IMPROVING WELL WATER CONTAMINANT AWARENESS AMONG BIG HORN COUNTY HEALTHCARE PROFESSIONALS THROUGH COMMUNITY ENGAGEMENT

by

Raelene Ursula Schott

A scholarly project submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Nursing Practice

in

Family and Individual Health

MONTANA STATE UNIVERSITY
Bozeman, Montana

November 2020

©COPYRIGHT

by

Raelene Ursula Schott

2020

All Rights Reserved

DEDICATION

I would like to dedicate this project to my loving, supportive family. First, to my father, Ray, my mother, Susan, and my step-father, Nort, thank you for all your constant encouragement, motivation, inspiration, and love, especially during the past four years of this journey. I could not have done this without you. To my brother, Jesse, for always being my most vocal cheerleader, my sounding board, and for keeping me grounded when I felt out of control. To my entire family, my friends, and my co-workers who have helped me in numerous ways and who always encouraged and supported me - thank you from the bottom of my heart.

ACKNOWLEDGEMENTS

I would like to give special thanks to my Committee Chair, Dr. Sandra Benavides-Vaello, who stepped in near the end of my graduate education and helped bring this project to fruition. I could not have completed this project without you. Your guidance and patience, support, motivation, and suggestions were invaluable. I would also like to express my gratitude to the other members of my committee: Dr. Mari Eggers, who introduced me to the topic of my project and re-kindled my interest in the lack of safe, potable water, and offered her continued support and guidance whenever it was needed; and to Dr. Laura Larsson and Lianna Danielson, who both provided valuable input, encouragement and suggestions throughout the course of this project. I'd like to thank Dr. Sandy Kuntz, who chaired my committee until her retirement, always holding me accountable and working with me on the vision for this project. Finally, I'd like to offer special thanks to the Crow Environmental Health Steering Committee for reviewing the materials and offering me feedback in order to make my project the best it could be.

TABLE OF CONTENTS

TABLE OF CONTENTS CONTINUED

LIST OF TABLES

ABSTRACT

Bighorn County, Montana sits in the Little Bighorn River Valley in the south-central part of the state. The Crow Reservation, a Northern Plains Indian Reservation, encompasses 2.3 million acres in the Little Bighorn River Valley; the majority of the reservation is in Bighorn County.

Over 8,000 tribal members live on the reservation, many of whom reside near rivers and streams. Due in part to the rurality of the area, up to 60 percent of the people living on the reservation have home wells as their primary water source.

A variety of contaminants has been discovered in well water in Bighorn County, including manganese, uranium, nitrate, and arsenic. Manganese has been shown to cause cognitive delays in children with minimal exposure, along with neurological effects in children and adults alike, known as "manganism", signified by extrapyramidal dysfunction. Uranium exposure causes kidney damage, increases the risk for various types of cancer, and can have reproductive and developmental effects on women. With minimal exposure, arsenic can cause neurological effects, hypertension, peripheral vascular disease, cardiovascular disease, respiratory disease, diabetes mellitus, and malignancies - including skin cancer. Arsenic toxicity includes links to cancer, cardiovascular disease, immune dysfunction, diabetes, and altered neurodevelopment.

There are clear public health implications to providing an educational intervention regarding the contaminants to the healthcare providers in Hardin, MT, a community in Big Horn County, in order for them to provide evidence-based information to their patients. This pre/post-quasi-experimental project was designed to evaluate the knowledge gained by healthcare providers in Hardin following a short PowerPoint presentation with voiceover that provided educational information about the common contaminants and their health effects. There were seven healthcare providers who participated in the project.

Results of the survey showed an overall improvement in their knowledge about the contaminants, as well as their comfort speaking to patients about these contaminants. These results indicated that the educational intervention provided by the author was successful in meeting the goals of this scholarly project.

CHAPTER 1

INTRODUCTION

Introduction

Water is held in high regard among the Apsaálooke (Crow) Indians in South-central Montana, as a source for drinking, cooking, swimming, fishing, and many traditional practices. The Crow people see water as a powerful entity because it comes from the sky in many forms – rain, snow, sleet, and hail (Eggers et al., 2015). The researchers report "water as a 'giver of life', an "essence of life", has always been highly revered by the Apsaálooke people and considered a source for health. Water also continues to be a sacred resource essential for many prayers, ceremonies and other traditional practices (pp. 68-69). A large portion of the Crow Reservation sits in the Little Bighorn River Valley, in Big Horn County, Montana. Roughly half of the reservation's population have wells as their main water source (Eggers et al., 2015), due in large part to the rurality of the area and lack of municipal water sources, according to John Doyle (personal communication, July 17, 2017).

The Crow Indian Tribe has over 11,000 enrolled tribal members, of whom roughly 8,000 live on the Crow (Apsaálooke) Reservation in south-central Montana (Doyle et al., 2018), within the Missouri plateau (Eggers et al., 2015). The Reservation is located on the homeland of the Crow tribe, which holds strong cultural significance for the tribal members who live there. According to Eggers et al. (2015), "the reservation is rich in water resources, including the Little Bighorn River, Bighorn River, Pryor Creek and their tributaries, fed by the Wolf, Big Horn, and Pryor Mountain ranges" (p. 68).

Indoor plumbing, along with the drilling of home wells, did not become available for rural reservation residents until the 1960's; before this time rural families would haul their water from the rivers near their homes (Eggers et al., 2015). According to Cummins et al. (2010), many rural residents on the Crow reservation "obtain their water from wells that were drilled only to the first aquifer, or "first water" to reduce costs" (p. 168). The researchers also state that there are several abandoned uranium mines in one watershed on the reservation. The groundwater feeding these shallow home wells has been shown to be "high in total dissolved solids, including so much sulfate, iron and manganese that it was undrinkable" (Eggers et al., 2015, p. 69). Uranium has also been found in much of the water coming from wells. Despite the poor quality of the well water, it is still used for cooking and drinking by many people. Mari Eggers (personal communication, March 6, 2017) explained that the contamination issue was initially identified as a widespread environmental health issue in late 2004 when a group of federal health volunteers offered to provide training to community members in order to facilitate a community health assessment on the Crow Reservation. Through this assessment, water contamination was found to be the most significant health risk posed to the Crow people. As a result, Little Big Horn College (LBHC), the tribal college on the Crow reservation, partnered with Montana State University (MSU) "to tackle both well and river water contamination issues" (Eggers et al., 2015, p. 69). Due to the continued efforts of this collaborative group, many families have since switched to the use of five-gallon water coolers for drinking, rather than consuming water from their wells.

The results of the assessment, along with studies conducted by LBHC and MSU, have been continually disseminated to the people of the Crow Tribe. However, despite the best efforts at community engagement and continued education by the community health workers, the Crow Environmental Health Steering Committee (CEHSC) (composed of Tribal members - including a retired employee of the Crow Indian Health Service (I.H.S.) Hospital, plus an academic partner from MSU), there are some people who continue using contaminated water for cooking, bathing, and even drinking. Additionally, healthcare providers (HCPs) in the area have voiced a lack of expertise regarding the contaminants found in well water and the health effects these contaminants can cause. LBHC researcher John Doyle (personal communication, July 17, 2017) explained that when the Indian Health Service (I.H.S.) dug home wells in the 1960's, they commonly told families that their well had "the best water (quality) on the reservation". Mr. Doyle said it has been difficult to change this perception put forth by the I.H.S. over 50 years ago; many residents continue to tell him their water is the best on the reservation, despite having the results of well water testing which prove otherwise.

Formal education for the Crow people and their HCPs, as well as continued engagement at the community level regarding well water contaminants are necessary steps toward health improvement on a large scale. According to Eggers et al., (2015), community members may not request well water testing if their water "tastes fine" (p. 85), and some still cook with their well water despite a bad taste that prevents them from drinking it. Educating the HCPs who care for the people affected by well water contaminants, as well as continued education for the people themselves, will potentially reduce the number of people impacted by the health risks that contaminated well water poses and prevent contamination-related morbidity and mortality in the future.

According to Jumper-Reeves et al. (2014), “interventions that are not aligned with prospective participants’ world views are only minimally effective” (p. 547). Effective interventions require principles that have meaning to the target group. Community-based participatory research (CBPR) places emphasis on partnerships and collaboration, utilizing tribal members as experts, and ensures that cultural factors are included in all phases of implementing an educational program and affecting real change (Dingan et al., 2014, p. 412). One type of research closely related to CBPR is participatory action research (PAR), which is defined as “systematic inquiry, with the collaboration of those affected by the issue being studied, for the purpose of education and taking action or affecting social change” (Gonzalez et al., 2007). The PAR approach can be adapted depending on conditions within a specific location, which makes it uniquely appropriate for this scholarly project.

Background

Within mainstream American culture, “children are among the most underserved and neglected members of society” (Boyer, 1992, p. 12), with one-fifth of children in America growing up below the poverty line. Abuse and neglect are also commonplace among this population. However, Native American children are shown common concern by all members of their tribes and family units. Children represent the future of their respective tribes in a real way, and are cherished as such (Boyer, 1992). Children are cared for and educated by the entire communities in which they live. They are seen as the future generation of people responsible for carrying on cultural traditions, and for some, living the way their ancestors did in accordance with their beliefs. Often, children and elders have close-knit relationships, with the elders acting as teachers of life lessons, and the children respectful and eager to learn. Raising children is the responsibility of everyone in the tribe, and ideally children know they have a large support system. The Crow tribe has a strong clan system that prevents children from being ignored and many people in the tribe are involved in raising the children (Boyer, 1992). In such a system, the tribal members offer support to one another and have a connection to the larger tribal community.

It is important to remember the Boarding School Era, which lasted from the late 1800's to the mid-1900s, during which "the U.S. government enacted legislation that forcibly removed Native children from their homes and placed them in Christian boarding schools" (Traditions & Culture, 2018). It is written in the National Indian Law Library that "in the 1950s and 1960s, the federal government worked with non-Indian organizations, such as the Child Welfare League of America, to outright remove Indian children from their homes and place those children in non-Indian homes" (ICWA Guide Online, n.d..) The Indian Child Welfare Act (IWCA) of 1978 finally allowed Native people the right to refuse placing their child in schools off the reservations in which they lived, as well as establish "minimum federal jurisdictional, procedural and substantive standards aimed to achieve the dual purposes of protecting the right of an Indian child to live with an Indian family and to stabilize and foster continued tribal existence" (ICWA Guide Online). According to the National Indian Child Welfare Association, "the intent of Congress under ICWA was to "protect the best interests of Indian children and to promote the stability and security of Indian tribes and families" (NICWA, 2019). ICWA allowed for the return of Native American autonomy with regards to their children, who have always been such important members of the tribe and community.

In spite of their importance to the Crow tribe and community, children have little to no choice in the toxins they are exposed to on a daily basis. According to Nicole (2018), the rates of childhood cancers, neurodevelopmental disorders, and a multitude of other illnesses as a result of different types of environmental exposures are increasing in the U.S. There have been many studies designed to address children's environmental health. In the U.S., "the 1997 signing of Executive Order 13045, which charged federal agencies with identifying and assessing children's environmental health risks, was the catalyst that really launched this area of research" (p. 1). Children are more vulnerable to environmental exposure than adults, a fact which has long been known and widely accepted. Exposure during critical periods of child development can have lifelong impacts on children. Additionally, "low-income families and minorities often face disparities in exposure to environmental hazards and the speed with which remediation occurs" (Nicole, 2018, p. 012001-1). According to Firestone et al. (2016), children react differently than adults to environmental exposures because they do not have fully developed organ systems or metabolic capabilities. Children are exposed to toxins differently than adults due to behaviors which are specific to children, such as crawling on the ground, hand-to-mouth and/or object-to-mouth activities, and breastfeeding. Over the past 20+ years, the goal of the U.S. Environmental Protection Agency (E.P.A.) has been to enhance "consideration of the potential for early-life susceptibility" to toxins (Firestone et al., 2016, p. A214). With regard to children's environmental health, the E.P.A. continues to focus on "three principle areas – science to better understand early-life susceptibility, consideration of children in environmental regulations, and outreach to inform health care providers and the public" (Firestone et al., 2016, p. A218).

Nicole (2018) stated that HCPs can act as effective first-line resources in protecting children from the risks posed by harmful toxin exposures through collaboration among other "stakeholders who provide education, health care, and other services to the youngest members of society" (p. 012001-1). According to Afzal et al. (2016), HCPs are trusted and influential resources who participate in ongoing efforts to educate "their membership, policy-makers, the media, and the general public" (p. 209) about specific environmental health hazards. It should be noted, however, that few HCPs receive formal training in environmental health. The development of the Pediatric Environmental Health Specialty Units and the Children's Environmental Health and Disease Prevention Centers Program under the Environmental Protection Agency acknowledged this problem of lacking or inadequate HCP training and attempted to provide a way to better train HCPs and improve community outreach and education.

Statement of the Problem

There are many contaminants that have been found in well water used for drinking on the Crow reservation and in the greater Little Bighorn River Valley. Among them are arsenic, nitrate, uranium, and manganese, which all pose significant short- and long-term health risks to children (as well as adults). Manganese has been shown to cause cognitive delays in children with minimal exposure, along with neurological effects in children and adults alike, known as "manganism", signified by extrapyramidal dysfunction (Rizvi et al., 2017). According to the researchers, "the clinical features of manganism are similar to those of a parkinsonian illness that are characterized by bradykinesia, rigidity, gait disturbance, dysarthria and masked facies" (p. 1248). Uranium exposure causes kidney damage, increases the risk for various types of cancer, and can have reproductive and developmental effects on women (Magdo et al., 2007). With minimal exposure, arsenic can cause neurological effects, hypertension, peripheral vascular disease, cardiovascular disease, respiratory disease, diabetes mellitus, and malignancies - including skin cancer. Arsenic toxicity includes links to cancer, cardiovascular disease, immune dysfunction, diabetes, and altered neurodevelopment (Li et al., 2016). According to Parvez et al., (2011), arsenic exposure has also been shown to have "demonstrated evidence of an impact on cognitive development, reflected in lower intelligence scores, deficits in long-term memory, and delayed linguistic abstraction among children" (p. 1665).

There are clear public health implications to providing an educational intervention to healthcare providers who provide care for people living in Big Horn County, specifically those who treat patients who live on the Crow reservation, as the Native American population is exposed to higher levels of environmental contaminants when compared to those who do not live in Native American communities (Simonds et al., 2019).

Purpose of the Project

The purpose of this scholarly project is, in collaboration with members of the Crow Environmental Health Steering Committee (CEHSC), was to develop evidence-based educational materials for HCPs that address both local well water contaminants and the potential impact of the environmental exposures of each contaminant, specifically as they pertain to children. The CEHSC is a group of tribal and non-tribal members who have been working for the past 15+ years to conduct water testing on the reservation and educate people living on the reservation about the contaminants they have found. Prior to implementing the use of these materials, in accordance with a PAR approach, they have been reviewed by members of the CEHSC. The HCPs and members of the CEHSC were considered experts due to their knowledge on the Native American population living in Big Horn County. They helped to ensure the development of relevant, effective tools that were appropriate for HCPs living in Big Horn County. Once the appropriate educational materials were developed, formal education was provided to HCPs in order to enhance their expertise and increase their comfort level speaking about contaminants found in well water. This education should help them start conversations with residents, especially parents, with regards to the contaminants and their health effects to which children are exposed through the use of contaminated water. Therefore, the specific aims of this project were 1) to educate HCPs about common well water contaminants (manganese, uranium, nitrate, and arsenic) and their health effects; and 2) to increase the HCPs comfort level and familiarity with the contaminants in order for them to initiate and sustain conversations with community members about the health effects of contaminants found in well water.

Theoretical Framework

Health disparities are prevalent among American Indian (AI) people, who often live in third-world conditions, especially when living on reservations. According to Van Dyke et al. (2016), available data suggests that AI people "suffer some of the worst health disparities among racial and ethnic groups in the United States" (p. 1). When considering health disparities related to water contamination, it is important to discuss the two theoretical frameworks that guided this scholarly project. First, the Translational Environmental Research in Rural Areas (TERRA) model developed by Butterfield, Potsma, and the ERRNIE research team (2009) addresses environmental health inequalities faced by people living in low-income, rural communities. The researchers discussed the importance of considering the rural perspective with regards to environmental health. People who live in rural areas face a unique challenge when trying to obtain environmental health risk reduction advice. Due to their geographic distance from city municipal services, these rural residents instead may rely on neighbors or friends, who may lack the education to provide adequate or accurate information. Furthermore, the chronic underfunding and understaffing of rural health services results in many areas receiving little to no service. This lack of services translates to late awareness by public health officials in these areas, thus the focus becomes secondary prevention efforts rather than primary prevention efforts. Additionally, the researchers describe limitations of educational materials related to environmental health. The TERRA framework takes the approach that "health is considered as a whole within the context of multiple environmental health risks" (p. 112).

Another consideration is that well water contamination on the Crow reservation is a sensitive subject, due in part to the cultural beliefs the Crow people have surrounding the water on their land. Therefore, nurses and other healthcare professionals will need to be aware of the cultural background of the Apsaálooke people as it pertains to their internal and external environment. This awareness will support healthcare professionals as they initiate conversations with people who live on the reservation regarding their water sources. To facilitate this cultural awareness and effectively engage in conversations regarding water contaminants, health professionals will be able to engage in a PAR-style discussion with their patients. Participation of the CEHSC was key in relation to having accurate information on well water contaminants, as well as what type of learning is best for Native people living in Big Horn County. The TERRA model is based on informed decision-making and focuses on persons as problem solvers. One goal of the TERRA model is to "facilitate an interactive process that promotes co-understanding about environmental health issues and concerns between researchers, nurses, and the communities in which we work" (p. 113).

The second theoretical framework, which specifically discusses cultural factors and the influence they have on the ability to provide culturally competent care, is the Culture Care Theory (CCT), developed by Madeleine Leininger in 1978. She found that all cultures included caring in some form, but "that the specific manifestations and practices of caring were very different" (Nelson, 2006, p. 50). Leininger developed a model she called the sunrise model as a visual aid to show how the different elements of the theory interact. The sunrise model consists of three levels: the upper level, depicted as a rising sun with sun rays, which represents "the cultural and social structure dimensions of a culture care worldview" (p. 50) and assessment of the culture. The rays come together in the core of the sun, giving the suggestions that the different elements influence the way care is provided to people within a community. The middle level "portrays nursing care as a circle, overlapped by two other circles representing generic (indigenous or emic) or professional (outsider or etic care systems)" (p. 50). This section of the model advocates for basing care on knowledge of both types of care systems. The lower level shows three nursing strategies:

> culture care preservation, which emphasizes support of indigenous care practices; culture care accommodation, which involves synthesis indigenous and professional care practices; and culture care repatterning, which means implementation of professional care with respect for indigenous beliefs and values (Nelson, 2006, p. 50).

There are arrows pointed in all directions throughout the model, which suggests that all parts are influenced by and influence each other, which is a contrast to other models that only provide unidirectional and quantitative implementation.

According to McFarland and Eipperle (2008), the CCT can be useful and appropriate for nurse practitioners and other advanced practice providers to provide culturally competent care to patients with diverse backgrounds, in part because it allows them to examine multiple factors through which personal experiences are shaped. Additionally, the practitioners can incorporate CCT into their approach to primary care "through role modeling, policy making, procedural performance and performance evaluation, and the use of the advance practice nursing process (p. 49). Although nurse practitioners are making efforts to integrate the CCT teachings into practice, they need more education about culture care earlier in their undergraduate education, according to the authors, because "change is easiest when it starts at the beginning".

McFarland and Wehbe-Alamah (2019) stated that with the CCT, "both similarities (commonalities) and diversities (differences) can be identified as culture-specific modalities to provide culturally congruent care related to the desired goal of health or well-being" (p. 542). The CCT was utilized in this scholarly project when working with healthcare providers to find the most culturally-appropriate educational tools for Native Americans living on and near the Crow Reservation.

This project was guided by a PAR approach and was informed by the TERRA model, which deals specifically with environmental health in rural communities, and CCT, which addresses the importance of cultural competence when working with Native Americans and the utilization of tribal members during decision-making.

Significance of the Project to Nursing

Water contamination and consequent access to potable water are global health concerns; environmental health concerns disproportionately affect vulnerable populations (Simonds et al,

2019) According to the researchers, along with Doyle et al., (2018), the regulation of contaminated water on reservation land is disparately complex due to "conflicts between tribal jurisdiction and state and federal regulations" (Simonds et al, 2019, p. 350).

Children are a particularly vulnerable population when it comes to environmental health. They "experience proportionally greater exposure on a body-weight basis" (Weidemann, et al., 2016, p. 2043). At six months old, infants drink "sevenfold more water" (p. 2044) than adults in relation to their body mass.. Additionally, children may be exposed to higher levels of environmental toxins through foods, some of which contain pesticides. According to Magdo et al. (2007), There is a risk of groundwater contamination by a wide array of both industrial pollutants and naturally-occurring toxic metals, including arsenic, manganese, and uranium. The researchers state the following:

> private wells in the United States are largely exempt from states and federal drinking water regulations, and thus in most states they are not subject to much of the mandatory testing that is required of public drinking water supplies under the provisions of the Safe Drinking Water Act Amendments of 1996 (Magdo et al., (2007), p. 1237).

Operational Definitions

Terms and concepts discussed frequently throughout this project are defined below:

- Environmental health is a "branch of public health that focuses on the interrelationships between people and their environment, promotes human health and well-being, and fosters healthy and safe communities" (Definitions of Environmental Health, 2020)
- TERRA Model is Translational Environmental Research in Rural Areas, developed by Patricia Butterfield. The TERRA model is a "framework to explicate environmental

health risks experienced by the rural poor" (Butterfield, Postma, & the ERRNIE research team, 2009, p. 107).

- CCT is the Culture Care Theory, developed by Dr. Madeleine Leininger in 1978. The goal of CCT is "to help researchers and clinicians discover, document, know, and explain the interdependence of care and cultural phenomena while noting the differences and similarities between and among cultures" (McFarland & Wehbe-Alamah, 2019, p. 542).
- Participatory Action Research (PAR) is "collaborative research, education, and action used to gather information to use for change on social or environmental issues" (Pain et al., 2017, p. 2). In PAR, people who are affected by a certain issue take leading roles in the production and use of knowledge related to that issue.
- Contamination, in this context, is water pollution, which occurs when harmful substances get into water, worsening the quality of the water so it is toxic to humans and/or the environment (Denchak, 2018).
- Manganese is "an essential element that functions as a cofactor in a number of enzymes and in certain antioxidants" (Rahman et al., 2017, p. 1), yet can cause adverse health effects at higher concentrations.
- Uranium is heavy metal, specifically "a naturally occurring radioactive metal and may cause adverse health effects related to both its radiological and chemical properties" (Hunter et al., 2015, p. 42).
- Nitrate is a plant-available form of nitrogen (Naylor et al., 2018)
- Arsenic is a toxic metalloid that commonly contaminates groundwater (Centers for Disease Control, 2015).

- Well water is a private water supply that is not part of a public water system and uses groundwater for its water source. Well water is often used by private parties for drinking, bathing, and cooking (Ablah et al., 2019).
- Healthcare provider refers to "health professionals who provide healthcare services. Sometimes, the term refers only to physicians. Often, however, the term also refers to other healthcare professionals such as hospitals, nurse practitioners, chiropractors, physical therapists, and others offering specialized healthcare services" (Provider, 2020).

Assumptions

1. Healthcare providers are willing to learn about health effects of well water contaminants and talk to patients about these effects – share their reactions to materials
2. Children are affected differently than adults by water contaminants
3. People are drinking contaminated well water
4. There is an alternative to drinking contaminated well water
5. People are willing to adapt in order to use potable water for drinking and cooking.

Limitations

1. There is limited data regarding environmental toxicity regarding children in existence; most research has been performed either in animals or in adults (Weidemann et al., 2016).
2. The population of focus in this project is limited to HCPs living and practicing in Big Horn County.

3. This project is limited to addressing four specific common contaminants found in well water and does not include coliform bacterial contamination or other metallic contaminants.
4. This project focuses on the environmental health effects of water contamination on children but does not include lifelong effects of exposure to contamination.

CHAPTER 2

REVIEW OF THE LITERATURE

Review of the Literature

It is due in part to the aforementioned reverence of children that this scholarly project was conducted. Native children living in the Little Bighorn and Bighorn River Valleys, most of whom live on the Crow reservation, are at high risk for the detrimental health effects brought about by drinking or eating foods prepared with well water that has not been treated or filtered. Manganese, uranium, nitrate, and arsenic are among the metals and nutrients found in the water in Big Horn County (personal communication with John Doyle, July 17, 2017), and all have been shown to have damaging health effects on people, especially children, which starts in utero.

According to Weidemann et al. (2016), fetal nephrogenesis occurs between gestational weeks six and 36. Exposure to nephrotoxic agents, including environmental exposure to toxins, results in a decreased number of nephrons, as well as damage to remaining nephrons, which leads to decreased glomerular filtration rate (GFR). The kidneys are unable to regenerate nephrons once they are damaged.

A thorough examination of the evidence was conducted using multiple academic databases and journals. Assistance from research librarians at Montana State University was provided. Three databases were primarily used to gather evidence: CINAHL, PubMed, and the Web of Science Core Collection. Search terms used included “Native American children”, “Native American future”, “traditional culture” “indigenous” “manganese and children”, “arsenic and children” “Crow reservation”, “nitrate and health effects”, “nitrate and children”, “nitrate and health effects and children” “uranium and children”, “uranium and health effects” “community based participatory research”, “TERRA”, “culture theory”, “culture care theory” “Butterfield” “rural health”, “water and contaminant and removal”, “water and mitigation”, “participatory action research and Native American”, “PAR”, “environmental health”, “children and environmental health”, “uranium”, “nitrate”, “nitrite”, “arsenic”, “manganese”, “environmental health”, and “arsenic toxicity” “healthcare provider and education and environmental health”. A multitude of published studies highlight the negative health effects the four inorganic compounds discussed in this scholarly project have on children around the world, as well as emphasize the use of PAR-aligned approaches to find effective solutions to health problems.

Manganese

Manganese (Mn), as previously stated, has been proven to cause cognitive delays in children. According to Normandin et al., (2014), Mn is an essential element required for normal human brain function and is present in all body tissues. It also “plays a strong role in iron absorption and transport” (Haynes et al, 2015, p. 1070). According to Youssef et al. (2014), high levels of manganese in water is commonly found in groundwater, due to the fact that Mn “leaches from manganese-bearing minerals and rocks into the aquifers” (p. 1343).

A study conducted in Marietta, Ohio, the home of the nation’s largest operating ferromanganese refinery, by Haynes et al. (2015) showed a statistically significant negative association in children aged 7-9 between blood and hair samples and IQ scores with both low and high Mn concentrations. Beaudin et al. (2017) tested 115 Long-Evans male rats to determine whether early childhood exposure to Mn causes long-term attention and impulse control deficits into adulthood, as well as determine if continued exposure throughout the lives of those same rats exacerbated the effects. Through the exposure of rats to differing levels of Mn from the time they were neonates until the end of the study, after the rats had reached adulthood, researchers discovered that early postnatal Mn exposure causes long-term attention dysfunction in a rodent model of childhood Mn exposure, comparable to dysfunction exhibited by children with Attention Deficit Hyperactive Disorder (ADHD). Youssef et al. (2014) searched for an association of manganese exposure (measured in water and hair) with motor function, memory, attention, and reported hyperactive behaviors in children. In this study, 375 children were recruited; Mn was measured in home tap water (MnW) as well as in hair (MnH). It is important to note that several studies use MnH as a biomarker of exposure, and "significant correlations between exposure to manganese and MnH concentrations have been reported in several studies, supporting the contention that hair is a valid biomarker of manganese exposure (p. 1349). In this study, the researchers concluded that "higher levels of exposure to manganese are associated with poorer performance of memory, attention, and motor function, but not hyperactivity" (p. 1348). Another study conducted by Wasserman et al. (2016) expressed concern that exposure to Mn in the drinking water from household wells is "associated with decreases in children's intellectual functioning" (p. 1114). This study also discussed arsenic exposure in water, which will be discussed in a later section of this literature review. According to the researchers, it was demonstrated in 2006 that 10-year old children with "elevated water manganese concentrations (WMN) had lower intelligence scores" (p. 1114). Deeper home wells were dug to find if Mn was present at deeper levels. Results showed that the installation of these wells, along with education provided to the participants of the study in Bangladesh, showed a statistically significant modest improvement in working memory, but not overall IQ scores.

Not all studies found statistically significant results. Rahman et al. (2017) state “elevated Mn concentrations in drinking water (W-Mn) are associated with impaired cognitive abilities, adaptive behaviors, or both in 6- to 13-year- old children” (p. 1). The United States Institute of Medicine (now called the National Academy of Medicine) has made the Tolerable Upper Intake Level of Mn 6mg/day for children ages 9-13. One aim of the study conducted by this group of researchers was to determine whether the timing of exposure to Mn had differing neurotoxic effects. Fetal exposure often occurs at high levels because Mn passes through the placenta, along with elevated maternal exposure during all months of pregnancy and increased gastrointestinal (GI) absorption, cause high levels of exposure to the fetus. Early childhood is a critical time for Mn exposure, since biliary excretion and regulation of GI absorption are not fully developed. The study found that prenatal exposure and exposure at ages 5 and 10 years was associated with an “increased risk of parent-reported conduct problems, particularly in boys” (p. 5) and low prosocial behavioral scores in girls. While there was a tendency towards cognitive impairment in boys with early childhood exposure to Mn, the effect on Full-Scale IQ only had a <0.01 standard deviation from normal. However, the researchers concluded that “elevated prenatal and early childhood exposure to Mn (mainly from medium-deep wells) appeared to increase the risk of children’s behavior problems at 10 years of age” (p. 7).

Uranium

Uranium is an important contaminant to include in this scholarly project specifically because of the effects it has on kidney function. According to Eggers et al. (2015), Crow people in Big Horn County have a high prevalence of diabetes at 12.1%, as compared to 6.2% in the state of Montana. This statistic is relevant because “chronic kidney disease is a severe complication of diabetes mellitus” (Zhang et al., 2019, p. 150).

According to Weidemann et al. (2016), uranium (U) has direct nephrotoxic (kidney) effects in children at high levels of exposure. Chronic low levels of exposure also increase the risk of the development of chronic kidney disease (CKD) later in life. Exposure occurs “via groundwater contamination from natural uranium deposits, as well as from uranium mining milling, and processing” (p. 2018). Uranium accumulates in bone, similar to lead, although to a lesser extent. It also targets the S3 site of the proximal renal tubule, which results in tubular dysfunction. According to the authors, a case study was conducted of a family exposed to well water which had been contaminated with U. The youngest child in the family had an elevated β2-microglobulin, which suggested that children are especially vulnerable to the effects of U. Of note, the β2-microglobulin level decreased when exposure was ceased. According to Magdo et al. (2007), elevated “beta-2-microglobulin is a nonspecific marker of proximal tubule damage” (p. 1239).

An article written by Markstrom and Charley (2003) describes the effects of uranium mining in the Four Corners area (Arizona, Colorado, New Mexico, and Utah) of the Navajo reservation on children. These children, while exposed to U through air as well as water, suffered from tumors (unknown type or part of the body); some women had to have their uteruses removed due to the exposure. According to Fido and Al-Saad (2005), an excess level of uranium, along with other trace metals, in the hair of children with autism was found during their study. Forty healthy boys and 40 boys with autism aged 4-7 years, from single-incidence autism families, had in-hair concentration levels of U, tested by Perkin-Elmer mass spectrometry. The children with autism had “significantly ($p < 0.001$) higher in-hair concentration levels” (p. 290) of U. Further research on this topic is necessary, but the results of this study may offer a starting point. Another study conducted by Magdo et al. (2007) focused on a family of seven (two adults and five children) in Connecticut who discovered naturally-occurring high concentrations of U in their drinking water. Although concentrations of U found in the area varied, elevated levels were noted in all wells tested. The researchers tested the family members’ urine for uranium four weeks after the family had ceased drinking the well water and found “at least one urine uranium measurement” (p. 1238) to be high. Urine β2-microglobulin was also measured to assess for injury to the renal tubules. Five of the seven family members had elevated β2-microglobulin, suggesting that proximal renal tubule damage was present in those people. Additionally, the youngest child in the family had a decreased β2-microglobulin excretion rate, at more than twice the normal rate.

Nitrate

Nitrates, nitrites, and their effects have been studied around the world over many years. Nitrate is the most common groundwater contaminant in the world (Ward et al., 2005). According to the researchers, the nitrogen cycle has been altered by humans, which has resulted in an increasing accumulation of nitrate in water resources. Prolonged exposure to nitrate in drinking water increases the risk factors for specific types of cancer (non-Hodgkin's lymphoma, prostate cancer, bladder and ovarian cancer), negative reproductive outcomes, and some other chronic health effects. Elevated risks have also been observed with nitrate related to colon cancer and neural tube defects, even at concentration levels below the regulatory limit (Ward et al., 2005). Conversely, the International Agency for Research on Cancer (IARC) and the USEPA state that “nitrate and nitrite are non-carcinogenic pollutants” (Gu et al., 2018, p. 1519). Nitrates found in drinking water come from both organic and inorganic sources, according to Chalupka (2005). Common inorganic nitrates are potassium nitrate and ammonium nitrate, which are both used in fertilizers. Organic nitrate comes from livestock manure, leakage from septic systems, and discharge from municipal wastewater treatment plants (p. 47). Symptoms of nitrate toxicity in older children manifest as “irritability, tachypnea, altered mental status, and headache” (p. 47). According to Ward et al. (2005), infants are especially susceptible to methemoglobinemia, or “blue baby syndrome”, which is why the Environmental Protection Agency (EPA) set a “maximum contaminant level for nitrate in drinking water of 10mg/L nitrate-nitrogen (nitrate-N)” (p. 1607). According to Afzal (2006), methemoglobinemia develops “when the immature infant gut converts nitrates to nitrites. Nitrites oxidize hemoglobin, thus reducing its ability to carry oxygen. Infants under the age of 4 months are at greatest risk” (p. 14). Chalupka (2005) states that in infants younger than six months of age, untreated methemoglobinemia leads to anoxia, followed by brain damage and death. In a study conducted by Lee et al., (2018), the researchers studied nitrate concentration in the saliva and urine of a specific population in the Huai River basin, China. They found that nitrate concentration was twice as high in the youth age group studied, as compared to the average level in the control group. This is due in part to the lack of in vivo reductive transformation to nitrite in young people. As people age, they are able to break down nitrate more effectively in the GI system, which may be one reason young people are more susceptible to the detrimental effects of nitrate within the body.

Arsenic

Arsenic is carcinogenic and is associated with skin, lung, bladder, and possibly other types of cancer. There has also been an association made between arsenic and “cardiovascular disease, skin lesions, nonmalignant respiratory disease, and deficits in child development” (Wasserman et al, 2016, p. 1114). According to Gagnon et al. (2016), drinking water could represent the most significant source of arsenic exposure, so in order to limit the risks of cancer from chronic exposure, different organizations (WHO, U.S. EPA, Health Canada) have set a standard of 10 μg/L for public supplies of drinking water. According to Murray and Sharmin (2015), adverse effects of arsenic in the child population include “verbal comprehension, long-term memory, attention, cognitive development, neurobehavioral development such as pattern memory and switching attention, and intelligence” (p. 2). Adachi-Mejia, Murray, and Karagas (2019) describe arsenic (As) as a colorless, odorless, tasteless metalloid. Its presence can only be determined through water testing, and “private well water testing often does not occur as recommended” (p. 26). In a study conducted by Wasserman et al. (2007), 301 six-year old children in Bangladesh were randomly selected who had been exposed to arsenic in their drinking water from home wells. These children had their intellectual function assessed using subtests from the Wechsler Preschool and Primary Scale of Intelligence, Version III. Raw scores were taken from the Verbal, Performance, Processing Speed, and Full-Scale domains. Urine specimens were collected from the children to measure urinary As. The researchers assessed the children’s school attendance and opportunities for stimulation at home, along with intellectual function. Water analyses were conducted, as well as biochemical measurements of the urine samples. The results of this study showed that children exposed to As in drinking water had reduced intellectual function, even after the researchers adjusted for other metal contaminants in the water, as well as sociodemographic features which are known to contribute to intellectual function. Arsenic was "significantly negatively associated with both Performance and Processing Speed raw scores" (p. 285). Wasserman et al. (2014) conducted a similar study in Maine, USA, recruiting children in grades 3-5 for their study. The school districts in which the study took place were known to have home well water with As content elevated above the EPA Guideline of 10µg/L. Overall, 272 children from three school districts participated in the study. Water samples from each home were collected, along with toenail samples from the children, to be used for testing. Intelligence was assessed using the Wechsler Intelligence Scale for Children – Fourth Edition. Results showed that children who drank well water that had higher than 5µg/L As "showed reductions of 6.09 FSIQ (full scale IQ) points, 4.97 points in Perceptual Reasoning scores, 4.88 points in Working Memory scores, and 6.22 points in Verbal Comprehension scores" (p. 6-7). It was noted that in the U.S., nearly "13 million people are exposed to drinking water that exceeds the US standard" (p. 7). Del Rio et al., (2017) state that children absorb 40% to 90% more ingested heavy metals, when compared to adults, due to the fact that liver pathways do not mature until mid-childhood and mechanisms needed to metabolize and eliminate these metals evolve throughout a child's life. Therefore, "un-excreted" As continues to circulate and is deposited in other organs. Chronic circulating arsenic burdens and damages organs. Developmental arsenic exposure has also been shown to alter neurodevelopment" (p. 1). Early interference with organ systems increases the chance for chronic diseases during adulthood. A study conducted by Osorio-Yanez et al. (2015) focused on arsenic exposure-related cardiovascular disease in children between 3 and 8 years old. According to the researchers, drinking arsenic-contaminated water is associated with carotid atherosclerosis, ischemic heart disease, hypertension, cerebrovascular disease, and black foot disease. However, the researchers were unable to find a significant correlation between As exposure in children and hypertension, which is the leading cause of the other cardiovascular outcomes mentioned. There was, however, a significant correlation between left atrium diameter and As exposure.

Efforts to Remediate Contaminants

Efforts to mitigate contaminants from well water on the Crow reservation have been ongoing, including offering free refillable five-gallon water coolers, (personal communication, John Doyle, July 17, 2017), as well as education in the forms of a publication and a DVD offering information about ground water treatment and caring for septic systems, respectively (Eggers et al., 2017). In a study conducted by Eggers et al. (2015), project data was provided to the Crow tribe, the Crow Tribal Environmental Protection Department, and the Apsaálooke Water and Wastewater Authority (AWWA). As a result, the AWWA raised the necessary funds to install a "“water salesman”, an automated dispensing system in the main Reservation town of Crow Agency, which allows rural residents to purchase municipal water at a very low cost" (p. 78).

There has been a significant amount of research conducted regarding the removal of heavy metal toxins from drinking water, especially the use of low-cost adsorbents in the developing world (Joseph et al., 2019). According to the researchers, the lack of consistent access to potable drinking water "increases the likelihood of water-related diseases" (p. 143). The researchers described one study in which manganese, along with eight other metal toxins, were removed from drinking water using rice husk, a waste material from rice. Additionally, the study discussed "the use of amendments to remediate heavy metal contamination in soil" (p.

149). Soil amendments discussed include mud, rock, and phosphate, along with other soil materials. Arsenic was shown to be removed from water through "naturally-occurring iron and manganese oxides, clays, and natural organic matter" (p. 149).

In a separate study conducted by Tobiason et al., (2016), manganese removal from drinking water entailed "source water management as well as treatment processes" (p. 169). Treatment process refers to the oxidation and particle separation. According to the Centers for Disease Control (CDC), nitrate can be removed from drinking water through water treatment, including distillation, reverse osmosis, and ion exchange (Drinking Water, Nitrate, 2015b). The CDC also states that boiling water will concentrate arsenic and should not be considered when trying to mitigate. Instead, arsenic can be removed by treatments such as "reverse osmosis, ultra-filtration, distillation, or ion exchange" (Drinking Water, Arsenic, 2015a). Another study conducted by Elless et al., 2005, discussed the effective remediation of arsenic through the use of "phytofiltration, the use of plants to remove contaminants from water" (p. 3864), specifically a fern species (*Pteris vittata),* which accumulates arsenic from soil in its fronds. Uranium was shown to be removed effectively through the use of Strong base anionic (SBA) resins, specifically sulfate (Chen et al., 2020).

PAR

There are a number of strengths that contribute to the resiliency of Native people which are universal. The value placed on family, especially children, is one commonality across tribes, along with Native peoples' reliance on other tribal members and their communities. These strengths, as well as many challenges, face scientists who perform research with tribal communities. According to Holkup et al. (2009), understanding and respecting the traumatic history shared by Native people, starting with their removal from their respective homelands and subsequent restrictions placed on where they could live, broken treaties, the attempt to destroy their religion, culture, and language, and years of government interference in their lives are central themes to remember when trying to conduct research or implement change with tribal communities.

Looking at research from a historical perspective, the best interest of Native American communities has not always been the focus of those conducting research in these communities; in some instances, it has been harmful and caused unnecessary trauma and distress, according to Mitchell (2018). As an answer to the negative connotation placed on research in indigenous areas, PAR engages tribal communities and their people through community participation and community members as experts. The sharing of power allows for members of a community to oversee what is done, which has shown to be the best way to truly benefit these communities. According to Christopher et al. (2011), there are many strategies in place for developing general research partnerships; significantly less strategies have proven effective within the context of research with Native American communities. The collaborative approach utilized in PAR was a proven success in engaging community partners in a study conducted in a Native American setting (Smylie et al., 2009). PAR is suitable for environmental health issues because it integrates multiple ways of knowing and integrates many lines of evidence (Gonzalez et al., 2007). For the aforementioned reasons, PAR has unique factors that make it the most appropriate type of approach to use when implementing a scholarly project such as this and within a Native American community.

CHAPTER 3

METHODS

Methods

Healthcare professionals (HCPs) receive limited formal education on topics related to environmental health during their training. Consequently, clinicians often have an inadequate comprehension of the connection between environmental factors (such as contaminants) and physical health, and how to apply this limited knowledge in the practice setting (Woolf et al., 2016). Thus, there is a critical need to improve the education of HCPs with regard to environmental health issues related to children.

As previously discussed, multiple water contaminants have been discovered in home wells on the Crow reservation and throughout the Bighorn and Little Bighorn River Valleys. Educating healthcare providers on the health risks these contaminants pose to children was expected to help improve their knowledge base, confidence in relation to subject matter, and improve HCP communication with parents of pediatric patients regarding these health risks and exposures.

Design Overview

A PAR approach to research was utilized in this pre/post-quasi-experimental scholarly project. PAR is driven by the group of people with a stake in the issue being examined and allows them to take the role of leadership in the production and use of knowledge about the issue (Pain et al., 2017). Collaboration with HCPs in Hardin and members of the CEHSC, many of whom who live in the Bighorn River and Little Bighorn River Valleys and work in the healthcare, community health, and research settings, provided a participatory-driven impetus for change. CEHSC members reviewed the draft presentation for HCPs and provided feedback, to ensure the materials accurately reflected CEHSC water quality research. A pre-assessment of pediatric health risks posed by arsenic, manganese, nitrate, and uranium was created and administered to HCP collaborators by the Doctor of Nursing Practice (DNP) student to assess knowledge and confidence (Appendix A). A post-assessment was also created and administered to these collaborators by the DNP student to assess whether an improvement of knowledge and confidence related to the risks was made. These post-assessment questions were the same questions asked in the pre-assessment (Appendix A). A demographic questionnaire was created to assess sex, age, specialty (type of HCP), years in profession, years spent practicing in Big Horn County, and tribal affiliation, if any (Appendix B).

Additionally, the DNP student drafted a presentation composed of educational literature which would allow HCPs to offer evidence-based educational information to patients and parents of pediatric patients regarding health risks of total dissolved solid contaminant exposure and risks. Prior to finalizing the presentation, an outline of ideas was presented to members of the CEHSC via WebEx conference; collaborators were encouraged to make suggestions for changes, add information, and share their expert opinions.

Finally, the DNP student created a draft of an educational sheet that HCPs could disseminate to their patient population. This form is meant to be printable and can be laminated for cleaning and re-use in the clinic setting (Appendix C). The DNP student will present this educational information sheet to the CEHSC during a WebEx meeting in early December and ask for their feedback prior to disseminating to HCPs in Hardin for use as a patient resource.

Population and Sample

Twenty-six healthcare providers (HCPs) in Hardin, MT, including physicians, nurse practitioners, physician assistants, nurses, and public health workers, were recruited to take part in the project. The HCPs were invited by email and asked to complete a demographic sheet and a pre-assessment of knowledge of pediatric health risks posed by arsenic, manganese, nitrate, and uranium. They were then asked to watch a 7.5 minute voiceover PowerPoint presentation about the aforementioned health risks (Appendix D). Finally, they were asked to complete a post-assessment about knowledge gained from the information provided.

Ethical Considerations

The student emailed Mark Quinn, chair of Montana State University's Institutional Review Board (IRB) on February 20, 2020 to discuss an expedited vs. full application for IRB approval (Appendix E). According to Dr. Quinn, the expedited application for this project was appropriate, as the project did not directly relate to caring for patients. Rather, it was an educational project with a focus on health promotion. Upon review of the IRB application for the project, Dr. Quinn granted exempt status for the project (Appendix F). This project did not commence until IRB approval was obtained. There was no research conducted on the Crow reservation; therefore, approval from the Rocky Mountain Tribal Leaders Council (RMTLC) was not required. In lieu of RMTLC approval, the meeting between the DNP student and the CEHSC members was recorded on WebEx and sent to Dr. Gerlinda Morrison and Dr. David Yarlott at

LBHC for their approval in efforts to maintain the collegial relationship between MSU and LBHC and to make them aware of the research being conducted by the student.

All participants were informed that participation was voluntary, and they were not required to participate. Participants were also informed that they would remain anonymous through data coding via Qualtrics™.

Procedure

The time frame for this project was from October 19th to October 28th, 2020. Prior to the implementation of the project CEHSC members received a PowerPoint presentation developed by the DNP student via email. A WebEx meeting was held between the DNP student and CEHSC on October 6th, 2020, during which the DNP student discussed the health risks associated with the common well water contaminants that were examined throughout this project and asked the CEHSC to provide feedback for necessary changes to be made in order for the materials to be appropriate and factually correct. Apart from minor grammatical, wording, and pronunciation changes, the main modification suggested by the CEHSC was to add questions to the survey to gauge HCPs perceptions of the importance of educating patients about contaminant health effects and feasibility of discussing these health risks with patients. The survey was created in Qualtrics™ by the DNP student which included questions suggested by the CEHSC.

As previously stated, HCP participants were contacted via email on October 19th and 20th, 2020 (Appendix E). These participants were asked to complete a demographic form and a pre-assessment of knowledge about contaminants. Following the review of educational materials provided by the student (a PowerPoint presentation with voiceover), participants were asked to fill out a post-assessment of knowledge about contaminants. A reminder email was sent on

October 26th, 2020 asking HCPs to participate. Upon the conclusion of the survey, scores were calculated and compared for pre- and post-test assessments and conclusions were inferred based on demographic information, assessment scored, and feedback from participants.

After receiving approval from the scholarly project committee, the student applied for, and received, exempt status through the IRB at MSU. The project did not require statistical support from a statistician; Qualtrics ™ was used to analyze the descriptive data obtained from the participants. Data included demographic information (age, sex), type of provider (MD/DO, NP, PA, RN), number of years practicing in Big Horn County, and tribal affiliation, if any.

Expected Outcomes and Rationale

It was expected that the education provided to the HCPs would increase their level of confidence and improve their familiarity with the health risks associated with total dissolved solid and particulate contaminants in well water. Therefore, it was expected that the scores from the post-assessment would be higher than those from the pre-assessment, regardless of demographics. This project was expected to raise awareness in HCPs and patients alike with regard to the health risks.

As part of dissemination and sustaining the project, the DNP student will present findings to the Crow Environmental Health Steering Committee via video conference at their convenience in December, as well as offer the presentation to HCPs working for the I.H.S. on the Crow Reservation. The DNP student has offered to donate a copy of this completed paper to the LBHC library after it has been approved by the College of Nursing and the Graduate School at MSU. In accordance with the PAR approach, the DNP student will seek ways to provide her support to

Crow tribal community members who are continuing their engagement in addressing or mitigating contaminants in their water supply.

CHAPTER 4

RESULTS

Results

The overall goals of this project were to educate HCPs about common well water contaminants (manganese, uranium, nitrate, and arsenic) and their associated health effects, as well as increase the comfort and familiarity of these same HCPs in order for them to initiate and sustain conversations with community members about this health concern. Content analysis was conducted on data gathered through the use of a Qualtrics ™ survey.

Participants were asked to answer questions pertaining to demographics and a pre-assessment of their knowledge of health effects related to manganese, uranium, nitrate, and arsenic. They were then asked to watch an educational 7 ½ minute PowerPoint presentation with voiceover provided by the DNP student, with information specific to each contaminant, as well as the "next steps" for patients to take if they have questions or want to get their well water tested. These "next steps" are based on whether the patient is a Tribal member or descendant or a non-Tribal member, as non-Tribal members do not have access to Tribally-based resources. Following the presentation, the participants were asked to complete a post-assessment of knowledge they had gained from the presentation, by again answering the same six questions they were asked in the pre-assessment.

A total of twenty-six HCPs in Hardin were emailed an anonymous link to a Qualtrics™ survey. However, only seven HCP surveys were completed via Qualtrics™, for a 26.9% participation rate.

Demographics

The HCPs who were recruited for the project were doctors, nurse practitioners, physician assistants, nurses, and community health workers in Hardin, MT. Nurse practitioners comprised 71.43% (n=5) of the participants. One participant was an RN (14.29%) and one participant marked the box labeled “Other” (14.29%). Ages ranged from 29 years old to 61 years old. All participants were female, have been in practice from zero to 28 years, and have been practicing in Big Horn County from zero to 22 years. Of the participants, one had a tribal affiliation, which was identified as Cree. The other six participants had no tribal affiliation.

Pre-Assessment of Knowledge

Participation occurred through an anonymous link to a Qualtrics™ survey, sent to participants’ email addresses. After participants opened the survey, an informative statement again explained that participation in the survey was completely voluntary, they may stop at any time, and they need not answer any questions they didn’t wish to answer. All participants marked a box stating they understood the statement.

Six demographic questions were asked, which were previously discussed. Questions seven through 12 (Q7-Q12) were asked prior to the participant watching the presentation in order to get a baseline pre-assessment of their knowledge, comfort level, and the importance of health risks associated with common well water contaminants, specifically uranium, manganese, nitrate, and arsenic.

Post-Assessment of Knowledge

Following the voiceover PowerPoint presentation provided, participants were asked to answer the same questions again. The expectation was that they would be more familiar and comfortable with the topic materials after watching the presentation. The pre-assessment and post-assessment data is shown in Tables 1-6 below:

Table 1.
Question: How familiar are you with the more common hazardous contaminants found in well water throughout the Big Horn County specifically uranium, manganese, arsenic, and nitrate?

Pre-Assessment

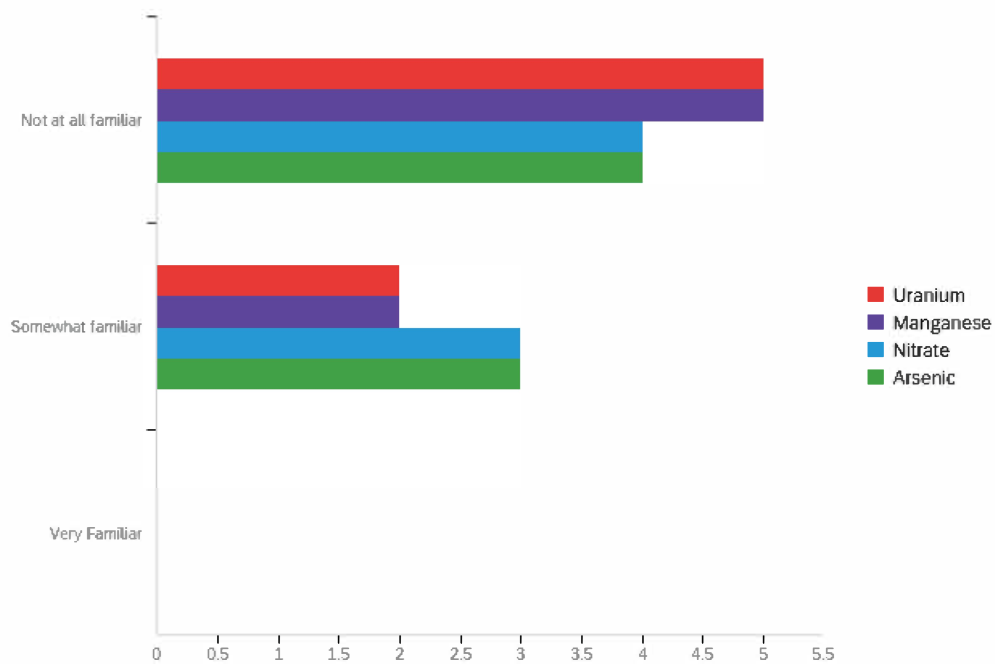


Table 1 continued

Post-Assessment

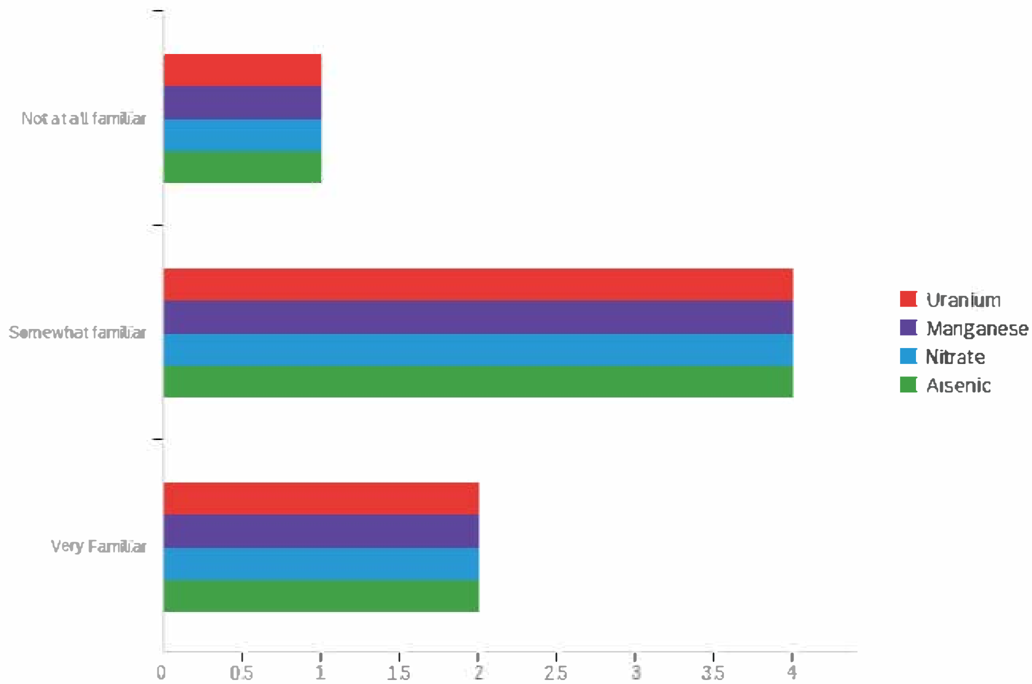


Table 2.
Question: How comfortable are you talking to patients about the hazardous contaminants found in well water throughout Big Horn County and the health effects they have on children and people of all ages?

Pre-Assessment

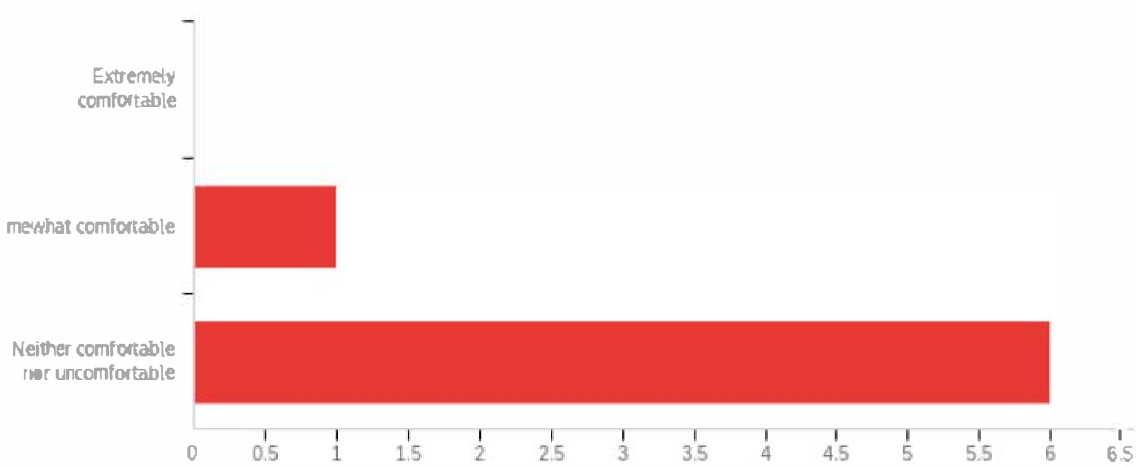


Table 2 continued

Post-Assessment

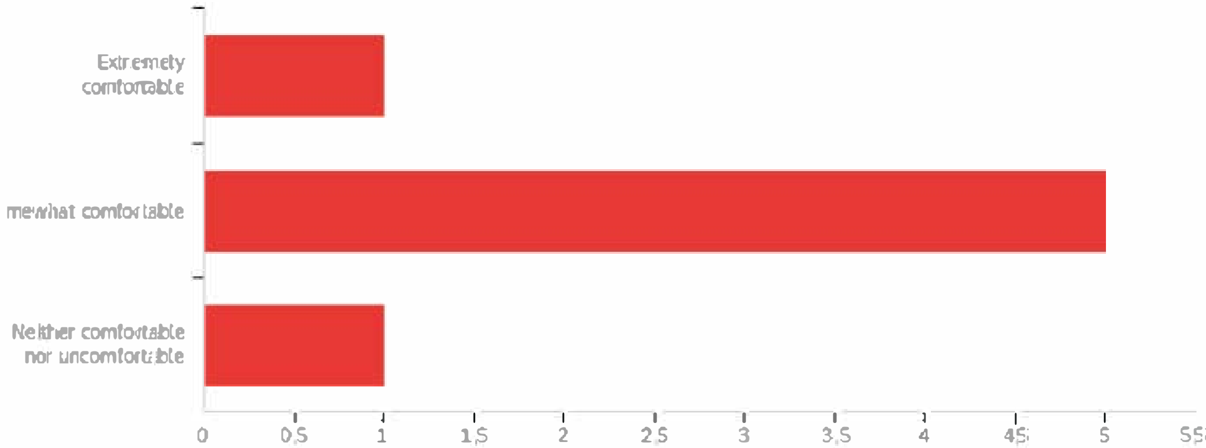


Table 3.
Question: How comfortable are you engaging patients in identifying solutions to common hazardous contaminants found in well water throughout Big Horn County?

Pre-Assessment

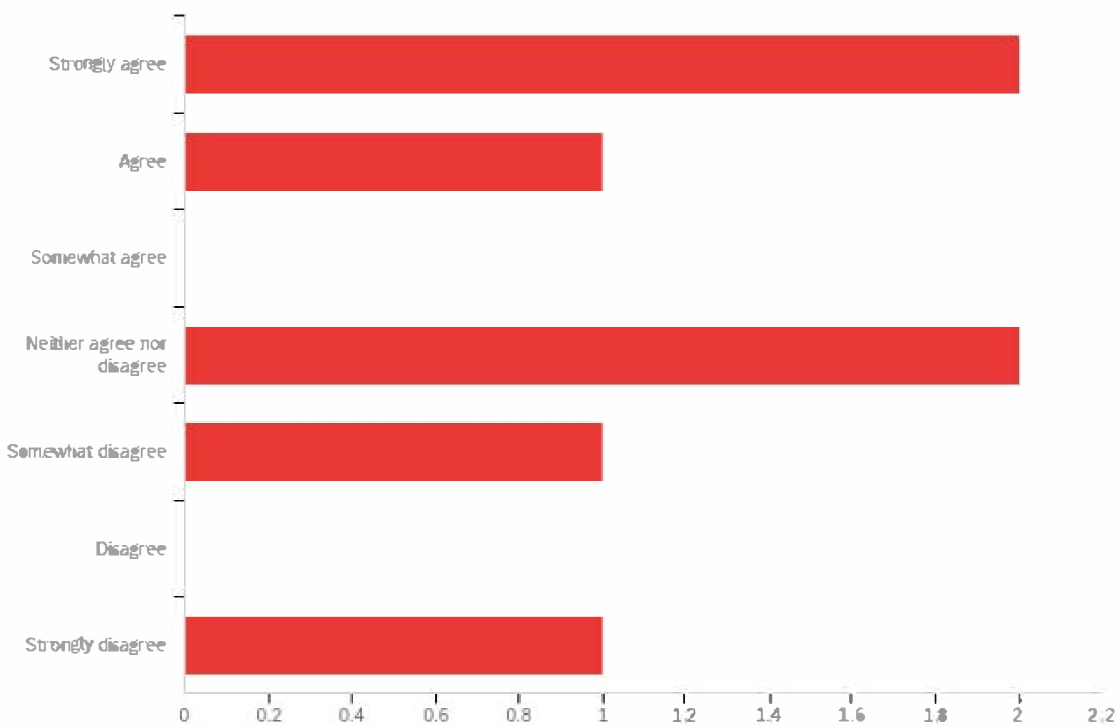


Table 3 continued

Post-Assessment

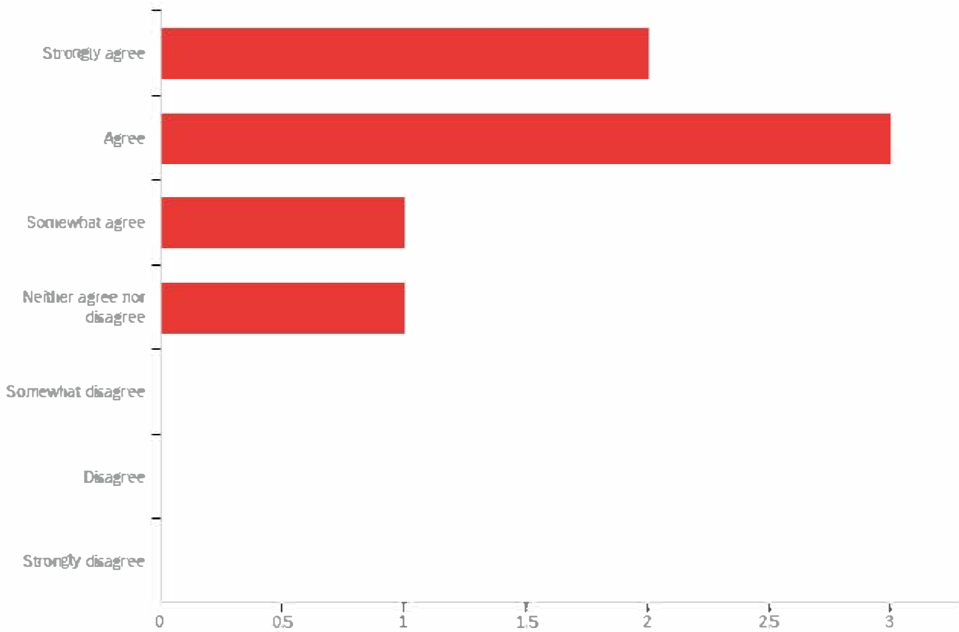


Table 4
Question: How likely are you to educate patients about these contaminants and their health risks?

Pre-Assessment

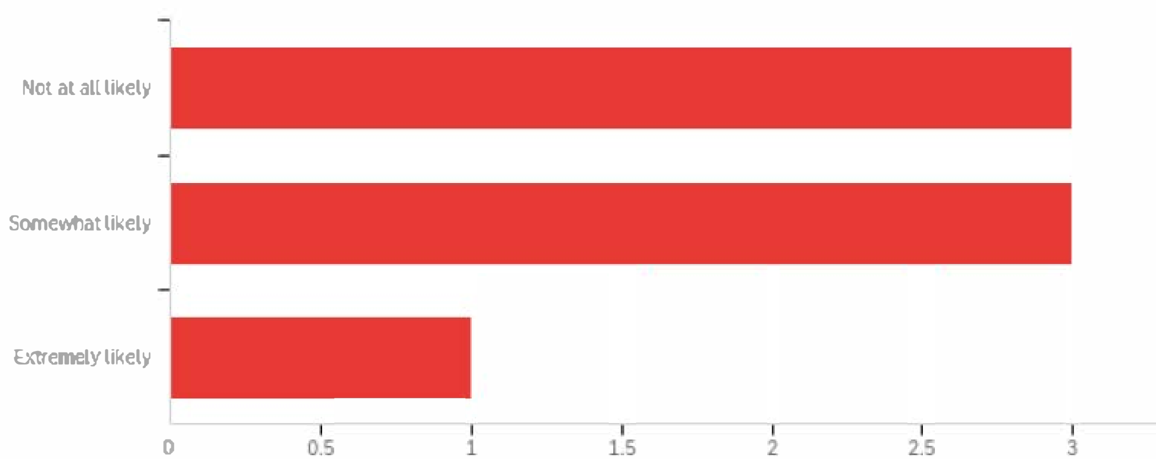


Table 4 continued

Post-Assessment

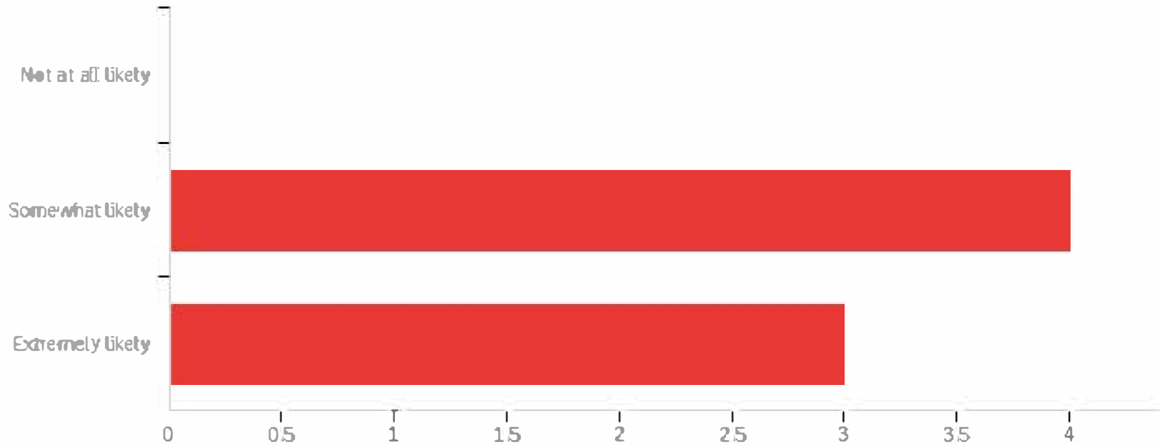


Table 5.
Question: How important do you find the topic of well water contamination and the health effects they pose to all ages is to emphasize during patient visits?

Pre-Assessment

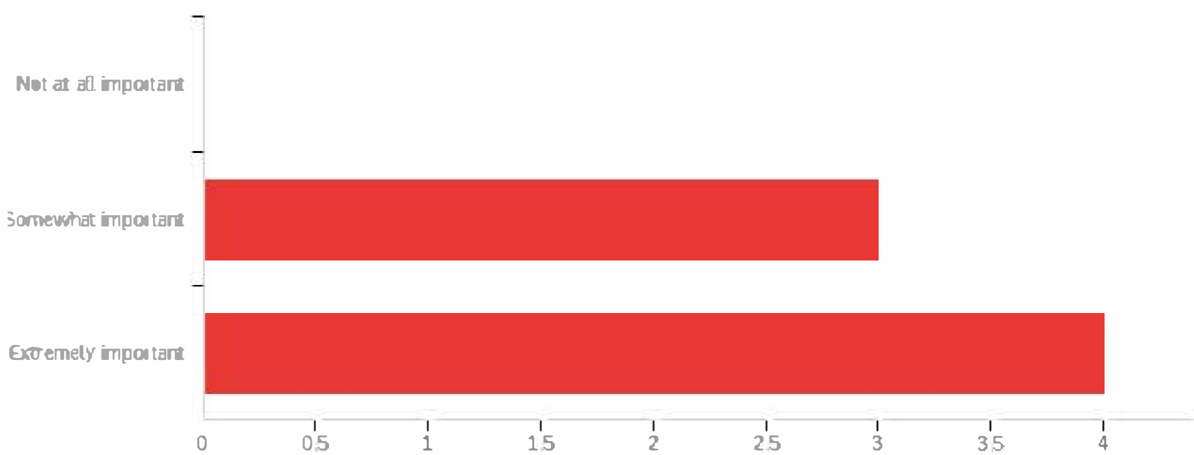


Table 5 continued

Post-Assessment

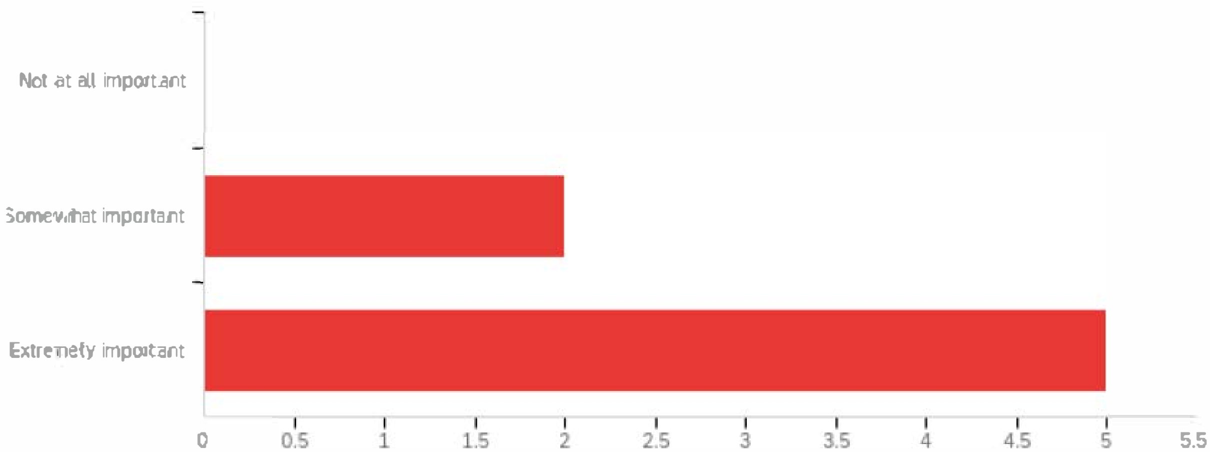


Table 6.
Question: Which of the following would make it more feasible for you to discuss well water contamination and health effects with patients?

Pre-Assessment

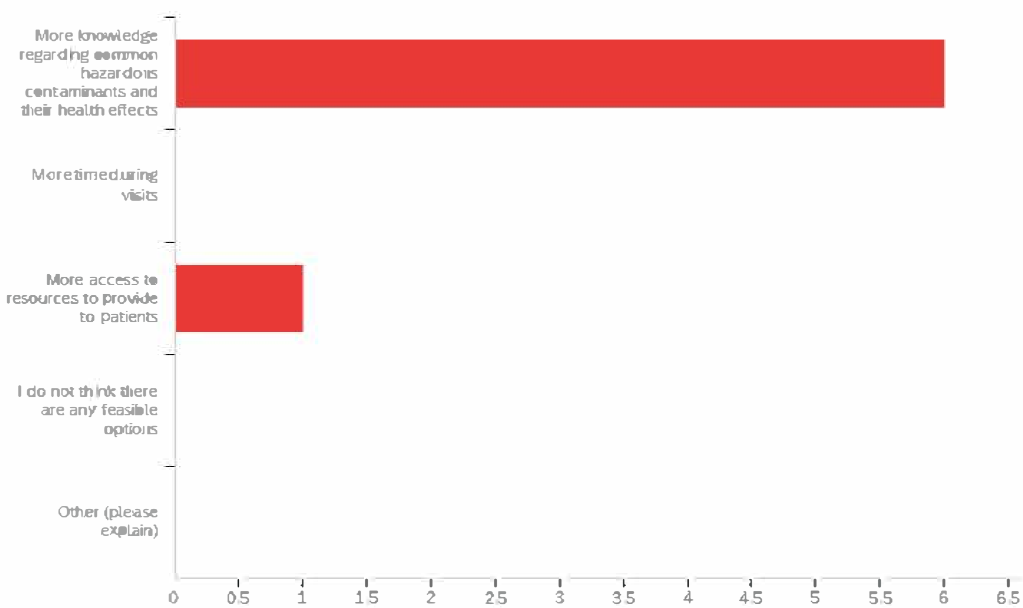
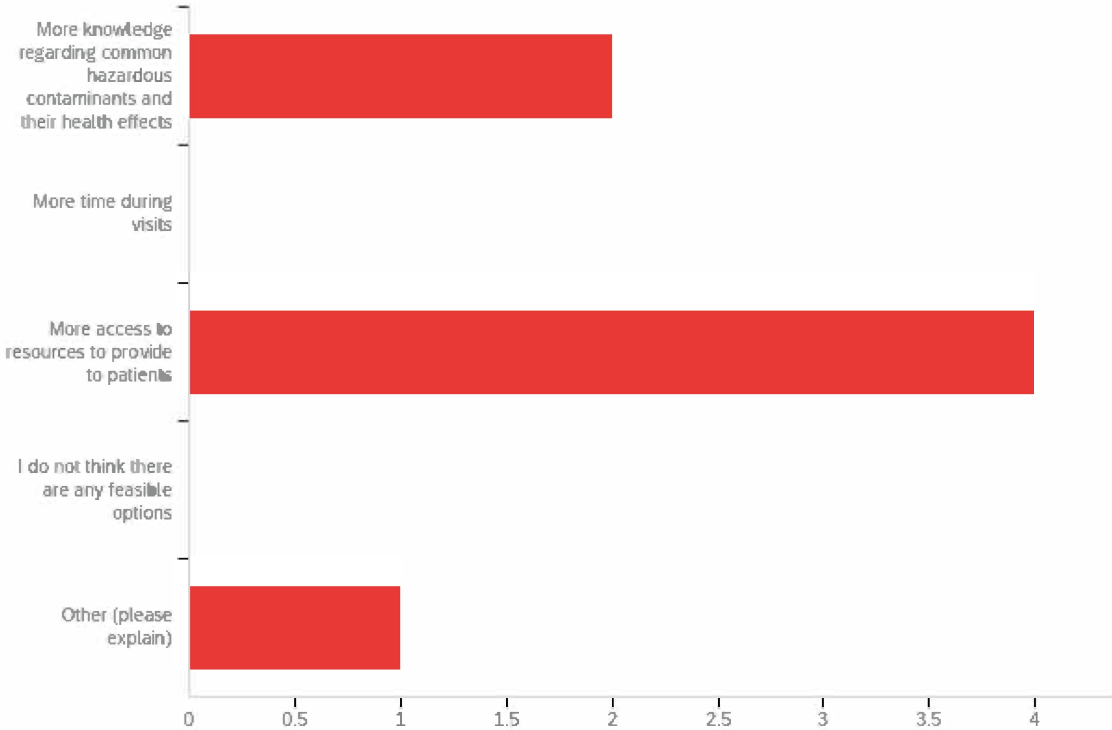


Table 6 continued

Post-Assessment



Analysis of the Results

The first question asked participants how familiar they were with uranium, manganese, nitrate, and arsenic in order to assess baseline knowledge (Table 1). With regards to uranium and manganese, 71.4% (n=5) reported “not at all familiar”, while the other 28.6% (n=2) reported “somewhat familiar”. For arsenic and nitrate, 57.1% (n=4) were “not at all familiar” while 42.9% (n=3) were “somewhat familiar”. There were no responses for any of the four contaminants wherein participants reported to be “very familiar” with them. After the intervention, participants answered the same question with different results, showing an improvement in their familiarity with the contaminants. The breakdown of answers was the same for all four contaminants, with

14.3% (n=1) reporting "not at all familiar", 57.1% (n=4) reporting "somewhat familiar, and 28.6% (n=2) reporting "very familiar".

The second question in the survey was asked in order to gauge participants' comfort level in talking to patients about the contaminants and their health risks (Table 2). Prior to the intervention, 85.7% (n=6) stated they were "neither comfortable nor uncomfortable" whereas 14.3% (n=1) reported being "somewhat comfortable". None of the participants reported being "extremely comfortable" talking to patients. However, after the intervention, only 14.3% (n=1) stated they were still "neither comfortable or uncomfortable", while the majority, 71.4% (n=5) reported being "somewhat comfortable" and 14.3% (n=1) was "extremely comfortable" talking to patients.

The third question asked participants how comfortable they were engaging patients to identify solutions to using contaminated water. However, the DNP student made a mistake during the creation of the Qualtrics™ survey and the answer options were related to agreement rather than comfort level (see Table 3). This mistake was not noticed until two participants had completed the surveys and watched the presentation, so no changes were made to the question in order to maintain data validity. Due to the fact that the pre-assessment question was copied and added as a post-assessment question, the same mistake can be found in the post-assessment. However, despite the mistakes in the survey, all participants answered the questions. Prior to the intervention, 14.3% (n=1) answered "strongly disagree", 14.3% (n=1) answered "somewhat disagree, 28.6% (n=2) answered "neither agree nor disagree", 14.3% (n=1) answered "agree", and 28.6% (n=2) "strongly agree" with engaging patients in finding solutions to using contaminated water.

The fourth question asked how likely participants were to educate patients about the contaminants and their health effects. Prior to the intervention, “not at all likely” and “somewhat likely” each had 42.9% (n=3) of the participants’ answers, respectively, whereas only 14.3% (n=1) thought it was “extremely likely”. After the intervention, 57.1% (n=4) answered that they were “somewhat likely” and 42.9% (n=3) that they were “extremely likely” to educate patients.

The fifth question asked participants to indicate their thoughts about the importance of the topic of well water contamination and the health risks they pose to people. In the pre-assessment, 42.9% (n=3) stated they thought it was “somewhat important” while the remaining 57.1% (n=4) thought it was “extremely important”. After watching the presentation, 28.6% (n=2) still thought it was “somewhat important”, but 71.4% (n=5) answered “extremely important”.

The final question asked which of the following possible options would help make it easier for participants to discuss well water contamination and its risks with patients. The options were a) more knowledge regarding common hazardous contaminants and their health effects; b) more time during visits; c) more access to resources to provide to patients; d) I do not think there are any feasible options; and e) Other (please explain). In the pre-assessment, 85.7% (n=6) of participants answered that they would like more knowledge regarding contaminants – option A. The other 14.3% (n=1) wanted more access to resources to provide to patients – Option C. After participants watched the presentation, only 28.6% (n=2) answered with Option A, while 57.1% (n=4) chose Option C, and 14.3% (n=1) chose option E – Other. The participant who chose option E stated “I work in the ED setting so I am not in the primary care setting. This is certainly something to keep in mind and possibly add to the differential”.

Relative Knowledge Gain

The DNP student assigned a numerical value to each answer option in order to calculate the positive shift in knowledge between the pre-assessment and the post-assessment for each participant. For example, in the first question, “Not at all Familiar” was assigned zero points, “Somewhat Familiar” was assigned one points, and “Very Familiar” was assigned two points. A total of 20 points were possible when all five questions were added up. Pre-assessment question 12 (post-assessment question 19) was not included because this question was not gauging knowledge gained, but rather asking for options to make it more feasible for HCPs to discuss contamination with patients in-office. Participant A gained 14 points between their pre-and post-assessments for a gain of 70% knowledge. The seven participants’ knowledge gain is shown in the table below:

Table 7. Individual Knowledge Gained

Participant	A	B	C	D	E	F	G
Numerical Gain	14	2	5	7	0	12	9
Percentage Gain	70%	10%	25%	35%	0%*	60%	45%

*Participant E actually showed a loss of knowledge, for which the DNP student assumed that the question was answered incorrectly because it seems unlikely that the participant had less knowledge about the contaminants after watching the presentation, especially when all other participants showed some knowledge gained. It is, however, also possible that the participant believed she had a good working knowledge about the contaminants prior to the intervention, but then realized after watching the presentation that she needed more knowledge before she would feel comfortable with the contaminants and their associated health risks.

On average, the participants gained 35% knowledge about the common contaminants in Big Horn County that were discussed in the presentation.

CHAPTER 5

DISCUSSION AND CONCLUSION

Discussion of the Results

It was assumed that participants who watched the presentation created by the DNP student would improve their comfort and familiarity with the well water contaminants and their associated health risks that were discussed in the presentation. Scores were expected to improve in the post-knowledge assessment surveys for all participants, regardless of demographics. Although the number of participants was small (n=7), this assumption was supported by the results of the surveys.

The aims of this scholarly project were to educate HCPs about non-dissolved solid well water contaminants (manganese, uranium, nitrate, and arsenic) and their health effects on children and people of all ages; and to increase the HCPs comfort level and familiarity with the contaminants in order for them to initiate and sustain conversations with community members about the health effects of contaminants found in well water. These aims were both accomplished by using the PAR approach to provide an evidence-based educational PowerPoint presentation that could be saved and printed, should the participants choose to do so, and used for future reference. Moreover, the voiceover that accompanied the PowerPoint provided more detailed information about each contaminant that further improved participants' understanding than viewing the PowerPoint alone. Finally, the last slide of the presentation offered participants a real-life solution to patient questions regarding what they could do if their well water was contaminated.

Limitations

Three primary limitations were identified in this project. First, there was a low number of HCPs (n=7) who responded to the survey and watched the presentation, despite that 26 providers were sent the initial email and reminder email during the 10-day project window for the survey. Although exact reasons are unknown, this could have been due in part to the providers' focus on the ever-increasing number of COVID-19 cases and deaths in Big Horn County throughout the timeframe in which the project was conducted, as well as the related stress and fatigue felt by healthcare providers during this global pandemic. Time constraints could have also been a factor, with the Qualtrics™ survey staying open for only 10 days.

Secondly, the vast majority of participants identified as Nurse Practitioners (85.7%), and all participants were female. It is unknown whether male participants or other types of HCPS would have answered the questionnaires differently or found the presentation to be beneficial.

Finally, the project was limited to HCPs in Hardin, MT although there are many small towns with I.H.S. healthcare options for tribal members and descendants in Big Horn County, on the Crow Indian reservation. It was mentioned earlier that IRB approval from the Crow tribal council was not obtained because no research was conducted on the reservation. Due to time constraints, research was limited to Hardin. However, HCPs working for I.H.S., as well as public and community health workers on the reservation, could have potentially benefitted from this project as did HCPs in Hardin. Future research could potentially include the expansion of the project to HCPs within the I.H.S. system on the reservation.

Due to the above mentioned limitations, results cannot be generalized to a greater population or geographical area and are instead specific to HCPs in Hardin. It is important to remember that the HCPs in Hardin have most likely received some form of news about the common contaminants discussed in this project, thanks to the continued efforts of researchers in the area over the past 14+ years attempting to disseminate information.

Implications for Clinical Practice

This project serves as an assessment of the knowledge gained among HCPs in one community in Big Horn County about common well water contaminants found in the county and their associated health risks. Based on the data that was collected, it should be noted that six of the seven participants showed an increase in familiarity with all four contaminants that were discussed (Table 1), all participants showed increased comfort with all contaminants and were more likely to discuss these contaminants with patients and engage patients in finding solutions after watching the presentation provided by the DNP student (Tables 2 and 3). The HCPs also became more likely to educate patients about the well water contaminants and their associated risks (Table 4) and increased their feelings of the importance of discussing well water contaminants and their health risks with patients during visits (Table 5). One participant stated that knowing more about the health risks associated with the contaminants would be something she could add to the list of differential diagnoses when a patient comes to be seen and has symptoms matching those discussed in the presentation. Finally, there was a shift from participants wanting more knowledge themselves about the contaminants prior to watching the presentation, to the participants wanting more resources that they could provide to patients after watching the presentation (Table 6), which further demonstrates that they realized the importance of teaching patients about the contaminants.

Recommendations

The results of this project provided information that supported the expectation that HCPs in Big Horn County would benefit from an increased knowledge about common contaminants found in the county and the health risks they pose to patients, especially children. One recommendation is to repeat this project over a longer time period and change the delivery to providing in-person presentations for HCPs throughout Big Horn County. Another is to delay implementation (repeating) of the project until the demands of the COVID-19 pandemic have reached more manageable levels. These changes could help in obtaining a larger sample size and offer more inclusive perspectives. Furthermore, the addition of a control group could provide information of baseline knowledge and actual knowledge gained by the participants.

DNP Core Essentials

#1 Scientific Underpinnings

There were two theoretical frameworks that guided this scholarly project. First, the TERRA framework developed by Butterfield, Potsma, and the ERRNIE research team (2009) addressed health disparities faced by people living in low-income, rural communities and emphasized the importance of recognizing the rural perspective when considering environmental health. This theoretical framework helped the DNP student acknowledge that rural residents often do not receive health information from HCPs, but rather friends, families, and neighbors. In order to best educate large groups of people, the HCPs caring for these people living in rural areas should have a strong baseline knowledge about environmental health risks faced by their patient population. This way, the information that trickles down to people who do not seek regular healthcare will be somewhat more accurate. The TERRA framework proved to be appropriate in the rural setting in which the project took place.

The second framework, Leininger's Culture Care Theory, was associated with cultural factors and their influence on the ability to provide culturally competent care. The DNP student used this framework to guide the PAR approach to research, which included review and feedback on the draft educational PowerPoint by the CEHSC. The members of the CEHSC were considered experts on the contaminants being discussed in this project. The Culture Care Theory was appropriate for the creation of the PowerPoint presentation with voiceover that would be disseminated to HCP participants in Hardin, some of whom were expected to be Native American, and all of whom were expected to care for Native American patients. The student also drew from personal experience of being Native American during the development of the presentation.

#2 Organizational and Systems Leadership for Quality Improvement

The leadership role for this project was assumed by the DNP student. As a DNP core essential, leadership emphasizes the role of the DNP graduate in the improvement of patient outcomes (American Association of Colleges of Nursing, 2006). Using the PAR approach to research and utilizing the CEHSC as experts, in addition to finding a deficit in knowledge of HCPs in Hardin, MT, the DNP student implemented a plan that utilized the delivery of evidence-based knowledge to the same HCPs who initially voiced a deficit in their knowledge regarding well water contaminants and their associated health risks. Guidance was provided by the DNP committee chair, committee members, and the CEHSC when asked or when necessary.

#3 Clinical Scholarship and Analytical
Models for Evidence-Based Practice

The DNP student conducted a thorough review of existing evidence surrounding uranium, manganese, arsenic, and nitrate in order to develop and disseminate the most up-to-date, evidence-based information about these contaminants to HCPs. Additionally, the DNP student assessed the needs of the multidisciplinary group of HCPs and evaluated the findings from this project in order to address a deficit in HCP knowledge about common well water contaminants found in the communities where these HCPs and their patient population live. Through the dissemination of a PowerPoint presentation with voiceover the DNP student provided an educational modality that could be both watched and listened to as many times as HCPs chose, as well as printed and/or saved for future reference. HCPs were thus encouraged to perpetuate their knowledge to their patients who show signs and symptoms of contaminant health effects and/or pose questions about the contaminants to the HCPs.

#4 Information Systems/Technology for the
Improvement and Transformation of Health Care

The DNP student utilized multiple information systems/technology over the course of this project. First, the Montana State University online research library was utilized throughout the entire project from inception to completion. Secondly, a web-based survey platform, Qualtrics™ was utilized for the creation and organization of the questionnaires and dissemination of the presentation. Electronic mail was utilized to disseminate the anonymous link to the Qualtrics survey. WebEx, an online meeting platform that utilized video, audio, and screen sharing, was the third example of technology used in this project. Finally, a Microsoft

PowerPoint presentation with voiceover was created to deliver the educational information to HCPs.

#5 Health Care Policy for Advocacy in Health Care

The implementation and delivery of this project involved the issues of health disparities, cultural sensitivity, and ethics in creating and disseminating educational materials. Through seeking advice and input from the CEHSC, the DNP student was able to create an ethically responsible educational presentation that satisfied the deficit voiced by HCPs at the beginning of this project, in order to improve their care of a marginalized patient population.

#6 Interprofessional Collaboration for
Improving Patient & Population Health Outcomes

The DNP student utilized interprofessional collaboration on two fronts. First, the CEHSC was engaged in reviewing the presentation to ensure the creation of a meaningful, accurate presentation. As a reminder, the CEHSC is a collaborative group of Crow tribal stakeholders and faculty members at LBHC, whose mission is to “reduce health risks and health disparities from unsafe drinking water and contaminated rivers” (Doyle et al., 2018, p. 2). Secondly, the DNP student utilized both the Director of Providers at Big Horn County Memorial Hospital and the Director of the Regional Community Action Team for Big Horn County, employed by Big Horn Valley Health Center, who volunteered to disseminate educational materials to HCPs in Hardin, MT. Additionally, the DNP student utilized multidisciplinary HCPs in Hardin as participants in the project after it was expressed that the topic of the project was needed due to a deficit in their baseline knowledge of the contaminants. The project was conducted in order to improve outcomes for Native American patients living in Big Horn County.

#7 Clinical Prevention & Population Health for
Improving the Nation's Health

The DNP student was able to implement a project that addressed clinical prevention through the improvement of knowledge about common well water contaminants found in Big Horn County. The knowledge gained can assist HCPs in improving the health of the Native American population living in the same county. This health promotion project was guided in part by the cultural factors that affect the health of Native Americans, such as the traditional practices as well as disparities mentioned earlier in this paper.

#8 Advanced Nursing Practice

The DNP student was able to advocate for healthcare policy through the creation and implementation of a project that addressed particular health risks that are more likely to affect Native Americans living in rural Big Horn County. This project incorporated a diverse, culturally appropriate approach using nursing frameworks to guide the project pertaining to rural environmental health and professional development materials. The educational presentation delivered to HCPs in this project can serve as a guide in their achievement of excellence in practice through improving outcomes.

Conclusion

The health risks associated with uranium, manganese, nitrate, and arsenic are well established after years of research in numerous locations worldwide. However, HCPs in the clinical setting in Hardin, MT, like most providers in the U.S., have not received formal education about the common contaminants found in Big Horn County or their health effects. The goals of this project were to educate HCPs about dissolved and particulate well water contaminants (manganese, uranium, nitrate, and arsenic) and their health effects; and to increase the HCPs comfort level and familiarity with the contaminants in order for them to initiate and sustain conversations with community members about the health effects of contaminants found in well water. These goals were largely met by providing participating HCPs with an informational presentation. A process for positively impacting this community, in terms of reducing water contaminant risk, has been initiated.

Although the results of this project are not generalizable to a larger group of HCPs, further research with a larger sample size, greater geographical area consisting of other towns and healthcare settings in Big Horn County, and a control group have been recommended in order to better understand the changes made to clinical practice as a result of the intervention.

REFERENCES CITED

Ablah, E., Marrow, M.W., Brown, J., Green, S., Konda, K., Gallagher, L.,…Aschengrau, A. (2019). Private well water practices among environmental health professionals in Kansas. *Journal of Environmental Health 82*(3). 34-38.

American Association of Colleges of Nursing (2006). The essentials of doctoral education for advanced nursing practice. Retrieved on November 2, 2020 from https://aacnnursing.org/Portals/42/ Publications/DNPEssentials.pdf.

Adachi-Mejia, A.M., Murray, C.J., & Karagas, M.R. (2019). "If providers had recommended it, we would have had it tested": Rural mothers' perspectives on barriers and facilitators to testing for Arsenic in their well water. *Journal of Environmental Health 82*(3) 26-32.

Azfal, B.M. (2006). Drinking water and women's health. *Journal of Midwifery and Women's Health 51*(1) 12-18. doi: 10.1016/j.jmwh.2005.08.014

Beaudin, S.A., Strupp, B.J., Strawderman, M., & Smith, D.R. (2017). Early postnatal manganese exposure causes lasting impairment of selective and focused attention and arousal regulation in adult rats. *Environmental Health Perspectives 125*(2) 230-237.

Butterfield, P., Postma, J., ERRNIE Research Team. (2009). The TERRA framework: Conceptualizing rural environmental health inequities through an environmental justice lens…translational environmental research in rural areas. *Advances in Nursing Science 32*(2) 107-117.

Boyer, P. (1992). Young and old alike: Children and the elderly are a priority in Native American cultures. *Tribal College Journal of American Indian Higher Education 3*(4). Retrieved on October 18, 2018 from https://tribalcollegejournal.org/young-alike-children-elderly-priority-native-american-cultures/

Centers for Disease Control and Prevention (2015). Drinking water: Arsenic and drinking water from private wells. Retrieved on January 17, 2019 from https://www.cdc.gov/healthywater/drinking/private/wells/disease/arsenic.html.

Centers for Disease Control and Prevention (2015). Drinking water: Nitrate and drinking water from private wells. Retrieved on January 17, 2019 from https://www.cdc.gov/healthywater/drinking/private/wells/disease/nitrate.html.

Chalapuka, S. (2005). Tainted water on tap: What to tell patients about preventing illness from drinking water. *American Journal of Nursing 105*(11) 40-52.

Chen, A.S.C., Wang, L., Sorg, T.J., & Lytle, D.A., (2020). Removing arsenic and co-occurring contaminants from drinking water by full-scale ion exchange and point-of-use/point-of-entry reverse osmosis systems. *Water Research 172*(2020) 1-13. DOI: 10.1016/j.watres.2019.115455. [Epub ahead of print].

Christopher, S., Saba, R, Lachapelle, P., Jennings, D., Colclough, Y., Cooper, C., Cummins, C.,…& Lachapelle, P. (2011). Applying indigenous community-based participatory research principles to partnership development in health disparities research. *Family & Community Health 34*(3) 246-255. DOI: 10.1097/FCH.0b013e318219606f.

Cummins, C., Doyle, J., Kindness, L., Lefthand, M., Bear Don't Walk, J.D., Bends, A.L., …& Eggers, M.A. (2010). Community-based participatory research in Indian country: Improving health through water quality research and awareness. *Family and Community Health 33*(3) 166-174. DOI: 10.1097/FCH.0b013e3181e4bcd8.

Del Rio, M., Alvarez, J., Mayorga, T., Dominguez, S., & Sobin, C. (2017). A comparison of arsenic exposure in young children and home water arsenic in two rural West Texas communities. *BMC Public Health 17* 1-13. DOI: 10.1186/s12889-017-4808-4.

Denchak, M. (2018). Water pollution: Everything you need to know. Retrieved on December 28, 2019 from https://nrdc.org/stories/water-pollution-everything-you-need-know.

Dingan, M.B., Jones, K., Burhansstipano, L., & Michalek, A.M. (2014). Evaluation lessons learned from im[lamenting CBPR in Native American communities. *Journal of Cancer Education 29*(3) 412-413. DOI: 10.1007/s13187-014-0648-4.

Doyle, J.T., Kindness, L., Realbird, J, Eggers, M.J., & Camper, A. K. (2018). Challenges and opportunities for tribal waters: Addressing disparities in safe public drinking water on the Crow reservation in Montana, USA. *International Journal of Environmental Research and Public Health 15*(567) 1-13. DOI: 10.3390/ijerph15040567.

Eggers, M.J., Doyle, J.T., Lefthand, M.J., Young, S.L., Moore-Nall, A.L., Kindness, L., …& Camper, A.K. (2017). Community engaged cumulative risk assessment of exposure to inorganic well water contaminants, Crow reservation, Montana. *International Journal of Environmental Research and Public Health 15*(1) 1-34. DOI: 10.3390/ijerph15010076.

Eggers, M.J., Moore-Nall, A.L., Doyle, J.T., Lefthand M.J., Young, S.J., Bends, A.L., …& Camper, A. (2015). Potential health risks from uranium in home well water: An investigation by the Apsaalookee (Crow) tribal research group. *Geosciences 5,* 67-94. doi:10.3390/geosciences5010067.

Elles, M.P., Poynton, C.Y., Willms, C.A., Doyle, M.P., Lopez, A.C., Sokkary, D.A., …& Blaylock, M.J. (2005). Pilot-scale demonstration of phytofiltration for treatment of arsenic in New Mexico drinking water. *Water Research 39*(16) 3863-3872.

Farsi, Z., & Azarmi, S. (2016). Effect of Roy's Adaptation Model-guided education on coping strategies of the veterans with lower extremities amputation: A double-blind randomized controlled clinical trial. *International Journal of Community Based Nursing & Midwifery 4*(2) 127-136.

Fido, A., & Al-Saad, S. (2005). Toxic trace elements in the hair of children with autism. *Autism 9*(3) 290-298. DOI: 10.1177/1362361305053255.

Firestone, M., Berger, M., Foos, B., & Etzel, R. (2016). Two decades of enhancing children's environmental health protection at the U.S. Environmental Protection Agency. *Environmental Health Perspectives 124*(12) A214-A218.

Gagnon, F., Lampron-Goulet, E., Normandin, L., & Langlois, M. (2016). Measurements of arsenic in the urine and nails of individuals exposed to low concentrations of arsenic in drinking water from private wells in a rural region of Québec, Canada. *Journal of Environmental Health 78*(6) 76-83.

Gonzalez, E.R., Lejano, R.P., Vidales, G., Conner, R.F., Kidokoro, Y., Fazeli, B, & Cabrales, R. (2007). Participatory action research for environmental health: Encountering Friere in the urban barrio. *Journal of Urban Affairs 29*(1) 77-100.

Gu, H., Lan, S., Wang, M., Chi, B., & Wang, H. (2018). Human health risk assessment and sources analysis of nitrate in shallow groundwater of the Liujiang basin, China. *Human & Ecological Risk Assessment 24*(6) 1515-1531.

Haynes, E.N., Sucharew, H., Kuchnell, P., Alden, J., Barnas, M., Wright, R.O.,… Dietrich, K.N. (2015). *Environmental Health Perspectives 123*(10) 1066-1071.

Holkup, P.A., Rodehorst, T.K., Wilhelm, S.L., Kuntz, S.W., Weinert, C., Flanders Stepans, M.,B., Salois, E.M. et al. (2009). *Journal of Transcultural Nursing 20*(2) 164-175 DOI: 10.1177/1043659608325845.

ICWA Guide Online (N.D.). Introduction. Retrieved on June 18, 2017 from https://narf.org/nill/documents/icwa/ch1.html

Indian Health Service (N.D.). Crow Service Unit. Retrieved on January 14, 2020 from https://www.I.H.S..gov/billings/healthcarefacilities/crow/.

Joseph, L., Jun, B.M., Flora, J.R.V., Park, C.M., & Yoon, Y. (2019). Removal of heavy metals from water sources is the developing world using low-cost materials: A review. *Chemosphere 229*(2019) 142-159.

Jumper-Reeves, L., Dustman, P.A., Harthun, M.L., Kulis, S., & Brown, E.F. (2014). American Indian cultures: How CBPR illuminated intertribal cultural elements fundamental to an adaptation effort. *Prevention Science 15*(4) 547-556. DOI: 10.1007/s11121-012-0361-7.

Lee, J., Kang, G., Li, Y., Yang, D., Zhang, P., Pang, B., & Yu, Z. (2018). Disparity of nitrate and nitrite in vivo in cancer villages as compared to other areas in Huai River Basin, China. *Science of the Total Environment 612*(2018) 966-974.

Li, S.G., Xu, S.Z., Niu, Q., Ding, Y.S., Pang, L.J., Ma, R.L.,…&Li, F. (2016). Lutein alleviates arsenic-induced reproductive toxicity in male mice via Nrf2 signaling. *Human & Experimental Toxicology 35*(5) 491-500. DOI: 10.1177/0906327115595682.

Magdo, H.S., Forman, J., Graber, N., Newman, B., Klein, K., Satlin, L.…& Landrigan, P.J. (2007). Grand rounds: Nephrotoxicity in a young child exposed to uranium from contaminated well water. *Environmental Health Perspectives 115*(8). 1237-1241.

Markstrom, C.A., & Charley, P.H. (2003). Psychological effects of technological/human-caused environmental disasters: Examination of the Navajo and uranium. *American Indian and Alaska Native Mental Health Research 11*(1) 19-45.

Masters, K. (2015). *Nursing theories: A framework for professional practice.* Burlington, MA: Jones & Bartlett.

McFarland, M. (2006). Culture care theory of diversity and universality. In A. Marriner-Tomey, & M.R. Alligood (Eds.). *Nursing Theorists and their Work* (6th ed). St. Louis: Mosby.

McFarland, M.R., & Wehbe-Alamah, H.B. (2019). Leininger's theory of culture care diversity and universality: An overview with a historical retrospective and a view toward the future. *Journal of Transcultural Nursing 30*(6) 540-557. DOI: 10.1177/1043659619867134.

McFarland, M.M., & Eipperle, M.K. (2008). Culture care theory: A proposed practice theory guide for nurse practitioners in primary care settings. *Contemporary Nurse: A Journal for the Australian Nursing Profession 28*(1-2) 48-63.

Mitchell, F.M. (2018). Engaging in Indigenous CBPR within academia: A critical narrative. *Journal of Women and Social Work 33*(3) 379-394. DOI: 10.1177/0886109918762570.

Murray, M.P., & Sharmin, R. (2015). Groundwater arsenic and education attainment in Bangladesh. *Journal of Health, Population, and Nutrition 33*(20) 1-10.

N.A. (2016). Two decades of enhancing children's environmental health protection at the U.S. Environmental Protection Agency. *Environmental Health Perspectives 124*(12) A214-A218.

N.A. (2019). Arsenic in drinking water may increase CVD risk. *Today's Dietitian 21*(6) 61-61.

National Environmental Health Association (2020). Definitions of environmental health. Retrieved on January 3, 2020 from https://www.neha.org/about-neha/definitions-environmental-health.

Naylor, E., Humphrey, C., Easter, L, & Iverson, G. (2018). Evaluation of nitrate concentrations and potential sources of nitrate in private water supply wells in North Carolina. *Journal of Environmental Health 80*(9) 16-23.

Nelson, J. (2006). Madeleine Leininger's culture care theory: The theory of culture care diversity and universality. *International Journal for Human Caring 10*(4) 50-54.

Nicole, W. (2018). Advocates for children's health: Working together to reduce harmful environmental exposures. *Environmental Health Perspectives 126*(1) 1-7.

NICWA: For Families & Service Providers (2019). Retrieved on December 4, 2019 from https://www.nicwa.org/families-service-providers/.

Normandin, L., Passinet, M., & Zayed J. (2014). Manganese neurotoxicity: Behavioral, pathological, and chemical effects following various routes of exposure. *Reviews on Environmental Health 17*(3) 189-218.

Osorio-Yanez, C., Aylllon-Vergara, J.C., Arreola-Mendoza, L., Aguilar-Madrid, G., Hernández-Castellanos, E., Sanchez-Peña, L.C., & Del Razo, L.M. (2015). Blood pressure, left ventricular geometry, and systolic function in children exposed to inorganic arsenic. *Environmental Health Perspectives 123*(6) 629-635.

Pain, R., Whitman, G., & Milledge, D. (2017). Participatory action research toolkit: An introduction to using PAR as an approach to learning, research, and action. Retrieved on December 21, 2019 from communitylearningpartnership.org/wp-content/uploads/2017/01/PARtoolkit.pdf.

Parvez, F., Wasserman, G.A., Factor-Litvak, P., Liu, X., Slavkovich, V., Siddiquie, A.B.,…& Graziano, J.H. (2011). Arsenic exposure and motor function among children in Bangladesh. *Environmental Health Perspectives 119*(11) 1665-1670.

Provider: What is a provider? (2020). Retrieved on January 8, 2020 from https://www.healthinsurance.org/glossary/provider/.

Rahman, S.M., Kippler, M., Tofail, F., Bölte, S., Hamadani, J.D., & Vahter, M. (2017). Manganese in drinking water and cognitive abilities and behavior at 10 years of age: A prospective cohort study. *Environmental Health Perspectives 125*(5) 1-8.

Rizvi, I., Garg, R.K., Malhotra, S., Kumar, N., & Uniyal, R. (2017). Manganese, manganism, and other neurodegenerative diseases: Is it a cause of concern? *Neurology India 65*(6) 1248-1251. DOI: 10.4103/0028-3886.217970.

Simonds, V.W., Kim, F.L., LaVeaux, D., Pickett, V., Milakovich, J., & Cummins, J. (2019). Guardians of the living water: Using a health literacy framework to evaluate a child as change agent intervention. *Health Education & Behavior 46*(2) 349-359. DOI: 10.1177/1090198118798676.

Smylie, J., Kaplan-Myrth, N., McShane, K., Metis Nation of Ontario, Pikwakanagan First Nation, & Tungasuvvingat Inuit Family Resource Centre (2009). Indigenous knowledge translation: Baseline findings in a qualitative study of the pathways of health knowledge in three indigenous communities in Canada. *Health Promotion Practice 10*(3) 436-446.

Tobiason, J.E., Bazilio, A., Goodwill, J., Mai, X., & Nguyen, C. (2016). Manganese removal from drinking water sources. *Current Pollution Reports 2*(3) 168-177. DOI: 10.1007/s40726-016-0036-2.

Traditions & Culture (N.D.). Retrieved on October 27, 2018 from https://indianyouth.org/american-indian-life/traditions-culture.

Van Dyke, E.R., Blaksher, E., Echo-Hawk, A.L., Bassett, D., Harris, R.M., & Buchwald, D.S. (2016). Health disparities research among small tribal populations: Describing appropriate criteria for aggregating tribal health data. *American Journal of Epidemiology 184* (1) 1-6. doi: 10.1093/aje/kwv334.

Ward, M.H., deKok, T.M., Levallois, P., Brender, J., Gulis, G., Nolan, B.T., & vanDerslice, J., (2005). Workgroup report: Drinking-water nitrate and health – recent findings and research needs. *Environmental Health Perspectives 113*(11) 1607-1614.

Wasserman, G.A., Liu, X., Parvez, F., Ahsan, H., Factor-Litvak, P., Kline, J.,…& Graziano, J.H. (2007). Water arsenic exposure and intellectual function in 6-year-old children in Araihazar, Bangladesh. *Environmental Health Perspectives 115*(2) 285-289.

Wasserman, G.A., Liu, X., Parvez, F., Factor-Litvak, P., Kline, J., Siddique, A.B.,…& Graziano, J.H. (2016). Child intelligence reductions in water arsenic and manganese: A two-year follow-up study in Bangladesh. *Environmental Health Perspectives124*(7) 1114-1120.

Weidemann, D.K., Weaver, V., Fadrowski, J.J. (2016). Toxic environmental exposures and kidney health in children. *Pediatric Nephrology 31*(11) 2043-2054. DOI: 10.1007/s00467-015-3222-3.

Woolf, A.D., Sibrizzi, C., & Kirkland, K. (2016). Pediatric environmental health specialty units: An analysis of operations. *Academic Pediatrics 16*(1) 25-33.

Youssef, O., Mergler, D., Barbeau, B., Bellinger, D., Bouffard, T., Brodeur, M.,…Bouchard, M.F. (2014). Neurobehavioral function in school-age children exposed to manganese in drinking water. *Environmental Health Perspectives 122*(12) 1343-1350.

Zhang, Z., Cui, T., & Kong, X. (2019). High prevalence of chronic kidney disease among patients with diabetic foot: A cross-sectional study at a tertiary hospital in China. *Nephrology 25*(2) 150-155. DOI: 10.1111/nep.13596.

APPENDICES

APPENDIX A

PRE-AND POST- ASSESSMENTS OF KNOWLEDGE ABOUT COMMON CONTAMINANTS AND KNOWLEDGE GAINED

Pre-and Post- Assessments of Knowledge about Common Contaminants and Knowledge Gained

Q7 and Q14

How familiar are you with the more common hazardous contaminants found in well water throughout the Big Horn County specifically uranium, manganese, arsenic, and nitrate?

	Not at all familiar	Somewhat familiar	Very Familiar
Uranium			
Manganese			
Nitrate			
Arsenic			

Q8 and Q15

How comfortable are you talking to patients about the hazardous contaminants found in well water throughout Big Horn County and the health effects they have on children and people of all ages?

- Extremely comfortable
- Somewhat comfortable
- Neither comfortable nor uncomfortable

Q9 and Q16

How comfortable are you engaging patients in identifying solutions to common hazardous contaminants found in well water throughout Big Horn County?

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

Q10 and Q17

How likely are you to educate patients about these contaminants and their health risks?

- Not at all likely
- Somewhat likely
- Extremely likely

Q11 and Q18

How important do you find the topic of well water contamination and the health effects they pose to all ages is to emphasize during patient visits

- Not at all important
- Somewhat important
- Extremely important

Q12 and Q19

Which of the following would make it more feasible for you to discuss well water contamination and health effects with patients?

- More knowledge regarding common hazardous contaminants and their health effects
- More time during visits
- More access to resources to provide to patients
- I do not think there are any feasible options
- Other (please explain)

APPENDIX B

DEMOGRAPHIC INFORMATION

Demographic Information

Your participation in this survey is completely voluntary. You may stop at any time. You do not need to answer any questions you do not wish to answer.

- I understand

Q1

Which type of healthcare provider are you?

- MD
- DO
- NP
- PA
- RN
- LPN
- Public Health Worker
- Other

Q2

What is your age?

Q3

What is your gender?

- Male
- Female

- Other

Q4

How many years have you been in practice?

Q5

How many years have you been practicing in Big Horn County?

Q6

Are you a member or a direct descendant of a Native American Tribe?

- Yes (If yes, please write which Tribe below)
- No

APPENDIX C

PATIENT EDUCATION

ARE THERE TOXINS IN YOUR WATER?

You might have **Manganese** in your water if:

- Your water is brown, rust-colored, or black-ish or has a bad smell
- If your child has any of the following symptoms, you should get your water tested:
    - Poor memory, poor attention, delayed motor skills, very slow movements or stiff body, difficulty speaking, or walks with a limp

You might have **Nitrate** in your water if:

- You live near livestock or use industrial fertilizer
- If your child has any of the following symptoms, you should get your water tested:
    - Infant – bluish skin – Medical Emergency – bring to nearest ER
    - Irritability, fast heart rate, headache, significant changes in behavior

You might have **Arsenic** in your water if:

- You live near the railroad tracks
- You live near someone who uses industrial pesticides
- If your child has any of the following symptoms, you should get your water tested:
    - Memory loss or poor memory, difficulty understanding what you're saying, abnormal skin

You might also have **Uranium** in your water.

- It is colorless, odorless, and tasteless. There are no symptoms of toxicity, but it causes cancer and severe kidney damage.

How to Get your Water Tested

If you are a tribal member or descendant, contact:

- **John Doyle or Christine Martin: 406-638-3155**
  doylej@lbhc.edu martinc@lbhc.edu

If you are not a tribal member or don't live on the reservation, contact:

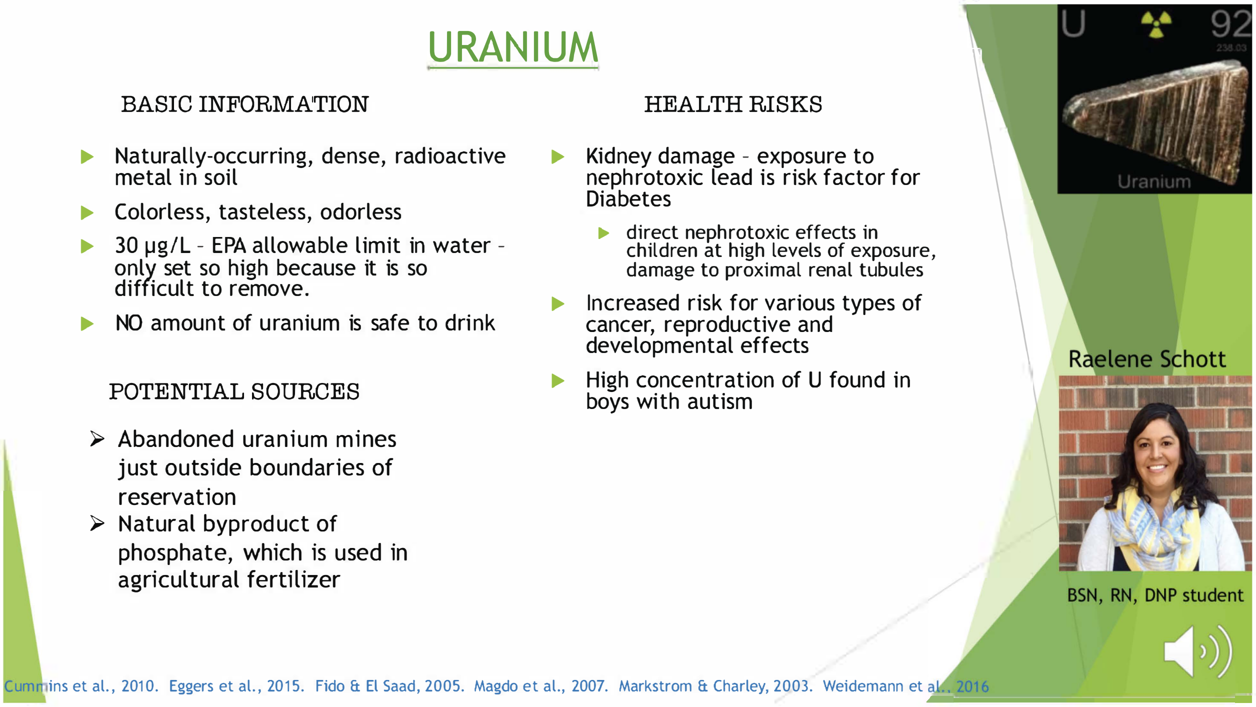
- **MSU Extension Office in Hardin – 406-665-9770**

APPENDIX D

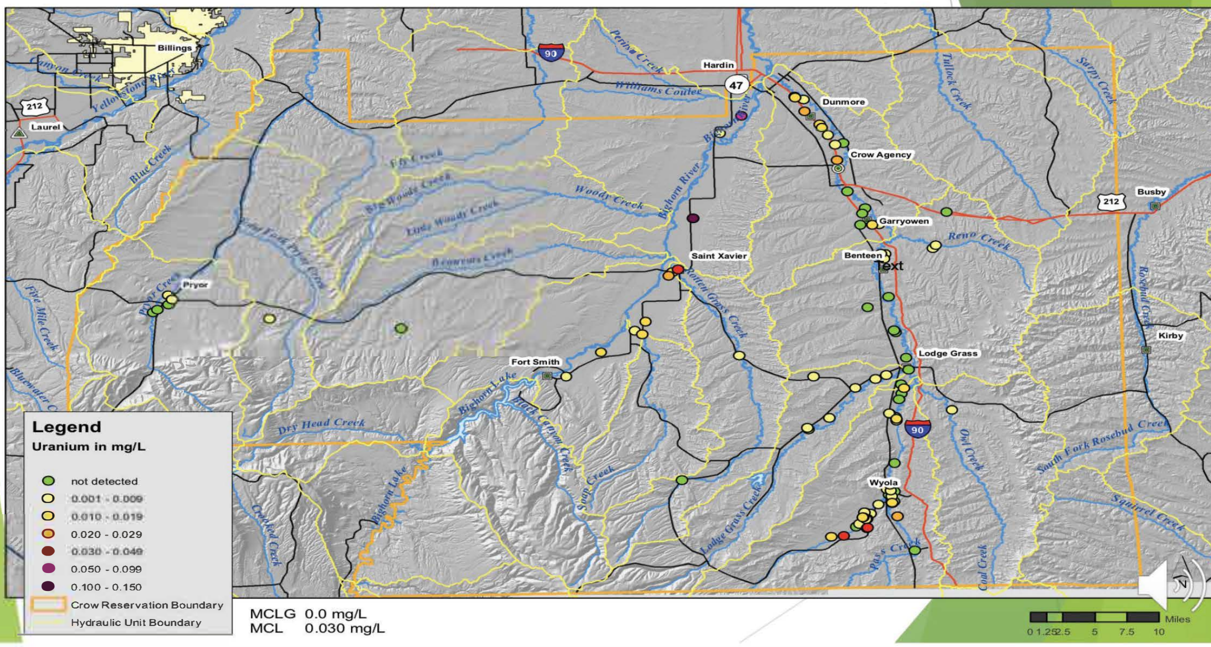
LINK TO POWERPOINT PRESENTATION WITH VOICEOVER CREATED AND DISSEMINATED TO HCPS BY DNP STUDENT AND COPY OF POWERPOINT SLIDES

Link to PowerPoint Presentation with voiceover created and disseminated to HCPs by DNP student and Copy of PowerPoint slides:

https://youtu.be/ITr-QUmgxsQ



Uranium in Well Water, Crow Reservation, Montana



MANGANESE

BASIC INFORMATION

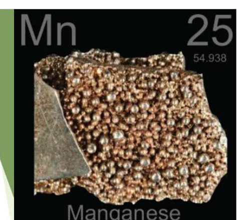
- Similar in appearance to IRON in water
  - Brown, rust-colored, or black-ish water, possible foul smell
  - Stains sinks, drains, and/or hands

POTENTIAL SOURCES

- Naturally-occurring in soil
- Often found in conjunction with iron

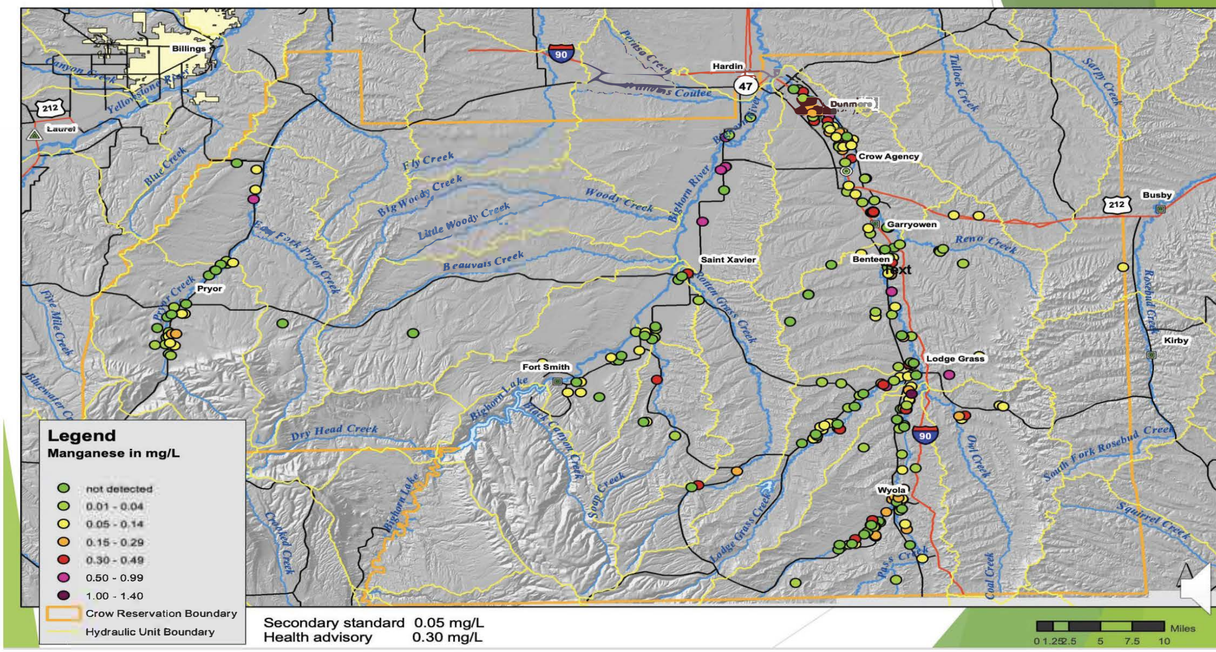
HEALTH RISKS

- Fetal exposure – Mn passes through placenta
- Cognitive delays in children – higher levels of Mn associated with poorer performance of memory, attention, motor function, lower intelligence scores
- Long-term attention dysfunction comparable to that of children with ADHD
- "Manganism" – extrapyramidal dysfunction – clinical features similar to parkinsonian illness, characterized by bradykinesia, rigidity, gait disturbance, dysarthria, masked faces



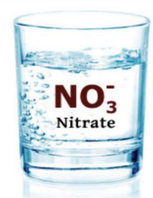
Beaudin, Strupp, Strawdermann, & Smith. 2017. Haynes et al., 2015. Rizvi, Garg, Malhotra, Kumar, & Uniyal, 2017

Manganese in Well Water, Crow Reservation, Montana



Secondary standard 0.05 mg/L
Health advisory 0.30 mg/L

NITRATE



BASIC INFORMATION

- Most common groundwater contaminant in the world
- Colorless, odorless, tasteless

POTENTIAL SOURCES

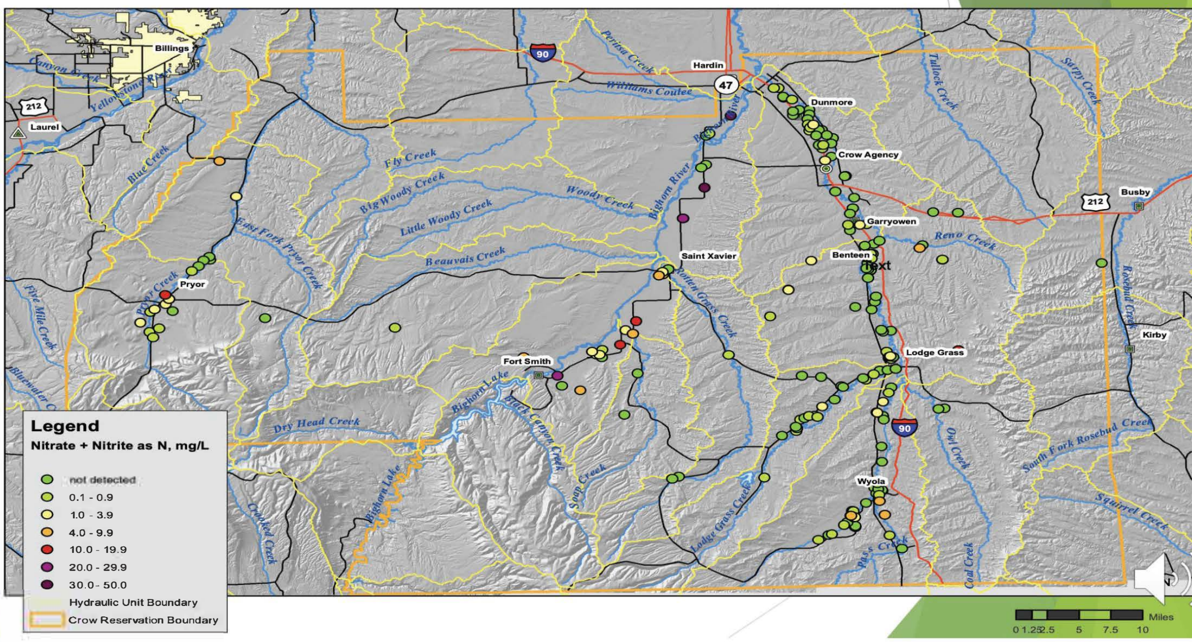
- *Organic*- livestock manure, septic leakage, wastewater treatment plant discharge
- *Inorganic* - Potassium Nitrate and Ammonium Nitrate – fertilizer

HEALTH RISKS

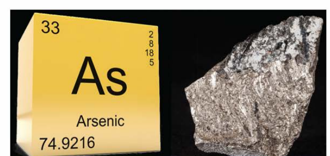
- "Blue Baby Syndrome" - MEDICAL EMERGENCY
  - Methemoglobinemia -Immature GI system unable to break down nitrate effectively, converts nitrate to nitrite → Nitrite oxidizes hemoglobin, thereby reducing its oxygen-carrying capacity
- Older children may have symptoms of irritability, tachypnea, altered mental status, headache
- Prolonged exposure increases risk factors for specific types of cancer – colon, Non-Hodgkin's lymphoma, prostate, bladder, ovarian

Chalupka, 2005. Lee et al., 2018. Ward et al., 2005

Nitrate in Well Water, Crow Reservation, Montana



ARSENIC



BASIC INFORMATION

- Element found in Earth's crust
- Colorless, odorless, tasteless

POTENTIAL SOURCES

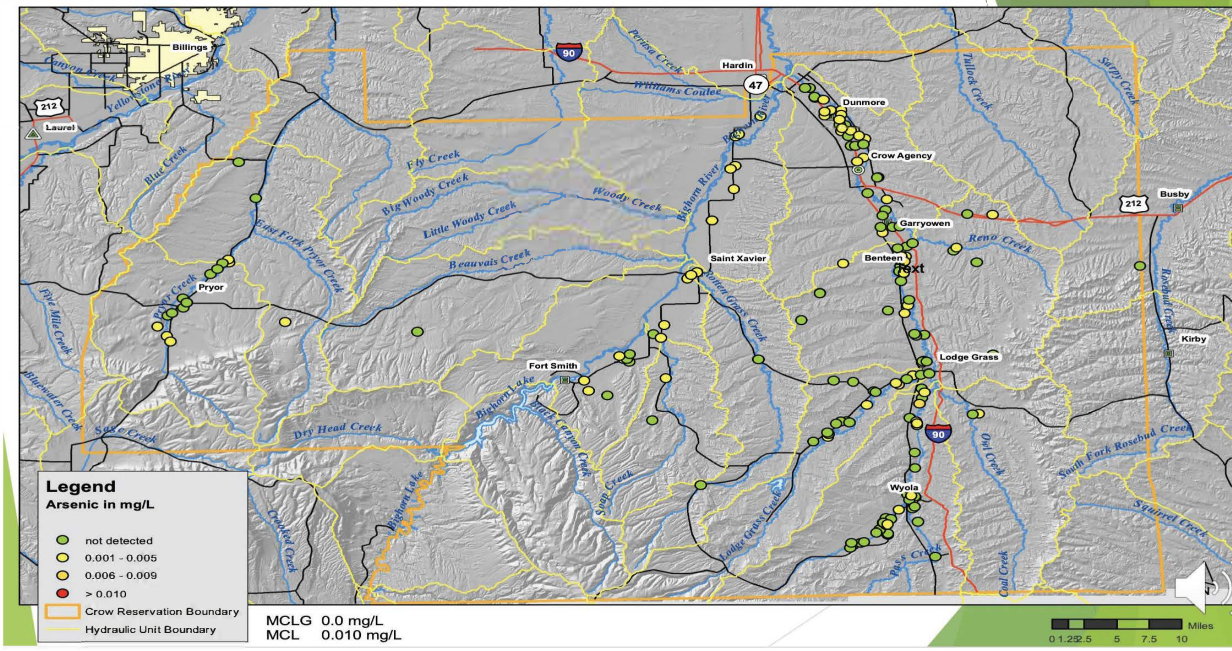
- Creosote containing As has been and is still being used as a preservative in railroad ties on the reservation
- Used in agriculture as a pesticide/insecticide

HEALTH RISKS

- Impacts cognitive development
  - reflected in lower intelligence scores, long-term memory deficits, delayed linguistic abstraction
- Decreased verbal comprehension, attention, intelligence
- Carcinogenic – associated with skin, lung, bladder cancer
- Cardiovascular disease, non-malignant respiratory disease, skin lesions

Murray & Sharmin, 2015. Parvez et al., 2011. Radke, Dembska, Pazikowska-Sapota, & Galer-Tatarowicz, 2019. Wasserman et al., 2016

Arsenic in Well Water, Crow Reservation, Montana



NOW WHAT?

- Non-Tribal Members – Well Educated Program –
  - MSU extension office in Hardin – 317 N. Custer Ave
  - OFFICE: (406) 665-9770
- For Tribal Members – Free water testing through Crow Water Quality Program- contact John Doyle or Christine Martin
  - OFFICE: (406) 638-3155.
  - John Doyle: doylej@lbhc.edu.
  - Christine Martin: martinc@lbhc.edu
  - Five Gallon water cooler provided for people who have contaminated well water

Questions or concerns?
My email address: raelene.schott@student.montana.edu

REFERENCES

- Beaudin, S.A., Strupp, B.J., Strawderman, M., & Smith, D.R. (2017). Early postnatal manganese exposure causes lasting impairment of selective and focused attention and arousal regulation in adult rats. *Environmental Health Perspectives 125*(2) 230-237
- Chalapuka, S. (2005). Tainted water on tap: What to tell patients about preventing illness from drinking water. *American Journal of Nursing 105*(11) 40-52
- Cummins, C., Doyle, J., Kindness, L., Lefthand, M., Bear Don't Walk, J.D., Bends, A.L., ...& Eggers, M.A. (2010). Community-based participatory research in Indian country: Improving health through water quality research and awareness. *Family and Community Health 33*(3) 166-174 DOI: 10.1097/FCH.0b013e3181e4bcd8
- Eggers, M.J., Moore-Nall, A.L., Doyle, J.T., Lefthand M.J., Young, S.J., Bends, A.L., ...& Camper, A. (2015). Potential health risks from uranium in home well water: An investigation by the Apsaalooke (Crow) tribal research group. *Geosciences 5*, 67-94. doi:10.3390/geosciences5010067
- Haynes, E.N., Sucharew, H., Kuchnell, P., Alden, J., Barnas, M., Wright, R.O.,... Dietrich, K.N. (2015). *Environmental Health Perspectives 123*(10) 1066-1071
- Fido, A., & Al-Saad, S. (2005). Toxic trace elements in the hair of children with autism. *Autism* 9(3) 290-298. DOI: 10.1177/1362361305053255
- Lee, J., Kang, G., Li, Y., Yang, D., Zhang, P., Pang, B., & Yu, Z. (2018). Disparity of nitrate and nitrite in vivo in cancer villages as compared to other areas in Huai River Basin, China. *Science of the Total Environment 612*(2018) 966-974
- Magdo, H.S., Forman, J., Graber, N., Newman, B., Klein, K., Satlin, L....& Landrigan, P.J. (2007). Grand rounds: Nephrotoxicity in a young child exposed to uranium from contaminated well water. *Environmental Health Perspectives 115*(8). 1237-1241
- Markstrom, C.A., & Charley, P.H. (2003). Psychological effects of technological/human-caused environmental disasters: Examination of the Navajo and uranium. *American Indian and Alaska Native Mental Health Research 11*(1) 19-45
- Murray, M.P., & Sharmin, R. (2015). Groundwater arsenic and education attainment in Bangladesh. *Journal of Health, Population, and Nutrition 33*(20) 1-10
- Parvez, F., Wasserman, G.A., Factor-Litvak, P., Liu, X., Slavkovich, V., Siddique, A.B.,...& Graziano, J.H. (2011). Arsenic exposure and motor function among children in Bangladesh. *Environmental Health Perspectives 119*(11) 1665-1670 Radke, B., Dembska, G., Pazikowska-Sapota, G. & Galer-Tatarowicz, K. (2019). Many faces of arsenic. *International Journal of Oceanography and Hydrobiology 48*(1) 90-104. DOI: 10.1515/ohs-2019-0010
- Rizvi, I., Garg, R.K., Malhotra, S., Kumar, N., & Uniyal, R. (2017). Manganese, manganism, and other neurodegenerative diseases: Is it a cause of concern? *Neurology India 65*(6) 1248-1251 DOI: 10.4103/0028-3886.217970
- Ward, M.H., deKok, T.M., Levallois, P., Brender, J., Gulis, G., Nolan, B.T., & vanDerslice, J., (2005). Workgroup report: Drinking-water nitrate and health - recent findings and research needs. *Environmental Health Perspectives 113*(11) 1607-1614.
- Wasserman, G.A., Liu, X., Parvez, F., Factor-Litvak, P., Kline, J., Siddique, A.B.,...& Graziano, J.H. (2016). Child intelligence reductions in water arsenic and manganese: A two-year follow-up study in Bangladesh. *Environmental Health Perspectives 124*(7) 1114-1120
- Weidemann, D.K., Weaver, V., Fadrowski, J.J. (2016). Toxic environmental exposures and kidney health in children. *Pediatric Nephrology 31*(11) 2043-2054. DOI: 10.1007/s00467-015-3222-3

APPENDIX E

INITIAL EMAIL WITH DR. MARK QUINN REGARDING IRB APPLICATION

Initial email with Dr. Mark Quinn regarding IRB application

Quinn, Mark

Thu 2/20/2020 4:35 PM

To: Schott, Raelene

Hi Raelene, This would fit with expedited or below, so the expedited application would be fine. Is any of this work to be done on a Reservation? If so, then you will need Tribal IRB approval as well. Thanks, mark

From: Schott, Raelene <raelene.schott@student.montana.edu>

Sent: Thursday, February 20, 2020 3:54 PM

To: Quinn, Mark <mquinn@montana.edu>

Cc: Benavides-Vaello, Sandra <s.benavidesvaello@montana.edu>

Subject: DNP scholarly project review

Good afternoon Dr. Quinn,

My name is Raelene Schott, and I'm a student in the Doctor of Nursing Practice program here at Montana State University. Dr. Benavides-Vaello is the chair of my committee. I am emailing you about my DNP scholarly project and the possibility of applying for an expedited application for IRB approval. I am conducting an educational project targeting healthcare providers with an emphasis on health promotion among Native Americans living on and near the

Crow Indian reservation, in the Bighorn River Valley. The tentative title for my project is *Improving Well Water Contaminant Awareness in Bighorn County through Community Engagement.*

My scholarly project involves educating healthcare providers in Hardin, MT and Crow Agency, MT about the heavy metal contaminants (manganese, arsenic, nitrate, and uranium) that are found in well water in the Bighorn River Valley, and the health effects these contaminants have on children. There will be a pre-test and post-test assessment about knowledge and confidence gained by healthcare providers talking to their patients about these contaminants. Additionally, I will provide the healthcare providers with educational materials to send home with patients about the health effects their well water has on children. An action committee comprised of key members of the Crow tribe and community members in Crow Agency and Hardin will help me create culturally appropriate materials for Native American patients.

I am wondering, based on my project's focus on healthcare providers, if you think it will be necessary for me to fill out an application for full committee review, or if my project will meet the criteria for the expedited application.

Thank you for your attention to this matter. I look forward to hearing from you.

Sincerely,

Raelene Schott

APPENDIX F

IRB APPROVAL LETTER

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA [illegible]165

2155 Analysis Drive
c/o Microbiology & Immunology
Montana State University
Bozeman, MT 59718
Telephone: 406-994-4706
FAX: 406-994-4303
E-mail: cheryl@montana.edu

Chair: Mark Quinn
406-994-4707
mquinn@montana.edu

Administrator:
Cheryl Johnson
406-994-4706
cherylj@montana.edu

MEMORANDUM

TO: Raelene Schott and Sandra Benavides-Vaello

FROM: Mark Quinn *Mark Quinn mlq*
Chair, Institutional Review Board for the Protection of Human Subjects

DATE: October 13, 2020

RE: *"Improving Well Water Contaminant Awareness in Big Horn County through Community Engagement" [RS101320-EX]*

The above research, described in your submission of October 13, 2020, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

____ (b)(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects, and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 18 111(a)(7).

____ (b)(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b)(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b)(5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

____ (b)(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it; if you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX G

EMAIL SENT TO HEALTHCARE PROVIDERS IN HARDIN

Good morning,

My name is Raelene Schott. I am a student in the Doctor of Nursing program at MSU. I'm conducting my scholarly project on the health effects of common well water contaminants found in Big Horn County, mostly in the Bighorn and Little Bighorn River Valleys. My goal is to provide education to healthcare providers who have patients living in the area, specifically on the Crow Reservation. I am set to graduate in November upon the successful completion of this project.

The contaminants this project focuses on are uranium, manganese, nitrate, and arsenic. If you would take 15 minutes to answer some survey questions and watch a short presentation, that would help me greatly with my goal of providing education. I would like to have as many surveys as possible completed by October 28th. The link to the survey is below:

https://corexms8jk67ybykz9td.sjc1.qualtrics.com/jfe/form/SV_daFQikVvQ1NybCR

Thank you for taking the time to consider helping me with this project. All surveys are anonymous, and you are not obligated to participate. I look forward to seeing your surveys. Thanks again.

Sincerely,

Raelene Schott