to counteract or neutralize the free radicals before they can damage our healthy cells by lending a hand (actually, an electron) when stabilization is needed. This is the reason why we are fond of so many antioxidants such as vitamin C, E, carotenoids, resveratrol, taurine, coenzyme Q10 and melatonin, to name but a few.

Medical Syndromes

Nuclear or ionizing radiation that penetrates the body can affect your body in a number of different ways, and the adverse health effects of extreme radiation exposure may not be apparent for many years.

Among the specific health disorders associated with Chernobyl radiation there was increased morbidity and prevalence of the following groups of diseases:

- Circulatory system (owing primarily to radioactive destruction of the endothelium, the internal lining of the blood vessels).
- Endocrine system (especially nonmalignant thyroid problems).
- Immune system ("Chernobyl AIDS," increased incidence and seriousness of all illnesses).
- Respiratory system.
- Urogenital tract and reproductive disorders.
- Musculoskeletal system (including pathologic changes in the structure and composition of bones: osteopenia and osteoporosis).
- Central nervous system (changes in frontal, temporal, and occipitoparietal lobes of the brain, leading to diminished intelligence and behavioral and mental disorders).
- Eyes (cataracts, vitreous destruction, refraction anomalies, and conjunctive disorders).
- Digestive tract.
- Congenital malformations and anomalies (including previously rare multiple defects of limbs and head).
- Thyroid cancer (All forecasts concerning this cancer have been erroneous; Chernobyl-related thyroid cancers have rapid onset and aggressive development, striking both children and adults. After surgery the person becomes dependent on replacement hormone medication for life.)
- Leukemia (blood cancers) not only in children and liquidators, but in the general adult population of contaminated territories.
- Other malignant neoplasms.

[Nesterenko, A. V., Nesterenko, V. B. and Yablokov, Chernobyl: Consequences of the Catastrophe for People and the Environment.]

Other health consequences of the Chernobyl catastrophe include:

- Changes in the body's biological balance, leading to increased numbers of serious illnesses owing to intestinal toxicoses, bacterial infections, and sepsis.
- Intensified infectious and parasitic diseases (e.g., viral hepatitis and respiratory viruses).
- Increased incidence of health disorders in children born to radiated parents (both to liquidators and to individuals who left the contaminated territories), especially those radiated *in utero*. These disorders, involving practically all the body's organs and systems, also include genetic changes.
- Catastrophic state of health of liquidators (especially liquidators who worked in 1986 - 1987).
- Premature aging in both adults and children.
- Increased incidence of multiple somatic and genetic mutations.

Chernobyl actually "enriched" the medical vocabulary with such terms as "cancer rejuvenescence," as well as three new syndromes:

- "Vegetovascular dystonia" - dysfunctional regulation of the nervous system involving cardiovascular and other organs (also called autonomic nervous system dysfunction), with clinical signs that present against a background of stress.
- "Incorporated long-life radionuclides" - functional and structural disorders of the cardiovascular, nervous, endocrine, reproductive, and other systems owing to absorbed radionuclides.
- "Acute inhalation lesions of the upper respiratory tract" - a combination of a rhinitis, throat tickling, dry cough, difficulty breathing, and shortness of breath owing to the effect of inhaled radionuclides, including "hot particles."

> [Nesterenko, A. V., Nesterenko, V. B. and Yablokov, *Chernobyl: Consequences of the Catastrophe for People and the Environment*.]

Several other new syndromes, reflecting increased incidence of some illnesses, appeared after Chernobyl. Among them:

- "Chronic fatigue syndrome" - excessive and unrelieved fatigue, fatigue without obvious cause, periodic depression, memory loss, diffuse muscular and joint pains, chills and fever, frequent mood changes, cervical lymph node sensitivity, weight loss; it is also often associated with immune system dysfunction and CNS disorders.
- "Lingering radiating illness syndrome" - a combination of excessive fatigue, dizziness, trembling, and back pain.
- "Early aging syndrome" - a divergence between physical and chronological age with illnesses characteristic of the elderly occurring at an early age.

Specific Chernobyl syndromes such as "radiation *in utero*", "Chernobyl AIDS", "Chernobyl heart", "Chernobyl limbs," and others await more detailed and definitive medical descriptions.

But deterioration of public health (especially of children) in the Chernobyl-contaminated territories 23 years after the catastrophe is not due to psychological stress or radiophobia, or from resettlement... **it is mostly and primarily due to Chernobyl irradiation**. Other than the first powerful shock in 1986 there is the continual chronic low-dose and low-dose-rate radionuclide exposure.

Psychological factors ("radiation phobia") simply have no bearing on the pathologies described because morbidity continued to increase for some years after the catastrophe, whereas radiation concerns have decreased.

Infections on the Rise

> There is evidence of increased incidence and severity of diseases characterized by intestinal toxicoses, gastroenteritis, bacterial sepsis, viral hepatitis, and respiratory viruses in areas contaminated by Chernobyl radionuclides (Batyan and Kozharskaya, 1993; Kapytonova and Kryvitskaya, 1994; Nesterenko et al., 1993; Busuet at al., 2002; and others). Genetic instability markedly increased in the contaminated territories and has resulted in increased sensitivity to viral and other types of infections (Vorobtsova et al., 1995).

© Unknown **Chernobyl children**

Whether activation and dispersion of dangerous infections is due to mutational changes in the microorganisms (which render them more pathogenic), impaired immunological defenses in the populations, or a combination of both, has not yet been fully answered.

> One gram of soil contains some 2,500,000,000 microorganisms (bacteria, microfungi, and protozoa). Up to 3 kg of the mass of an adult human body is made up of bacteria, viruses, and microfungi. In spite of the fact that these represent such important and fundamentally live ecosystems, there are only scarce data on the various microbiological consequences of the Chernobyl catastrophe. - Nesterenko, A. V., Nesterenko, V. B. and Yablokov

There was activation of retroviruses (Kavsan et al., 1992). Tuberculosis became more virulent in the more contaminated areas of Belarus (Chernetsky and Osynovsky, 1993; Belookaya, 1993; Borschevsky et al., 1996). From 1993 to 1997 the hepatitis viruses B, C, D, and G became noticeably activated in the heavily contaminated areas of Belarus (Zhavoronok et al., 1998a,b). Herpes viruses were activated in the heavily contaminated territories of Belarus 6 to 7 years after the catastrophe (Matveev, 1993; Matveev et al., 1995; Voropaev et al., 1996). Among soil bacteria that most actively accumulate Cs-137 are Agrobacterium sp., Enterobacter sp. and Klebsiella sp. Sharp reduction in the abundance of healthy gut bacteria (bifidus bacteria) and the prevalence of microbes of the class Escherichia; in particular, a sharp increase in E. coli has been noted in the intestines of evacuee children living in Ukraine.

> All microorganisms (viruses, bacteria, fungi, and protozoa) and microbiological communities as a whole undergo rapid changes after any additional irradiation. The mechanism of such changes is well known: inclusion and increase in the frequency of mutations by natural selection and preservation of beneficial novel genes that for whatever reason appear more viable under the new conditions. This microevolutionary

mechanism has been activated in all radioactively contaminated areas and leads to activation of old and the occurrence of new forms of viruses and bacteria. All but a few microorganisms that have been studied in Chernobyl-affected territories underwent rapid changes in heavily contaminated areas.

Our contemporary knowledge is too limited to understand even the main consequences of the inevitable radioactive-induced genetic changes among the myriad of viruses, bacteria, protozoa, and fungi that inhabit the intestines, lungs, blood, organs, and cells of human beings. The strong association between carcinogenesis and viruses (papilloma virus, hepatitis virus, Helicobacter pylori, Epstein - Barr virus, Kaposi's sarcoma, and herpes virus) provides another reason why the cancer rate increased in areas contaminated by Chernobyl irradiation (for a review, see Sreelekha et al., 2003).

Not only cancer, but also many other illnesses are connected with viruses and bacteria. Radiologically induced pathologic changes in the microflora in humans can increase susceptibility to infections, inflammatory diseases of bacterial and viral origin (influenza, chronic intestinal diseases, pyelonephritis, cystitis, vaginitis, endocolitis, asthma, dermatitis, and ischemia), and various pathologies of pregnancy.

The long-term consequences for microbial biota may be worse than what we understand today.

- Nesterenko, A. V., Nesterenko, V. B. and Yablokov

A Note on Environmental Consequences

All the initial forecasts of rapid clearance or decay of the Chernobyl radionuclides from ecosystems were wrong, it is now known that they are taking much longer than predicted because they recirculate. The overall state of the contamination in water, air, and soil appears to fluctuate greatly and the dynamics of Sr-90, Cs-137, Pu, and Am contamination still present surprises to Chernobyl scientists.

"As a result of the accumulation of Cs-137, Sr-90, Pu, and Am in the root soil layer, radionuclides have continued to build in plants over recent years. Moving with water to the above-ground parts of plants, the radionuclides (which earlier had disappeared from the surface) concentrate in the edible components, resulting in increased levels of internal irradiation and dose rate in people, despite decreasing total amounts of radionuclides from natural disintegration over time.

"In 1986 the levels of irradiation in plants and animals in Western Europe, North America, the Arctic, and eastern Asia were sometimes hundreds and even thousands of times above acceptable norms. The initial pulse of high-level irradiation followed by exposure to chronic low-level radionuclides has resulted in morphological, physiological, and genetic disorders in all the living organisms in contaminated areas that have been studied - plants, mammals, birds, amphibians, fish, invertebrates, bacteria, and viruses.

"What happened to voles and frogs in the Chernobyl zone shows what can happen to humans in coming generations: increasing mutation rates, increasing morbidity and mortality, reduced life expectancy, decreased intensity of reproduction, and changes in male/female sex ratios.

[Nesterenko, A. V., Nesterenko, V. B. and Yablokov, *Chernobyl: Consequences of the*

> *Catastrophe for People and the Environment*.]

Proven Effective Detox Protocols

The therapies described here are widely available as over-the-counter supplements in most countries.

Green stuff and other sea food

In Chernobyl, 5 grams of **spirulina** for 45 days was used successfully against radiation poisoning. **Chlorella** algae also has shown radio-protective effects. A study showed that spirulina reduced urine radioactivity levels by 50% after only 20 days and so the Institute of Radiation Safety in Belarus developed a special program to treat 100 children every 20 days with spirulina. Furthermore, the healing occurred during the continuous presence of radiation as well as the presence of radiation contaminated food and water sources. In particular, spirulina given to children with accumulated high doses of radionuclides reduced radioactive cesium. No side effects were registered. **Only buy spirulina or chlorella from a certified heavy-metal free source.**

Studies on sea vegetables with **sodium alginate** have shown that they selectively bound with radioactive strontium and eliminated it from the body. Sodium alginate is found in many **seaweeds**, especially **kelp**. Sodium alginate binds tightly to such substances as strontium, calcium, barium, cadmium and radium. Some seaweeds are contaminated with lead or arsenic so you only want to consume seaweed that is deep ocean harvested or has been tested to be free of metal toxicity (such as kelp from the west coast of South Africa).

Black and green tea have shown radioprotective effects when taken either before or after exposure to radiation. This anti-radiation effect was observed in several Japanese studies, and studies from China also suggest that the ingredients in tea are radioactive antagonists. Tea catechins are associated with antioxidant properties and can have radio-protective effects when taken both before and after irradiation.

Kelp also has organic iodine which will saturate the thyroid so radioactive iodine will not be absorbed. You can take 1 or 2 tsp or 5 to 10 tablets.

Pectin

Pectin is one of the most effective means of protecting against radiation when consumption of contaminated food becomes unavoidable. Pectin preparations, along with vitamins and minerals, have demonstrated a high efficiency in eliminating incorporated radionuclides. The recommended dose is 5 grams once or twice a day for one month, 4 times a year.

> "In 1999 BELRAD together with "Hermes" Hmbh (Munich, Germany) developed a composition of apple pectin additives known as Vitapect® powder, made up of pectin (concentration 18 - 20%) supplemented with vitamins B1, B2, B6, B12, C, E, beta-carotene, folic acid; the trace elements K, Zn, Fe, and Ca; and flavoring. BELRAD has been producing this food additive, which has been approved by the Belarussian Ministry of Health, since 2000.
>
> "The pectin additive Vitapect with clean nutrition appears to be 50% more effective in decreasing the levels of Cs-137 than clean nutrition alone (Nesterenko et al., 2004).
>
> "A clinical study of 94 children, 7 to 17 years of age, divided into two groups according to their initial level of Cs-137 contamination determined by whole body counting

(WBC) and given Vitapect orally for 16 days (5 g twice a day) revealed both a significant decrease in incorporated Cs-137 and marked improvement in their electrocardiograms.

"From 1996 to 2007 a total of more than 160,000 Belarussian children received pectin food additives during 18 to 25 days of treatment (5g twice a day). As a result, levels of Cs-137 in children's organs decreased after each course of pectin additives by an average of 30 to 40%.

"Based on long-term experience, the BELRAD Institute recommends that all children living in radioactive contaminated territories receive a quadruple course of oral pectin food additives annually along with their conventional food ration. Eleven years of BELRAD's activities in controlling levels of incorporated Cs-137 in more than 327,000 children has not caused alarm in the population or radiophobia and has led to the spread of knowledge concerning radiation protection and an increased sense of personal responsibility for one's health."

[Nesterenko, A. V., Nesterenko, V. B. and Yablokov, *Chernobyl: Consequences of the Catastrophe for People and the Environment*.]

Antioxidants and Sulfur Compounds

DMSO is available in various formats.

Sulfur has a long history of use as an antidote for acute exposure to radioactive material. Antioxidants have the capacity to reduce toxic effects of radiation in our bodies. Early research identified sulfur-containing antioxidants as among those with the most beneficial therapeutic effects.

Dimethylsulfoxide (DMSO) is the classical sulfur compound and a powerful anti-oxidant, exactly what we need for detoxification and protection from radiation. A Japanese study showed that even low concentrations of DMSO had radio-protective effects through the facilitation of DNA double-strand break repair, providing protection against radiation damage at all cellular levels in the whole body. **The information and experience on DMSO is so fascinating that it can be described only as miraculous.** Due to its importance, we have dedicated an entire article to it. See DMSO: The

Antidote for Radiation Poisoning.

The use of anti-oxidants such as alpha lipoic acid, Vitamin E, Vitamin C (ascorbic acid), vitamin B, selenium, N-acetylcysteine and other sulfur compounds becomes crucial. It is important to use several of them, as they work best as a team. In addition to that, individual anti-oxidants can act as pro-oxidants when they themselves are oxidized, therefore individual anti-oxidants could enhance the progression of post-irradiation damage to tissues and organs. Several studies have shown the importance of anti-oxidant supplementation to be an effective therapy against radiation hazards.

Alpha Lipoic Acid (ALA) is a crucial supplement. It is water and fat soluble and it is also capable of crossing the blood-brain barrier. This means that it is capable of reaching and preventing damage in our fatty tissues, our brains, and every single organ for that matter. ALA also repairs DNA. It is a good heavy metal chelator, it protects the heart and brain from cell death, stimulates the regeneration of liver tissue and is rapidly absorbed high up into the digestive tract. ALA recycles other antioxidants such as vitamin C, vitamin E, and glutathione which is an indispensable antioxidant for detoxification and is synthesized within the mitochondrion. Glutathione may not reliably be augmented by oral supplementation because it cannot always pass over the mitochondrial membrane, therefore it must be synthesized within the mitochondrion. ALA and its metabolite DHLA provoke the cell to produce significantly higher levels of glutathione (even by 70%). So if the glutathione levels in a cell are kept up to a satisfactory level by ALA, even if the cell is poisoned, the cell will have a better chance of recovering instead of dying. It is of critical importance in order to reduce or reverse radiation-induced oxidative damage after radiotherapy. The recommended dose of ALA is 100mg twice a day with meals, although others have used higher doses of between 300mg and 600mg. A study conducted on some of those who worked on the Chernobyl clean-up operation 10 years after the accident showed that 600 mg of lipoic acid for two months was able to normalize many, but not all, of their lab abnormalities.

The anti-oxidant **N-acetyl cysteine (NAC)**, as a source of glutathione and sulfur, is an excellent supplement to take. Studies have suggested that it might prove efficient in saving individuals exposed to lethal and sub-lethal radiation doses with few or no side effects on individuals exposed to lower doses. It is also widely available. Around 500mg twice a day is a good dose, although some have used with great success around 5 grams of NAC (per day, in a hospital setting) in 7 day cycles in order to detoxify heavy metals.

Other important supplements include **magnesium** and **vitamin C**. For more information on the many forms of magnesium and dose recommendation, see here. Calcium and magnesium both help your body to pass off Strontium 90, but make sure to take enough magnesium in order to properly metabolize the levels of calcium.

For vitamin C (ascorbic acid), 1-4 grams as a daily maintenance is a good dose, but during detox or acute exposure, more will probably be required. Vitamin C cannot only protect against radiation but also repair damage from previous exposure. It will also be very handy in case of infections. You can try taking 4 grams of vitamin C 3 times per day. If you have diarrhea or abdominal bloating, cut out one dose. If there are no signs of intestinal "gurgles", you can increase your dose throughout the day.

Consider taking also a good **B complex** which help to normalize the red and white blood cell count, since the destruction of white blood cells by radiation can last for extended periods of time.

Vitamin E 800-1000 IU per day and **selenium** 200 mcg per day are also important since radiation studies support evidence for the synergistic effects of vitamin E and Selenium in protecting from oxidative damage.

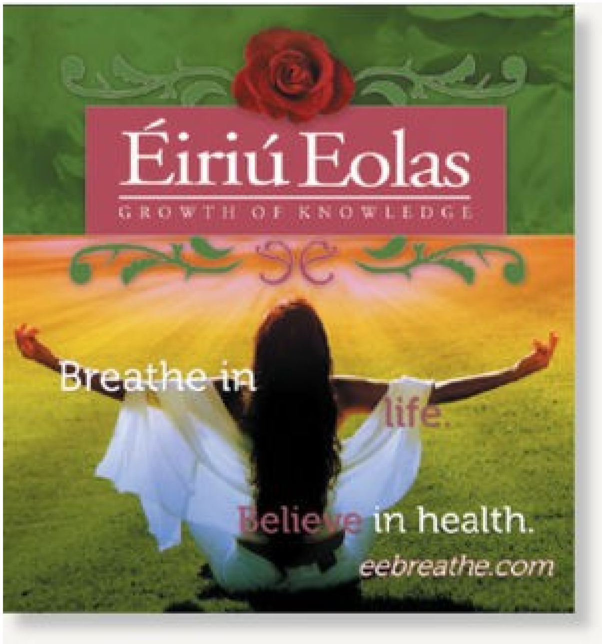
Zinc has been successfully used to chelate americium-241 from a nuclear accident victim. Natural zinc will also help the body eliminate several toxic heavy metals including cadmium, aluminum and lead. The recommended dose is 50 mg per day. You might want to supplement yourself with a good mineral complex in order to avoid deficiencies or imbalances brought on by increasing your zinc intake.

If there is a deficiency in **potassium** , radionuclides like cesium-137, cesium-134, potassium-40 and potassium-42, are absorbed through selective uptake. Too much potassium supplementation can be dangerous, so make sure to follow label instructions.

Melatonin, other than being our "sleeping hormone", also has powerful antioxidant properties. Animals subjected to whole-body irradiation and given melatonin exhibited increased survival and the protection against radiation-induced oxidative damage was apparent throughout the body. More importantly, melatonin administered orally results in higher circulating levels and more rapidly increasing tissue concentrations. As soon as an exposure occurs, depending on the wind direction after radiation explosion, people living at a distance could protect themselves by oral administration of melatonin, which can be ingested repeatedly as required.

Curcumin is a naturally occurring compound contained in the spice turmeric. Curcumin has been found to have antioxidant, anti-inflammatory and anti-tumor activity in a variety of animal models of human diseases including radiation-induced pulmonary diseases.

Breathing and meditation techniques



The Éiriú Eolas Healing and Rejuvenation program is a key ingredient in detoxing

The proven and effective Éiriú Eolas program includes well-known stress control techniques that **stimulate the vagus nerve**, which then activates the parasympathetic system which is a powerful anti-inflammatory system. It also includes well known emotional releasing techniques. It can be applied to improve symptoms associated with breathing difficulties, autoimmune diseases and mood problems. It reduces oxidative stress with an improvement of the overall antioxidant status, and thus it has application in numerous diseases including, chronic radioactive exposure.

> There is no question but that social and economic factors are dire for those sick from radiation. Sickness, deformed and impaired children, death of family and friends, loss of home and treasured possessions, loss of work, and dislocation are serious financial and mental stresses. - Alexey V. Yablokov, Vassily B. Nesterenko, and Alexey V. Nesterenko.

During the breathing exercises and the meditation portion of the program, levels of the anti-stress hormones GABA, melatonin, and serotonin are increased, and levels of the stress hormones cortisol and norepinephrine are decreased. Learn more about the many benefits of this program here. The program is available for free at eebreathe.com.

Diet

There are several simple cooking techniques that decrease radionuclides: boil foods several times and discard the water, wash food thoroughly, soak some foods and discard the water, avoid the peels of fruits and vegetables, salt and pickle some foods but throw away the pickling juice! Avoid eating strong broths, use butter, etc.

Remember that another way of boosting your body's detox capabilities and overall anti-oxidant levels is through the foods we eat which then become key to survival in these stressful times. Being on a detox diet is crucial to regaining health in a toxic environment. Our extensive experience and research shows that **those on a no grain/low carb (no gluten) and non dairy diet fare MUCH better.**

Chronic ailments often involves an imbalanced immune/defense system in which food sensitivities are involved even if they are not the cause of the problem, leading in turn to chronic inflammation - which translates into disease. This is why it is important to undergo an elimination diet in order to balance the body's immune system. Some of our immune cells take 6 months to regenerate, so it can take that much time in order to see results if you are very sick. But often you can see positive results in the first two weeks on an appropriate diet, even when you can't afford any other detox therapies. You can find the diet and how to transition to it here.

Everyone is different and it is only by testing foods that we can discern our individual problematic foods. Having said that, **no one should be eating cereals or dairy products or high processed foods because the human system is simply not constructed to digest them properly.** What we eat is crucial in recovering our health and **it is a great healing medicine when done correctly.**

Garlic and onions, being sulfur containing foods, help bind and deactivate both the radioactive isotopes and toxic metals such as cadmium, lead and mercury. The sulfur will help the kidneys and liver detoxify the body.

The most direct way of decreasing radionuclide intake is to avoid foods that are potentially heavily contaminated and to consume foodstuffs with lower levels. However, this is not easy to do because the average level of radionuclide bio-accumulation differs in each region owing to differences in soils, agricultural techniques, etc.

The Chernobyl experience tells us that soaking in water, boiling, salting and pickling foods such as vegetables can decrease the amount of radionuclides in some foods several-fold. **Milk always contains high levels of radiation; processed products that reduce contamination levels, such as butter and ghee butter, are safer.**

Radionuclide concentrations in the visceral organs of animals are usually significantly higher than in muscle tissue. Among visceral organs the order of decreasing levels of Cs-137 is: lung > kidney > liver > fat.

The Chernobyl experience showed that in contaminated territories the same species of fish taken from rivers and streams have significantly lower radionuclide levels than those from lakes and ponds. Plant feeding fish had three to four times lower radionuclide levels than predatory species (catfish, pike, etc.). Fishes at lower levels of the ocean (crucian, tench, etc.) had several times more contamination than fish which live in the top water layers (small fry, chub, etc.).

> It is very important to avoid radionuclides in food and if they are consumed to try to eliminate them from the body as quickly as possible. In a baby, the biological half-life of Cs-137 is 14 days; for a 5-year old it is 21 days; for a 10-year old, 49 days; for teenagers, about 90 days; and for a young male, about 100 days (Nesterenko, 1997).

From the Chernobyl experience, the order of decreasing levels of Cs-137 were: chicken > beef > lamb > pork. Meats from older animals have more radionuclides that meat from younger ones owing to accumulation over time. Bones of young animals have more Sr-90. Eggs: shell > egg-white > yolk.

Pork and fats were not only the safest, they also prove to be a very healthy option for detox and healing purposes. For more information, see 'I have high cholesterol, and I don't care'.

The biological properties of Cs-137 are similar to those of stable potassium and Rubidium, and Sr-90 and Pu are similar to calcium. These properties determine where they concentrate in the body so the use of stable elements may help to decrease the absorption of radionuclides.

Foods rich in potassium include potatoes, beets, raisins, dried apricots, bananas, tea, nuts, lemons, and dried plums. Calcium rich foods include butter and ghee butter, eggs, horseradish, green onions, turnip, parsley, dill, and spinach. Green vegetables, apples, sunflower seeds, black chokeberries are rich in iron; and Rubidium is found in red grapes.

A diet to protect against radioactive contamination should include uncontaminated fruits and vegetables, especially those rich in pectin such as apples to promote the rapid elimination of radionuclides.

Sleeping in Total Darkness

Low melatonin production leaves you not only susceptible to radiation damage, but it also leaves you vulnerable to accelerated aging, depression, weight gain. People with lower levels of melatonin have lower immune/defense function, less antioxidant activity and accelerated cancer cell proliferation, and they also tend to have more unhealthy imbalances in gut bacteria. **But sleeping in total darkness is a natural way of enhancing the secretion of melatonin during the night.** The room where you sleep has to be completely dark to the point of not been able to see anything. If lights seeps underneath your door, put a towel along the base. Cover your electric clock radio with something. Even the smallest light can decrease melatonin secretion, even if you're not able to see it with your own eyes.

Miscellaneous

Natural **zeolites** (i.e., those found in volcanogenic sedimentary rocks) is a mineral which possesses attractive properties that contribute directly to their use in the extraction of Cs and Sr from nuclear wastes and the mitigation of radioactive fallout, but also as a dietary supplement for heavy metal detoxification. It also has anti-bacterial properties and it stimulates the immune system. It was used during successfully during Chernobyl.

Organic Germanium (Ge-132) protects cells exposed to cesium-137 without affecting cellular growth or survival. 25 mg to 100 mg per day has been typically used. (My favorite colon cleanser has organic germanium on it).

Activated charcoal has the ability to absorb and neutralize radioactive substances and some toxic materials. Researchers report that 10 grams or 1 tablespoon of charcoal can absorb about 3 to 7 grams of materials.

There are excellent articles out there focusing on iodine, clays, magnesium therapies and sodium bicarbonate. For more information, see:

Treatments for Nuclear Contamination

Iodine Treatments for Radiation Exposure

Greenmedinfo.com - Radioprotective

All this information will help you to not only protect yourself from chronic radiation exposure, but it will also help you to regain your health by improving your mood and mental functions in these crucial and stressful times.

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Latest News

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Treatments for Nuclear Contamination

Posted by **Mark Sircus - Director** on **13 March 2011** | Filed under Medicine

Iodine – Glutathione – Natural Chelation – Clay – Baking Soda

It is too early to call everyone in North America to prepare for a radiation cloud streaming down radioactive particles from the accident in Japan. According to the media and government, America is not at risk due to radioactive fallout from the recent Japanese nuclear accidents in several reactors but that could change in a heartbeat as authorities race to combat the threat of multiple nuclear reactor meltdowns. Nuclear plant operators are working frantically to try to keep temperatures down in several reactors crippled by the earthquake and tsunami, wrecking at least two by dumping sea water into them in last-ditch efforts to avoid meltdowns.

Now, just hours after writing this above paragraph we get a report in the New York Times indicating that even best case scenarios include radioactive releases of steam from the crippled plants could go on for weeks, months or even years. So prepare we must. "Pentagon officials reported Sunday that helicopters flying 60 miles from the plant picked up small amounts of radioactive particulates — still being analyzed, but presumed to include Cesium-137 and Iodine-121 — suggesting widening environmental contamination. More steam releases also mean that the plume headed across the Pacific could continue to grow," printed the Times.

The incident is a reminder that preparedness should include being prepared for nuclear events with foods and medicinals in our medical cabinets that will protect us and our families as much as humanly and medically possible. Many people in Japan and elsewhere around the world that live and work close to nuclear plants will be seriously affected by nuclear accidents. When a meltdown happens the effects can be carried thousands of miles by the prevailing winds.

It is unclear how far the impact of a meltdown might reach. In the United States, local communities plan for evacuation typically within 10 miles of a nuclear plant. However, states must be ready to cope with contamination of food and water as far as 50 miles away. When it comes to risks and toxic exposure levels we can count on the government and medical officials to understate the threat. This is something consistent in their approach to all types of toxic exposures.

Besides having iodine on hand for emergencies, we can grow (and, at present, purchase) herbs and foods that prevent our bodies from storing radioactive particles. Some of these foods and herbs even remove radioactive particles from our bodies. As we are all already being affected by radiation released by numerous sources, eating these foods and doing detoxification and chelation protocols regularly is a good idea.

If you have been exposed to too many X-rays or CAT scans, if you fly too much, work with diagnostic medical equipment or are environmentally sensitive and have ingested elevated levels of radioactive contaminated food, air or water, you also want to partake of the following protocol on a regular basis.

Sodium Bicarbonate (Baking Soda)

The oral administration of sodium bicarbonate diminishes the severity of the changes produced by uranium in the kidneys.

The kidneys are usually the first organs to show chemical damage upon uranium exposure. Old military manuals suggest doses or infusions of sodium bicarbonate to help alkalinize the urine if this happens. **This makes the uranyl ion less kidney-toxic and promotes excretion of the nontoxic uranium-carbonate complex.** The oral administration of sodium bicarbonate diminishes the severity of the changes produced by uranium in the kidneys. So useful and strong is sodium bicarbonate that at Los Alamos National Laboratory in New Mexico, researcher Don York has used baking soda to clean soil contaminated with uranium. **Sodium bicarbonate binds with uranium, separating it from the dirt; so far, York has removed as much as 92 percent of the uranium from contaminated soil samples.** I started writing about baking soda after discovering that the United States Army recommends the use of bicarbonate to protect the kidneys from radiation damage.

Sodium bicarbonate can safely remove paint, grease, oil and smoke residue, decreasing workers' exposure to harsh chemicals and eliminating much of the hazardous waste associated with other cleaners. "Sodium bicarbonate is able to clean in areas where other substances pose fire hazards, because baking soda is a natural fire extinguisher," says Kenneth Colbert, a general manager for Arm & Hammer. This is the reason it's used by oncology centers to control chemo agent spills and it's actually used intravenously to protect patients from the hazardous toxicity of chemotherapy.

"Uranium is one of the only metals that get significant bonding from carbonate. Just flushing a lot of bicarbonate through the system, along with whatever kidney support you are going to use, will be very helpful," writes Dr. Chris Shade. There is no better therapy for radiation sickness then intense sodium bicarbonate (baking soda) and magnesium baths with the appropriate clay added in. Even sodium thiosulfate can be added to these baths and that instantly neutralizes any chlorine in the bath water while simultaneously providing sulfur for the vital sulfur pathways.

Bicarbonate and Nuclear Fallout

If the bombs start dropping anywhere on earth, or if you live near a nuclear plant, you will want to have a large amount of sodium bicarbonate on hand. Minimum stocks should be 25 or 50 pounds. Normally I recommend someone start with using one pound of bicarbonate in a bath but that could easily be two or three pounds in an emergency situation. It is not a joke that one can get 50 pounds of the most powerful medicines on earth for 35 bucks. You will also need a lot of magnesium salts and the very best and most penetrating of them is the magnesium chloride in the form of magnesium bath flakes. Dead Sea salt is also quite fine for this application.

Exposure to radiation causes a cascade of
free radicals that wreak havoc on the body.
Radiation decimates the body's supply of glutathione.

Please read my essay on Glutathione and Bicarbonate Nebulization. Nebulization is one of the best ways to quickly increase glutathione levels as is the use of glutathione suppositories. The main cancer risk from inhaled uranium oxide and other airborne radioactive particles would be from tiny insoluble particles lodged deep in the lungs. That's a good reason to nebulize both glutathione and bicarbonate directly into the lungs and one must wonder why governments and health officials have not sponsored this treatment.

Dr. Sarah Mayhill, speaking about uranium oxide says, "It can be inhaled by soldiers and civilians, it sticks to the lining of the lungs, it is taken up by cells of the immune systems and gets into lymph glands, bone, brain, hormone producing glands, ovaries and testes. It stays in these organs for many decades and is only very slowly excreted in urine." Nebulization transdermally treats the lung tissues allowing for best effect on contaminated lung tissues.

I have had the pleasure through the years to learn from some of the most intelligent doctors and scientists about heavy metal chelation and the opening of detoxification pathways. The individual who wins the Nobel Prize in the area of chelation, the scientist with the greatest genius, especially when it comes to mercury chelation, is Dr. Chris Shade. He has developed a sophisticated detoxification system based on enhancing the natural removal of metals through the intestines.

Though his specialty is mercury, detoxification and chelation of radioactive poisons use the same pathways as mercury. He has developed three products that are effective for the removal of mercury including a liposome formula that allows us to get glutathione into the system via oral administration. (For more information or ordering of Dr. Shade's products I only have a phone: 1-866-257-8168, talk to Karen.)

Combining his formulas with HMD (Heavy Metal Detox) from Dr. George Georgiou, another medical genius, gives us, in my opinion, the best possible medical formula to help remove radioactive contamination as long as iodine, magnesium chloride, a super food spirulina-based formula like Rejuvenate and edible clay are used as well. Rejuvenate is a powerful chlorophyll-rich formula that is easy to administer in high quantities because of its exceptionally pleasant taste. The intense levels of RNA in Rejuvenate will quickly help build up a person's immune system and help them recover from the RNA/DNA damage caused by radiation exposure.

Table 1. Mean percentage increases in toxic metals between baseline and post-hair sample while taking the HMD™ Ultimate Detox Protocol

Mean % increase of heavy metals between pre and post-hair samples							
Toxic Metals	Uranium	Arsenic	Beryllium	Mercury	Cadmium	Lead	Aluminium
Mean % increase	252.34%	306.80%	0	205.09%	333.33%	200%	155.52%

N.B. The levels of Beryllium were very insignificant in this sample of patients, in both the baseline and post samples.

It is interesting to see that uranium-238 is being eliminated in the hair using the HMD protocol; to date there is no natural chelating agent known to mobilize and eliminate uranium-238 from body tissues. HMD is the only chelation product that I have seen that has actually been tested and shown to be effective for uranium toxicity.

HMD's cilantro will move heavy metals and radioactive material out of the cells into the detoxification pathways with Dr. Chris Shade's IMD (Intestinal Metal Detox) pulling down hard on those pathways to get the stuff out through the intestines. The internal consumption of edible clay and external clays dramatically facilitate this process. Clay baths are a very effective way of removing heavy metals from the body and increase one's chances of survival if exposed to nuclear fallout.

Iodine

Iodine is the most obvious and important element in protecting against radiation damages. Radioactive iodine will plunge in to any and all iodine receptor cites that have no iodine in them due to iodine deficiencies. This is a serious problem because over 90 percent of people in North America, according to Dr. David Brownstein, are iodine deficient. This leaves them incredibly vulnerable to radioactive iodine, which is one of the principle forms of radiation given off in nuclear accidents and from nuclear weapons.

In as separate article are videos of an interview I did today with Dr. Brownstein and a lot of important information about iodine supplementation as a vital defense against radiation contamination and damage.

Intravenous Cocktails

In cases of serious exposure, IV cocktails with high dosages of vitamin C, magnesium chloride or sulfate, sodium bicarbonate and very pure seawater full of all the minerals necessary for life would be ideal.

Dr. David Brownstein administers a slow IV vitamin C drip—usually 25-50 gm, with minerals, and he adds 10cc of sodium bicarbonate. The addition of bicarb to the IV's made a huge clinical improvement. He also adds 1 cc of bicarb to all Myers cocktail IV's, which he says is "a great addition."

Nutrients to the Rescue

Spirulina and chlorella have been used heavily by the Russians after the Chernobyl nuclear plant disaster. And the Japanese love their miso soup and that was said to help some of their citizens survive the fallout after the Americans attacked two of their cities. This is why I recommend Rejuvenate in high doses because of its high spirulina and chlorella content and because it is like refined rocket fuel for the cells providing them with a broad range of concentrated nutrients.

Tan Koon Peng from Singapore writes: “Miso is effective for detoxifying your body of radiation. During World War II, two hospitals that were located side by side were hit with atomic radiation, in one hospital people consumed Miso and all of them survived while many people in the other hospital that did not take miso died. Miso is rich in vitamin B therefore it is suitable for vegetarians who are in shortage of vitamin B. For best results do not cook miso.”

Herbalist Brigitte Mars says, “There are a number of foods that can better help our bodies tolerate the effects of pollution. Eating lower on the food chain minimizes our chemical intake. Consuming more whole grains has a multitude of benefits. Their high fiber content binds with toxins and lessens intestinal transit time. Their vitamin B6 content nourishes the thymus gland and their vitamin E content helps the body to better utilize oxygen. The grain buckwheat is high in rutin and helps to protect against radiation and stimulates new bone marrow production. The mucilaginous fiber in seaweed helps to prevent the reabsorbing of radioactive strontium 90.

“Following the bombing of Nagasaki, a group of surviving macrobiotic doctors and their patients avoided radiation sickness by eating brown rice, miso and seaweed. They also did not get leukemia. Seaweeds also help to break down fatty deposits. High-chlorophyll foods like wheatgrass and barley grass strengthen cells, transport oxygen, help to detoxify the blood and liver as well as help to neutralize polluting elements and stimulate RNA production. Sulfur-rich vegetables like broccoli, cabbage and mustard greens combine with heavy metals and help prevent free radical damage,” says Mars.

Dr. Shade commenting on the above said, “In the last sentence Brigitte Mars, a local friend actually mentions the broccoli family. A normal misconception is restated here – namely that the sulfur compounds in the broccoli family bind the heavy metals. Actually the **sulfur compounds trigger increased expression of your glutathione system**, which results in both metal detoxification and free radical neutralization. The other group of food compounds that do this is the polyphenolic antioxidants – pine bark extract, green tea extract, grape seed extract, and my favorite Haritaki or terminalia chebula, an Ayurvedic fruit that is the basis for many medicines including the intestinal detoxifier Triphala. This fruit is used extensively in Tibetan Medicine where it is pictured being held by the Medicine Buddha and call the "King of Herbs". It has potent effects on the glutathione system and on expression of other intracelluar antioxidants such as superoxide dismutase. Haritaki is one of the superpowers in Clear Way. Clear Way also includes other polyphenolics such as Pine Bark extract, large amounts of liver cleansing dandelion root extract, natural iodine and minerals from fucus extract (or what is known as bladderwrack, a sea vegetable), the metal chelator and super antioxidant R-Lipoic acid, nerve protectors gotu kola and bacopa monniera, and B-vitamins 1, 5, and 6.

Research on animals indicates that curcumin (an antioxidant and anti-inflammatory compound found in the curry spice turmeric) may help protect against radiation-induced damage to the skin. Other research in animals shows that the herb ginkgo biloba may help shield against organ damage resulting from radiation therapy. And aloe vera is often touted as a natural remedy for radiation-induced skin changes preventing or minimizing radiation-induced skin reactions.

Iodine Treatments for Radiation Exposure

Posted by **Mark Sircus - Director** on **14 March 2011** | Filed under Medicine

Second half of Interview

After testing over 500 patients, I found that 94.7
percent of my patients are deficient in inorganic iodine.
Dr. David Brownstein

Clearly we are just at the beginning of this disaster and very far from its end, and already it is unprecedented in scope. "If this accident stops right now it will already be one of the three worst accidents we have ever had at a nuclear power plant in the history of nuclear power," said Joseph Cirincione, an expert on nuclear materials and president of the U.S.-based Ploughshares Fund, a firm involved in security and peace funding.

There is absolutely zero chance that this disaster in progress is going to stop now or any time soon, so precautions need to be taken right away by every citizen in the northern hemisphere that is downwind and on the track of the jet stream that will quickly carry radioactive materials first to North America then to Europe and beyond to Russia. This is all going to be much worse than people want to believe, so rush to get your iodine right now! Get your hands on whatever you can for in a few days there will be no iodine to have of any type.

Dr. Brownstein writes, "If there is enough inorganic, non-radioactive iodine in our bodies, the radioactive fallout has nowhere to bind in our bodies. It will pass through us, leaving our bodies unharmed. It is important to ensure that we have adequate iodine levels BEFORE this fallout hits." There is some very important information about iodine below not being presented by the government or press. This is an IMVA Emergency Alert and we will be updating this document in the days and weeks ahead so check back to the IMVA blog for the most current form.

Think again, think seven times again before you leap
and start construction of new nuclear power plants.
Mikhail Gorbachev
June 2006

Though the United States, Canadian and European governments are not warning their citizens of the dangers that will drop down on them from the jet stream, this following video does a good visual job of showing what areas will be most affected. With the true size of the catastrophe starting to take shape populations downwind across the entire northern hemisphere had better start becoming concerned enough to secure supplies of iodine to protect themselves from one large part of the radioactive dangers.

Humans tolerate large doses of iodine so the very high dosages recommended for protection for radioactive iodine are not usually a problem except for those who already have serious problems with their thyroids, which is quite a lot of people considering how many are deficient in this vital nutrient. The government's recommendation of a onetime pulse dose might perhaps be appropriate when confronted with a nuclear blast but for chronic long term exposure, which is suggested with what is in progress in Japan, calls for different formula and dosages through time.

Dr. Michael B. Schachter says, "The treatment dose when a person is iodine insufficient is generally between 12.5 mg and 50 mg daily. Preliminary research indicates that if a person is iodine insufficient, it takes about three months to become iodine sufficient while ingesting a dosage of 50 mg of iodine daily and a year to achieve that while ingesting a dosage of 12.5 mg of iodine daily.

If radiation threatens, it behooves people to start taking the highest dosages tolerable to protect not only their thyroids but also all the glandular tissues as well. Iodine protects the thyroid, breasts, prostate and ovary glands as well as other tissues in the body from radiation if present in sufficient quantities.

When treating life-threatening diseases we do not have months to fool around with low dosages. We need to zoom up iodine levels quickly. And we need to get it concentrated to certain tissues or organs. Just to give you an idea of how high iodine dosages have been taken we have to revisit the 1930s when iodine was still a universal medicine present in the U.S. Pharmacopeia and used at much higher dosages than anyone even dreams of using today.

The usual dose for treatment back then was 300 mgs (46 drops of full strength Lugol's) to 1 gm (1000 mg, 154 drops). It is very important to realize that today's Lugol's is not universally the same as it was because of new federal legal requirements about concentration levels. The best company offers Lugol's at varying concentration levels.

Potassium iodide (also called KI) is a salt of stable (not radioactive) iodine. Stable iodine is an important chemical needed by the body to make thyroid hormones. Following a radiological or nuclear event, radioactive iodine may be released into the air and then breathed into the lungs of any being breathing that air. Radioactive iodine may also contaminate the local food supply and get into the body through food or drink. In the case of internal contamination with radioactive iodine, the thyroid gland quickly absorbs this chemical. Radioactive iodine absorbed by the thyroid can then injure the gland. Because non-radioactive iodine acts to block radioactive iodine from being taken into the thyroid gland, it can help protect this gland from injury.
There will be little or no time to consult doctors and other health care practitioners to get the proper dosage. The standard dose for potassium iodide during radiation emergencies: For infants, babies and children, KI is administered for exposure of 5 centigrays (cGy) or more. For birth through 1 month, 16 mg can be administered; for 1 month through 3 years, 32 mg can be administered; for 3-12 years, 65 mg can be administered; for adolescents ages 12-18 years, 65 mg can be administered (**or up to 120 mg if the adolescent is approaching adult size**).

[Nascent Iodine]

Nascent iodine, though more expensive, actually tastes and feels good while going down and is gentle enough to give to children, who do not seem to complain about its taste. My recommendation would be to use the Nascent Iodine in high dosages to both saturate the thyroid (which makes it less vulnerable to chemical and radioactive attack) while it will also knock out any contaminants already absorbed. Nascent iodine contains approximately 400 mcg per drop so 10 drops is 4 mg and 100 drops is only 40 so it's safe to take much higher dosages than is suggested on the bottle. In fact one has to completely ignore the suggested dosages on the bottle and take some of the information below as ones guidance for dealing with threatening radiation dropping down out of the clouds that are moving along with the jet stream.

One hundred drops a day is a strong dose, but when treating life threatening diseases it would not be unheard of to use upward of 200 drops a day in divided doses, but if you get your iodine on the day the news is sounding the radiation alarm I would jump right to 100 drops or 50 drops in divided dosages for children. It is my belief that the Nascent atomic form is much more efficient than the molecular form meaning you would need less but when confronted with a cloud of radiation one wants to work beyond the speculative. Again the government is recommending a onetime dosage, which makes sense if there is no time to address iodine deficiencies.

It normal conditions it is important to remember that one should not shoot straight up to these dosage levels; rather, start at low dosages and monitor for detoxification reactions, which will be less if sodium bicarbonate and other substances are used in conjunction with it. But in emergencies involving radiation we have not the luxury of time so one has to thrust iodine levels up sharply in burst dosages.

Dr. Brownstein said he was using 200-300 mg with his prostate and breast cancer patients, and those who have metastases needing the highest dosages. He also uses both Lugol's and Nascent reserving the Nascent for his more sensitive patients. There is also the tablet form of varying dosages (Iodoral), which is used by more than several of the iodine doctors I know.

Iodine is needed in microgram amounts for the thyroid,
milligram amounts for breast and other tissues,
and can be used therapeutically in gram amounts.
Dr. David Miller

Potassium iodide can be found in many health food stores. Combinations of iodide/iodine can be obtained from holistic physicians. Iodoral, Iodozyme HP, and Lugol's solution are examples of this form of iodine. I prefer the Nascent iodine, especially for children, because it is gentler on the system being that it is in the atomic form making it easy for the body to convert it into the needed forms—iodide and iodine.

These onetime high pulse dosages of potassium iodine are necessary during an emergency but they do not come without some risk of side effects, which include: severe allergic reactions (rash, hives, difficulty breathing, tightness in the chest, swelling of the mouth, face, lips or tongue), black, tarry stools, confusion, fever, irregular heartbeat, metallic taste in the mouth, mouth sores, numbness or tingling of the hands or feet, skin rash, stomach pains, swelling in the neck or throat, unusual tiredness, weakness.

Endocrinologic side effects have included both hyper- and hypothyroidism. By inhibiting the release of thyroid hormone from the thyroid gland, iodide can cause goiter and hypothyroidism. This has been called the Wolff-Chaikoff effect, occurring in approximately four percent of patients and may be more likely in patients with cystic fibrosis (CF). Iodide may induce hyperthyroidism, called the Jod-Basedow effect, when given to patients with preexisting iodide deficiency or autonomous, “hot” thyroid nodules. Iodide can cause parotid gland swelling.

Usually, side effects of potassium iodide happen when people take higher doses for a long time but they can occur from taking the government’s recommended onetime pulse dose. The standard warning from the mainstream is that “we should be careful not to take more than the recommended dose or take it for longer than you are told,” which is only once. “Side effects are unlikely because of the low dose and the short time you will be taking the drug.” This is not good advice at all since too-low dosages will not protect one from the radioactive iodine fallout and the short time of application is absolutely out of the question when the fallout will be continuous, as it will be because of the continuous venting of radioactive materials into the atmosphere at the crippled Japanese reactor sites.

When faced with a radioactive cloud it is absolutely imperative that you take iodine, **whatever iodine you can get your hands on**. If the only iodine available is topical iodine that is not suitable for oral use then you should paint your body and your children’s bodies with it. Few people have ready access to the Nascent iodine so will not enjoy its ease of application in repeated measured dosages that are more gentle to the system, thus yielding fewer side effects. Because Nascent is in the atomic form (I^1), it is absorbed faster and that can also be advantageous in emergency situations. Its only downside is the expense of having to use so much of it.

Don’t Trust Governments Recommendations

Dr. John W. Gofman, Professor Emeritus of Molecular and Cell Biology in the University of California at Berkeley, has written extensively about the effort to belittle the menace of low-level radiation. People associated with the nuclear and medical industries assert falsely, “there is no evidence that exposure to low-dose radiation causes any cancer—the risk is only *theoretical*,” or “the risk is utterly *negligible*,” or “the accidental exposures were below the *safe* level,” and even “there is reasonably good evidence that exposure to low-dose radiation is *beneficial* and lowers the cancer rate.” By any reasonable standard of scientific proof, the weight of the human evidence shows decisively that cancer is inducible by ionizing radiation even at the lowest *possible* dose and dose-rate—which means that the risk is never theoretical.

Nobel Laureate Linus Pauling described this process as follows: “The rays of high-energy radiation are like little bullets that shoot through the body. They tear electrons away from molecules and through subsequent reactions of the molecular ions that are formed, the molecules may be broken in two, some atoms may be torn away from them, some new molecules may be formed. The dose of 500 roentgens that usually leads to death by acute radiation sickness causes about 500,000 changed molecules to be formed in each cell. If any of the special molecules [that control the process by which the cell divides] happen to be damaged by a single little bullet of radiation from a single radioactive atom, it may be changed in such a way as to cause the cell to divide much more rapidly than the other cells. This cell may then produce a colony of rapidly dividing cells, which in the course of time would outnumber the normal cells of that type. Then the human being may die from cancer—perhaps leukemia, bone cancer, some other kind of cancer—caused by the single radioactive atom that produced the single little bullet of radiation."

Radioactive materials, plutonium in particular, affect the deepest level of the human being—bone marrow, DNA, genetic structure, inner organs and the deepest of emotions. The message is clear. We have created a horrific heritage.
Jeremy Sherr

Iodine will do nothing to protect a person from uranium, cesium or plutonium radiation exposure so one has to turn to my full protocol and especially to eating clay and clay baths to try to remove these other particles as fast as possible.

For the governments perspective on potassium iodide please go to the CDC site.

Radioprotective

Wikipedia link - Ionizing radiation

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Ionizing radiation

From Wikipedia, the free encyclopedia

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Please help improve this article by adding reliable references. Unsourced material may be challenged and removed. *(October 2008)*

Radiation hazard symbol.

Ionizing radiation hazard symbol (international standard confirmed in 2010).[1]

Ionizing (or **ionising**) **radiation** consists of particles or electromagnetic waves that are energetic enough to detach electrons from atoms or molecules, therefore ionizing them. Direct ionization from the effects of single particles or single photons produces free radicals, which are atoms or molecules containing unpaired electrons, that tend to be especially chemically reactive due to their electronic structure.

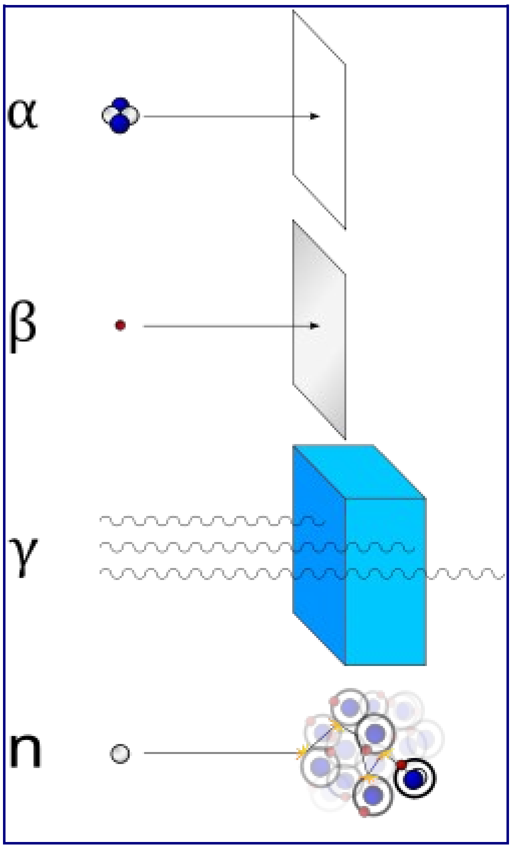
The degree and nature of such ionization depends on the energy of the individual particles (including photons), not on their number (intensity). In the absence of heating or multiple absorption of photons (a rare process), an intense flood of particles or particle-waves will not cause ionization if each particle or particle-wave does not carry enough individual energy to be ionizing (e.g., a high-powered radio beam). Conversely, even very low-intensity radiation will ionize, if the *individual particles* carry enough energy (e.g., a low-powered X-ray beam). Roughly speaking, particles or photons with energies above a few electron volts (eV) are ionizing, no matter what their intensity.

Examples of ionizing particles are alpha particles, beta particles, neutrons, and cosmic rays. The ability of an electromagnetic wave (photons) to ionize an atom or molecule depends on its frequency, which determines the energy of its associated particle, the photon. Radiation on the short-wavelength end of the electromagnetic spectrum—high-frequency ultraviolet, X-rays, and gamma rays—is ionizing, due to its composition of high-energy photons. Lower-energy radiation, such as visible light, infrared, microwaves, and radio waves, are not ionizing.[2] The latter types of low-energy non-ionizing radiation may damage molecules, but the effect is generally indistinguishable from the effects of simple heating. Such heating does not produce free radicals until higher temperatures (for example, flame temperatures or "browning" temperatures, and above) are attained. In contrast, damage done by ionizing radiation produces free radicals, even at room temperatures and below, and production of such free radicals is the reason these and other ionizing radiations produce quite different types of chemical effects from (low-temperature) heating. Free radical production is also a primary basis for the particular danger to biological systems of relatively small amounts of ionizing radiation that are far smaller than needed to produce significant heating. Free radicals easily damage DNA, and ionizing radiation may also directly damage DNA by ionizing or breaking DNA molecules.

Ionizing radiation is ubiquitous in the environment, and also comes from radioactive materials, X-ray tubes, and particle accelerators. It is invisible and not directly detectable by human senses, so instruments such as Geiger counters are usually required to detect its presence. In some cases it may lead to secondary emission of visible light upon interaction with matter, as in Cherenkov radiation and radioluminescence. It has many practical uses in medicine, research, construction, and other areas, but presents a health hazard if used improperly. Exposure to radiation causes damage to living tissue, and can result in mutation, radiation sickness, cancer,[3] and death.

Contents

Types



Alpha (α) radiation consists of a fast moving helium-4 (4He) nucleus and is stopped by a sheet of paper. Beta (β) radiation, consisting of electrons, is halted by an aluminium plate. Gamma (γ) radiation, consisting of energetic photons, is eventually absorbed as it penetrates a dense material. Neutron (n) radiation consists of free neutrons which are blocked using light elements, like hydrogen, which slow and/or capture them.

Various types of ionizing radiation may be produced by radioactive decay, nuclear fission and nuclear fusion, and by particle accelerators and naturally occurring cosmic rays. Muons and many types of mesons (in particular charged pions) are also ionizing.

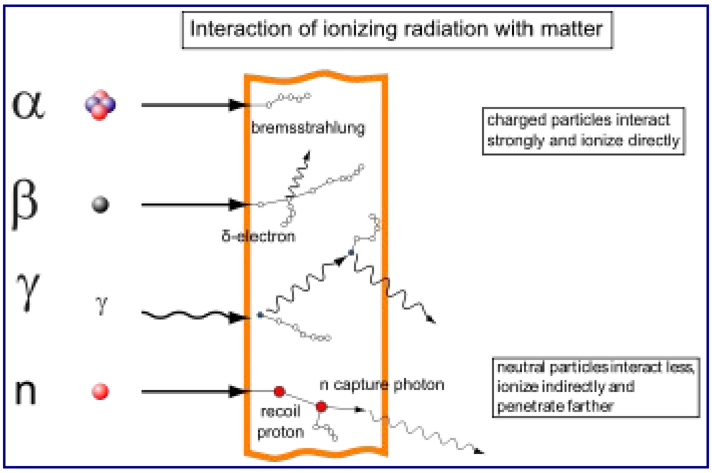
In order for a particle to be ionizing, it must both have a high enough energy and interact with the atoms of a target.

Photons interact electromagnetically with charged particles, so photons of sufficiently high energy also are ionizing. The energy at which this begins to happen with photons (light) is in the high frequency end of the ultraviolet region of the electromagnetic spectrum.

Charged particles such as electrons, positrons, muons, protons, alpha particles, and heavy atomic nuclei from accelerators or cosmic rays also interact electromagnetically with electrons of an atom or molecule. Muons contribute to background radiation due to cosmic rays, but by themelves are thought to be of little hazard importance due to their relatively low dose. Pions (another very short-lived sometimes-charged particle) may be produced in large amounts in the largest particle accelerators. Pions are not a theoretical biological hazard except near such operating machines, which are then subject to heavy security.

Neutrons, on the other hand, having zero electrical charge, do not interact electromagnetically with electrons, and so they cannot directly cause ionization by this mechanism. However, fast neutrons will interact with the protons in hydrogen (in the manner of a billiard ball hitting another, head on, sending it away with all of the first ball's energy of motion), and this mechanism produces proton radiation (fast protons). These protons are ionizing because they are charged, and interact with the electrons in matter.

A neutron can also interact with other atomic nuclei, depending on the nucleus and the neutron's velocity; these reactions happen with fast neutrons and slow neutrons, depending on the situation. Neutron interactions in this manner often produce radioactive nuclei, which produce ionizing radiation when they decay, then they can produce chain reactions in the mass that is decaying, sometimes causing a larger effect of ionization.



Types of radiation - gamma rays are represented by wavy lines, charged particles and neutrons by straight lines. The little circles show where ionization processes occur.

An ionization event normally produces a positive atomic ion and an electron. High-energy beta particles may produce bremsstrahlung when passing through matter, or secondary electrons (δ-electrons); both can ionize in turn. Energetic Beta-particles. like those emitted by ^{32}P, are quickly decelerated when passing through matter. The energy lost to deceleration is emitted in the form of X-rays called "Bremsstrahlung" which translates "Braking Radiation". Bremsstrahlung is of concern when shielding beta emitters. The intensity of bremsstrahlung increases with the increase in energy of the electrons or the atomic number of the absorbing medium.

Unlike alpha or beta particles (see particle radiation), gamma rays do not ionize all along their path, but rather interact with matter in one of three ways: the photoelectric effect, the Compton effect, and pair production. By way of example, the **figure** shows Compton effect: two Compton scatterings that happen sequentially. In every scattering event, the gamma ray transfers energy to an electron, and it continues on its path in a different direction and with reduced energy.

In the same figure, the neutron collides with a proton of the target material, and then becomes a fast recoil proton that ionizes in turn. At the end of its path, the neutron is captured by a nucleus in an (n,γ)-reaction that leads to a neutron capture photon.

General biological effects by type and dose

See the Biological effects section below for detail.

Non-ionizing radiation is thought to be essentially harmless below the levels that cause heating. Ionizing radiation is dangerous in direct exposure, although the degree of danger is a subject of debate.

The negatively-charged electrons and positively charged ions created by ionizing radiation may cause damage in living tissue. If the dose is sufficient, the effect may be seen almost immediately, in the form of radiation poisoning. See criticality accident for a number of cases of accidental radiation poisoning and their outcomes.

Lower doses may cause cancer or other long-term problems. The effect of the very low doses encountered in normal circumstances (from both natural and artificial sources, like cosmic rays, medical X-rays and nuclear power plants) is a subject of current debate. A 2005 report released by the U.S. National Research Council (the BEIR VII report, summarized in [1]) indicated that the overall cancer risk associated with background sources of radiation was relatively low. Some even propose that low-level doses of ionizing radiation are beneficial, by stimulating the immune system and self-repair mechanisms of cells. This hypothesis is called radiation hormesis.

Radioactive materials usually release alpha particles (which are the nuclei of helium), beta particles (which are quickly moving electrons or positrons), or gamma rays. Alpha and beta particles can often be stopped by a piece of paper or a sheet of aluminium, respectively. They cause most damage when they are emitted inside the human body. Gamma rays are less ionizing than either alpha or beta particles, but protection against gammas requires thicker shielding. The damage they produce is similar to that caused by X-rays, and include burns and also cancer, through mutations. Human biology resists germline mutation by either correcting the changes in the DNA or inducing apoptosis in the mutated cell.

Animals (including humans) can also be exposed to ionizing radiation internally: if radioactive isotopes are present in the environment, they may be taken into the body. For example, radioactive iodine is treated as normal iodine by the body and used by the thyroid; its accumulation there often leads to thyroid cancer. Some radioactive elements also bioaccumulate.

Units

Weighting factors W_R for equivalent dose

Radiation	Energy	w_R
x-rays, gamma rays, electrons, positrons, muons		1
	<10 keV	5
	10–100 keV	10
neutrons	100 keV – 2 MeV	20
	2–20 MeV	10
	>20 MeV	5
protons	>2 MeV	2
alpha particles, fission fragments, heavy nuclei		20

The units used to measure ionizing radiation are rather complex. The ionizing effects of radiation are measured by units of exposure:

- The coulomb per kilogram (C/kg) is the SI unit of ionizing radiation exposure, and measures the amount of radiation required to create 1 coulomb of charge of each polarity in 1 kilogram of matter.
- The roentgen (R) is an older traditional unit that is almost out of use, which represented the amount of radiation required to liberate 1 esu of charge of each polarity in 1 cubic centimeter of dry air. 1 Roentgen = 2.58×10^{-4} C/kg

However, the amount of damage done to matter (especially living tissue) by ionizing radiation is more closely related to the amount of energy deposited rather than the charge. This is called the absorbed dose.

- The gray (Gy), with units J/kg, is the SI unit of absorbed dose, which represents the amount of radiation required to deposit 1 joule of energy in 1 kilogram of any kind of matter.
- The rad (radioactivity absorbed dose), is the corresponding traditional unit which is 0.01 J deposited per kg. 100 rad = 1 Gy.

Equal doses of different types or energies of radiation cause different amounts of damage to living tissue. For example, 1 Gy of alpha radiation causes about 20 times as much damage as 1 Gy of X-rays. Therefore the equivalent dose was defined to give an approximate measure of the biological effect of radiation. It is calculated by multiplying the absorbed dose by a weighting factor W_R which is different for each type of radiation (see above table).

- The sievert (Sv) is the SI unit of equivalent dose. Although it has the same units as the gray, J/kg, it measures something different. It is the dose of a given type of radiation in Gy that has the same biological effect on a human as 1 Gy of x-rays or gamma radiation.
- The rem (Roentgen equivalent man) is the traditional unit of equivalent dose. 1 sievert = 100 rem. Because the rem is a relatively large unit, typical equivalent dose is measured in millirem (mrem), 10^{-3} rem, or in microsievert (µSv), 10^{-6} Sv. 1 mrem = 10 µSv.
- A unit sometimes used for low level doses of radiation is the BRET (Background Radiation Equivalent Time). This is the number of days of an average person's background radiation exposure the dose is equivalent to. This unit is apparently not standardized, and depends on the value used for the average background radiation dose. Using the 2000 UNSCEAR value (below), one BRET unit is equal to about 6.6 µSv.

For comparison, the average 'background' dose of natural radiation received by a person is around 2.4 mSv (240 mrem) per year (3.6 mSv (360 mrem) per year in the USA).[4] The lethal full-body dose of radiation for a human is around 4–5 Sv (400–500 rem).[5]

Uses

Ionizing radiation has many uses, such as to kill cancerous cells. However, although ionizing radiation has many applications, overuse can be hazardous to human health. For example, at one time, assistants in shoe shops used X-rays to check a child's shoe size, but this practice was halted when it was discovered that ionizing radiation was dangerous.[6]

Nuclear power

Nuclear reactors produce large quantities of ionizing radiation as a byproduct of fission during operation. In addition, they produce highly radioactive nuclear waste, which will emit ionizing radiation for thousands of years for some of the fission products. The safe disposal of this waste in a way that protects future generations from exposure to its radiation is currently imperfect, a highly controversial and arguably unsolved worldwide problem of this technology.

Radiation emissions from nuclear waste decrease extremely slowly. Waste from nuclear reactors is highly radioactive and has to be contained and stored safely for hundreds of thousands of years while this process occurs. While some sources indicate that radioactive emissions from nuclear power plants under normal conditions of operation are lower than radioactive emissions from coal-burning power producers,[7], dangerous amounts of radioactivity have been released during different nuclear accidents. Radioactive waste does not contain the same toxic substances found in the waste byproducts from fossil-fueled generators, but plutonium, which is produced in nuclear reactors, is also a powerful chemical poison.

Industrial measurement

Main article: Industrial radiography

Since ionizing radiations can penetrate matter, they are used for a variety of measuring methods.

X-rays and gamma rays are used to make images of the inside of solid products, as a means of nondestructive testing and inspection. The piece to be radiographed is placed between the source and a photographic film in a cassette. After a certain exposure time, the film is developed and it shows internal defects of the material if there are any.

Gauges

Gauges use the exponential absorption law of gamma rays

- Level indicators: Source and detector are placed at opposite sides of a container, indicating the presence or absence of material in the horizontal radiation path. Beta or gamma sources are used, depending on the thickness and the density of the material to be measured. The method is used for containers of liquids or of grainy substances
- Thickness gauges: if the material is of constant density, the signal measured by the radiation detector depends on the thickness of the material. This is useful for continuous production, like of paper, rubber, etc.

Applications using ionization of gases by radiation

- To avoid the build-up of static electricity in production of paper, plastics, synthetic textiles, etc., a ribbon-shaped source of the alpha emitter ^{241}Am can be placed close to the material at the end of the production line. The source ionizes the air to remove electric charges on the material.
- Smoke detector: Two ionisation chambers are placed next to each other. Both contain a small source of ^{241}Am that gives rise to a small constant current. One is closed and serves for comparison, the other is open to ambient air; it has a gridded electrode. When smoke enters the open chamber, the current is disrupted as the smoke particles attach to the charged ions and restore them to a neutral electrical state. This reduces the current in the open chamber. When the current drops below a certain threshold, the alarm is triggered.
- Radioactive tracers for industry: Since radioactive isotopes behave, chemically, mostly like the inactive element, the behavior of a certain chemical substance can be followed by *tracing* the radioactivity. Examples:
    - Adding a gamma tracer to a gas or liquid in a closed system makes it possible to find a hole in a tube.
    - Adding a tracer to the surface of the component of a motor makes it possible to measure wear by measuring the activity of the lubricating oil.

Medical, biological and sterilization applications

The largest use of ionizing radiation in medicine is in medical radiography to make images of the inside of the human body using x-rays. This is the largest artificial source of radiation exposure for humans. Radiation is also used to treat diseases in radiation therapy. Tracer methods (mentioned above) are used in nuclear medicine to diagnose diseases, and widely used in biological research.

In biology and agriculture, radiation is used to induce mutations to produce new or improved species. Another use in insect control is the sterile insect technique, where male insects are sterilized by radiation and released, so they have no offspring, to reduce the population.

In industrial and food applications, radiation is used for sterilization of tools and equipment. An advantage is that the object may be sealed in plastic before sterilization. An emerging use in food production is the sterilization of food using food irradiation.

Detractors of food irradiation have concerns about the health hazards of induced radioactivity. [*citation needed*] Alternatively, a report for the American Council on Science and Health entitled "Irradiated Foods" states: "The types of radiation sources approved for the treatment of foods have specific energy levels well below that which would cause any element in food to become radioactive. Food undergoing irradiation does not become any more radioactive than luggage passing through an airport X-ray scanner or teeth that have been X-rayed." [2]

Sources

Natural and artificial radiation sources are similar in their effects on matter.

The average exposure for Americans is about 360 mrem (3.6 mSv) per year, 81 percent of which comes from natural sources of radiation. The remaining 19 percent results from exposure to human-made radiation sources such as medical X-rays, most of which is deposited in people who have CT scans. However, in some areas, the average background dose can be over 1,000 mrem (10 mSv) per year. An important source of natural radiation is radon gas, which seeps continuously from bedrock but can, because of its high density, accumulate in poorly ventilated houses.

The background rate for radiation varies considerably with location, being as low as 1.5 mSv/a (1.5 mSv per year) in some areas and over 100 mSv/a in others. People in some parts of Ramsar, a city in northern Iran, receive an annual absorbed dose from background radiation that is up to 260 mSv/a. Despite having lived for many generations in these high background areas, inhabitants of Ramsar show no significant cytogenetic differences compared to people in normal background areas.[8] This has led to the suggestion that high but steady levels of radiation are easier for humans to sustain than sudden radiation bursts.

Natural background radiation

Natural background radiation comes from five primary sources: cosmic radiation, solar radiation, external terrestrial sources, radiation in the human body and radon.

Cosmic radiation

See also: Cosmic ray

The Earth, and all living things on it, are constantly bombarded by radiation from outside our solar system. This cosmic radiation consists of positively-charged ions from protons to iron nuclei. The energy of this radiation can far exceed that which humans can create even in the largest particle accelerators (see ultra-high-energy cosmic ray). This radiation interacts in the atmosphere to create secondary radiation that rains down, including x-rays, muons, protons, alpha particles, pions, electrons, and neutrons.

The dose from cosmic radiation is largely from muons, neutrons, and electrons, with a dose rate that varies in different parts of the world and based largely on the geomagnetic field, altitude, and solar cycle. The cosmic-radiation dose rate on airplanes is so high that, according to the United Nations UNSCEAR 2000 Report (see links at bottom), airline flight crew workers receive more dose on average than any other worker, including those in nuclear power plants.

External terrestrial sources

Most materials on Earth contain some radioactive atoms, even if in small quantities. Most of the dose received from these sources is from gamma-ray emitters in building materials, or rocks and soil when outside. The major radionuclides of concern for **terrestrial radiation** are isotopes of potassium, uranium, and thorium. Each of these sources has been decreasing in activity since the birth of the Earth.

Internal radiation sources

All Earthly materials that are the building blocks of life contain a radioactive component. As humans, plants and animals consume food, air and water, an inventory of radioisotopes builds up within the organism (see banana equivalent dose). Some radionuclides, like potassium-40, emit a high energy gamma ray that can be measured by sensitive electronic radiation measurement systems. Other radionuclides, like carbon-14, have such a long half-life that they can be used to date the remains of long-dead organisms (such as wood that is thousands of years old). These internal radiation sources contribute to an individual's total radiation dose from natural background radiation.

Radon

Radon-222 is produced by the decay of radium-226 which is present wherever uranium is found. Since radon is a gas, it seeps out of uranium-containing soils found across most of the world and may accumulate in well-sealed homes. It is often the single largest contributor to an individual's background radiation dose and is certainly the most variable from location to location. Radon gas could be the second largest cause of lung cancer in America, after smoking.[9]

Artificial sources

Above the background level of radiation exposure, the U.S. Nuclear Regulatory Commission (NRC) requires that its licensees limit human-made radiation exposure for individual members of the public to 100 mrem (1 mSv) per year, and limit occupational radiation exposure to adults working with radioactive material to 5,000 mrem (50 mSv) per year. Occupationally exposed individuals are exposed according to the sources with which they work. The radiation exposure of these individuals is carefully monitored with the use of pocket-pen-sized instruments called dosimeters.

Examples of industries where occupational exposure is a concern include:

- Airline crew (the most exposed population)
- Industrial radiography
- Medical radiology and nuclear medicine[10][11]
- Uranium mining
- Nuclear power plant and nuclear fuel reprocessing plant workers
- Research laboratories (government, university and private)

Some human-made radiation sources affect the body through direct radiation, while others take the form of radioactive contamination and irradiate the body from within.

Medical procedures, such as diagnostic X-rays, nuclear medicine, and radiation therapy are by far the most significant source of human-made radiation exposure to the general public. Some of the major radionuclides used are I-131, Tc-99, Co-60, Ir-192, and Cs-137. These are rarely released into the environment. The public also is exposed to radiation from consumer products, such as tobacco (polonium-210), building materials, combustible fuels (gas, coal, etc.), ophthalmic glass[*citation needed*], televisions, luminous watches and dials (tritium), airport X-ray systems, smoke detectors (americium), road construction materials, electron tubes, fluorescent lamp starters, and lantern mantles (thorium). A typical dose for radiation therapy might be 7 Gy spread daily (on weekdays) over two months[*citation needed*].

Of lesser magnitude, members of the public are exposed to radiation from the nuclear fuel cycle, which includes the entire sequence from mining and milling of uranium to the disposal of the spent fuel. The effects of such exposure have not been reliably measured due to the extremely low doses involved. Estimates of exposure are low enough that proponents of nuclear power liken them to the mutagenic power of wearing trousers for two extra minutes per year (because heat causes mutation).[*citation needed*] Opponents use a cancer per dose model to assert that such activities cause several hundred cases of cancer per year, an application of the controversial Linear no-threshold model (LNT).[*citation needed*]

In a nuclear war, gamma rays from fallout of nuclear weapons would probably cause the largest number of casualties. Immediately downwind of targets, doses would exceed 300 Gy per hour. As a reference, 4.5 Gy (around 15,000 times the average annual background rate) is fatal to half of a normal population, without medical treatment.

Some of the radionuclides of concern include cobalt-60, caesium-137, americium-241, and iodine-131.

Biological effects

[show]v · d · eRadiation poisoning

General	Accidents · Experiments · Biological timeline
Conditions	Radiation dermatitis · Radiation recall reaction · Radiation acne · Radiation cancer · Radiation-induced lung injury
Treatments	Dose fractionation · Radioresistance · Radiation protection · Radiation dose reconstruction

The biological effects of radiation are thought of in terms of their effects on living cells. For low levels of radiation, the biological effects are so small they may not be detected in epidemiological studies. The body repairs many types of radiation and chemical damage. Biological effects of radiation on living cells may result in a variety of outcomes, including:

1. Cells experience DNA damage and are able to detect and repair the damage.
2. Cells experience DNA damage and are unable to repair the damage. These cells may go through the process of programmed cell death, or apoptosis, thus eliminating the potential genetic damage from the larger tissue.
3. Cells experience a nonlethal DNA mutation that is passed on to subsequent cell divisions. This mutation may contribute to the formation of a cancer.
4. Cells experience "irreparable DNA damage." Low level ionizing radiation may induce irreparable DNA damage (leading to replicational and transcriptional errors needed for neoplasia or may trigger viral interactions) leading to pre-mature aging and cancer.[12][13][14]

Other observations at the tissue level are more complicated. These include:

1. In some cases, a small radiation dose reduces the impact of a subsequent, larger radiation dose. This has been termed an 'adaptive response' and is related to hypothetical mechanisms of hormesis.[15]

Acute

Acute radiation exposure is an exposure to ionizing radiation which occurs during a short period of time. There are routine brief exposures, and the boundary at which it becomes significant is difficult to identify. Extreme examples include

- Instantaneous flashes from nuclear explosions.
- Exposures of minutes to hours during handling of highly radioactive sources.
- Laboratory and manufacturing accidents.
- Intentional and accidental high medical doses.

The effects of acute events are more easily studied than those of chronic exposure.

Chronic

Exposure to ionizing radiation over an extended period of time is called chronic exposure. The term chronic (greek cronos = time) refers to the duration , not the magnitude or seriousness. The natural background radiation is chronic exposure, but a normal level is difficult to determine due to variations. Geographic location and occupation often affect chronic exposure.

Radiation levels

The associations between ionizing radiation exposure and the development of cancer are mostly based on populations exposed to relatively high levels of ionizing radiation, such as Japanese atomic bomb survivors, and recipients of selected diagnostic or therapeutic medical procedures.

Cancers associated with high dose exposure include leukemia,[16] thyroid, breast, bladder, colon, liver, lung, esophagus, ovarian, multiple myeloma, and stomach cancers. United States Department of Health and Human Services literature also suggests a possible association between ionizing radiation exposure and prostate, nasal cavity/sinuses, pharyngeal and laryngeal, and pancreatic cancer.

The period of time between radiation exposure and the detection of cancer is known as the latent period. Those cancers that may develop as a result of radiation exposure are indistinguishable from those that occur naturally or as a result of exposure to other carcinogens. Furthermore, National Cancer Institute literature indicates that chemical and physical hazards and lifestyle factors, such as smoking, alcohol consumption, and diet, significantly contribute to many of these same diseases.

Although radiation may cause cancer at high doses and high dose rates, public health data regarding lower levels of exposure, below about 1,000 mrem (10 mSv), are harder to interpret. To assess the health impacts of lower radiation doses, researchers rely on models of the process by which radiation causes cancer; several models have emerged which predict differing levels of risk.

Studies of occupational workers exposed to chronic low levels of radiation, above normal background, have provided mixed evidence regarding cancer and transgenerational effects. Cancer results, although uncertain, are consistent with estimates of risk based on atomic bomb survivors and suggest that these workers do face a small increase in the probability of developing leukemia and other cancers. One of the most recent and extensive studies of workers was published by Cardis, *et al.* in 2005 .[17]

The linear dose-response model suggests that any increase in dose, no matter how small, results in an incremental increase in risk. The linear no-threshold model (LNT) hypothesis is accepted by the Nuclear Regulatory Commission (NRC) and the EPA and its validity has been reaffirmed by a National Academy of Sciences Committee (see the BEIR VII report, summarized in [3]). Under this model, about 1% of a population would develop cancer in their lifetime as a result of ionizing radiation from background levels of natural and man-made sources.

Ionizing radiation damages tissue by causing ionization, which disrupts molecules directly and also produces highly reactive free radicals, which attack nearby cells. The net effect is that biological molecules suffer local disruption; this may exceed the body's capacity to repair the damage and may also cause mutations in cells currently undergoing replication.

Two widely studied instances of large-scale exposure to high doses of ionizing radiation are: atomic bomb survivors in 1945; and emergency workers responding to the 1986 Chernobyl accident.

Approximately 134 plant workers and fire fighters engaged at the Chernobyl power plant received high radiation doses (70,000 to 1,340,000 mrem or 700 to 13,400 mSv) and suffered from acute radiation sickness. Of these, 28 died from their radiation injuries.

Longer term effects of the Chernobyl accident have also been studied. There is a clear link (see the UNSCEAR 2000 Report, Volume 2: Effects) between the Chernobyl accident and the unusually large number, approximately 1,800, of thyroid cancers reported in contaminated areas, mostly in children. These were fatal in some cases. Other health effects of the Chernobyl accident are subject to current debate.

Ionizing radiation level examples

See: Orders of magnitude (radiation)

Recognized effects of acute radiation exposure are described in the article on radiation poisoning. The exact units of measurement vary, but light radiation sickness begins at about 50–100 rad (0.5–1 gray (Gy), 500–1000 mSv, 50–100 rem, 50,000–100,000 mrem).

Although the SI unit of radiation dose equivalent is the sievert, chronic radiation levels and standards are still often given in millirems, 1/1000 of a rem (1 mrem = 0.01 mSv).

Table A.2 presents a scale of dose levels, with an example of the type of exposure that may cause such a dose, or the special significance of such a dose.

Hormesis

Main article: Radiation hormesis

Radiation hormesis is the conjecture that a low level of ionizing radiation (i.e. near the level of Earth's natural background radiation) helps "immunize" cells against DNA damage from other causes (such as free radicals or larger doses of ionizing radiation), and decreases the risk of cancer. The theory proposes that such low levels activate the body's DNA repair mechanisms, causing higher levels of cellular DNA-repair proteins to be present in the body, improving the body's ability to repair DNA damage. This assertion is very difficult to prove in humans (using, for example, statistical cancer studies) because the effects of very low ionizing radiation levels are too small to be statistically measured amid the "noise" of normal cancer rates.

The idea of radiation hormesis is considered unproven by regulatory bodies, which generally use the standard "linear, no threshold" (LNT) model. The LNT model, however, also remains unproven, and was originally created as an administrative convenience, to simplify the process of developing safety standards. The LNT states that risk of cancer is directly proportional to the dose level of ionizing radiation, even at very low levels. The LNT model is perceived to be safer for regulatory purposes because it assumes worst-case damage due to ionizing radiation. Once this assumption is made, the conclusion is that regulations based on it will ensure the protection of workers - that they might be over-protected, but never be under-protected. However, if the LNT does not apply at low levels, it is conceivable that regulations based on it will prevent or limit the hormetic effect, and thus have a negative impact on health.[18]

Monitoring and controlling exposure

Radiation has always been present in the environment and in our bodies. The human body cannot sense ionizing radiation, but a range of instruments exists which are capable of detecting even very low levels of radiation from natural and man-made sources.

Dosimeters measure an absolute dose received over a period of time. Ion-chamber dosimeters resemble pens, and can be clipped to one's clothing. Film-badge dosimeters enclose a piece of photographic film, which will become exposed as radiation passes through it. Ion-chamber dosimeters must be periodically recharged, and the result logged. Film-badge dosimeters must be developed as photographic emulsion so the exposures can be counted and logged; once developed, they are discarded. Another type of dosimeter is the TLD (Thermoluminescent Dosimeter). These dosimeters contain crystals that emit visible light when heated, in direct proportion to their total radiation exposure. Like ion-chamber dosimeters, TLDs can be re-used after they have been 'read'.

Geiger counters and scintillation counters measure the dose rate of ionizing radiation directly.

Limiting exposure

There are three standard ways to limit exposure:

1. Time: For people who are exposed to radiation in addition to natural background radiation, limiting or minimizing the exposure time will reduce the dose from the radiation source.
2. Distance: Radiation intensity decreases sharply with distance, according to an inverse-square law (in an absolute vacuum).[3]
3. Shielding: Air or skin can be sufficient to substantially attenuate low-energy alpha and beta radiation. Barriers of lead, concrete, or water give effective protection from more energetic particles such as gamma rays and neutrons. Some radioactive materials are stored or handled underwater or by remote control in rooms constructed of thick concrete or lined with lead. There are special plastic shields which stop beta particles and air will stop most alpha particles. The effectiveness of a material in shielding radiation is determined by its half-value thicknesses, the thickness of material that reduces the radiation by half. This value is a function of the material itself and of the type and energy of ionizing radiation.

Some generally accepted thicknesses of attenuating material are 5 mm of aluminum for most beta particles, and 3 inches of lead for gamma radiation.

Containment: Radioactive materials are confined in the smallest possible space and kept out of the environment. Radioactive isotopes for medical use, for example, are dispensed in closed handling facilities, while nuclear reactors operate within closed systems with multiple barriers which keep the radioactive materials contained. Rooms have a reduced air pressure so that any leaks occur into the room and not out of it.

In a nuclear war, an effective fallout shelter reduces human exposure at least 1,000 times. Other civil defense measures can help reduce exposure of populations by reducing ingestion of isotopes and occupational exposure during war time. One of these available measures could be the use of potassium iodide (KI) tablets which effectively block the uptake of radioactive iodine into the human thyroid gland.

Spaceflight

During human spaceflights, particularly flights beyond low Earth orbit, astronauts are exposed to both galactic cosmic radiation (GCR) and possibly solar particle event (SPE) radiation. Evidence indicates past SPE radiation levels which would have been lethal for unprotected astronauts.[19] GCR levels which might lead to acute radiation poisoning are less well understood.[20]

Air travel

Air travel exposes people on aircraft to increased radiation from space as compared to sea level, including cosmic rays and from solar flare events.[21] Software programs such as Epcard, CARI, SIEVERT, PCAIRE are attempts to simulate exposure by aircrews and passengers.[21] An example of a measured dose (not simulated dose), is 6 μSv per hour from London Heathrow to Tokyo Narita on a high-latitude polar route.[21] However, dosages can vary, such as during periods of high solar activity.[21] The United States FAA requires airlines to provide flight crew with information about cosmic radiation, and an ICRP recommendation for the general public is no more than 1 mSv per year.[21] In addition, many airlines do not allow pregnant flightcrew members, to comply with a European Directive.[21] The FAA has a recommended limit of 1 mSv total for a pregnancy, and no more than 0.5 mSv per month.[21] Information originally based on *Fundamentals of Aerospace Medicine* published in 2008.[21]

See also

- Background radiation
- Background radiation equivalent time (BRET)
- Banana equivalent dose
- Civil defense
- Electromagnetic radiation
- Fallout shelter
- Gamma ray
- Geiger counter
- Hormesis
- Ionometer
- Irradiated mail
- National Council on Radiation Protection and Measurements
- Non-ionizing radiation
- Nuclear safety
- Nuclear semiotics
- Nuclear weapon
- Particle radiation
- Radiant energy
- Radiation poisoning
- Radiation protection of patients
- Radiation therapy
- Radioactive contamination
- Radioactivity
- Radiobiology
- Treatment of infections after accidental or hostile exposure to ionizing radiation

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External links

- The Nuclear Regulatory Commission regulates most commercial radiation sources and non-medical exposures in the US:
- NLM Hazardous Substances Databank – Ionizing Radiation
- United Nations Scientific Committee on the Effects of Atomic Radiation 2000 Report Volume 1: Sources, Volume 2: Effects
- Beginners Guide to Ionising Radiation Measurement

- Radiation Risk Calculator Calculate cancer risk from CT scans and xrays.
- Health Physics Society Public Education Website
- Oak Ridge Reservation Basic Radiation Facts

[show]v · d · eNuclear technology

Science	Chemistry · Engineering · Physics · Atomic nucleus · Fission · Fusion · Radiation (ionizing)		
Fuel	Deuterium · Fertile material · Fissile · Isotope separation · Plutonium · Thorium · Tritium · Uranium (enriched · depleted)		
Neutron	Activation · Capture · Cross-section · Fast · Fusion · Generator · Poison · Radiation · Reflector · Temp · Thermal		
Reactors	Fission reactors by moderator	Water	Boiling (BWR · ABWR) · Heavy (CANDU · PHWR · SGHWR) · Natural (NFR) · Pressurized (PWR · VVER · EPR) · Supercritical (SCWR)
		Carbon	Advanced gas-cooled (AGR) · Magnox · Pebble bed (PBMR) · RBMK · UHTREX · Very high temperature (VHTR)
		FLiBe	Molten salt (MSR)
		None (Fast)	Breeder (FBR) · Integral (IFR) · Liquid-metal-cooled (LMFR) · SSTAR · Traveling Wave (TWR) Generation IV by coolant: (Gas (GFR) · Lead (LFR) · Sodium (SFR))
	Fusion reactors by confinement	Magnetic	Field-reversed configuration · Levitated dipole · Reversed field pinch · Spheromak · Stellarator · Tokamak
		Inertial	Bubble fusion (acoustic) · Fusor (electrostatic) · Laser-driven · Magnetized target · Z-pinch
		Other	Dense plasma focus · Migma · Muon-catalyzed · Polywell · Pyroelectric
	List of nuclear reactors		
Power	Nuclear power plant · By country · Economics · Fusion · Isotope thermoelectric (RTG) · Propulsion (rocket) · Safety		
Medicine	Imaging by radiation	Gamma camera	Scintigraphy · Positron emission (PET) · Single photon

		emission (SPECT)
	X-ray	Projectional radiography · Computed tomography
	Therapy	Boron neutron capture (BNCT) · Brachytherapy · Proton · Radiation · Tomotherapy
Weapon	Topics	Arms race · Delivery · Design · Explosion (effects) · History · Proliferation · Testing (underground) · Warfare · Yield (TNTe)
	Lists	Popular culture · States · Tests · Treaties · Weapon-free zones · Weapons
Waste	Products	Actinide: (Reprocessed uranium · Reactor-grade plutonium · Minor actinide) · Activation · Fission (LLFP)
	Disposal	Fuel cycle · HLW · LLW · Repository · Reprocessing · Spent fuel (pool · cask) · Transmutation

[show]v · d · eRadiation (Physics & Health)

Main articles	Non-ionizing radiation	Acoustic radiation force · Infrared · Light · Microwave · Radio waves · Ultraviolet
	Ionizing radiation	Background radiation · Cosmic ray · Gamma ray · Nuclear fission · Nuclear fusion · Nuclear radiation (Nuclear reactors · Nuclear weapons) · Particle accelerators · Radioactive materials (Radioactive decay) · X-ray
	Earth's radiation balance · Electromagnetic radiation · Thermal radiation	
Electromagnetic radiation and health	Radiation therapy · Radiation poisoning · Radioactivity in the life sciences · List of civilian radiation accidents Health physics · Laser safety · Lasers and aviation safety · Mobile phone radiation and health · Wireless electronic devices and health	
Related articles	Half-life · Nuclear physics · Radiation hardening · Radiobiology	

See also categories: Radiation effects, Radioactivity, and Radiobiology

[show]v · d · eCarcinogen - Cancer causing materials and agents

Main articles	Cancer · Cancer Cells
Major suspected carcinogens	PFOA · Tobacco smoke · Xenoestrogen · Bisphenol A · **Ionizing radiation** · DDT · 1,3-Butadiene · List of breast carcinogenic substances · PAH
IARC	International Agency for Research on Cancer / IARC carcinogen lists: Group 1 · Group 2A · Group 2B · Group 3 · Group 4

See also: Neoplasm · Oncology · Non-stick pan

Categories: Radioactivity | Radiobiology | Radiation health effects

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