

NUCLEAR RADIATION AWARENESS
FOR RESIDENTS OF CASCADE COUNTY-MONTANA

by

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July 2006

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ABSTRACT

The potential of a radiation mishap is real and lack of public awareness only potentiates the devastating outcomes on the citizens in the effected area should one occur. Low-level exposures of radiation may result in cancer and leukemia. A radiation mishap can occur at a missile site, a research or medical facility using radioactive material, a fixed nuclear facility, during nuclear detonation, and during transport of nuclear material. Guidance and education for limiting personal radiation exposure and how to combat radiation hazards would effectively reduce the number of individuals exposed if such a disaster were to occur.

The intent of this project was to create an educational tool that would guide the residents of Cascade County in radiation awareness and ways to minimize radiation exposure to themselves and their families should a mishap occur. The outcome was the creation of a brochure for Cascade County's Disaster and Emergency Services department to use as an educational tool for the residents of Cascade County for radiation disaster preparedness. The brochure provides an organized, reader friendly outline of prevention of radiation exposure.

CHAPTER 1

INTRODUCTION

In Montana there are over twenty-eight independently owned radiation sites at which work occurs with radioactive material. Eighteen of these sites are mines, eight sites focus on industry, science, and research, and two are military owned. Additionally there are two hundred and fifty active nuclear missiles manned by military personnel (Larcombe, 2005). The potential of a radiation mishap is real. Lack of public awareness only potentiates the devastating outcomes on the citizens in the effected area should one occur. Millions of people across the world have died or suffered illnesses or diseases that have been linked to the exposure to radiation (Yard, 1996). The first known victims documented were the Czechoslovakian uranium miners (Edwards, 1992). Pioneering physicists like Irene Curie were shrewd enough to document some early exposures of radiation. Early watch dial painters licked the tips of their radium-coated paintbrushes and later suffered from horrible deaths in the early twentieth century (Johnston, 2004). When the nuclear age began in the 1940s there were millions that suffered and died (Gofman, 1999). The death toll rose among the American Indian uranium miners, nuclear plant workers, individuals that lived down wind from nuclear test sites, human radiation experiment victims, and individuals that resided close to nuclear reactors and factories. The advancement of nuclear technology has become more prevalent than ever before, and the potential threat of global fallout justifies the need to educate citizens how to be a

radiation survivor. In the United States alone from 1950 through 1980 there were 55

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nuclear accidents with only 32 acknowledged by the United States government (The Center for Defense Information, 1981).

As of 2005 our government issued over 22,000 nuclear material licenses (National Safety Council [NSC], 2005). These licenses cover academic, development, manufacturing, medical, and research on current nuclear usage and future nuclear advances. Though present guidelines have established mandatory annual inspections for environmental and safety concerns, the actuality is that just over 7,000 inspections are conducted annually (United States Nuclear Regulatory Commission [USNRC], 2005). This is in part due to not enough inspectors qualified to conduct the inspection, and those inspectors that are qualified are unable to meet the demand. The citizens of our country and state must rely on good faith that the individuals or corporations practice within the safety guidelines and do not inadvertently expose the population to a nuclear mishap disaster. Our medical community has greatly benefited from the advances of nuclear technology and its involvement in providing and improving treatment. A recent example is the advancement of diagnosing and treating cardiac ailments by the use of myocardial perfusion scanning and the in-depth diagnosing of cancer by positron emission tomography (American College of Radiology and Radiological Society of North America [ACR RSNA], 2005).

A radiation mishap can have long-term deadly consequences. Low-level exposures of radiation may result in cancer and leukemia. These are detailed in low-level radiation mishaps that have been documented in the *Biological Effects of Ionizing*

[BEIR], 2006).

A radiation mishap can occur at a missile site, a research or medical facility utilizing radioactive material, a fixed nuclear facility, or from a nuclear detonation. Radiation mishaps are not initially deadly, unless an individual is exposed to a large amount of radioactive material at relatively close proximity. Radiation substance can be compared to chemical matter in that they do not usually cause death outright (Edwards, 1992). A frightening fact is that it takes time for radioactive matter to decay and render itself inert, and each component varies in its timetable of decay. Radioactive substances can exist in the environment for days, months, years, and even centuries, impacting the lives of individuals and their communities. Our nuclear power reactors and weapons compose the vast majority of the radiation generated in our nation, and presently no permanent repository exists to store the used irradiated fuel rods, so they are stored on nuclear sites to limit radiation exposure (NSC, 2006).

The need for citizens to be prepared for a radiation mishap is essential. They need to have a family disaster plan, emergency numbers, emergency disaster supply kits, and a shelter designated area in their homes or in the immediate local area. An educated and prepared community lessens the devastating impact a radiation mishap can have later on a community. The increasing threat of terrorism pervades our world today providing an even greater impetus for the necessity of individual preparedness.

A personal interest developed for this project after the Gulf Coast of the United States was devastated by two back-to-back Category 5 hurricanes in the Fall of 2005.

Having recently lived on the Gulf Coast and being involved in the yearly disaster and

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hurricane training exercises, I know the importance of being prepared for the unexpected. There is no such thing as being overprepared in the case of a natural disaster. Though my family did not sustain any physical injuries; they did lose homes, jobs, and had to stand for hours waiting for food and water. Upon returning to Montana I began to ponder what natural or man-made disasters could possibly occur in Cascade County. I discovered that given the number of missile sites in Montana, little information was available for guiding the public for the unexpected nuclear missile mishap.

Statement of the Problem

There are approximately 80,357 residents living in Cascade County (Cascade County, 2005) with varying degrees of awareness of the hazards associated with a potential radiation accident. There are presently 500 active nuclear missiles in the United States, 250 of which are strategically positioned in the rural state of Montana. This information is public knowledge as it was published in the Great Falls Tribune in early 2005 (Larcombe, 2005). These active missiles are under the military jurisdiction of Malmstrom Space Command located in Cascade County, Montana. An interview on October 24, 2005 with the Cascade County Disaster Preparedness Coordinator, Vince Kolar, revealed that there was no literature or education provided or available to county residents on potential radiation exposure and prevention and that a real need existed for public awareness. According to the interview with Vince Kolar the major medical facilities in Cascade County are not equipped to handle the influx of decontaminating

individuals if a radiation mishap were to occur (Kolar, 2005). Guidance and education

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for limiting personal radiation exposure and how to combat radiation hazards would effectively reduce the number of individuals exposed if such a disaster were to occur.

Purpose

The purpose of this project was to create a pamphlet that would provide information to residents of Cascade County on ways to protect themselves from nuclear missile radiation exposures. The informational pamphlet will be utilized by the Disaster and Emergency Services (DES) Coordinator of Cascade County in community awareness programs. This pamphlet will be available to the public at no charge through the DES office.

Conceptual Model/Theoretical Framework

Orem's Self Care Deficit Theory

The ideal conceptual framework for this project is Orem's self-care deficit theory. Orem's self-care theory emphasizes that an individuals have the inherent capacity to care for themselves, so an individual or family collectively putting together a preparedness plan for self-preservation falls in line with the philosophy of Orem's self-care theory (Orem, 1995). What is self-care? For the sake of this project self-care is defined as the ability of an individual or family to "initiate and perform activities to maintain life, health, and well-being" (Orem, Denyes, & Bekel, 2001, p.50). The clinical nurse specialist's role is to assist in the development of self-care by providing education and

resources necessary to enhance awareness and survivability to the residents of Cascade

County.

There have been several revisions and three theories developed over the last thirty-four years on Orem's self-care deficit theory. The original theory was based on the principle that an individual initiates and executes behaviors on his own to maintain health and well-being. The fundamental direction of the theory is that individuals have certain necessities in common that are essential in meeting crucial personal needs. These crucial needs are categorized as universal self-care demands which include air, water, food, activity, rest, elimination, and social interaction (Orem, Denyes, & Bekel, 2001). When individuals are independent and do not require the physical support of others it is determined that the universal self-care demands have been met. It is when the individual is not able to meet their universal self-care demands that outside agencies or individuals need to become involved to provide resources and sustainment.

When care is rendered and a discrepancy in self-care is noted, the nurse will design a plan that will allow the individual to capitalize on those abilities to render self-care. In addition to designing a plan to enhance self-care abilities, the nurse will stipulate areas that enhance patient capabilities to strengthen those self-care attributes. Orem's theory allows the nurse to categorize the individual into areas that capitalize on the strengths he has at that moment in time. The three categories are: a wholly compensatory system, partly compensatory system, and the supportive-educative system (Burns & Grove, 2001). The wholly compensatory system means that the individual does not have any active role in the delivery of self-care. The partly compensatory system is where the

individual has some capacity to delivery partial self-care but still requires the assistance

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of other individuals. The third area is the supportive-educative system where the individual is able to maintain his independence by applying the learned self-care measures effectively. This project draws from the supportive-educative system so that the individual is able to actively prepare for and limit radiation mishap exposures effectively to maintain quality of life and reduce the long-term illnesses to self and family. By educating and providing resource material or interventions to the residents of Cascade County and collaborative involvement with the healthcare field, individuals and families will be better prepared for the unexpected disaster.

The individual will have to be proactive in preparing for self-preservation and this requires him to be motivated and have the ability to make decisions or seek solutions to roadblocks in his endeavors. Providing information to allow the individual to make an educated decisions assist them in a improving his survival. This decision making is accomplished in a deliberate, logical manner, a process elucidated in Orem's theory of nursing systems (Renpenning & Taylor, 2003). Printed material with pertinent information allows individuals to prepare in advance for the unexpected, reduce their chances of exposures and reduce their chances of acquiring debilitating long-term illnesses, and provides a sense of reassurance of preparedness, thus providing some control over their outcome.

Clinical Nurse Specialist Role

Clinical Nurse Specialists are exceptionally qualified to assist the residents of

Cascade County to become skilled at ways to limit radiation exposure and minimize

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hazards associated with the exposure to maintain a quality of life. The clinical nurse specialist is essential in promoting health awareness and disease prevention in rural to urban communities, thus becoming a critical connection in limiting escalation of a potential health care disaster. Self care and preservation can be learned and the clinical nurse specialist has the unique characteristics to foster individuals to reach their highest potential at providing self-care. A partnership develops with the clinical nurse specialist that further facilitates health promotion, prevention, and self-care. The efforts to reach out, educate and promote health awareness generate heightened environmental consciousness.

According to the National Association of Clinical Nurse Specialists (NACNS) the Clinical Nurse Specialist (CNS) operates within the three spheres of influence: patients and families, care providers, and the organization (system). This extensive base permits the clinical nurse specialist to operate on a more large-scale level and influence organizational outcomes (Jones & Moloney-Harmon, 2004). As an educator, change agent, researcher, consultant, and caregiver the clinical nurse specialist thrives as the expert in promoting high quality care, promoting health, and reducing medical related expenses. The clinical nurse specialist has exceptional qualities to influence the education and care those individuals receive. According to Sparacino (2005) “the essence of the clinical nurse specialist role is based on the application of expert clinical and systems knowledge to improve outcomes” (p.382). The clinical nurse specialist is an integral part of the health care system and is essential to analyzing quality of care, education,

healthcare prevention, infection control, and protection. As a patient advocate the clinical

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nurse specialist has the opportunity and an obligation to intercede on the behalf of the patient to provide education, healthcare prevention, and awareness of environmental hazards to physical health.

The CNS is identified as a *Clinical Expert* who possesses clinical reasoning skills. The clinical reasoning includes clinical decision-making, critical thinking, and a global grasp of the situation, coupled with nursing skills acquired through a process of integrating formal and experiential knowledge. The CNS furthers her expertise through the ongoing process of questioning and evaluating practice and providing informed practice. The CNS creates practice changes through research utilization and experiential learning. The CNS has clinical expertise that is employed in any of a number of practice environments including acute care, hospice, long-term care facilities, medical clinics, or community health. The advanced nursing education and experience of the CNS is instrumental in assisting the staff with assessment and evaluation of patients, potential interventions for predictable outcomes can be anticipated. The CNS is instrumental in synchronizing the flow of patient healthcare from the time of admission to the ultimate discharge home and continued home health care. As the clinical resource the CNS provides direction for patient care and serves as the expert clinician in giving direct and indirect patient care. The CNS is active with the staff and serves as a positive role model. Through these interactions the CNS is able to identify areas of educational or clinical weaknesses and develop ways to correct or strengthen those areas before a mishap occurs. The CNS maintains open dialog with the healthcare team and encourages

application of evidence-based practice and up-to-date treatments in the acute care setting.

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Limited resources have dramatically affected the work area and having an open-door approach encourages the staff to have input in the nursing practice thus being empowered to make a difference (Hamric, Spross, & Hanson, 2005).

The *Consultation* role of the CNS in the acute care, hospice, long-term care facilities, medical clinics, and community health is important/significant. Collaborating involves working with patients, families, and healthcare providers. The CNS promotes and encourages contributions so that optimal and realistic patient goals may be achieved. The collaboration involves both intra- and inter-disciplinary work with the healthcare team. Clinical nurse specialists are available to the staff for discussion of a plan of care for the ill patients, thus expanding the clinical expertise of the staff and their confidence. Times will arise where the CNS will work with the staff to develop short and long term goals for the ill patient. The CNS is able to stand outside of the circle and identify needs of the patient that the staff may not see due to over-saturation. The CNS can facilitate change as the consultant during multidisciplinary rounds to improve future patient outcomes, be a voice of the patient, family, or staff member and offer informed suggestions to positively influence the outcome of care. As a consultant the CNS is often brought into the discussion of life-support choices or approaching family members with end of life decisions. Clinical issues or problems are often brought to the attention of the CNS so that resolution or solutions can be sought. The importance of the CNS to be involved in staff meetings cannot be understated; the CNS can update staff on clinical

issues and changes, thus allowing the staff to stay current. The staff will be able to keep the CNS informed of issues or conflicts that need addressing. The CNS facilitates health

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promotion, maintaining community programs, and identifies healthcare needs. The ultimate goal of the CNS as a consultant is to work with the healthcare team and provide the best quality of care to each patient (Hamric, Spross, & Hanson, 2005).

The CNS in the role of an *Educator* continuously keeps the staff abreast of the most up-to-date standards of care and evidence-based practice issues. As a staff nurse utilizing the expert knowledge base of the CNS are able to continue to improve and promote the healthcare provided to their patients, preventing further illness or injury. Ideally the CNS polls the staff at the beginning of each year to determine what the staff feels is a need or weakness that they want addressed. The CNS takes that information and further evaluates it by utilizing subjective and objective means from the staff, patients, family members, and ancillary staff. All educational in-services are coordinated through the CNS to ensure standards of care compliance, appropriate continuing education units are assigned and better quality of care is provided to the patients. The nursing care environment is continually receiving new equipment to try out from vendors or to replace old technology. The CNS provides the training or arranges for the technical representative to train the staff. When educational questions arise from staff member to family members the CNS is the appropriate resource. Continual assessment by the CNS keeps the staff aware of educational need of the nursing unit. The CNS develops strategies so that in-services, teaching methods, and the utilization of experts may meet the needs of the nursing staff. Patient education is important to incorporate into the care

of the patient and family, together with the staff the CNS gears the patient education plan to be specific to the individual patient and diagnosis (Hamric, Spross, & Hanson, 2005).

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The *Facilitator* of professional and patient care activities is the CNS. They have the ability to facilitate patient learning. They coordinate with other healthcare professionals to develop protocols to facilitate patient education. The CNS facilitates nurses' patient-education related skills like needs assessment, evaluation of learner comprehension, and integration of education throughout delivery of care. Using adult learning theory they adapt strategies to facilitate the teaching and learning process. The clinical nurse specialist contributes to and advances the knowledge base through presentations, publications, and involvement in professional organizations (Hamric, Spross, & Hanson, 2005).

The CNS *Researcher* takes the time to review up-to-date literature, evidence-based practice, and applies the standards of practice to specific nursing practice and patient clientele. One example of evidence-based practice was in a critical care environment where nurses were able to demonstrate that by decreasing sedation and raising the head of ventilator patients the weaning process could begin earlier, decreasing ventilator acquired pneumonia, and thus reducing hospital stays (Lindgren & Ames, 2005). The CNS was the key person in promoting the use of this evidence-based practice and therefore increasing the quality of care provided. Research and technology change frequently and the CNS keeps current on research applicable to nursing practice and is able to dissect the information into an understandable practice in the practice setting. The CNS utilizes the medical libraries, journals, textbooks, and Internet to research answers

and concerns. This footwork done by the CNS allows the staff to broaden their clinical knowledge, increase professional development, encourage autonomy, and give the sense

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of empowerment. The experienced CNS eventually begins to conduct research to facilitate the quality of care provided by the nursing profession (Hamric, Spross, & Hanson, 2005).

Furthermore the CNS implements these roles within three spheres of influence: individual patient/family level, a nurse-nurse level, and a systems level. Additionally a synergy model was developed by the American Association of Critical Care Nurses (AACN) which described the characteristics that the CNS would employ in each sphere of influence, thus outcomes of effectiveness could be measured (Cox & Galante, 2003). The characteristics were clinical judgment, clinical inquiry, facilitator of learning, collaboration, systems thinking, advocacy/moral agency, caring practices, and response to diversity. The CNS is ideal to help patients and families navigate through a complicated healthcare system because of their mastery of systems thinking. They have assessed, developed, implemented, and evaluated care delivery models. The CNS guides healthcare providers in implementing these models. They develop organizational strategies that are driven by the needs of the patients, families, communities, and healthcare workers.

As the CNS approaching this project the roles of expert clinician, consultant, educator, and researcher were all collectively utilized. The expert clinician was able to look at the potential of the disaster broadly and noted the lack of resources and know-how in preparing for such a disaster available to the public. The consultant initiated

contact with the Disaster and Emergency Services (DES) of Cascade County and developed contacts with the Disaster Preparedness department on Malmstrom Air Force

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Base. The CNS consultant fostered an interest from DES to want to have usable resources and self-preparedness information available for public access. As an educator the CNS determined the teaching platform to reach the maximum number of people in the urban and rural areas of Cascade County. The educator addressed educational theory in development of the brochure to determine appropriate readability level and comprehension. The researcher identified current pertinent information and resources available and incorporated that information into the brochure. The development of the brochure allows the DES to reach out to the rural areas during their community outreach educational presentations on disaster and family preparedness, thus reaching areas that are untouched.

The clinical nurse specialist helps to identify problems before they become a crisis, seizing every opportunity to suggest ways to use resources or interventions effectively to achieve desired outcome. Due to the unique position of the clinical nurse specialist in an acute care setting, she has the have the ability to assist the facility in developing a disaster preparedness plan aimed at caring for radiation exposure victims and thus reduce the complications resulting from delayment of treatment.

CHAPTER 2

REVIEW OF LITERATURE

In Montana, the Cascade Emergency and Disaster services coordinator, Vince Kolar, considers the probability of a serious radiation hazard small (Skornogoski, 2005). However, since the risk of accident does exist, preparations need to be in place to protect the public. The back-to-back hit to the Gulf Coast region of the United States by large hurricanes and the damage they sustained was the impetus for the article released in the Great Falls Tribune, a local newspaper, titled “Is Montana ready for the worst?” The article addresses various disasters that have occurred in Montana and Cascade County. It was of interest to note that the awareness of a potential accident involving transportation of the nuclear missiles did exist and the limited information provided to assist the civilians affected in the nearby areas (Skornogoski, 2005). A radiation hazard could be caused by a nuclear missile explosion or an accident at a radiation site in Montana or its nearby areas.

Radiation - Related Accidents in History

Since the 1940s history has noted several episodes of nuclear radiation accidents. The atomic bomb dropped on Hiroshima and Nagasaki 1945 during World War II resulted in 115,000 people being killed instantly and the delayed deaths of 110,000 from

burns and radiation associated illnesses (World War II Air Power, 1996). Leukemias, still-births, and congenital malformations suffered by the future generations of Japanese

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people have been linked to the dropping of the atomic bomb (Shannon, 1995).

The Three Mile Island nuclear plant located in New York had a meltdown of overheated fuel rods on March 28, 1979. Though no immediate deaths were reported related to Three Mile Island, data gathered over subsequent years reveal an increase in hypothyroidism, doubling of infant deaths compared to same six-month period of the previous year, low birth weight babies, and low APGAR (appearance, pulse, grimace, activity, and respiration) scores. Newly diagnosed cancer cases rose 64 percent, and substantial increases occurred in the number of cases of leukemia, lung cancer, non-Hodgkin's lymphoma and in all cancers in persons under age 25 (Mangano, 2004). Further links associated with the radiation exposure has been noted by area veterinarians. Local veterinarians reported dramatic increases in the number of animals developing Hodgkin's disease, sterility, stillbirths, malformations, unexplained deaths, and the disappearance of game, snakes, wild insects, and vegetation (Goodman, 2004).

The Ukraine city of Chernobyl on April 26, 1986 had a nuclear meltdown of one of its reactors affecting approximately 17 million people. Thyroid cancer has been diagnosed in over 5,000 people who were children at the time of the Chernobyl accident. The United Nations has reported that there are over 9,000 cancer deaths among the initial survivors of Chernobyl (United Nations News, 2006). Many exposed survivors have demonstrated increased anxiety levels, multiple unexplained physical symptoms and perceived poor health in comparison to the unexposed individual (United Nations News,

2006). Victims of Chernobyl have experienced problems from lack of immunity, short and long term respiratory complications, blood disorders, embryonic defects, thyroid

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gland cancer and traumatic births. The effects of Chernobyl are expected to continue until 2056 with the potential of being linked to another 20,000 deaths (Humanity for Chernobyl, 2006).

Three physicians that owned and operated a cancer clinic in Goiania, Brazil, abandoned their practice. They left a radiotherapy machine in an abandoned building that had no windows or doors for security. Two years later on September 13, 1987, the lead canister that contained the radioactive cesium was pried open and contaminated the local area. There were four immediate deaths due to radiation overexposure, 50 exposed individuals with acute clinical compromise, and 14 with severe radiation injury (Turai & Veress, 2001).

In the remote area of Tokaimura, Japan, on September 30, 1999, an explosion occurred in the nuclear fuel factory involving radioactive uranium (Balk, et al., 2005). Over 119 individuals were exposed to the radiation. There were two immediate deaths due to radiation overexposure, 3 exposed individuals with acute clinical compromise, and 3 with severe radiation injury (Turai & Veress, 2001).

Effects of Radiation Exposure

Radiation exists all around us and is naturally present in our environment. Levels of natural or manmade radiation vary from one location to another while the average annual radiation exposure from natural sources is about 300 millirem per person

(USNRC, 2004b). Manmade sources of radiation come from medical, commercial, and industries and add another 60 millirems to our annual exposure. The largest amount of

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manmade exposures come from medical X-rays (USNRC, 2004b). The Nuclear Regulatory Committee requires that manmade radiation exposures be limited to 100 millirem per year, and limit occupational radiation to adults working with radioactive material to 5,000 millirems per year (USNRC, 2004c).

Many short and long term effects come with over-exposure to radiation. The first apparent risk to over-exposure to radiation or being in the proximity of a radiation explosion is death. Death can occur from blast explosion, flying debris, burn injury, and vaporization (substances change from liquid to gas) of the radiation gamma rays. A gamma ray is a very-high-energy form of electromagnetic radiation with a wavelength even shorter than that of an X ray. Gamma rays are produced by changes in atomic nuclei and are also decay products of collisions between cosmic rays and interstellar matter (USNRC, 2004a).

Multiple studies and research over the years have shown that radiation destroys the most rapidly dividing cells of the body. Rapidly dividing cells include the cells of the skin, hair, gastrointestinal tract, and bone marrow. The bone marrow produces white blood cells (which fight infection), red blood cells (which carry oxygen and nutrients throughout the body), and platelets (which aid blood clotting and healing) and staunches bleeding. The effects of radiation can increase the victims susceptibility to infections and hemorrhaging (Sun, 1987).

The external physical problems associated with overexposure to radiation are skin reddening, rash, severe burns and peeling. The severity of these symptoms depends upon the amount of exposure. Blindness is a potential problem, especially when the individual

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looks directly at the blast. Blindness could be temporary or permanent if there is burning of the retina. Discoloration of the skin can occur through radiodermatitis due to the capillaries breaking down (Center for Disease Control and Prevention [CDC], 2005).

The radiation from a nuclear explosion can cause a variety of internal problems as the radiation gets into the body and corrupts and kill cells. The extent of these problems is dependent upon the amount of exposure. The effects can include radiation sickness, cancer, birth defects, infertility, anemia, infections, gastrointestinal problems, and hemorrhaging (CDC, 2005). Radiation sickness can be identified by symptoms such as vomiting, diarrhea, fatigue, fainting, dehydration, hair loss, loss of appetite and bleeding from the nose, mouth, rectum or gums. Additionally serious consequences can result in death. Cancer can result from radiation exposure. There is a latency (time delay) period between exposure and onset of symptoms, so time may elapse before the cancer appears. Birth defects can result from exposure to nuclear radiation and result in physical or mental disabilities (CDC, 2005). Other health issues that can be caused by exposure include infertility, anemia, infections, gastrointestinal problems, and hemorrhaging.

The effects of being exposed to a nuclear explosion or radiation can be devastating. Those who do not die immediately may suffer a long and painful death as the internal organs slowly die due to the radiation exposure. Cancers, infections and other internal problems can end up being the cause of death. The effects of overexposure to

radiation can be passed on to future generations for years to come. Depending on the levels of exposure, some people may experience both immediate and delayed effects, which can ultimately end in death through radiation or through a disease caused by the

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radiation (CDC, 2005).

Radiation and Public Health

Knowing that there are potential radiation hazards linked with the numerous radiation sites and missile locations, it is easy to presume that those are the only source of a radiation hazard. In the United States as much as 82% of radiation exposure is natural in origin (USNRC, 2004). Radioactive radon gas is the source of much of this exposure and is found in the rock and soil. This gas leaches through foundations and builds up in concentration in unventilated areas. When radon decays it forms particles that attach themselves to dust fragments that, when inhaled, lodge in the lungs and irradiate lung tissue (USNRC, 2004a). The Environmental Protection Agency (EPA) has linked 22,000 annual American deaths to radon alone (National Safety Council, 2006). The public awareness has increased over the years of the potential harms associated with radiation hazards, yet they lack direction to protect themselves and family from potential mishap. Cascade County has a high radon potential according to the Environmental Protection Agency (2006). Many states and counties across the nation require that radon testing be completed on homes that are for sale, the Environmental Protection Agency highly recommends the testing (EPA, 2006). In Cascade County a house has to have had an acceptable radon test completed within five years of the sale of the home. Radon testing

allows monitoring of the radon level and if high levels are detected measures can be taken to lower the radon level and decrease the health risks exposures.

Though not all states have nuclear power plants or nuclear weapons facilities, the

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Department of Energy revealed in 2002 that 165 million Americans live within 75 miles of one (Harrison, Gustafson, & Dixon, 2003). Nuclear fuel and radioactive waste is transported across the United States by trucks and railroads. A potential accident is very real and would expose the public to radioactive material that could remain radioactive for thousands of years (United States Nuclear Regulatory Commission, 1997). Evacuation and shelter are crucial when a radioactive hazard occurs. Exposure from a radiation hazard could last for days and residents need to know how to reduce their risk of exposure. What has been learned from the Chernobyl mishap is that exposure from both direct and indirect environment contamination was highly associated with multiple cancers diagnosed among young children and young adults (Webster, 2003). Some of these individuals were exposed to the actual fallout, whereas others were exposed by consuming the food grown in exposed fields and drinking the milk produced by the exposed dairy cows (The Chernobyl Forum, 2005).

Vulnerability

Radiation mishaps that occurred in Chernobyl, Three Mile Island, and Tokaimura have shown the medical community and public that there is a correlation between the risk of developing cancer and radiation exposure (The Chernobyl Forum, 2005). The thyroid has been highlighted as especially vulnerable and begins to immediately absorb

radionuclides, yet a firm direct link that would tie the risk of developing diseases associated with the exposure has yet to be connected. Elevated blood pressures have been measured in many of the personnel that assisted with the Chernobyl clean-up, though

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research has not directly linked the two together (Nuclear Engineering International, 2003). Approximately 600,000 individuals assisted in the Chernobyl clean-up and a high number have developed posttraumatic stress disorder (Nuclear Engineering International, 2003). Male Chernobyl survivors and clean-up workers that have submitted to studies have been noted to have changes in sperm production ranging from the number of sperm to structural changes in the sperm itself (The Chernobyl Forum, 2005). Individuals exposed to the Tokaimura radiation mishap are showing changes to their DNA that have been linked to the exposure. Therefore long-term health effects are still emerging and providing new information on health risk (Waselenko et al, 2004).

The state of the world today complicates the vulnerability the public has to radiation hazards. Terrorism makes all individuals a target, and with the high volume of radiation and nuclear energy sites that potential becomes very real, even to the rural population. Many local and state governments have done studies that reveal that it would not be possible to protect the public adequately from a radiation mishap caused by a major accident or terrorist attack (Harrison, Gustafson, & Dixon, 2003). The reality of a major mishap could easily overwhelm our emergency response system and medical facilities (Harrison, Gustafson, & Dixon, 2003). Contamination and destroyed emergency services may limit the response to a mishap. Therefore each individual needs to be educated on how to protect themselves and family from exposure.

Healthcare

It is a fair assumption that the war on terrorism has impacted how individuals

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view the safety of family and friends in their community centers, churches, schools, and personal homes. Those individuals that live near radiation sites, missile sites, hospitals, and military facilities may have a sense of increased vulnerability, while there are also those that have no idea of the hazards in their neighborhoods. Children are being taught about bioterrorism and radiologic mishaps in addition to fire drills, safety on the playground, buddy care, and suspicious characters (Department of Education, 2003).

September 11, 2001, changed our lives forever, and as healthcare workers our focus has to broaden to include developing evacuation and safety plans, proper shelters, and administering proper antidotes for exposure. The advancement of technology has propelled radiation and nuclear energy into our everyday lives, and with that mishaps will occur either by accident or by terrorism.

Healthcare workers and emergency personnel will be in the forefront in the response to such an emergency and with that the community needs continual support and education. It is the social responsibility of health care and emergency personnel, including nurses, to help prepare schools for the protection of children and adolescents in the event of a radiologic emergency during school hours. School nurses and school-based health center personnel, as well as other school and community officials who may be the first to respond to such an emergency, will need to be provided with ongoing support and education (Department of Education, 2003). Providing easily understood educational

material to assist the individual in ways to protect and prepare themselves would enhance their capabilities to survive a mishap and prevent or reduce health hazards to themselves and others is an important aspect of primary care.

Knowledge is Key

When faced with potential hazards individuals will seek the knowledge to protect themselves, and when they sense that the authorities may not be willing or able to protect them the desire to protect themselves increases (Dixon, 2002). The terrorist attacks on the World Trade Center and the Pentagon of September 11, 2001, greatly increased the awareness of vulnerability to the American public and particularly to those areas of the country that have radiation and nuclear sites. In a disaster situation information is sought out of fight or flight mindset and often the information received is controversial and thus harms more than it protects. Individuals have a right to know the short and long-term effects when exposed to radiation or nuclear fallout. The aftermath of September 11, 2001, and the pioneering work of Homeland Defense have restricted the availability of some radiation and nuclear information previously available on the internet to the public. An interview with the Disaster and Emergency Services Coordinator of Cascade County revealed that since the terrorist attack on the Twin Towers in New York, disaster risks pertinent to individual counties can no longer be accessed by the public through the Internet channels. Information may still be obtained but the individual has to go in personally to the Cascade County Coordinator of their local Disaster and Emergency Services center in the community due to the Homeland security guidelines.

The Radiation Awareness Brochure

Education is crucial in keeping individuals informed and is essential in assisting

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those in implementing the education into practice. Individuals need to know how to protect themselves and family. Communities need to know if they have an emergency plan and how it is implemented. Public awareness, understanding, and the ability to put into action an emergency mishap plan is crucial in preventing or reducing health hazards or death. Presently we have evidence-based practice that supports the education and awareness of the perils of lead poisoning to adults and children. Increased awareness, support groups, communities, and healthcare workers have combined to reduce the number of lead poisoning victims (Office of Pollution Prevention and Toxics, 2006). Educating the residents of Cascade County has been key in keeping up the awareness of the dangers. Unless the residents and citizens are aware of potential dangers the information will not be sought out. It is through education that actions and plans can change or be developed, and therefore a brochure was developed to inform the residents of Cascade County on ways to minimize exposure to radiation associated to nuclear missile mishaps.

Readability and Comprehension

Readability describes the ease with which a document can be read. Readability is defined as whether the document is fit to be read, interesting, agreeable, attractive in style, and whether it is enjoyable (Dubay, 2004). The educational materials provided to

patients and families are presently written at a level that is too high for the majority to comprehend (Miller & Bodie, 1994). Fifty percent of patients have difficulty reading material written at just a fifth grade level (Spadero, 1983; Doak, Doak, & Root, 1995). A

literature review reports that the readability assessment of educational materials reflected an average readability level above the eighth grade level (Spadero, 1983; Mumford, 1997).

Readability tests have been developed because of the reading difficulty and comprehension of educational materials. Readability formulas were first developed in the 1920s in the United States. They are designed as mathematical equations which correlate measurable elements of writing like the number of pronouns, number of syllables in a word, and the number of words in a sentence (Zakaluk & Samuels, 1988). The readability test is only a screen and offers only a prediction.

One such readability test is the Flesch-Kincaid grade level index. This test is automatically calculated for those using the Microsoft Word document program. After Microsoft Word completes a grammar check, readability statistics are displayed. This index computes readability based on the average number of syllables per word and the average number of words per sentence. The score in this case indicates a grade-school level. For example, a score of 8.0 means that an eighth grader would understand the document. Standard writing approximately equates to the seventh to eight-grade level. However, for patient education documents, the recommended reading level is around the sixth grade level (Davis, Crouch, Wills, Miller, & Abdehou, 1990).

The readable and understandable brochure allows the DES to reach out to the rural communities to educate and prepare individuals and families for the unexpected nuclear missile mishap. Telecommunication technology is changing the way the world gathers data, but not all rural areas have embraced that technology. Informational

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brochures provided at community outreach educational forums give those residents information in ways to protect themselves.

CHAPTER 3

METHODOLOGY

The intent of this professional project was to create an educational tool that would inform the residents of Cascade County about radiation awareness and ways to minimize radiation exposure. This section will emphasize the steps taken to create a pamphlet that would increase awareness of the radiation hazards and ways to minimize and protect against such exposure. The inspiration for this project originated from the numerous recent natural disasters that have occurred globally and the concern for potential hazards that may occur in the community of Cascade County. When informally engaging in conversation with local Cascade County residents, many admitted that they were not aware of the potential of radiation hazards that existed in their county. Many residents expressed surprise that Cascade County is still home to many of the nuclear missiles in active use in the United States military, even though a local newspaper published the number of active nuclear missiles still claiming Montana as home (Larcombe, 2005). Further discussion with these individuals revealed that there was limited knowledge in ways to minimize exposure or risks associated with radiation exposure. The lack of a concise easy-to-read tool which presented radiation awareness and prevention in an

organized, non-threatening manner was noted. A face-to-face discussion with the Disaster Emergency Preparedness Coordinator (Kolar, 2005) revealed a need for the development of an educational handout that could be provided to the residents during the community disaster preparedness meetings that are held yearly across the county.

Data Collection

An extensive review of the literature was completed in the areas of radiation exposure, history of radiation mishap, site location, radiation exposure prevention, and personal preparedness. A further review of the census of Cascade County and readability and comprehension of literature was completed. The initial phase of the research took place on the Internet, locating radiation sites and other potential radiation hazards pertinent to Cascade County. Meetings were held with the Emergency Disaster and Emergency Services Coordinator of Cascade County (Vince Kolar) as well as the Public Relations officer and Disaster Preparedness coordinator assigned to Malmstrom Air Force Base. A broad search utilizing the Montana State Library Indexes and Data Bases provided the starting point for the necessary research. Several relevant articles were located by accessing both the CINAHL and Medline data bases utilizing the keywords *radiation, hazards, radiation prevention, natural disasters and disaster preparedness*. Further exploration through the Websites of National Safety Counsel, American College of Radiology, Radiological Society of North America, Center for Defense, Environmental Protection Agency, and the Biological Effects of Ionizing Radiation committee of the National Academy of Science provided additional information on the

positive and negative effects of radiation exposure. Making use of the same two data bases, a search was conducted with the keywords *readability, public education, Orem, and self-care*. Benefis Hospital Library located in Great Falls, Montana, and the Montana State University Library were searched for pertinent articles and the reference pages of

those articles were searched for further citations. Additional data and procedures were located through Air Force Manual 91-224 *Ground Safety Investigations and Reports* which can be accessed through the Air Force Publication Internet site. The Disaster and Emergency Services of Cascade County made available their *Annex L*, which governs the Radiological Defense protocol and guidance in defending against radiation accidents and exposures. This information is available to the public through the local Disaster Emergency Services office. However it is not available by Internet or independent access.

Networking with a practicing radiation oncology registered nurse allowed access to a radiation oncologist (a physician that is trained in treating cancer using radiation therapy), a certified dosimetrist (an individual that is trained to measure and produce radiation doses), and a radiation physicist. A radiation physicist is an individual that works together with the radiation oncologist to choose the treatment schedule and dose that has the best chance of killing the most cancer cells and makes sure the radiation machine delivers the right amount of radiation to the correct site in the body. Networking with professionals in the medical environment exposed the extensive safety precautions utilized to protect the clients receiving treatment and the healthcare workers delivering the treatment. The physicist was an invaluable source of information and discussed at

length what to do if a nuclear disaster is imminent and serves as the contact person at the local hospital for radiation mishaps.

Actual Development of Brochure/Handout

A brochure handout was decided upon after communication with Vince Kolar, the

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Disaster and Emergency Services Coordinator of Cascade County. Mr. Kolar wanted a brochure handout developed that would be similar in format to the handouts presently used by their department in community education. The Internet was utilized for obtaining a site for creating and developing a pamphlet or brochure. The website Google was selected and the keywords *creating a pamphlet/brochure* were entered. After reviewing the available sites and discussion with Mr. Kolar it was decided to utilize the Microsoft Word Document program to create the brochure, therefore making it easy to incorporate necessary future changes as educational or public needs require. The brochure would be printed on an 11 inch by 17 inch piece of paper and then folded to form a four page handout. The word document program allowed for creation and importation of photographs to assist in the teaching process.

The brochure addressed the following topics: *nuclear missile mishap, nuclear radiation...what is it, is it bad, things to consider in preparing for the unexpected mishap, should you stay and take shelter, do you evacuate, what do you do first, food and supplies, collect and store water, develop your shelter, and miscellaneous essentials.* These topics were decided upon through extensive research through internet channels, meeting with the DES coordinator, meeting with the military Disaster Preparedness

coordinators along with personal experience gathered being assigned to austere military combatant environments.

Pilot Testing of Brochure

The readability of the brochure was tested using the Flesch-Kincaid grade index. The

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Flesch-Kincaid index indicated a ninth grade readability grade index. Upon completion of the Flesch-Kincaid grade index, a pilot testing of the completed brochure was conducted with twelve undergraduate sophomore nursing students currently enrolled at Montana State University Great Falls campus to test for readability, comprehension, and practicality. This group of students had not yet entered the clinical portion of the nursing program and so had minimal experience in the healthcare field. A test copy of the brochure was then sent electronically to Vince Kolar to assess the readability of the document. He previously developed a generic family disaster preparedness brochure, which has been utilized for several years. A copy of the brochure was presented to the public relations officer and military disaster preparedness coordinator at Malmstrom Air Force base to assess reliability and validity of information.

CHAPTER 4

RESULTS

The result of this project was the creation of a brochure for Cascade County's Disaster and Emergency Services department to use as an educational tool for the residents of Cascade County for radiation disaster preparedness. The brochure provides an organized, reader friendly outline of nuclear radiation hazards awareness and prevention. (See Appendix A). This brochure will serve as a resource for both Cascade County residents and healthcare providers.

Components of the Brochure

A four page brochure was developed using the Microsoft Word Document program. The initial page clearly states the topic of radiation awareness and prevention preparation emphasizing the potential for a radiation accident. The brochure goes into depth on how to be prepared for an accident, what to have on hand in the home, suggestions and reminders, and how to stay informed. References and resources are provided along with the contact number for the Cascade County Disaster and Emergency

Services.

Limitations

The intent of this project was to offer guidance to Cascade County residents to reduce exposure to nuclear radiation hazards to themselves and their families. This was

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dependent on the ability to educate and distribute this information to the community sources. Funding of this project was not an issue considering that the Disaster and Emergency Services Coordinator of Cascade County said his department would print the brochure for their use in community awareness meetings.

Another anticipated limitation of this project is the challenge to present the most up-to-date information as technology changes. On May 24, 2006, *Good Morning America*, a national news program, recently informed the nation that the current United States President, George W. Bush, was touring companies in pursuit of nuclear powered fuel to replace the vast need of petroleum, especially in light of the dwindling petroleum supply and increased cost (Zakaria, 2006). A future projection of nuclear powered fuel increases the probability of a radiation accident occurring and the need for awareness and prevention increases.

Utilizing college students in pilot testing for readability and comprehension may not be a true representation of the diverse group of residents of Cascade County. Additional pilot testing with a more representative sample of the individuals residing in Cascade County should be considered.

No actual measurement was made or data collected regarding the effectiveness of

the educational value that the brochure brought to the citizens of Cascade County. A future study to follow-up on the effectiveness, whether negative or positive, would be useful in providing information that would enhance or protect the residents from harm's way.

Implications for Future Study

There are obvious implications for future investigation from this project. The next rational action would be evaluating whether this brochure was beneficial to the residents of Cascade County and how it could be improved or expanded. Locating the recipients of the brochure would prove to be a challenging task unless they could be found through an attendance list of community awareness meetings held by the Disaster and Emergency Services department. Currently the disaster preparedness team works with the Cascade County Disaster and Emergency Services in conducting disaster drills. These drills occur approximately every two years and cover medical management, containment, response time, decontamination, notification, and resource utilization. Future studies should include civilian residents, how they respond to the mishap, whether they have a plan, where they go, and whether they know how to protect themselves from mishap exposure.

As radiation technology expands and begins to affect the common citizen in everyday life, it would be of great interest to evaluate the value of the brochure in expanding radiation awareness and prevention of exposure. Did the brochure make a difference? Was the brochure too vague? Was the brochure comprehensive enough?

Were enough resources made available for additional information?

Implications for Practice

Despite the limitations, brochures also permit broad dissemination of information to large community groups through printed material. Providing copies of the brochure to

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healthcare workers would increase their knowledge and awareness on this topic benefiting them personally and professionally so to be able to educate clients, patients, families, and co-workers as they come into contact with them in the form of patient education. This would facilitate preparedness in the healthcare workers and increase awareness in the place of employment.

Conclusion

Lack of education and limited resources available hinders individuals from protecting themselves and their families from adverse effects of overexposure to nuclear radiation mishaps. Providing information allows the option to take control over a situation and minimize exposure, thus avoiding long-term illnesses or death. Information in a brochure assists families in preparing for mishaps, reduces the anxiety of the unknown, and provides some sense of having control.

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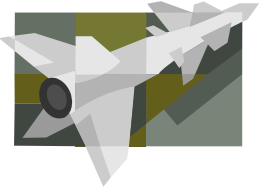
APPENDICES

APPENDIX A

BROCHURE



“Nuclear Missile Mishap” *Prepared for the unexpected?*



Could a “**Nuclear Missile Mishap**” happen here in Cascade County? Malmstrom Air Force Base has the largest number of missiles assigned to it, more than any other military base in the United States, so the possibility of a “**nuclear missile mishap**” does indeed exist. Will it occur in Cascade County? To date Malmstrom Air Force Base has not had a nuclear missile mishap, so in all likelihood probably not. Regardless of the possibility we all need to be prepared for the unexpected. The residents of the Gulf Coast never thought a Category 5 Hurricane would come ashore in 2005, much less two of them in the same Hurricane season.

Nuclear Radiation...What is it? Nuclear radiation can be both extremely beneficial and extremely dangerous. It just depends on how you use it. Nuclear materials are fairly common and have found their way into our normal vocabularies in many different ways. You have probably heard many of the following terms: uranium, plutonium, x-rays, nuclear power, nuclear bombs, nuclear fallout, nuclear fission, neutron bomb, radon gas, and ionization smoke detectors to just name a few. All have something to do with nuclear elements, either natural or man-made.



Is it “bad”? Too much radiation or overexposure to radiation can trigger changes in body cells leading to cancer, birth defects, illness, and in some cases death. Too much exposure to the sun’s rays can damage eyes and burn skin, causing cataracts or cancer.

Things to consider in preparing for the unexpected mishap:

1. Should you stay and take shelter or should you evacuate
2. If you stay what do you do first
3. Gather Food and Supplies
4. Collect and store water
5. Develop your shelter
6. Miscellaneous

1. Do you stay and take shelter or do you evacuate?



Decide whether you are prepared to stay where you are (have shelter) or whether you will evacuate. If you decide to stay then you need to take shelter as soon as the mishap occurs, if you decide to evacuate then you will need to leave as soon as the mishap occurs or is imminent, do not wait, and take 72-hours of supplies with you.

2. If you stay what do you do first?

Assign adult family members specific tasks so that food, shelter, supplies, and water are all collected.

3. Gather Food and Supplies



The Cascade County Disaster and Emergency Services has a great **“Your Family Preparedness Needs”** guide that list what a family needs to have in a “Family Disaster Supply Kit”, use that guide along side with this one to maximize preparedness and protection. Try and preserve your cash by using your credit cards at the stores.

4. Collect and store water

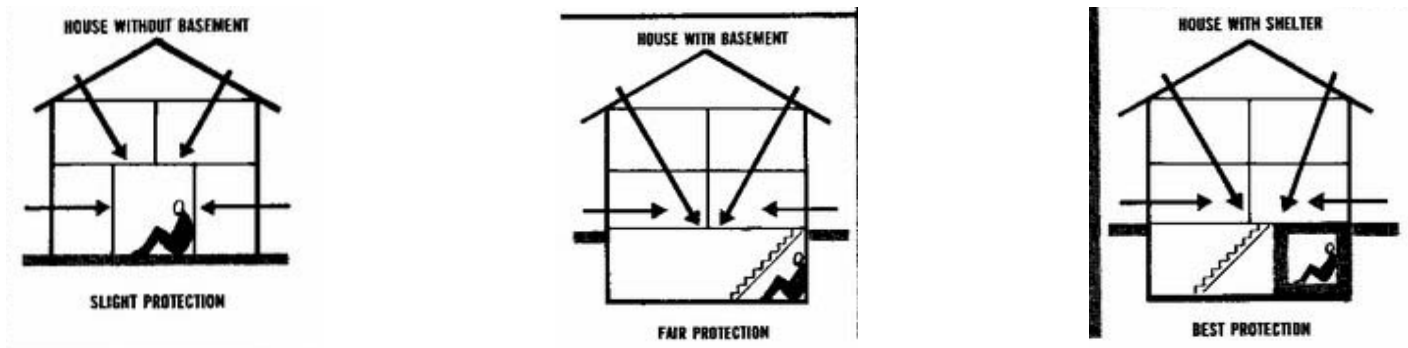


Lack of clean water will devastate your family much more quickly and more severely than any lack of food. Every possible container needs to be filled with water. There is never too much water. Empty soda bottles (1-3 liter) are ideal for water storage. You can also fill up the bathtub and washing machine. You will also have water in your hot water tank. Line garbage cans (after you have cleaned it with bleach) with liner bags and fill it with water. Place garbage cans close to shelter before filling with water, since once you fill them up with water they will not be easy to move. Being close located close to the shelter also helps in shielding.

5. Develop your shelter (Goals of the shelter)

- A. Maximize the distance away from the fallout dust outside on the roof and ground
- B. Place sufficient mass between you and the fallout to absorb the deadly radiation
- C. The shelter should be tolerable to stay in while the radiation subsides each hour

A Fallout shelter can be built anywhere, but the best options are at home or nearby. Some homes already provide significant shielding or partial shielding that can be enhanced for adequate protection. Choose a structure with both the greatest mass and distance already in place between the outside, where the fallout would settle, and you can shelter inside. If you have a basement, or nearby that you can use, fortify and use it. The ground level outside ideally needs to be above the top of the inside shelter. An effective fallout shelter constructed in a basement may reduce your radiation exposure 100-200 fold. What stops radiation and shields you is putting mass between you and the radiation source. The thicker the mass, the more radiation it stops. Also, the denser the mass used, the more effective it is with every inch more you add to your fallout shelter.



6. Miscellaneous

Filtering the air coming into your basement shelter is not necessary. Air does not become radioactive, and if the basement is snug, there won't be any wind to carry fallout dust inside. Sealing any basement windows and other openings prevents fallout from getting inside.

Fallout contamination, any food or water stored in sealed containers, that can have fallout dust brushed or rinsed off the outside of the container, will then be safe to use. If you suspect that your clothes have fallout on them, remove your outer clothing before you come inside and leave them outside. Keep a plastic hooded rain poncho that can be easily rinsed off or left outside. Have water and baby shampoo near the entrance (hose and containers) to wash and thoroughly rinse any exposed skin and hair.

Have a portable radio and make sure it functions from inside the shelter and that you have plenty of fresh batteries, listening for official guidance to know when it is safe to leave the shelter.

Have on hand: dust filter masks and hooded rain ponchos. Potassium Iodide (KI) or Potassium Iodate (KIO₃) tablets for thyroid protection against cancer causing

radioactive iodine, a major product of nuclear weapons explosions. If no tablets available, you can topically (on the skin) apply an iodine solution, like tincture of iodine or Betadine, for a similar protective effect. Iodine solutions are NEVER to be ingested or swallowed, and should not be used if allergic to iodine. Have additional tools like: crow bars, car jacks, building supplies, tools, sheet plastic, staple guns, for repairing any holes from damage. Seal around the last door you use to enter with duct tape all around the edges.

Utilize ready-to-eat foods to prevent/eliminate risk of fire, burns, and asphyxiation.

Lighting the shelter, try and use LED flashlights so that the battery life can be extended. Try to limit candle use. Store games, books, cushions, blankets, pillows, and mattresses to provide comfort and entertainment for family members.

Toilet use, a 5 gallon bucket with a seat borrowed from the house toilet can be used if a portable toilet was not purchased. Garbage bag liners should always be used and lined. The garbage can designated for waste disposal should be positioned close to shelter entrance for depositing these.

Pets, letting animals run free is not humane. There is the potential to die a miserable death from radiation exposure and to be a danger to others. Caring for them is ideal. When collecting food/supplies remember to store enough pet food to last through the containment.

Boiling or bleach water treatments will be used for cleaning stored water for drinking. This is for killing bacteria, not for radiation contamination. Sealed and covered water containers will not have radiation contaminates. To purify water, bring it to a boil for 10 minutes. If unable to boil it, you can kill the bacteria by mixing in household bleach at the rate of 10 drops per gallon, let sit for at least 30 minutes. The bleach should be at least 5.25% pure, make sure it does not have additives.

Utilize the Internet and your Disaster and Emergency Services to prepare for the unexpected.



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