

## **THE IMPACT OF WRONG MASS MEDIA COMMUNICATION ON CITIZENS' PERCEPTION OF RADIATION RISKS**

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### **ABSTRACT**

In Knowledge Society, Internet and mass media contribute to build an inclusive informed society, providing information about all fields of knowledge. Nevertheless, nuclear sciences remain a mystery for a great fraction of the Brazilian population. Controversies on the biological effects of radiation distort and confuse public's perceptions of radiation risks and benefits. Internet reports that the exposure to indoor radon is a risk factor for lung cancer. Internet reports that the radioactive monazitic sand brings health benefits. It is not easy for the general public to understand contradictions and to identify reliable sources. Scientific community is expected to communicate about the impacts of ionizing radiation in daily life. Nevertheless, the public does not read highly specialized papers. There seem to be a gap between society and the scientific community. On the other hand, anti-nuclear information seems to be easily understood. This paper discusses wrong mass media information delivered all over the country, for kids and adults, in very simple language, through cartoons, comics books, newspapers and educational sites, among others. The article brings examples of newspapers errors due to misinformation, anti-nuclear didactic material plenty of omissions and wrong information delivered to children. People fear what they do not understand. People fear the harmful effects of ionizing radiation to human health and the environment. Risk perception and risk acceptance are a matter of education and properly communication. It is a must to invest in properly scientific divulgation about the risks and benefits of nuclear sciences that impact in citizens' everyday life, such as medical applications, industrial applications and nuclear power generation.

**Keywords:** Nuclear sciences communication; Radiological protection; Risk perception

### **RESUMEN**

En la Sociedad de la Información, Internet y los medios de comunicación contribuyen a construir una sociedad informada y inclusiva, proporcionando información sobre todos los campos del conocimiento. Sin embargo, las ciencias nucleares siguen siendo un misterio para una gran fracción de la población brasileña. Las controversias sobre los efectos biológicos de la radiación distorsionan y confunden las percepciones del público sobre los riesgos y beneficios de la radiación. Internet informa que la exposición al radón en interiores es un factor de riesgo para el cáncer de pulmón. Internet informa que la arena monazítica radioactiva aporta beneficios para la salud. No es fácil para el público comprender las contradicciones y identificar fuentes confiables. Se espera que la comunidad científica comunique sobre los impactos de las radiaciones ionizantes en la vida diaria. Sin embargo, el público no lee artículos altamente especializados. Parece haber una brecha entre la sociedad y la comunidad científica. Por otro lado, la información antinuclear parece ser fácil de entender. Este paper discute la información equivocada de los medios de comunicación entregados en todo el país, para niños y adultos, en un lenguaje muy simple, a través de dibujos animados, cómics, periódicos y sitios educativos. El artículo trae ejemplos de errores de los periódicos debido a la información errónea, material didáctico antinuclear, muchas omisiones e información errónea entregada a los niños. La gente teme lo que no entiende. La gente teme los efectos nocivos de las radiaciones ionizantes para la salud humana y el medio ambiente. La percepción del riesgo y la aceptación del riesgo son una cuestión de educación y comunicación adecuada. Es imprescindible invertir en una divulgación científica adecuada sobre los riesgos y beneficios de las ciencias nucleares que impactan en la vida cotidiana, como las aplicaciones médicas, las aplicaciones industriales y la generación de energía nuclear..

**Palabras clave:** Comunicación de las ciencias nucleares, Protección radiológica; Percepción del riesgo

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## 1. INTRODUCTION

In Knowledge Society, Internet and mass media contribute to build an inclusive informed society, providing information about all fields of knowledge. Nevertheless, nuclear sciences remain a mystery for a great fraction of the Brazilian population. Controversies on the biological effects of radiation distort and confuse public's perceptions of radiation risks and benefits. It is not easy for the general public to understand contradictions and to identify reliable sources. A great number of websites report that the exposure to indoor radon is an important risk factor for lung cancer among the general population. On the other hand, Guarapari Beach, a coastal town in Southern Brazil, is visited by thousands of tourists every year due to the supposed health benefits of the monazite sand. These are examples of controversies on the biological effects of low-dose radiation that distort and confuse public's perceptions of radiation risks and benefits.

Scientific community is expected to evaluate and communicate about the presence and the impacts of natural radiation, offering a wider perspective on the real benefits and risks in everyday life. As a matter of fact, scientific community does publish many papers about the growing impact of newest scientific and technological possibilities and studies related to nuclear science and radiological protection. However, the public does not read highly specialized papers. People fear what they do not understand.

People fear the harmful effects of ionizing radiation to human health and the environment. The general public is not aware that there is a discipline called "Radiological Protection" exclusively dedicated for the protection of people, as well as the environment, from the harmful effects of the exposure to ionizing radiation. There seem to be a gap between society and the scientific community.

Nevertheless, pseudo-scientific anti-nuclear information seems to be easily spread and in a very understandable way. In other words, it is more likely that the public learn from social media rumors than from correct scientific sources. This paper discusses wrong mass media information delivered all over the country, for kids and adults, in a very simple language, through cartoons, comics books, newspapers and educational sites, among others. It is a must to invest in properly scientific divulgation about the risks and benefits of nuclear sciences that impact in citizens' everyday life. Risk perception and risk acceptance are a matter of education and properly communication.

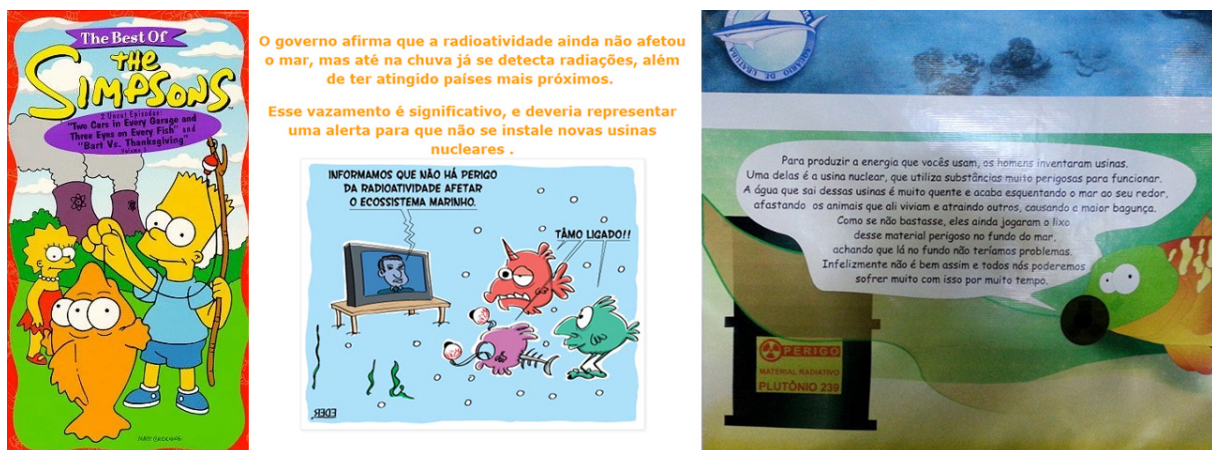
## 2. PROBLEM STATEMENT

Not only it is difficult for the general public to identify reliable sources, but also it is difficult to understand discrepancies. Regarding low-dose effects from ionizing radiation, for example, there are disagreements even among the scientific community. Whether experts do agree that radiation causes observable health effects at high doses, regarding low-dose radiation biological effects, information gathered in Internet highlights many controversies that distort and confuse public's perceptions of radiation risks and benefits. International publications [1] - [3] prudently assume that stochastic biological effects may occur and that low doses increase biological damage risk in linear proportion to dose, proposing the suitable linear-non-threshold model (LNT). Nevertheless, there is no scientific consensus on such assumption and radioprotection experts have different hypotheses which cannot be scientifically excluded.

Hormesis defenders, based on naturally background evidences, as well as UNSCEAR scientific published results since 1958 [4], strongly suggest the presence of benefits from low-dose. If it is hard to identify and understand correct information, on the other hand, anti-nuclear information seems to be very easy to understand.

The article brings examples of newspapers errors due to misinformation, anti-nuclear didactic material plenty of omissions and wrong information delivered to children. A common example of the harmful effects of ionizing radiation and environment contamination is given in Figure 1. It is true that water contamination creates serious food, agriculture and environmental problems. Nevertheless, the images, shown in Figure 1, suggest that radioactive waste is systematically negligence and that radioactive facilities do not assume full responsibility for all their wastes. The figure shows respectively: (1) The Simpsons, a cartoon for adults and children which shows a nuclear facility ran by irresponsible non-prepared people which results in accidents, water contamination and... the famous three-eye-fish; (2) Internet blog about radioactivity, affirming that there are many cases of important water contamination and warning the population to refuse new nuclear facilities in our country; (3) A very didactic banner, for teachers and students, explaining that nuclear power generation results in water and fish contamination, suggesting even that Plutonium sources are thrown in the water.

**Figure 1: Water contamination due to ionizing radiation**



Source: Internet and authors' own file<sup>2</sup>

As a matter of fact, in an unpretentious way and using artistic communication, cartoons are very effective in transmitting information. And also are comics, as shown in FIGURE 2. This material, created by an organization called "Human Rights Brazilian Foundation", has elaborated this extremely easy-to-understand didactic material, which is spread through their website, as well as the social media. The headlines are clear: Anti-nuclear – in defense of the life, the water and for environmental justice. Once again, right concepts are manipulated, and omission of vital information leads the public to mistrust and fear. Not once it is mentioned in

<sup>2</sup> Fig 1(a) - [http://simpsons.wikia.com/wiki/The\\_Best\\_of\\_the\\_Simpsons:\\_Volume\\_5](http://simpsons.wikia.com/wiki/The_Best_of_the_Simpsons:_Volume_5); Fig 1 (b) <http://ilustraconto.blogspot.com.br/2011/03/radioatividade.html>; Fig 1 (c) Ubatuba Aquarium (2014)

this material radiological protection or radioactive waste management. On the contrary, readers are given an explanation that the transportation of radioactive material is not safe and that contaminations are not rare.

Figure 2: Original and modern design with themes to engage children and teenagers



Source: <http://www.fundodireitoshumanos.org.br/wp-content/uploads/2016/08/anexo-13-hq-ceara-antinuclear.pdf>

Moreover, Social media have increasingly gained popularity and has an enormous potential for spreading quickly information through a large community. The best example seems to be a youtube video “viralizing” in the Internet in 2017. In this video, that is still on Internet, mammography is presented not only as a risk, but also as a danger to women’s health. Using the name of a well-known Brazilian physician this woman talks about the “hidden dangers” of mammography warning everyone not to submit to this procedure. Evidently, the mentioned physician has never said such an absurd! The video was strongly repudiated by reliable press and many were the articles and interviews where the physician presented the correct information and the importance of mammography for early diagnosis and saving lives<sup>3</sup>.

Nevertheless, one wrong information seems to “viralize” more than one thousand corrections and, once it is delivered, the doubt is already instilled and can hardly be erased. The question is: why do people believe in sensationalistic rumors about the harmful effects of ionizing radiation? It seems that opinion makers and the media itself priorities risks upon benefits. Even though reliable press usually spread trustfully information, sometimes there is a lack of a bigger context, which would permit the reader to figure out the information in a bigger picture. Figure 3 brings the two above-cited examples: (1) the video that “viralized” among Brazilian women, containing false information about mammography, and (2) an article in a well-know reliable magazine, showing a big picture with the symbol of radioactivity and the words: “The history of nuclear Brazilian industry is marked by uncontrolled situations and accidents”. It is important to highlight that reinforcing past negative tend to confuse the public’s perception the difference between perceived and actual risk.

<sup>3</sup> Reliable press reject wrong information: BBC News - <http://www.bbc.com/portuguese/brasil-37581086>; Globo News <http://g1.globo.com/bemestar/noticia/2016/10/e-um-desservico-mulheres-drauzio-varella-desmente-boato-que-liga-mamografia-cancer-de-tireoide.html>



**Figure 3: Information for adults: video condemning mammography and the history of radioactivity in Brazil the last 3 decades, marked by “uncontrolled situations and accidents”.**



Source: Video- <https://www.youtube.com/watch?v=XlzJCL8ugfY> and Image - [https://istoe.com.br/94854\\_DESCONTROLE+ATOMICO/](https://istoe.com.br/94854_DESCONTROLE+ATOMICO/)

Even though reliable press make all efforts to combat fake news and sensationalism, the media still presents nuclear sciences as a polemic issue. Due to lack of knowledge (and maybe personal beliefs?) the public is given tendentious information in different forms: omission, errors and poor development of a constructive critical thinking. Figure 4 brings an example of a very well-known and reliable Brazilian channel, which presented a documentary about ionizing radiation and cancer. A welcome article to present the public symbols and basic concepts of ionizing radiation. However, we can clearly identify the reporter’s personal beliefs and (un)knowledge, among errors and omissions. A significant example: when he highlights that the patient is exposed to x-rays, while the technician “hides himself” behind a wall. It is clear that the word “hide” is not well placed and lead to a negative connotation. Workers do not hide; it is important to limit their exposure to radiation in their workplaces and they are supposed to protect themselves from unnecessary exposures according to national and international recommendations. Talking about dose limits for the public, the reporter was clearly explaining a concept that was meaningless to himself. If opinion makers do not have the basic information themselves, how can they transmit it in a fair way, with no errors or omissions and being aware of their own personal beliefs?

**Figure 4: Title of the documentary: “Know the risks of radiation” – Lack of understanding about thresholds, omission about occupational exposure in workplace and emphasis on AND damage.**



<http://g1.globo.com/bemestar/noticia/2015/06/saiba-quais-sao-os-riscos-da-radiacao.html>

### 3. RISK PERCEPTION AND RISK ACCEPTANCE

Risk perception and risk acceptance are a matter of education and properly communication. The general public do not read high-specialized articles written by the scientific community. They do not read IAEA or ICRP publications and recommendations, nor the legislation (norms) of our country emitted by the Brazilian Nuclear Energy Commission.

Due to the fact that the general public does not have enough understanding about all these issues, people fear the harmful effects of ionizing radiation to human health and the environment. It is a must to invest in properly scientific divulgation about radiological protection issues associated to the use of ionizing radiation in research, medicine, nuclear power generation and industrial applications. Analyzing the above examples of problems in communicating nuclear sciences, three topics seem essential to educate the population:

1. Radiological protection basic concepts: the population ought to know that radiological protection is a specific field that studies the biological effects in human body and establish dose limits in order to be compatible to other daily risks in our everyday life. The dose limit for the population is only  $1 \text{ mSv a}^{-1}$ . For workers involved with ionizing radiation limits are much bigger: an annual limit of 20 mSv (average in 5 years) or up to 50 mSv in a single year. The technique of food irradiation follows national and international recommendations and requirements to ensure radiation safety and physical security of radioactive sources, workers and the environment. There are Radiation Protection Programs to protect human health and the environment from unnecessary exposure to radiation and to study several aspects of environmental protection.
2. Safe transport of radioactive material: the population accept daily transportation of dangerous goods by all modes, which includes substances that have explosive, flammable, corrosive or environmentally hazardous properties. It is the case of gasoline, ethanol, alcohol and diesel. The population ought to know that, for the transportation of radioactive materials, as well, there are Safety Standards and specific requirements, so that it cannot harm workers, the public or the environment. For the transport of radioactive materials and radioactive waste, besides internationally standardized markings and labels on packages, casks and transportation vehicles, there are also safety and training practices for officers, technicians, managers and others involved in transporting radioactive materials or in preparing radioactive materials for transport.
3. Management of Radioactive Waste: the population ought to know that licenses are required to construct and operate a nuclear or a radioactive facility. There are international and national advisory bodies providing recommendations and guidance on radiological protection regarding radioactive waste management, which includes handling, pre-treatment, treatment, conditioning, storage and disposal of radioactive waste. All efforts are made in order to reduce the amount of radioactive material to ensure public health and safety and protection of the environment.

#### **4. FINAL CONSIDERATIONS**

According to ICRP Publication 103, in its paragraph 26 [5], the primary aim of the system of radiological protection is: “to contribute to an appropriate level of protection for people and the environment against the detrimental effects of radiation exposure without unduly limiting the desirable human actions that may be associated with such exposure”. Nevertheless, general public seems to be unaware of the radiological protection issues. Lack of knowledge leads the public to distrust and unfounded prejudices.

In knowledge society where Internet seems to be the most used source to obtain information, the adequacy of the communication is a must and a challenge. While the public do not have the ability to access reliable information sources, the media and the press seem to privilege sensationalistic or polemic issues about nuclear technology, rather than the beneficial applications of ionizing radiation. Meanwhile, fake news goes viral, through misinformed social media posts and once it is done, it is a hard task to rebuild trust in scientific experts.

The balance between risk perception and risk acceptance depends on effective and trustworthy information. The scientific community must invest in properly scientific divulgation about the risks and benefits of nuclear sciences that impact in citizens’ everyday life, such as medical applications, industrial applications and nuclear power generation. It is essential to combat fake pseudo-scientific information of social networks and omissions of the media, in order to decrease the difference between perceived and actual risk regarding ionizing radiation.

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