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Miriam Elizabeth Marx, Talia Quandelacy, Cole Archambault, Jennifer Hogan, Hyejo Jun
Contributors

Dr. Ross Feldberg
Faculty Advisor

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THE BENEFITS AND ETHICAL ISSUES BEHIND USING GENETICALLY MODIFIED ORGANISMS IN AGRICULTURE

by Miriam Elizabeth Marx

1.0 Introduction

1.1 Purpose

The use of genetically modified organisms (GMOs) in agriculture is rising, but not without debate. There are many scientists who argue that genetic engineering in agriculture is the best way to solve many issues of poverty, food security, environmental harm, and the need for increasing competitiveness in sales, but others raise ethical issues regarding the health of the people who consume the genetically modified products, the possible harm to the environment, the depredation of the welfare of the farmers and their food security, and the general introduction of engineering into mainstream use in society.

1.2 Definition of Genetically Modified Organisms

Genetically Modified Organisms, commonly called GMOs, refer to organisms whose genetic material has been altered using recombinant DNA technology, a method used to recombine the DNA of different organisms.

1.3 Sequence of Discussion

I begin the paper with an introduction to the issues of using biotechnology and generating GMOs in agriculture. I continue with arguments both for and against the use of biotechnology in agriculture. I conclude the paper with information about the current debate on this issue and resources to obtain more information.

2.0 Prelude to the Issues

The use of genetically modified organisms to enhance the production, yield, and quality of agriculture is under much discussion. Biotechnology companies are actively investigating the research and development of new technologies to improve food security and augment production of goods in both the developed and developing worlds, while activist groups work to ensure that biotechnology is not used in food production at all for fears of damage to the environment and human health, among other issues. On the other hand, according to Dr. Miguel Altieri, a leading spokesperson in the field, the view that GMOs can enhance food security in the developing world "rests on two assumptions: that hunger is due to a gap between food production and human population density or growth rate and that genetic engineering is the best or only way to increase agricultural production and so meet future food needs".[1] While it is clear that there are benefits to using biotechnology to improve crop production, there are also many fundamental and ethical arguments against its use, as is illustrated shortly.

3.0 The Argument for Biotechnology

3.1 Applications of Biotechnology to the Goal of Poverty Reduction

Several objectives of using biotechnology in agriculture are associated with the reduction of poverty. Introducing GMOs into agriculture is predicted to increase rural incomes, sustain production in resource-poor areas, and provide more nutritious foods. Supporters of the use of biotechnology in food production believe that developed nations with technology have a social and political obligation to assist these poorer nations.

In India, Vietnam, and Kenya, diseased vegetable crops and trees can benefit from genetically produced bio-pesticides. The cardamom crops in India, potato crops in Vietnam, and banana crops in Kenya are often farmers' sole source of income, such that diseased crops can have an extremely damaging affect on the farmers' lives. Problems with a lack of clean and pure seeds and planting material can be solved by using bio-pesticides, which allow for leniency in the purity of the seeds and planting material. In this way, GMOs can potentially provide a means for high-resistance and high-yielding crops.[2]

Biotechnology can also contribute to sustaining the production of foods, commonly cereals and maize, in resource-poor areas. Drought, pests, and acidic soil often cause detrimental problems to farming, but insect resistance and aluminum tolerance can circumvent these environmental barriers. The ability to provide a full farming season through using GMOs to assist in the production of larger quantities of food for these farmers helps to ensure a profitable growing and harvesting season.[2]

Finally, GMOs can contribute to generating more nutritious foods with higher nutrient content—this technology most commonly being applied to rice. The people in countries such as India and China rely heavily on rice in their diets, but rice alone does not provide the necessary nutrients for a balanced diet. Vitamins, such as Vitamin

A, and micronutrients, such as ß-carotene and iron, can be genetically engineered into what is commonly referred to as "Golden Rice."[1, 2]

3.2 Applications of Biotechnology to the Goal of Financial Security for Farmers

Farmers can make great use of transgenic techniques in their agriculture with the goals of both ensuring food security and increasing the competitiveness of their crops. Biotech companies and supporters of the use of GMOs believe that there exists a political obligation to assist in the security and well-being of farmers who supply goods to more developed countries.

3.2.1 Food Security

The biotechnology objectives in agriculture that are associated with issues of food security include meeting the demand predictions for staple foods, increasing livestock numbers, and increasing vegetable and fruit yields. Two major constraints that farmers encounter with regard to meeting the demand predictions for staple foods, which must be grown in large quantities, include the presence of pests and the consequential infectious diseases, and problems associated with biotic stress. Pests and disease are often a problem in rice crops in China, and the addition of genetically modified rice varieties with pesticides can assist in the prevention of diseases in these crops. In addition, GMOs are valuable for avoiding abiotic stresses, such as salinity and drought. In India, China, and Thailand, hydration and salinity tolerance in cereals, considered to be staple foods, assist in the security of high yields of these food crops to meet the demand.[1]

In India, biotechnology can help to avoid the major problem associated with the keeping of livestock, i.e., the probability of diseased animals, including cattle, pigs, and sheep. In addition, embryo technology can sidestep issues of productivity in dairy cattle. Both of these uses for GMOs lead to an increase in both livestock number and productivity.[2]

Biotechnology is also useful for securing a stable food supply by increasing vegetable and fruit production. Pests and diseases infect these crops, often completely depleting their production. Examples of crops are tomato and potato crops in Vietnam, as well as papaya crops, which can become infected with the ringspot virus.[2]

3.2.2 Increasing Competitiveness

The use of biotechnology in agriculture can also assist farmers' competitiveness on the global market, specifically by sustaining productivity exports, regulating food safety and quality control, and adding value to exports. Biotechnology is useful in sustaining exports by increasing the yield of crops, such as coconut crops in the Philippines, banana crops in countries such as India, China, and Vietnam, and potatoes, rice, maize, wheat, cassava, and beans in other developing countries.[2]

In addition, GMOs can contribute to food safety and quality control with respect to food exports by controlling pesticide residues and ensuring the competitive quality of exports.[2] Improved quality can include characteristics such as texture, taste, appearance, and nutritional value, and the ability to delay the ripening of fruits and vegetables can greatly approve the longevity of some produce. "Specific improvements for producers are an increased flexibility during production, harvesting, storage, distribution, and transport stages, leading to a reduction of overall production costs" and a greater guarantee of quality product at the time of selling.[3]

3.3 Applications of Biotechnology to the Goal of Environmental Protection

The introduction of technology into the environment can be hazardous and brings up ethical issues associated with protecting the environment through the use of technology (also see section 4.2). However, many supporters of GMOs claim that biotechnology in agriculture can enhance protection of the environment, specifically by reducing pesticide use and enabling the efficient use of water.

Pesticide misuse on cotton and rice crops in China and on vegetables in Malaysia is a common problem when farmers are misinformed of use of pesticides, or when pesticides are overused in attempt to deter crop failure due to pests. Transgenic crops can potentially reduce the need for and usage of pesticides by assisting pest extermination and preventing weed growth. GMOs such as Bacillis thuringiensis (Bt), a natural soil bacterium, can be used to kill insects by allowing the plants to produce their own toxin against pests, sidestepping the problem of farmers who are mis- and overusing pesticides. In addition, herbicide tolerant crops ideally require fewer herbicide applications, because the crop is genetically "programmed" to more efficiently utilize the particular chemical product.[4] Finally, transgenic herbicides can be applied to pre-treat the land, so that weeds are altogether prevented, and farmers can weight the options and costs of using more chemicals versus dealing with weed growth during harvest.[3]

Making more efficient use of water is another way to encourage environmental protection, and water misuse can be dangerous during drought or times of high salinity. Maize, rice, and sorghum are examples of crops that, through molecular remodeling, can use water more efficiently.[2] Since more than 70% of the world's water sup-

plies are currently being used for agricultural purposes, the use of bioengineered crops that are able to use water more adeptly or to grow in dry and/or salty soil are extremely useful.[3]

4.0 The Argument Against Biotechnology

4.1 Uncertainty of the Safety of Humans After Consumption

Although there is a lot of anticipation and excitement about the beneficial effects that can potentially result from the use of biotechnology in agriculture, there is also a lot that is unknown about the uses of transgenics and their impending consequences. Specifically, examples of these issues include the lack of available public information and knowledge about the content and effects of GM foods, the possible inactivation of many nutrients present in naturally-grown foods, and the introduction of allergens through the use of GMOs. These are all social, ethical, and legal issues based on the morality of tampering with foods in a way that will have an unknown effect on human health.

As just stated, one major issue regarding the allowance of the free use of GMOs in agriculture is associated with the unknown potential health effects of consuming chemically treated foods. Consumers assume that the foods they buy are safe, even though many contain compounds that are potentially toxic or allergenic. The general public has a large misunderstanding about genetically modified (GM) foods because companies do not boldly advertise their use of transgenic components in their products. For this reason, people often consume GM foods without even knowing it.

In addition, while many biotechnology companies advertise the use of transgenics in agriculture as beneficial to human health by improving the nutritional content of food, genetic engineering also has the potential to remove or deactivate many nutritional substances present in naturally-grown foods: "Recent research shows that GE [(genetically engineered)] herbicide resistant soybean have lower levels (12–14 percent) of isoflavones, [which are] key phytoestrogens . . . that occur naturally in soybeans and may protect women from severe forms of cancer."[1] These genetic modifications boost the activity of a gene that makes critical amino acids, but the resulting shift in amino acid levels shifts the metabolism of the plant to alter the levels of the aforementioned phytoestrogens. This effect is clearly seen in GM soybeans, even when the chemical residue data is within the Environmental Protection Agency (EPA) tolerance limits.[4]

Finally, the use of GMOs in agriculture brings to question the compromise of human safety because of wide reports of increased allergenicity after consumption of GM foods. For example, a protein was expressed in a crop used for animal feed in order to increase the content of the amino acid methionine. This "protein was subsequently shown to be an allergen, as are a number of related [proteins of this type] from other species."[5] Another example of the use of biotechnology introducing an allergen into a food product is the use of a Bt protein in GM maize, which also shows the general features of allergenic proteins.[6] These are simply two examples of how the application of biotechnology can introduce allergens into crops. Since research is still just beginning on many GMOs, the allergenic effects of the use of biotechnology in agriculture remains unclear and under investigation.

4.2 Uncertainty of the Safety of the Environment

Furthermore, while several environmental arguments support the use of biotechnology in agriculture, GMOs also have the potential to damage the environment, and questions arise as to whether it is ethical to interfere with the biological balance of nature. Some of these issues include the production of superweeds and superbugs, which result from antibiotic resistance to the GM pesticides and chemicals; the potential change in climate after using GMOs and the dependence on use of these chemicals; the loss of biodiversity due to the encouragement of monocultures; and effects on non-target species.

Antibiotic resistance is the ability of a bacterium or microorganism to withstand the use of an antibiotic because of its ability to synthesize a protein that neutralizes the antibiotic.[7] While it is thought that the use of genetically engineered pesticides and herbicides on crops might only have the effect of reducing pests and weeds, it can actually have an opposing effect as well. The generation of "superbugs" and "superweeds," pests and weeds resistant to the GM pesticides and herbicides, respectively, can result. Not only can the crops that are sprayed acquire these characteristics, but hybrid crops can arise when crops cross. This can cause resistance in crops that were not previously sprayed with GMOs, and can also cause multi-tolerant crops when two crops that are sprayed with different chemicals cross. The result of this second cross is a crop that is resistant to multiple herbicides (i.e., superweeds) or pesticides (i.e., superbugs), which are even more difficult to control. In addition, this resistance can give these weeds and bugs a selective advantage over the naturally-tolerant weeds and bugs, allowing them to propagate efficiently.[5]

In addition, the use of biotechnology in agriculture can largely affect the climate of the immediate environment around the crop. Characteristics such as limited water supply, salination, pollution, and soil erosion are often circum-

vented by the use of biotechnology, but this can cause the dependence of the soil and environment on the GMOs. For example, "the sustained reliance of a single herbicide such as glyphosate or bromoxynil would predictably shift the soil microflora for longer periods, perhaps changing the overall composition of the soil's living matter irrevocably. Such an effect, should it occur, could affect soil quality for future plantings" and would likely be cause to continue use of the herbicide to avoid complete crop loss.[4] Likewise, transgenic seeds are often sold with corresponding genetically engineered pesticides, for which the seeds are targeted. Again, this causes dependence on the crop for a chemical compound.

A third and especially major issue with the use of GMOs adversely affecting the environment is the loss of biodiversity due to the encouragement of monocultures and uniformity in crop planting. "Plant breeders are acutely aware of the risks of too much inbreeding and the potential of wild and unusual genotypes for providing genes that might improve a crop breeding line," yet GMOs are still in constant use, and farmers still use inbreeding as a means for creating stronger individual crops.[5] This push for uniformity disrupts the biodiversity and biological complexity that underlies the sustainability of traditional farming methods and natural ecosystems, causing the integrity of plant species to be compromised.[1] The continued use of these tactics to create stronger monocultures is slowly destroying both the natural flora that was once present on the land, as well as the ability of the soil to harbor other types of crops. Similarly, the encouragement of monocultures and the continual use of the same pesticides in one area can affect the natural fauna in an ecosystem, often having an unfavorable affect on non-targeted species. At first, it often seems useful that GM crops could potentially deter natural enemies, but this is "of concern to small farmers who rely on the rich complex of predators and parasites associated with their mixed cropping systems for insect pest control."[1]

4.3 The Adverse Effects on the Welfare of Farmers

A generally popular argument for the use of biotechnology in agriculture is that there are benefits to the farmers who own the GM crops. However, this is often not the case. There are generally a large number of adverse effects to the welfare of farmers, including inaccessibility to the available agricultural technology, potential harm that the technologies can have on the farmers' crops, and limits to farmers' options by working against ancient and accepted farming methods.

While the potential benefits to poor farmers in developing countries seems great, it "should be noted that the majority of the research on transgenetic plants is of private origin and focuses on the production of crops grown in and/or for developed countries. Therefore, unless government spending increases or private investment is stimulated in another direction, the benefits for developing countries and their populations will remain rather small."[3] The result of privatization is that GMOs become private property and part of the globalization process, and many activists against the use of technology argue that this globalization is socially and politically unethical. Globalization cuts farmers out of their own production, allowing the government to take over. In addition, poor people, who potentially could benefit the most from the increased crop yields and better quality of product, often cannot take advantage of the technology. This is because of the high cost, and because they often feel discouraged from adopting biotechnology into agriculture for fear of the loss of potential exports to countries that do not encourage the use of biotechnology, specifically countries associated with the European Union.[8]

Moreover, even if farmers do incorporate GMOs into their crops, biotech companies provide no guarantee that the introduction of these technologies will help their crops. For example, farmers lose productivity due to requirements to leave part of a crop non-transgenic to delay the evolution of antibiotic resistance, but this can impose a "higher dependence on uniform soil conditions, higher fertilizer and water use, and machine-dependent harvesting methodologies" on farmers.[4] In addition, farmers are often stuck if they purchase GM seeds that are linked with what is known as "terminator technology." Biotech companies use this technology to link a terminator trait to the seeds that they sell to farmers, so that the farmers must buy new GM seeds every season because their crop yields only sterile seeds. This is yet another ethical problem with the way that companies control the farmers who use their technologies.[5] Similarly, the introduction of GMOs into crop culture can jeopardize the validity and competition of organic crops. Artificially created crops compete with and destroy the marketability of natural products, and can also contaminate organic crops. Since the regulations that enforce isolation distances between transgenic and organic crops are sparse, the segregation of these crops can easily fail through the accidental mixing of seeds, cross-pollination, and/or mixing of products across farm borders after they leave the farm.[1]

The promotion of monocultures through the use of biotechnology in agriculture can also have a negative effect on the welfare of farmers, because it completely undermines ancient ecological methods of farming. Examples include rotation and multicropping, which are used to ensure a harvest season even when something goes wrong with one or more of a farmers' crops. In this way, the threat of

diminished crops and biodiversity loss is increased by the use of biotechnology: "For thousands of years, farmers exchanged seeds allowing them to maintain a dynamic portfolio. Often, the resulting broad-based gene pool proved essential to protect their fields from blights or other depredation."[4] Biotech companies often encourage the growth of single crops enhanced by the use of biotechnology, but this is generally in the interest of greater yield of particular singular crops to benefit the economy and science, and is not in the interest of the farmer.

5.0 Conclusions

While there are many points both in favor and against the use of GMOs in agriculture, some people believe that the question simply comes down to whether or not it is ethical to engineer in agriculture, which has always been managed by farmers themselves in conjunction with local biological cycles and ecological balances. Activists against the use of technology worry about future generations, and how the use of biotechnology in agriculture now will affect food production in years to come. They raise concerns that regulations are too loose and poorly enforced, and the eventual effects of the use of GMOs remain unknown. In addition, important issues revolve around whether or not it is ethical for well-fed people of developed nations to regulate access to agricultural technology in developing nations. According to Dr. Altieri, "because the true root cause of hunger is inequality, any method of boosting food production that deepens inequality will fail to reduce hunger. Conversely, only technologies that have positive effects on the distribution of wealth, income, and assets, that are pro-poor, can truly reduce hunger."[1] Therefore, questions regarding the use of biotechnology in agriculture should better address the needs of poorer nations.

Many people are still under-informed about potential benefits and negative effects of using GMOs in agriculture, and are therefore not ready to form an opinion on the issue. For this reason, there are many forums on the internet and published books to help interested people learn more. In addition, several documentaries present these issues, an example being *The Future of Food*, a documentary by Deborah Koons.[9]

The issues regarding the use of biotechnology in agriculture are important and affect everyone, and should not be overlooked. People in favor of the use of biotechnology in agriculture argue that it is unethical not to help poorer nations when more developed nations have the technology to do so. On the other hand, activists against the use of GMOs in agriculture maintain that more harm than good comes from the introduction of GMs into food production. Despite the lack of public knowledge, it is imperative that this issue be addressed in order to protect human health, the environment, the welfare of farmers, and people in poorer nations.

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NUCLEAR RACISM: URANIUM MINING ON THE LAGUNA AND NAVAJO RESERVATIONS

by Talia Quandelacy

Abstract

The world's largest open uranium mine sits on the Laguna Pueblo in Western New Mexico.[1] The Laguna Pueblo was one of the largest sources of uranium from when it opened in 1953, to when it closed in 1982. Uranium mines proved essential to the successful creation of the atomic bomb and nuclear reactors.[2] They were also key components of the health problems and the environmental effects that uranium radiation inflicted on the Laguna Pueblo and its people. This paper will discuss the uranium mines of the Laguna Pueblo and the Navajo Reservation and the relation of these locations to uranium use during the Cold War, the negative health effects of uranium mining, the social implications, and the racial issues surrounding uranium radiation compensation.

1. History

In 1938, on the eve of World War II, Nazi Germany was in the beginning stages of developing atomic weapons.[3] In order to keep pace with German advances the United States government created its own atomic weapons program. In 1942, the United States began the Manhattan Project in Los Alamos, New Mexico to develop the first atomic bomb.[3] The Project established that uranium^{235} was a main ingredient for atomic bombs and the government began to look for areas in the United States where uranium could be mined.[2]

One of the first places that the government turned to was the southwestern United States. Parts of Utah, Arizona, and New Mexico were found to be rich in uranium-ore. Many of these areas (containing uranium) were on American Indian Reservations, including the Navajo Nation and the Laguna Pueblo in western New Mexico.[4] Despite the presence of populations on these lands, the Atomic Energy Commission (AEC) began mining and processing uranium for their nuclear weapons project.

Upon completion of the Manhattan Project, the first atomic bomb was dropped on Hiroshima, Japan on August 6th, 1945.[3] It was not until one year later, on August 1st, 1946, when President Truman signed the Atomic Energy Act that officially created the Atomic Energy Commission that responsibility was taken for the Manhattan Project.[4] The Atomic Energy Act gave civilian control over national nuclear weapons, research, and development.[5] It also gave the government the right to explore, condemn and obtain all lands that contain the existence of uranium by "authorize[ing] the government to buy all the uranium it could find and [giving] it control over the extent to which uranium would be mined or not mined in the United States."[4] The government, consequently, expanded its search for lands rich in uranium and began mining sites located on the Navajo and Laguna reservations.

In 1953 Kerr-McGee Oil Industries and Anaconda Jackpile signed contracts to establish mines and uranium mills in New Mexico. Kerr-McGee opened mines at Shiprock, New Mexico on the Navajo Reservation and Anaconda Jackpile at the Laguna Reservation.[4] Both reservations gave their consent to the development of their uranium reserves in the hope that revenue from the mines would increase economic development. Kerr-McGee's uranium mines remained in business until the late 1970's and Anaconda-Jackpile mines until 1982.[6]

2. Mining Process

Over the thirty years that the two companies mined and processed ore on the reservations many Native Americans were employed by the mines. The mines proved to be the primary sources of income for many individuals on the reservations. In the early stages of the mine development, Native American workers were not paid more than $2.00 an hour for ten-hour work shifts.[4] Later in the 1960's and 1970's, Indian workers were paid $8-12/hr for underground work.[6] Workers were used not only to mine the ore, but also to dig out the pits, transport the ore, and process the uranium in the milling facilities.

The mining process extracted the ore from underground and open mines. Both open and underground mining required the use of explosives to loosen the ore from the earth; explosives were used to create shafts and "ballrooms" for the underground mines and to clear away large debris and chunks of land for the open mines. At the Jackpile site on the Laguna reservation, blasting was required three times a day for each type of mining.[6] For both the open and underground mines, explosions occurred every eight hours. Blasts were periodic throughout the day and the workers were constantly entering into recently blasted areas to collect pieces of ore. One worker recalls, "When they did the blasting, they inhaled the smoke and dust…I fainted twice and they had to drag me out."[4] The conditions around the explosions were very dangerous above

ground, but were far worse in the underground mines. Conditions inside of the mines were atrocious. Ventilation was poor and dust from the explosions was always present in the air. Those who worked underground were subjected to dimly lit tunnels:

"It was not until 1963 that he [Wilson Benally] was given one of those masks…He was also given a helmet with a lamp. Before that, he used lamps that provided light from a slow-burning powder."[4]

Many, if not all, of the workers were not informed of the health hazards from working in the mines and around the milling facilities. In the mines, few workers wore masks to protect their air passageways and ended up inhaling the dust: "The dust stayed in the air a long time…you could smell the gunpowder. When you blew your nose, it was yellow dust."[4] Many other dangers existed in the mines. There was a constant danger of debris falling from the ceilings and hitting the miners:

"When he [Dan Benally] was in the mines, the rocks collapsed on him. One of the rocks tore the skin off his side and stomach, too. They had to do a skin graft. He lost part of his eyesight."[4]

The underground workers worked some of the longest shifts, most often from seven in the morning to eight at night and were kept underground for the entire duration, except for an hour break for lunch.[6] It was necessary to keep the uranium mines open constantly to find as much ore as possible.

Driving the pieces of uranium-ore from the mines to mills was also dangerous. The combination of poorly made roads and the poor conditions of the trucks made it very likely for accidents to occur. The trucks had no starters or brakes, and the workers had to start-roll them.[4] The roads that connected the mines to the milling facilities were poorly made, and were often very rugged and bumpy. Some workers were paralyzed when the trucks flipped over and crushed drivers.[4]

Once at the mills the process was no so safer. The ore went through a refining process once it was transported to the milling facilities. The milling separated the uranium-ore from other minerals and rocks. Giant grinders and crushing belts were used to break down the ore into a finer substance.[6] The ground ore substance was bathed in sulfuric acid, which separated out the uranium. The end product of the milling process called yellowcake is uranium oxide (U^3O^8), a yellow-colored powder.[2] Yellowcake was the beginning process of enriching the uranium to the desired uranium isotope, U^{235}. In the mills, loading the ore onto the crushing belts was dangerous because workers had to manually shovel ore. Sometimes the shovels would get caught in the belts that exerted such force, that workers would be dragged into the belts themselves. Many workers lost arms as a result of this.[6] The air in the mills was toxic, with powdery uranium everywhere in the buildings. When the workers had to clean up the dust, they only had dust scrubbers and vacuums, and without masks, often inhaled much of the dust: "We worked with acids, ammonia…this was all dusty. There were fumes in there. It really stunk. There was no ventilation. This was a danger, but no one ever told us at the time."[4]

3. Health Effects

The knowledge of health effects from radiation comes from three main sources: the bombing of Hiroshima, the bombing of Nagasaki, and from uranium miners.[2] Uranium emits three types of radiation: alpha particles, beta particles, and gamma photons. The alpha particles are heavy, very short-range particles and though they cannot penetrate skin or clothing, they can be harmful if ingested through inhalation or consumption.[7] The beta particles are light, short-range particles. They can penetrate clothing and can penetrate human skin down to the germinal layer where new skin is made.[7] Beta particles are hazardous to people because high exposure can mutate the skin cells and cause skin cancers or other skin problems; they are also harmful if ingested.

The most serious type of radiation is gamma radiation. Gamma rays are a type of long distance electromagnetic radiation and are the most energetic of all the types. They can travel the longest distance and it takes very dense materials such as lead to stop or slow them.[8] They can penetrate human tissues, even through clothing and protective gear. The energy of the gamma rays creates a double dosage effect; people can ingest gamma ray emitting photons as well as absorb them through the skin and cause radiation exposure to organs.[7] Gamma rays that are derived from uranium also have a very long half-life and remain in the human body many years after a person has had radiation exposure.

All types of radiation can cause lung cancer, other types of cancers, and also damage cells and DNA-structure, which can impair the immune system.[9] The known health risks of miners include silicosis, various types of cancers, and other physical illnesses that doctors have yet to properly diagnose. Wearing protective clothing, such as safety masks, gloves, and protective boots, could have prevented some of the health risks.

Workers suffered from many respiratory complications because they were not properly equipped with protective gear. One worker recalls that, "My lungs are not good. A lot of guys got killed down there…I can't walk a long way. I used to ride wild horses, but I'm not strong enough

now."[4] Many of the respiratory complications workers developed proved to be lung cancers and silicosis.[10]

There were also miners who suffered mysterious symptoms as a result of the radiation. Some experienced odd temperature fluctuations in their legs, going from burning hot to cold chills.[6] Common symptoms among the Native American workers were pains in the legs and the face.[4] Others lost partial vision and had cysts. The mines also affected families of the workers, with many wives and children of miners suffering from unexplainable health problems. One reason for this is likely due to the excess debris from explosions, rocks and other pieces of ore from the mining process called uranium tailings.[2] These tailings were placed in larges piles around the mines, roads, and milling facilities. Some of the mines were created near houses and schools, and many unknowing children played with the rocks of radioactive ore.

Many of the workers were not properly diagnosed or treated for radiation exposure because they relied on the Indian Health Services.[4] It is suspected that the Indian hospitals were told not to treat workers directly for radiation:

"He has the pains, that pain going through his lungs and to the back. He thinks it may be from the uranium. He goes to get treatment, but they [IHS] say there is nothing wrong. But the pain is still there. They told him there is nothing but high blood pressure."[4]

This was done out of fear that the workers would leave the mines if they knew about the radiation they were being exposed to daily.

Many Indians workers would not have worked in the mines if they had known of the health effects:

"He was never told what the things would do to [his] health until recently. If they had told him of the dangers it would cause… he would not have done it. Now he regrets having worked in the mines. He's breaking out in a rash that itches. He thinks it's from the uranium. He had an X-ray two years ago, but they never told him the results so he figures he's OK."[4]

Many worked in the mines for several years and some worked for the entire time the mines were open. Nearly all of those who worked in the mines for long periods of time have experienced severe health problems or have died as a result of the mines.

4. Radiation Compensation Act

In 1990, nearly ten years after the last uranium mine closed on the Laguna reservation, the Radiation Exposure Compensation Act (RECA) was passed by Congress. The RECA provided $100,000 in compensation to uranium miners who developed cancers and other serious diseases during above-ground nuclear weapon tests and underground mining and to the families of deceased uranium miners.[11] However at the time, the RECA did not provide compensation for drivers or uranium mill workers. Even uranium miners who did file a claim met great difficulty in getting compensation and had to go through layers of red tape and bureaucracy.[4]

In order to file a claim in relation to uranium mining, an individual had to have worked in uranium mines at any time during between January 1, 1947 and December 31, 1971.[11] Eligibility was separated into four categories: non-smokers exposed to 200 or more months of radiation exposure developed lung cancer, smokers exposed to 300 or more months of radiation exposure who before 45 years of age developed lung cancer, non-smokers exposed to 200 or more months of radiation exposure who have developed a nonmalignant respiratory disease, and smokers exposed to 300 or more months of radiation exposure who before 45 years of age have developed a nonmalignant respiratory disease.[11] The Attorney General determined if miners fulfilled the eligibility requirements and properly filed a claim; if so, the claimant received $100,000 compensation within one year.

Once the RECA went into effect, the Laguna and Navajo miners began filing claims for compensation. However, there were many barriers that had to be crossed before receiving compensation. A large barrier involved the types of tests that determined miners' eligibility. Dr Louise Abel, of IHS, conducted a study in 1993 that revealed that the type of tests used for determining compensation were inadequate.[4] As a result, the number of miners who qualified for eligibility was drastically lower than the number of people who actually suffered from radiation exposure. The eligibility tests were based on diagnostic tests for black lung victims.

As a result, the number of Indian miners who qualified for compensation was much lower than that of white miners: "Of 516 miners given the seated pulmonary test, only 8.3 % or 43, had a loss of 25 % or more of their normal lung capacity. Forty-three percent of those tested had some lung impairment but not enough to qualify under the RECA."[4] Other difficulties involved in medical eligibility included proving that uranium miners had "non-malignant respiratory diseases" and as a result, most lung cancer patients who did not suffer from "non-malignant respiratory diseases" were not able to establish eligibility for compensation.[11] Of some 549 Navajo miners, only 5 were given compensation.[4]

It was not until July 2000, when the RECA was amended to include uranium ore workers (includes mill workers) and ore transporters that substantial progress on the issue was made. The 2000 RECA version included ad-

ditional "compensable illnesses," lower radiation exposure standards, and "modified medical documentation." In 2002, 'technical amendments' were made to the RECA. The most important amendment made was: "All uranium workers diagnosed with lung cancer no longer required to submit evidence of 'non-malignant respiratory diseases.'"[11] As a result of this change, more workers were able to receive compensation.

5. Discussion

The Laguna and Navajo uranium workers suffered greatly under United States government policy. Recently, the term "nuclear racism" has been coined to categorize what the Laguna and Navajo people have experienced; it is defined as: "the operation, siting, or attempt to site a nuclear facility within or near a community of color."[12] Serious social implications of the uranium mining still reside in the affected communities. During the time of the mines, alcohol and drug abuse surfaced, along with spouse and child abuse.[4] Particularly on the Laguna Pueblo, the peak production years of the mines were also peak years for suicides and dropout rates.[4] In the mid 1960's and 1970's with a sudden increase in the uranium workers' salary, the Laguna workers suddenly had more money than they ever experienced; this resulted in a cultural shift away from the traditional ways of the pueblo towards modern mainstream American culture and as consequence of this shift, a loss of native language.[6]

Currently, the Lagunas and the Navajos are working to recover from the affects of the uranium mines. In April 2005, the Navajo Nation passed the Dine Natural Resources Protection Act banning uranium mining and processing, thus preventing any mining company from creating mine establishments on the Navajo reservation.[13] A group of lawyers and health service workers are actively seeking out Laguna workers to test them for uranium radiation exposure and to make sure those workers get the compensation they deserve.[6] As recently as October 2005, a group of "Post-71" uranium miners have made accusations that the government has withheld health studies that support compensation to workers who worked in the mines after 1971.[14] Both indigenous groups are no longer silent; they are taking action to make sure their voices are being heard. As long as there is forward movement, progress will be made.

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AN EXPLORATION OF DENTAL HEALTH DISPARITIES IN AMERICA

by Cole Archambault

Many would consider the United States one of the greatest countries in the world. Yet, the U.S. struggles to provide healthcare to its citizens. While the United States' bragging rights include the highest gross domestic product (GDP) in the world, one of the world's highest adult literacy rates (99%), and one of the world's strongest militaries, American healthcare, especially dental care, has not lived up to these statistics.[1] A study published in the Journal of the American Dental Association reports that only 63 percent of the adult population (ages 18-69) seeks regular dental care.[2] This low rate of dental care attainment is the result of myriad causes, and research has shown that its effects could be wreaking havoc on the health of millions of Americans.

Why is dental health care such an important asset? A link has been shown to exist between oral health and general health. In the words of the United States Surgeon General Dr. David Satcher, "oral health is integral to overall health. Simply put, that means you cannot be healthy without oral health."[3] Indeed, recent research has shown that gum disease (such as gingivitis and periodontitis) is a precursor to many systemic conditions. Included is the risk of prenatal complications, or complications in pregnancy. A study performed at the University of North Carolina Chapel Hill in 2002 linked periodontal disease to pre-term babies and low birth weight. "[Periodontal disease] increases the risk of pre-term delivery two-fold or greater depending on whether there is fetal exposure during pregnancy," said Dr. Steven Offenbacher from the University of North Carolina School of Dentistry.[4] Aside from pregnancy issues, an article in Scientific American states that gum disease has been proven to be a risk factor for coronary heart disease. This article, entitled, "Taken to Heart: Brushing your teeth may be good for your ticker," identifies infections, particularly those of the gums as a new risk factor for coronary heart disease. Author Julia Karow points to studies that "suggest an association between infected gums and heart disease…oral bacteria have even shown up in the sticky plaques lining diseased arteries."[5] This means that oral bacteria pass freely through the bloodstream, quite possibly to vital organs other than the heart. While it will take further research to show the degree to which dental plaques contribute to coronary heart disease, the number one killer of Americans, the research highlights an important benefit of dental care: prevention. If gum disease is a cause of other diseases, then dentistry can be used as a powerful tool in preventative medicine.

When considering the gravity of gum disease, which has been hereto shown to affect several other disease states, one must consider its prevalence within the American population. According to the same article from the University of North Carolina that cited gum disease as a cause of pre-term babies, "at least half of all Americans over age 30 have gingivitis."[4] The prevalence rate of this disease (50+%) is astounding, especially when compared to other prevalent diseases such as diabetes (7%) and HIV/AIDS (0.6%).[6, 7] In light of current research, it can be inferred that periodontal disease is at least partially responsible for the prevalence of many other diseases, such as heart disease. Research has been unsuccessful thus far in quantifying the effect of gum disease on other diseases. Regardless of its impact, it must be understood that gum disease, especially in its current prevalence, is a grave danger to the health of many Americans.

One reason for the great prevalence of gum disease in the adult population is that infected people do not realize that they have gum disease, and they do not seek proper dental care. In other words, many people do not go to the dentist unless they have a toothache. According to the Merck Manual, a medical encyclopedia, "pain is usually absent" in gingivitis.[8] Pain only becomes a symptom "if acute infection [such as an abscess] supervenes."[9] By the time pain is felt, the gum infection has progressed greatly and the patient is in danger of losing teeth. As a result, gum disease is usually severe by the time it is diagnosed by a doctor. A vast majority of the population is unaware of the symptoms of gingivitis: inflammation, redness, and sensitivity. More importantly, there is little awareness of the dangers of gum disease. Since the research showing the dangers of gum disease is relatively new, some dentists are just becoming aware of these dangers. At the current state, it will take many years for a majority of dentists to inform their patients of the newfound dangers of gum disease. And only then will those who regularly seek dental care know the danger of the bacteria that live in their mouths. Those who do not, almost 40% of the population, will continue to be unaware of the risks. This creates a dangerous cycle; those who do not seek regular dental care are not informed about the risks of not receiving the care they need to be healthy.

There are many reasons why such a large percentage of Americans do not visit a dentist regularly. The complex web of factors that affect healthcare distribution can be untangled to reveal two main types of causes: psychological and institutional. Psychological causes such as dental phobia cause people to avoid dental visits out of fear. This affects the distribution of dental care because it prevents even those people who can afford care from receiving it. Institutional causes are factors that prevent the equal distribution of care that are ingrained in society. Examples include racism, dental insurance structure, and the way in which dentists are compensated for their services. A press release from 2000 by the U.S. Surgeon General states, "major barriers to oral health include socioeconomic factors, such as lack of dental insurance or the inability to pay out of pocket, or problems of access that involve transportation and the need to take time off from work for health needs."[10] Affordability is one of the main influences that prevent people from visiting a dentist. As a result of both psychological and institutional causes, many people do not receive the dental care that they need.

A study by Doctors Woosung Sohn and Amid I. Ismail published in the Journal of the American Dental Association pinpointed one of the main reasons why many people do not seek dental care: dental phobia.[2] The study states, "Dental anxiety is a significant determinant of whether people will make regular dental visits." Doctors Sohn and Ismail attribute such anxiety to "traumatic dental experiences during childhood, family influences, certain psychological conditions, and a high general fear level." Essentially, many people refuse to put themselves in a situation that scares them, such as the dentist's chair, even if they know it may prevent health problems in the future. This could be explained by the correlation found between dental phobia and perceived dental health. According to the study, "Respondents who reported having good-to-excellent oral health were more likely to visit dentists regularly than were those who reported having fair-to-poor perceived oral health."[2] In other words, people are less likely to visit the dentist if they know that they are in poor oral health. While the reason for this correlation was not explored in this study, it is possible that it shows that people who do not go to the dentist due to dental phobias are aware that they have been forgoing preventative care, and thus reporting low oral health.

Also, race and class disparities of dental care will provide a long-term challenge. A study by Arizona State University explored the reasons why American minorities do not receive proper care. Sam Kim, a graduate research assistant at Arizona State, said that, "the low rate of health care utilization among minorities is attributed to the lack of knowledge about the importance of preventive health care."[11] While not all minorities are low income, a strong correlation exists between income level and minority status. A low income not only prevents many minorities from affording dental care, but it also restricts their access to information about dental care they need. Certainly, income disparities directly relate to healthcare disparities. In Drs. Sohn and Ismail's aforementioned study it was found that, "The proportion of respondents who visited a dentist regularly increased as their…annual household income increased."[2] The study also stated that, "the highest income group [in the study] was about nine times more likely to visit a dentist regularly than was the lowest income group." However, low income does not only limit care that a family can afford, but it also affects the information people receive about proper dental health.

The issue of dental care disparities as a result of income disparities raises an important question: how can dental care be made more affordable for low-income families? While there is presently no concrete solution, the dental clinic is a solution that gives some families hope. Dental clinics, establishments where people can go to receive both affordable and emergency care from either dental students or volunteer dentists. They can be a great resource for those who cannot afford a traditional trip to a dentist's private practice. However, these clinics face many problems that prevent them from being the dental care disparity panacea. An article from the Cincinnati Enquirer entitled "Special Report: Cincinnati's dental crisis" describes the overcrowding at the city's dental clinics. Author Erica Solvig writes that there are over 10,000 people each year who seek service from the ten doctors who man the city's clinics.[12] "Many others - as many as 4,000 - are on a two-year waiting list to be seen. Many of them are children," she writes. While many are lucky enough to see a dentist, many must either go without care or wait years to be seen. What is the factor that prevents all patients from receiving care?

Dr. Daniel Kane, the Dental Director at the Saint Joseph Hospital For Specialty Care, said there is no concrete answer to this question. According to personal correspondence with Kane, Dental clinics face a complex array of problems.[13] While many clinics are Federally Qualified and receive government subsidies, according to Kane, "Some are paid per patient visit and not by procedure." This makes some of the more complex, and thus expensive, procedures highly unprofitable. Dentists face financial pressures, too, says Kane. "It may be that dentists' willingness to accept lower paying positions in public … could be limited by the amount of student debt they have accumulated," said he. Indeed, dental students today face a

substantial debt upon graduation of dental school. According to a 1999 article in the Journal of the American Dental Association, 29.3 percent of dental school graduates leave dental school with a debt in excess of $150,000. The article reports that, "Educational debt is having a major impact on practice options and practice selection."[14] This means that many new dentists are focused on recuperating their financial losses than joining a more philanthropic practice like a clinic. These financial constraints certainly will perpetuate the disparities of dental care in America.

Due to these pressures, many doctors are unwilling to accept Medicaid in their private practices. Medicaid is government-funded health insurance available to low-income families, seniors, and the disabled. Kane writes, "The [Medicaid] reimbursement rate for dental procedures is very low (in [Rhode Island] it is about 40% of the usual and customary fee, so no private practicing dentist is going to take Medicaid)." Another factor that discourages dentists from accepting Medicaid is the high number of "no-show" appointments. As Kane points out, "Providers cannot bill for no-shows appointments." This is likely a result of transportation difficulties faced by those on Medicaid.[13] Due to enormous debt, dentists are forced to act in their best financial interest, even if that means that they will not be able to offer care to those without private health insurance. This financial pressure also explains one reason why dental care is so expensive.

Consequently, few people can afford to pay for dental care out-of-pocket. The rest of the population must rely on dental insurance to cover the high costs of care. However, current health insurance structure perpetuates the disparities; too few people have dental insurance. According to the Surgeon General's report on oral health from 2000, "While 44 million Americans lack medical insurance, about 108 million lack dental insurance. Only 60 percent of baby boomers receive dental insurance through their employers, and most older workers lose their dental insurance at retirement."[2] Many more people are without dental insurance than without medical insurance. The result is that people without insurance simply do not see their dentist as often. A study published by the Centers for Disease Control and Prevention entitled "Dental Service Use and Dental Insurance Coverage – United States, Behavioral Risk Factor Surveillance System, 1995" showed that in a 25-state study, 69.0% of all people interviewed had visited a dentist in the past twelve months, while the percentage was only 44.3% for those without dental insurance.[15] The difference in care received by those with and without health insurance shows that cost is often too great an obstacle for the uninsured to overcome. It seems as though the relatively low number of people who seek regular dental care will continue to persist as long as millions of Americans go without dental insurance.

Presently, the idea of an equal distribution of dental care is but a dream. The changes that must be made both socially and within the structure of healthcare itself are almost innumerable. The political and financial barriers for revolutionary changes in the healthcare system are great, and advances in the distribution of healthcare will likely see many decades of steady improvement instead of immediate resolution. With such diverse causes contributing to the problem at hand, from psychological factors to the structure of health insurance, a quick fix to the problem will likely not be discovered.

It is probable that racial and income disparities as well as dental phobia will be the most persistent of the problems relating to disparities of dental care. This is because these problems are rooted in social institutions; racial and income disparities can be attributed to the many social conventions that promote an unequal distribution of wealth, and dental phobia can be attributed to past experiences and the stigma of painful dentistry. Time is likely the only solution for these problems. As each generation becomes more aware of these disparities than the preceding generation, the negative effects that they have may be mitigated. Also, as each new generation experiences new technology that has made almost all dental procedures virtually painless, dental phobia will play less of a role in preventing people from visiting the dentist. The problem, of course, is the sluggish speed at which these changes will take place.

Another slow yet necessary step that must be taken to minimize dental care disparities is education. Very few people are aware of the recent research that shows the importance of oral health. Consequently, many people, especially those currently living with gum disease, do not value dental care nearly as much as they would if they knew about the dangers they faced. As mentioned before, proliferation of knowledge about the dangers of gum disease has been very slow. It must be sped up. Since the people who are most likely to be unaware of the hazards of gum disease are those who have not visited the dentist recently, the findings of recent research must make it to mainstream media outlets. Public service announcements, for instance, could be made via television or billboards. The next question, of course, is who will fund such an awareness campaign. Since dentists and dental care supply companies (Colgate Palmolive Co., for instance) would likely profit from an increased demand for their services and products, it is likely that the American Dental Association and dental supply companies would be willing to invest in American healthcare.

Another approach is adolescent dental education. In such a program, children are taught the proper technique of brushing and flossing. As a result, children learn the value of dental health at a young age. An example of such a program is the Tufts University School of Dental Medicine Smile, Share & Care Program. In this program, according to the program website, Tufts dental students visit with children at the Boston YMCA day care center and read them books related to dentistry.[16] It is extremely important that children value dental care from an early age. With greater education on the importance of receiving dental care, oral health becomes a greater health priority.

One viable resolution to the increasing costs of dental care is government subsidy of private dental education. Private dental school graduates leave dental school with the greatest debt, so it can be fairly assumed that these dentists would need to have the highest fees to recuperate their debt.[14] In order to mitigate this effect, the government could subsidize private dental care. This would, like universal health insurance, cause an increase in taxes and/or necessitate a decrease in other government spending.

With such a complex problem at hand, and so many contributing causes, each solution can only provide slight mitigation. Most would agree, though, that government intervention is necessary to some degree. This is because health care creates positive externality. In other words, a healthy population benefits everyone. The base economic model of externalities states that, in a private market, the socially optimum quantity of dental care will not be produced.[17] This is because high prices prevent many people from being able to afford the care they need. One of the solutions of this problem is the government subsidy of producers, or dentists in this case. There are still many variables with this solution. Will dentists lower their fees enough for everyone to obtain dental care? Will there be enough dentists to meet the demand? Will the government subsidize on a per-patient or per-procedure basis? As with any problem of this complexity, no solution will be work exactly as planned, and each solution will likely need to modified several times before a desired outcome is reached. As for the desired outcome of the disparity as a whole, a delicate balance of several solutions will have to be made for universally accessible dental care to be a reality.

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THE ETHICS OF FOOD IRRADIATION

by Jennifer Hogan

Introduction

The use of ionizing radiation to sterilize, disinfect, and preserve food is becoming more widespread as technology enables safer irradiation practices; however, public sentiment, wary of the use of radiation, is resisting its implementation. Anti-food irradiation groups believe that there has not been enough study surrounding irradiated food for it to be ethically distributed for consumption. In contrast, pro-food irradiation groups feel that it would be unethical not to irradiate food as the radiation process makes the food safer to eat.

In order to avoid the public's fear of the term 'radiation', food irradiation is often called cold pasteurization or electronic pasteurization. These terms attempt to emphasize the safety of treated food by drawing a parallel to traditional heat pasteurization. By law in the United States, food treated with ionizing radiation is labelled with the Radura symbol together with the word 'irradiated' or 'treated with radiation'. However, labelling has been inconsistent as there are no standards regarding the acceptable levels of radiation or pathogen reduction. There is no other method of distinguishing between unlabelled irradiated food and unirradiated food for a consumer. Additionally, food that has been processed or used in a restaurant is exempt from the labelling requirements.[1]

As of 2003, more than fifty countries around the world have approved the food irradiation process . Facilities in these countries are regulated jointly by the International Atomic Energy Agency (IAEA), the Food and Agriculture Organization (FAO), and the World Health organization (WHO) . Each country maintains its own laws regarding which irradiated foods may be sold within its borders. Within the United States and worldwide a variety of foods are commonly irradiated, including spices, beef, fresh fruit, frog legs, onion, garlic, chicken, pork, fish, rice, potatoes, eggs, seeds, cereals, and ready-to-eat meals . No regulatory agency has reversed its decision to allow the sale of a type of irradiated goods.[2]

Benefits

The benefits of irradiating food are clear and known. The irradiation process can have different beneficial effects depending on the dose of radiation. Radiation dose is measured in gray (Gy); one Gy is equal to the energy of one joule absorbed by one kilogram of matter. However, this is not a good indicator of biological effects as different kinds of radiation react differently with matter. Very low doses, which lie between a range of 0.05 – 0.15 Gy, can be used to inhibit sprouting in potatoes, onions, ginger, and other roots. Fairly low doses of 0.15 – 0.5 Gy kill any insects and parasites present; this is the dose used on cereals, fruits, and dried meats. A low dose of 0.25 – 1.0 Gy will delay ripening in fruits and vegetables. A medium dose of 1.0 – 3.0 Gy will extend the shelf life of highly perishable foods, such as fish and strawberries. A medium dose of 1.0 – 7.0 Gy will eliminate spoilage and pathogenic micro-organisms; this dose is often used on seafood, frozen poultry, and frozen meats. Increasing the dose to 2.0 – 7.0 Gy has an effect on the properties of the food; treated grapes are juicier, and treated dehydrated vegetables have a shorter cooking time. A high dose of 10 – 50 Gy serves to decontaminate the food; this dose level is often used on spices. Very high doses of 30 – 50 Gy, when combined with mild heat, sterilize foods; this is a common treatment for prepared foods and hospital diets.[3] Because of these preservative effects, irradiated foods do not require as much pesticide and fumigant as their non-irradiated equivalents.

As irradiated foods do not harbour disease, unless they are irradiated, some foods, such as fruits and vegetables, are restricted from sale on the international marke. Because irradiating the food makes it safer for consumption as well as easier to transport and store, pro-food irradiation groups believe that it is in the best interest of both the public and the food industry to irradiate food. Just as heat pasteurization of dairy products such as milk and cheese has saved lives, food irradiation can promote positive benefits as well by eliminating botulism, salmonella, and even prions known to cause Creutzfeldt-Jakob disease.[2] It is clear that if food can be made safer, there is an ethical responsibility to continue with the advantageous process.

Methods

There are three different technologies used to

irradiate food: electron beam irradiation, gamma radiation, and X-ray irradiation. Each varies in exposure time needed to treat the food, penetrative ability of the radiation, and safety to workers. Electron beam irradiation uses an electron gun to bombard the food with high energy electrons. The treatment time is very short, but electrons do not penetrate deeply into the food, so electron beam irradiation is not a suitable method for all foods.[3] Because there is no radiation source, the machinery can be turned off when not in use; when on, a concrete barrier is all that is needed to protect workers. Gamma radiation techniques usually employ either a cobalt-60 or cesium-137 radioactive source. Although treatment time is merely a few minutes, penetration is excellent.[3] When not in use, the radioactive source is kept under water for safety. While in use, the workers need to remain behind thick concrete barriers.[6] In X-ray irradiation, an electron gun produces an electron beam which strikes a metal target, producing the X-rays. Although the treatment time is longer than that of the gamma radiation technique, the penetration is just as deep.[3] The spread of the beam is controllable, increasing the safety of the workers, and without the use of a radiation source, the machinery can be turned off unless in operation. Workers need only use heavy concrete shielding to protect themselves when the machine is in use. As X-ray irradiation uses an electron gun just like electron beam irradiation, the two techniques can be used in the same facility.[6]

Concerns

Unlike electron beam irradiation and X-ray irradiation, gamma radiation uses a radioactive source. Over time, this source will become depleted in its ability to perform the food irradiation procedure. At that point, the source needs to be discarded and a new one procured. A worry of many environmentalists is that food irradiation through gamma radiation, the most cost effective technology, will produce harmful radioactive waste.[6] Pro-food irradiation groups claim that there is little or no waste as spent cobalt-60 can be 'recharged' and that the entire volumes of cobalt-60 and cesium-137 are very small.[7] However, anti-food irradiation groups claim that not all the cobalt-60 will be recharged, producing waste which needs to be stored similarly to the cesium-137. There is concern over the transportation and storage of radioactive waste. They also cite accidents in Georgia in 1988, Hawai'i in 1967, and New Jersey in 1982 where the radioactive water used to store the cobalt-60 or cesium-137 leaked into the groundwater of nearby towns.[8]

Radiation tends to be a sensitive public relations issue largely due to the public's ignorance of its properties. When irradiated foods first came onto the market, many people thought that the food itself was radioactive; however, the treatment does not leave the food itself radioactive.[9] The statement that treated foods are not radioactive has been widely touted by pro-irradiated food groups. Anti-food irradiation groups, such as the Organic Consumers Association (OCA) and Public Citizen, believe that X-ray and electron beam irradiation methods leave small but significant levels of radiation in the food; these groups quote government and scientific studies to back up their findings.[10, 11, 12, 13] Radiation can damage living cells and their DNA, and groups like the OCA worry that eating irradiated food will increase the risk of cancer in an individual. There have been no long-term studies done on the effects of ingesting irradiated food.[14] Pro-irradiation groups and governments claim that they are not needed as there is no lingering radiation in the food; that is, the food is not radioactive and completely safe so it does not need to be studied.[1]

Although no one disputes the fact that irradiated food has a longer shelf life, many wonder how the irradiation process has changed the food. While a highly subjective matter, changes in the taste and odor of irradiated foods have been recorded. Meats seem most vulnerable to these changes; post-irradiation, meats have been described as smelling and tasting burnt, of sulphur, of blood, of metal, and of acetic acid.[15, 16] Changes in the color of the meat were also recorded. Ground beef is said to take on green, yellow, and brown hues while pork and turkey are recorded as becoming red.[17, 18] With such changes, it is no wonder that the public distrusts irradiated foods. Pro-irradiation groups recognize this problem and are working to develop methods of irradiation that do not damage the sensory qualities of the food, such as irradiating at low temperatures.[3] Nevertheless, it is clear that consumers will not buy 'off' tasting food even if it is safe.[2]

Perhaps what worries people more than the cosmetic changes are the nutritional changes that can occur in some irradiated foods. Vitamins and nutrients can be damaged by the ionizing radiation. Vitamins A, C, E, K, and several B complex vitamins are especially vulnerable to degradation due to the radiation. Depending on the food itself and dose of radiation, there can be a 5% to 80% loss of vitamin concentration.[19] Pro-food irradiation groups note that irradiation damages the nutritional value of foods no more than traditional cooking.[1] Anti-food irradiation groups counter that irradiated 'fresh' foods contain similar nutritive value as their cooked counterparts and are misleading.[8] The FAO, IAEA, and WHO, in a meeting held in Geneva, Switzerland in 1997, however, concluded that these nutrient losses will not have an adverse effect on individuals because these vitamins are found in abundance

in a healthy diet.[20] Anti-food irradiation groups are quick to point out that not everyone being fed irradiated food is eating a healthy diet as irradiated foods are often used in food aid operations.[14]

In addition to vitamin loss, irradiated foods see an increase in other chemicals. The ionizing radiation results in an increase in free radicals in the food. Free radicals are atoms with at least one unpaired electron in the outermost shell. These atoms are highly reactive and can disrupt normal cells, causing damage and DNA mutation.[21] Anti-food irradiation groups worry about the long-term affects of ingesting an increased concentration of free radicals in combination with the decreased consumption of the vitamins E and C which help the human body safely get rid of radicals.[19] As the impact of free radicals in the body is an ongoing research topic, the risk, if there is one, is unknown. Pro-food irradiation groups draw attention to the fact that free radicals are created through many traditional food treatments and that free radicals have no proven toxicological affect on the body.[3]

The creation of exotic chemicals as radiolytic products is a great source of conflict between anti-food irradiation and pro-food irradiation groups. In fact, their very existence is a point of contention. The IAEA claims that the only radiolytic products are common chemicals, such as glucose and carbon dioxide, and that these products are similar to the ones created by cooking.[22] An United States Food and Drug Administration (FDA) study estimates that for food irradiated at 1 kGy, radiolytic products would be less than three parts per million.[23] On the other hand, anti-food irradiation groups say that irradiation produces potentially toxic or carcinogenic chemicals, such as 2-dodecylcyclobutanone and polychlorinated biphenyl.[24, 25] The IAEA claims that they were unable to detect these chemicals in their own tests.[3] Although anti-food irradiation organizations say the IAEA is being irresponsible by allowing the distribution of irradiated food without resolving the issue of radiolytic products, the IAEA stands by its results.[3, 24]

One widely held misconception is that irradiating food will reverse its spoilage; it cannot. Irradiated food must be handled and packaged carefully to avoid contamination with non-irradiated food as well as inorganic contaminates.[3] Many anti-food irradiation organizations wonder if the standards of safe handling will go down if food irradiation becomes widespread.[19] Although anti-food irradiation organizations are skeptical, pro-food irradiation groups insist that the practices of safe handling will not be loosened and that food irradiation will not be used as a cheap alternative to real sanitation issues.[2]

Conclusion

Although the debate around food irradiation is not a moral one, it is an ethical one. It is an issue which polarizes people. Pro-food irradiation organizations, such as IAEA and the FDA, believe that they know enough about the process of irradiation and the ways in which the ionizing radiation interacts with the food to recommend irradiated food for general consumption. These organizations believe that the benefits of safer, irradiated food outweigh any detriments. Irradiating food is good for the environment as less pesticide needs to be used. Most people consuming irradiated either do not know the food is irradiated or do not have a choice. Pro-food irradiation organizations have made an ethical choice to try to improve the health quality of food for people around the world. On the other hand, anti-food irradiation organizations claim that pro-food irradiation groups are favoring the food industry, as food irradiation leads to longer shelf lives, over the good of the consumer. Groups like Public Citizen and OCA, anti-food irradiation organizations, believe that it is unethical to distribute irradiated food for general consumption because of lingering radioactivity, radiolytic products, and decreased nutritional value. These organizations hold that there is not yet enough known about the affects of food irradiation. Additionally, they are concerned over the possible environmental impact of wide-spread radiation use. Instead, anti-food irradiation groups urge companies to use traditional methods of food preservation, such as vacuum packing and flash freezing.

Each type of organization believes that it is looking out for the good of the public and each organization is a proponent of what it believes is correct. If there are side effects to eating irradiated food, it may not be known for years to come. If food is not irradiated now, the world market may suffer due to the spread of diseases. The choice is not clear and may never be. Part of the complexity comes from the fact that if irradiated foods are distributed, they will be eaten by many people, not just the policy-makers. Ethical questions are, by their nature, personal ones. For an informed American consumer, there is a choice due to the FDA's labelling requirements and that choice is simple: if one does not wish to eat irradiated foods, one should not buy them; if one wishes to eat irradiated foods, they are available.

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DECEPTIVE CONTRACEPTIVE

by Hyejo Jun

Unfold the white pamphlet. Words divided into five sections: Method, How it Works, Advantages, Disadvantages, and Special Notes. Fifteen rows of Methods divided into four categories of Hormonal or Chemical, Barrier, Abstinence, and Sterilization. The information the pamphlet confers is reassuring because with these resources, one can have more control over the decisions regarding body and health. As citizens of a nation and members of a health community, it is a right to be provided with such knowledge and a responsibility of the government and the institutions that function by its law to protect and insure this right. Sadly, this is a fragile ideal and one that has been broken on many occasions. The Dalkon Shield mess that began with the introduction of the contraception to women in the early 1970s proved to be an appalling example of the withholding of crucial information and a product's misuse, especially in which it was targeted towards a certain population of women. Through an application of the term "biological citizenship" coined by Adriana Petryna in *Life Exposed: Biological Citizens after Chernobyl*, how the health of women was compromised and how their bodies were ultimately under a system of control through a lack of knowledge will be brought to light.

In her ethnography, Adriana Petryna eloquently discusses the aftermath of the biologically disastrous Chernobyl incident in which millions of Eastern Europeans were exposed to harmful radioactivity. She is especially concerned with the subsequent interactions between the survivors and the bureaucratic, medical, and scientific institutions in claim-making. Petryna uses biological citizenship, defined as the way in which "the damaged biology of a population has become the grounds for social membership and the basis for staking citizenship claims," as a vehicle to explore the relationship between the sufferers who demand but have selected access to compensation and recognition and the nation-state, who has the regulatory power to deny or accept claims based on their idea of an ideal sufferer.[1] From that relationship, a nation-state finds legitimacy and citizens find legitimacy in their bodies and of their experiences within the nation-state. In exposing a connection between biology and identity, biological citizenship is citizenship based on biology in its literal connotation. If there was an ideal sufferer in Chernobyl, delineated by medical, scientific, and legal criteria that both acknowledged biological injury and compensated for the suffering, then there was also an ideal citizen in terms of biological makeup in the Dalkon Shield controversy.[1] And in that controversy, those who failed to meet the requirements of ideal were subject to "biopower," a concept by Michel Foucault that is essentially a mode of control.[2] Therefore, citizenship based on biology was a means of subjecting to control those who were not ideal through a system of biopower.

The general use of contraceptives has long been a part of women's history, and due to its function as something which curbs reproduction, the desire to control reproduction has also been embedded in the minds of many women for some time. Lisa Baker, in her article *Control and the Dalkon Shield*, notes how a woman's body has consistently been a site of regulation and "conceptualized as a locus of practical cultural control."[3] Unfortunately, women have compromised their health in trying to avoid pregnancy by resorting to possibly dangerous contraception methods.[4] Why is it the case that women are the ones to negotiate their health in order to regulate reproduction? More importantly, have women and their bodies always been subjects of biopower? Who or what power structures are responsible for the "subjugation of [women's] bodies?"[3] It can then be said that women, citizens of a particular biological sex, are less than ideal and experience the unfolding of biopower, and as long as contraception was available, reproduction considered as needing to be checked, and a woman's body deemed a site of regulation, women have had little autonomy in controlling their lives and their ability to (re)produce life. The highly publicized Dalkon Shield, an intrauterine device (IUD) which was reported to be the "superior modern contraceptive," and the push for its use by the shield's creators and supporters was essentially a strategy of biopower and affected more than four million women around the world.[4]

Of the four million women who were exposed to the harms of the Dalkon Shield, women of certain biology or situated at a certain level of biological citizenship were especially targeted and impelled to use the shield. Professionals at this time believed it was imperative to curtail the growing population of the world to limit the economic and social problems inherent in overpopulation, thus risks involved in the use of contraception were justified.[4] The majority of the blame was placed on poor minority women and many felt underprivileged women would benefit most from IUDs such as the Dalkon Shield. This conviction lies underneath the controversial, overarching discourse of eugenics, the careful controlling of reproduction based on

the worth of a person for the sake of "the improvement of the 'race of man'" and the belief that humanity would be weakened by the rapid population growth of the inferior.[5] Eugenics is an endpoint in the spectrum of what Rayna Rapp, author of *Testing Women, Testing the Fetus: The Social Impact of Amniocentesis in America*, calls stratified reproduction by which some people are empowered to reproduce and others are disempowered. Middle to upper-class White women were encouraged/empowered to reproduce, or were not as urged to use contraception as women of lower economic status and minority background, who were discouraged/disempowered to reproduce. Because reproduction involves a sense of future, progress, and a reiteration of social identities and citizenship, it is seen with the objective of mobilizing towards the ideal: affluence and white skin.[2] Whilst women in general may have already experienced less than ideal biological citizenship because they were women, poor and non-White women faced an even less than less than ideal biological citizenship, placing them under harsher surveillance and regulation of their reproductive capacities.

One form of biopower utilized by the participating power structures in regulating reproduction was the outright coercion of women into using the Dalkon Shield. Dr. Hugh Davis, creator of the shield, conducted clinical trials of the contraception in a Baltimore public clinic on mainly poor, Black women, some of whom never gave consent. Under pressure from countries such as the United States in return for international aid, many developing nations implemented programs for controlling reproduction and population growth of its citizens. In Indonesia, women were "indoctrinated" by political authorities who offered four kilograms of rice to women who used the shield. These women were deemed angels (aspari). Bangladeshi women were awarded with money and wheat for using the shield, and disturbingly, administrators were given cash bonuses for exceeding the predetermined number for IUD "insertion and sterilization".[3] In these cases of coercion, women found themselves severely limited in their choice of contraceptive method and limited in the agency over their own lives and procreative bodies. Even in protest, a woman possessed little autonomy – a marginalized, poor, Black woman who had a shield inserted without her consent and spoke in dissension, was told by the doctor that he knew what would be best for her.[3] While women of a particular biological group were unacceptable because they did not fulfill the ideals of biological citizenship, the use of the Dalkon Shield was in a sense an alternative route to acquiring advancement of biological citizenship status. Whether or not this was the woman's intention and whether or not it would actually be recognized by the agents of biopower underscore the deliberate manipulation involved.

Undoubtedly, women across all socioeconomic strata used the shield, but White, middle to upper-class women's biological citizenship were not as compromised because they were closer to "ideal". The encouragement, rather, enforcement of its use by a more specific category of women - poor and non-White - contributed to the quietly terrorizing aspect of biopower, in which it is in the interest of those acting as agents in the use of biopower to further the lives of some at the expense of others based on the biased notions of biology.[2]

Paul Farmer, in *Infections and Inequalities: The Modern Plagues*, argues that poor African women suffer from HIV/AIDS as "a result of structural violence: neither culture nor pure individual will is at fault; rather, historically given (and often economically driven) processes and forces conspire to constrain individual agency."[7] Many women were not aware of Dr. Davis's financial stake in the success of the Dalkon Shield.[4] Farmer continues that "structural violence is visited upon those whose social status denies them access to the fruits of scientific and social progress."[7] The Dalkon Shield can hardly be said to be a fruit of progress, but some women received an imbalanced proportion of the harmful effects on health and were controlled more strictly because of their biology, place in society, and ultimately, their citizenship.

The other subtle but more extensive form of biopower, in its controlling effect on all of the women who used the Dalkon Shield, was the willful prevention to accurate information about the contraceptive. Formal citizenship guarantees every citizen rights and protections awarded by the ruling institution for having lived under its law and regulation.[2] One of these rights is a citizen's right to truth. However, women have been confronted with compromised citizenship, specifically biological citizenship, and structures of power have taken advantage of women in these precise moments of concession and manipulated their reproductive lives. In the embedded power dynamics of knowledge production and distribution, the ruling institutions determine what is knowledge, which knowledge is authorized, and which knowledge shown be known, supporting Michel Foucault's belief that power and knowledge are intimately connected and cannot be separated from one another.[6] At a time when a high dosage of hormones in oral contraceptives and the resulting birth control pill scare of the 1970s deterred their use by women looking to curb their reproductive capacity, IUDs enjoyed the promotion of its advantages as an inexpensive, safe, and successful method of birth control.[4] This was misleading knowledge and jeopardized the health and control over one's body but presented as truthful by the agents of biopower: Dr. Hugh

Davis, A.H. Robins Company, which eventually bought the rights to the shield, and the governments that allowed the distribution of the faulty contraception. The endorsement of the Dalkon Shield as effective was an obstacle to a citizen's right to knowledge.

When concerned with knowledge, it is important to think about the way in which knowledge is made and acknowledge that knowledge has a site of production.[6] Rayna Rapp richly described the cytogenetic laboratory as a site of knowledge production not only in determining the physical karyotype of the fetus, but the subsequent knowledge extracted from the results. In laboratories where knowledge created is purported to be objective, there is a "continuous construction of stable interpretations" even with ambiguous material, which leads to a variety of social interactions between the technicians to decipher the ambiguity.[5]

The production of product knowledge about the Dalkon Shield was situated in two locations: the research laboratory where clinical trials of the shield were conducted by Dr. Hugh Davis, and in the actual distribution of the knowledge pertaining to the Dalkon Shield by Dr. Davis, the government, the clinic, and society as institution. The fundamental problem with these sites of production was that the knowledge imparted was erroneous and detrimental to the health and well-being of the women who used the shield. Clinical trials of the Dalkon Shield were done on a relatively small number of women, some without consent. When results of the study were reported in the *American Journal of Obstetrics and Gynecology*, they were deemed a success in reducing pregnancy rate while maintaining high retention rate of the shield. Dr. Davis, however, failed to mention to the medical community and more importantly, the women who trusted in safety of the shield, that only 1.25% of the women endured the shield for the entire 12 months of the study and spermicidal foam was applied during the first four months to prevent pregnancy.[3] Disturbingly, "for women to 'accept' and to 'retain' IUDs, it was often necessary for them to endure months of pain and heavy bleeding."[4] There was also evidence to indicate that A.H. Robins was aware that the shield had a tendency to wick. Wicking allowed bacteria to travel up the tailstring of the shield from the vagina into the sterile cavity of the uterus, and increased the risk of infections, damage as serious as pelvic inflammatory disesase (PID), and death.[3] Even when the sale of the Dalkon Shield was taken off the market in the United States, the U.S. Agency for International Development bought and distributed the shields to women in particularly poor countries of Asia, Africa, and Central America as described earlier without an adequate amount of inserters and instruction, and without sterile packaging.[3] The knowledge produced and made available to the global community about the safety of the Dalkon Shield was severely lacking and caused ill-effects to a countless number of women, illustrating the tension between health and rights. Had women been given the truth about the shield, women in control over their reproductive bodies would not expose themselves to such harm. Without that knowledge as a right promised by the formal citizenship, women's bodies were placed under a system of biopower.

Adriana Petryna portrayed pain and suffering as "experiences that are…to some extent made into social instruments. That is not to say they are any less authentic, but that new determinations and values are being attached to them."[1] Institutions of power in the Dalkon Shield mess used lack of knowledge as a tool of control. The women who suffered under its use employed the social instruments Petryna described and began to claim files against A.H. Robins Company as reports of infections, other bodily harm, and deaths related to the use of the shield accumulated. In 1976, over 600 lawsuits were pending; by 1986, over 300,000 claims were made by women globally. However, relative to the total number of women who were terrorized by the Dalkon Shield, that number is scant.[4]

In the realm of claim-making, to which Petryna applied her concept of biological citizenship as aforementioned, the tension between health and rights is made clearer: filing a claim aims to redress the suffering of the women while simultaneously promoting more suffering.[2] Women who spoke out against the Dalkon Shield were interrogated about their "lifestyle, dress, practices, and conformity to standards of hegemonic femininity and sexuality" in order to deposit the blame of injury on the women themselves. "The discrediting and embarrassing of Dalkon Shield survivors through constant references to their sexual and hygienic practices" led to the eventually low number of claims and suits made to A.H. Robins Company.[3] A woman's effective citizenship, which is the capacity to activate the rights and protections offered through formal citizenship by making claims to the state or institution utilizing biopower, was severely limited.[2] The noxious effects to their health continued to be unrecognized and women were left with few tools of remedy.

Many women unfortunately believed that the Dalkon Shield was an effective and safe method of contraception. However, women's reproductive health around the world was compromised due to attacks on their formal, effective, and biological citizenship. Perhaps controlling reproduction for women will always involve a compromise. Until the underlying foundations of society are radically overturned, it is everyone's duty to minimize the compromise women have to make regarding their health and reproduction and provide all the knowledge available

for women to make informed decisions. Women will not have to participate in the use of biopower as subjects, but as agents of control over their reproductive bodies and counter the notion of a woman's body as a site of relentless compromise.

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