Caring for Children After a Radiological Disaster

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ABSTRACT: **Children require specialized treatment that differs from adults in nearly every field of medicine, particularly as it relates to emergency response to a large-scale radiation event. Infancy, childhood, and adolescence are distinct stages of growth and development that pose unique vulnerabilities, biological variations, physiological differences, and developmental needs. Screening, decontamination, treatment strategies, and the use of medical countermeasures must occur with respect for these differences. Responding to radiation disasters that impact children requires rapid evaluation and response by health care providers who are equipped with the knowledge, skills, and abilities to appropriately address the physical, emotional, and mental health needs of children. (J Radiol Nurs 2015;34:200-208.)**

KEYWORDS: **Children; Radiation; Nuclear; Disaster.**

INTRODUCTION

High-dose radiation exposure is an uncommon, but life-threatening, cause for seeking medical care (Rutherford & Seward, 2001). Whether intentional (such as a terrorist attack) or unintentional (as in a nuclear power plant accident), these events engender fear and social panic. As a high-impact but low-frequency event, radiation exposure of children poses a significant challenge to health care systems and the clinicians who work within them. Many preparedness and response plans do not adequately address the needs of children (NCCD, 2010). Multiple clinical and environmental factors may contribute to the complication of the medical and nursing care provided to individuals exposed to radiation. Victims may suffer from internal or external contamination, exposures may be acute and/or chronic, and the threat can consist of a number of different types of radiation, each causing its own type of damage. The area of the body affected by radiation will inform approaches to treatment and management. All these factors are further complicated when dealing with the unique physiological and developmental needs of children. This article will outline significant challenges to caring for children after a radiological disaster and provide guidance for disaster planning and response.

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BACKGROUND

Children account for nearly 25% of the U.S. population, yet most federal and state disaster preparedness plans do not include considerations for this vulnerable population (IOM, 2013). As disaster plans that fail to address the needs of children will fail to serve the entire community, the National Commission on Children and Disasters (NCCD) was established by Congress in 2007 as a federal advisory committee to the United States to study disaster preparedness and response activities and evaluate their effectiveness as it relates to the provision of care for children. The NCCD report included a broad range of recommendations including a heightened need to address planning for nuclear and radiological threats, the need to address the mental health effects of disasters on children, stockpiling pediatric doses of medical countermeasures (MCMs), and enhancing pediatric disaster training for health care providers (NCCD, 2010).

Expanding on these recommendations, the Institute of Medicine released a report stating that comprehensive all-hazards disaster response plans that include provisions for children will require a systems framework that spans medical and public health stakeholders to include community organizations, schools, childcare centers, the private sector, and nonprofit organizations (IOM, 2013). The discussions on incorporating children into disaster plans must include ways to empower and educate youth, provide for the needs of children with disabilities or those who are dependent on technology, and ways to provide lasting, sustainable programs (IOM, 2013). Formal training of health care clinicians in pediatric medicine, triage, and working with children who have special needs will be important in strengthening disaster plans for children (Allen et al., 2007).

Concerns regarding the potential for a large-scale radiation release as the result of a terrorist attack continue, and a recently released report by the Centers for Medical Countermeasures against Radiation Network questions our level of readiness as a nation to respond to the challenges that would result (Brenner, et al., 2015). A nuclear or radiological disaster would require an integrated and effective use of biodosimetric methods to assess exposure to radiation that can be applied on a large scale to entire populations. Such triage tools are not currently widely available, and many are still under development (Flood et al., 2011). Triage would have to rapidly evaluate thousands on thousands of individuals to determine who would benefit from treatment and which persons should not be admitted to a hospital (Flood et al., 2011). Of the currently available methodologies, the existing gold standard is dicentric chromosome analysis, yet more work must be done before deployment across large numbers (Brenner, et al., 2015). A recommendation exists that initial triage tools be able to assess millions of people within a few days of a large-scale radiological event and be able to detect anyone with a dose above a certain threshold (usually 2 Gy; Flood et al., 2011). Hemodose, a biodosimetry tool based on the analysis of multiple type blood cell counts, is still under investigation (Hu, Blakely and Cucinotta, 2015a). Radiation dose assessment based on lymphocyte counts continues (Hu, Blakely and Cucinotta, 2015b). Dosimeters will also be needed for effective medical management (Swartz, et al., 2006). Finally, the development of MCMs has been painfully slow (Brenner, et al., 2015). Local and federal communities and agencies must also consider risk communication, the need for evacuation, and other complex public health issues during mass-scale radiation exposures (Shimura et al., 2015).

Much of what we know about the effects of ionizing radiation are based off of previous clinical case studies of accident victims, persons exposed to radiation through warfare or acts of terrorism, and people who have undergone radiation therapy for cancer (Flood et al., 2011). The basis of this information is only as reliable as the documentation provided to victims of disasters and can be complicated by other medical therapies or conditions (as in the case for treating cancer; Flood et al., 2011).

THREATS AND SOURCES OF RADIATION

Radiological materials and nuclear processes are used in a variety of fields and industries including power production, research, and warfare. There is also a substantial amount of radiation that is produced naturally by the earth and surrounding space. The radioactivity that occurs through natural terrestrial processes is referred to as "background radiation" and can be thought of as the radioactivity present in everyday life. Natural sources of radiation account for approximately half of the average person's radioactive exposure and include radon/thoron (37%), cosmic radiation (5%), soil (3%), and internal sources (5%; NRC, 2014b). Human-made sources account for the remainder of a typical person's radiological exposure and include medical procedures (48%), consumer products (2%), and industrial and occupational exposure (<.1%; NRC, 2014b). An overview of sources of radiation is available in Figure 1. It should be noted that the largest single source of radioactivity for the average person is caused by medical procedures (X-rays, computed tomography, radiographic procedures, and nuclear medicine) making hospitals one of the largest sources of radiation (NRC, 2014b).

Several threats of radiological exposure exist outside the typical background radiation or the use of medical procedures. Explosions of nuclear power plants or failures of safety programs in industrial uses of radioactive

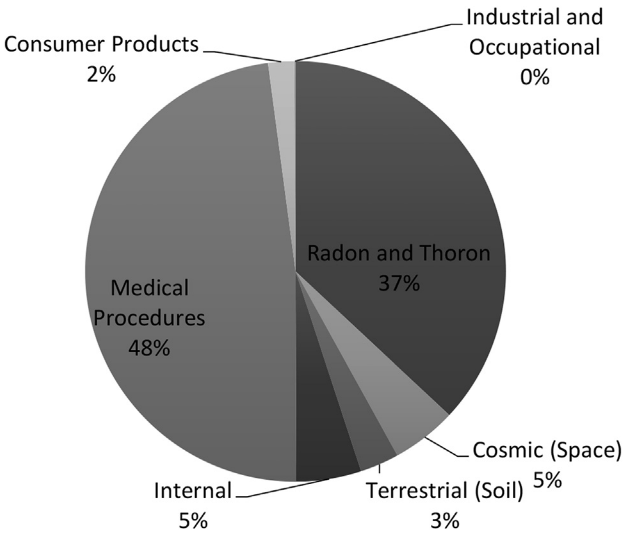

Figure 1. Sources of radiation. NCRP (National Council on Radiaiton Protection) report 2009. Retrieved on September 29, 2014, from http://www.nrc.gov/about-nrc/radiation/around-us/sources.html.