

December 5, 2014

Ms. Deborah Frederick
301 N. Kansas, Box 275
Lakin, KS 67860

Dear Ms. Frederick,

This letter summarizes the results of an investigation by the Kansas Department of Health and Environment (KDHE) in response to your concerns regarding high concentrations of uranium previously found in the public drinking water supply in Kearny County, Kansas and the number of breast, brain, and pancreatic cancers, as well as the number of birth defects, diagnosed in the county within the past 5 to 8 years. This investigation was requested by Dr. Robert Moser, Secretary of KDHE.

Background and Initial Assessment

On May 12, 2014, you discussed with Dr. Farah Ahmed your concerns about a potential increase in birth defects and several cancers in Kearny County including brain, female breast, and pancreatic cancers. You specifically mentioned a number of cancer cases diagnosed within the last 5 to 8 years and you were also concerned about birth defects and fertility issues in the county in general.

In response to these concerns, KDHE developed an investigation design that entailed: 1) gathering information on uranium in the public drinking water systems in the county, 2) determining if similar health concerns had previously been reported to KDHE, 3) analysis of pertinent cancer incidence rates in Kearny County, and 4) analysis of birth defects rates in Kearny County.

History of the Public Water Systems in Kearny County

At the time of this investigation, KDHE Bureau of Water (KDHE BOW) records indicated that there were two active public water systems in Kearny County: one in Lakin and one in Deerfield. Uranium was found to be above the recommended level in the Lakin water system only. Please note that uranium was not specifically regulated in drinking water until December 8, 2003. The Maximum Contaminant Level (MCL) for uranium is 30 µg/L. Lakin has had uranium levels between 9.6 and 62 µg/L with values typically in the 30-45 µg/L range since 2008.

In order to address this issue, the city undertook a project to construct a water treatment plant that will produce drinking water that complies with primary drinking water standards. Construction on the treatment plant started the beginning of May 2012. Records indicate that the public water system in Lakin currently serves 994 customers, including 96 commercial users, for a total population of 2,275. In 2013, the county population was estimated at 3,923 persons.

Cancer Incidence Analysis

Uranium is a naturally occurring radioactive mineral that is present in certain types of rock and soil. It can be found in ground water as a result of leaching from natural deposits or from human activities such as the use of phosphate fertilizers and nuclear power production¹. According to the United States Environmental Protection Agency (USEPA), most parts of the U.S. have very low levels of uranium. However, some parts of the mid-West have significantly higher

levels than the national averageⁱⁱ. Studies have shown that exposure to uranium and its daughter products may result in toxic effects to the kidney in the short term, and in higher risk of cancers in the long termⁱⁱ.

Within the past ten years, there have been no reports to the KDHE of suspect cancer clusters for Kearny County. However, between 1998 and 2002, concerns about rare diseases and environmental exposures, including contaminants in drinking water, lead to a comprehensive environmental study of neighboring Scott County. The report did not find an excess of either kidney or pancreatic cancerⁱⁱⁱ.

An incidence rate is the rate of occurrence of new cases diagnosed within a specific time period. Secondary cancer cases are not counted in the incidence rate. For example, a brain cancer that is the result of a breast cancer spreading to the brain will not be counted as an incident case of brain cancer. Age adjustment is a statistical process applied to rates of disease, death, injuries, or other health outcomes that allows communities with different age structures to be compared. In addition to the age-adjusted incidence rates, 95% confidence intervals (CI) are provided for the rates when appropriate. A confidence interval is the range around a measurement that conveys how precise the measurement is. If the confidence intervals for the rates do not overlap, the rates are significantly different. If the confidence intervals do overlap, we cannot determine whether or not the rates are significantly different. Best practices around reporting incidence rates of cancer and confidence intervals recommend that rates and related confidence intervals not be reported if the population of the specific category is less than 20,000 or the case count is less than 16^{iv}. This is necessary to protect the privacy of individuals and to avoid confusion often caused by the difficulty of interpreting unstable statistics.

Age-adjusted incidence rates are presented here for Kearny County, the 17 contiguous counties in southwest Kansas (Region 2), and Kansas. Region 2 includes the following 17 counties: Clark, Finney, Ford, Grant, Gray, Greeley, Hamilton, Haskell, Kearny, Lane, Meade, Morton, Scott, Seward, Stanton, Stevens, and Wichita. Incidence rates for Iowa are also presented for comparison because of its demographic and geographic similarity to Kansas. Iowa is a participant in the Surveillance, Epidemiology, and End Results (SEER) program.

Between 2001 and 2010, 15 female residents of Kearny County were diagnosed with primary invasive breast cancer (Table 1). The rate of female breast cancer for Region 2 was 106.6 cases per 100,000 population (95% CI: 99.0-114.7/100,000 population). It was statistically significantly lower than the rates for Kansas and Iowa during the same period.

Between 2001 and 2010, there was 1 primary brain cancer diagnosed in a Kearny County resident (Table 2). Seventy-seven new cases of brain cancer were diagnosed in Region 2 during the same period. The age-adjusted incidence rate for Region 2 was 5.7 cases per 100,000 population (95% CI: 4.5-7.0). The brain cancer incidence rate for Region 2 was similar to the rates for Kansas and Iowa.

There were 6 cases of pancreatic cancer diagnosed in Kearny County residents between 2001 and 2010 (Table 3). During the same period, Region 2 had 124 new cases for an age-adjusted incidence rate of 9.6 cases per 100,000 population (95% CI: 7.9-11.3/100,000 population). The incidence rate of pancreatic cancer for Region 2 was similar to the rates for Kansas and Iowa.

There were 4 cases of kidney cancer diagnosed in Kearny County residents from 2001 to 2010 (Table 4). There were 151 cases diagnosed within Region 2 for an age-adjusted incidence rate of 11.7 cases per 100,000 population (95% CI: 9.9-13.6/100,000 population). The incidence rate of kidney cancer for Region 2 was statistically significantly lower than the rates for Kansas and Iowa.

A Standardized Incidence Ratio (SIR) was used to determine if the observed number of cancer cases in Kearny County for each cancer site of interest was higher or lower than expected, given the age distribution of the county population. An SIR is important for assessing whether there was an excess of diagnosed cases in younger individuals. A 95% confidence interval around the SIR is calculated to determine how likely it is that the result obtained is due to chance. If the confidence interval includes 1.0, then the difference between the observed and expected number of cases is likely to

have occurred by chance. For this analysis, the most recent incidence rates from the Iowa Surveillance, Epidemiology and End Results (SEER) Program were used to determine the expected number of cases by age group.

The observed number of cases of female breast cancer in Kearny County was 42% less than the expected number of cases (SIR: 0.58, 95% CI: 0.32-0.84, 15 observed cases versus 26.0 expected cases). The observed number of cases did not significantly differ from the expected number in younger age groups.

The observed number of cases of pancreatic cancer in Kearny County was 24% greater than the expected number of cases (SIR: 1.24, 95% CI: 0.68-1.79, 6 observed cases versus 4.9 expected cases). This increase was not statistically significant. The observed number of cases did not significantly differ from the expected number in younger age groups.

The observed number of cases of kidney cancer in Kearny County was 36% less than the expected number of cases (SIR: 0.64, 95% CI: 0.35-0.93, 4 observed cases versus 6.2 expected cases). The observed number of cases did not significantly differ from the expected number in younger age groups.

The observed number of cases of brain cancer in Kearny County was 63% less than the expected number of cases (SIR: 0.37, 95% CI: 0.20-0.54, 1 observed case versus 2.7 expected cases). The observed number of cases did not significantly differ from the expected number in younger age groups.

Impressions

The analysis of specific cancer incidence rates for Kearny County used data available through the Kansas Cancer Registry. Although the registry data is a very reliable source for capturing cancer cases throughout the state, the data available on cancer risk factors is sparse.

Although some studies have shown that short term exposure to high doses of uranium may be associated with an increased risk of kidney damage, exposure to soluble uranium in drinking water has not been shown to increase the risk of developing cancer.^v In addition, exposure to uranium in drinking water is most likely to cause health problems due to its chemical properties than to its radioactive properties.^{vi} According to the Agency for Toxic Substances and Disease Registry (ATSDR), exposure to some chemicals can cause cancer in humans. However, most of these have been from high-level industrial exposures.^{vii} Cases where the occurrence of cancer has been linked to environmental contaminants in a community setting have only rarely been validated by scientific investigation.^{viii} This investigation did not find any indication that Kearny County residents were at a higher risk of developing cancers of the brain, pancreas, female breast, or kidney as indicated by the standardized incidence ratios (the ratio of observed versus expected cases).

Birth Defects and Fertility

The developing human fetus is very susceptible to environmental exposures. However, there is currently no evidence that exposure to uranium in drinking water is associated with birth defects. In February 2013, according to the statement released by the Agency for Toxic Substances and Disease Registry, "No scientifically strong human study that has shown birth defects due to uranium exposure has been identified."^{ix} Since radon is a gas produced from the radioactive decay of uranium, radon in drinking water was considered. The National Academy of Sciences report, released September 15, 1998, states that "No evidence suggests that radon causes any reproductive problems or birth defects, regardless of whether it is ingested or inhaled."^x

Hydrocephalus was named as a specific birth defect of concern during the May 12th telephone assessment. There was one case of hydrocephalus reported among Kearny County residents during the 2003-2012 period. Most of the time, we do not know why some babies are born with hydrocephalus.^x There is no indication that hydrocephalus is caused by uranium exposure in drinking water.

Uranium has been shown to decrease fertility in some studies of rats and mice but this conclusion was not supported by other studies.^{vi} Fertility rate measures the number of births occurring per 1,000 females between the ages of 15 and 44

in a particular year. There was a statistically significant increasing trend in the fertility rate during the 2003-2012 period in Kearny County (Table 5). Annual Percent Change (APC) is one way to characterize trends in fertility rates over time. The Annual Percent Change between 2003 and 2012 for Kearny County was 2.65 and was significant (Figure 1). This indicates that the fertility rate in Kearny County is rising. These statistics do not support the observation of a decreasing fertility rate in Kearny County.

We share your concern for the health of Kearny County residents. We recognize that every case of cancer and birth defects is significant for the person affected and his or her family. Within the limits of available resources, KDHE is extensively involved in efforts to reduce the occurrence of cancer and birth defects in Kansas and improve the care for those in whom it does occur. Staff from our Bureau of Health Promotion and the Bureau of Family Health can provide resources for members in your community who want information on how they can reduce their risk of cancer and birth defects. We at KDHE are committed to monitoring, and helping improve, the health of our communities. If you have any questions about this report, please contact the Bureau of Epidemiology and Public Health Informatics at 785-296-1415. For more information about cancer prevention, please contact the Bureau of Health Promotion at 785-296-1207. For more information about birth defects, please contact the Bureau of Family Health at 785-291-3368.

Sincerely,



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Robert Moser, Secretary and State Health Officer, KDHE
Paula Clayton, Director, Bureau of Health Promotion, KDHE
Rachel Sisson, Director, Bureau of Family Health, KDHE
Tom Langer, Director, Bureau of Environmental Health, KDHE
John Mitchell, Director, Division of Environment, KDHE
Mike Tate, Director, Bureau of Water, KDHE
Sara Belfry, Director, Office of Communications, KDHE

Table 1. Incidence Rates of Female Breast Cancer, 2001-2010			
Geographical area	Number of cases	Age adjusted rate[§] (per 100,000 population)	95% confidence interval (per 100,000 population)
Kearny County	15	*	*
Region 2	738	106.6	99.0-114.7
Kansas	19,115	124.4	122.6-126.2
Iowa [†]	22,307	125.0	123.33-126.69

[§] Rates are age-adjusted to the 2000 US standard population with 18 age groups
* Rates are suppressed if the population of the specific category is less than 20,000 or case counts are fewer than 16
[†] Iowa Cancer Registry data available at <http://www.cancer-rates.info/ia/index.php>

Table 2. Incidence Rates of Brain Cancer, 2001-2010			
Geographical area	Number of cases	Age adjusted rate[§] (per 100,000 population)	95% confidence interval (per 100,000 population)
Kearny County	1	*	*
Region 2	77	5.7	4.5-7.0
Kansas	1,748	6.8	6.5-7.1
Iowa [†]	2,244	6.9	6.7-7.2

[§] Rates are age-adjusted to the 2000 US standard population with 19 age groups
* Rates are suppressed if the population of the specific category is less than 20,000 or case counts are fewer than 16
[†] Iowa Cancer Registry data available at <http://www.cancer-rates.info/ia/index.php>

Table 3. Incidence Rates of Pancreatic Cancer, 2001-2010			
Geographical area	Number of cases	Age adjusted rate[§] (per 100,000 population)	95% confidence interval (per 100,000 population)
Kearny County	6	*	*
Region 2	124	9.6	7.9-11.3
Kansas	2,841	10.4	10.0-10.8
Iowa [†]	4,097	11.7	11.2-12.0

[§] Rates are age-adjusted to the 2000 US standard population with 19 age groups
* Rates are suppressed if the population of the specific category is less than 20,000 or case counts are fewer than 16
[†] Iowa Cancer Registry data available at <http://www.cancer-rates.info/ia/index.php>

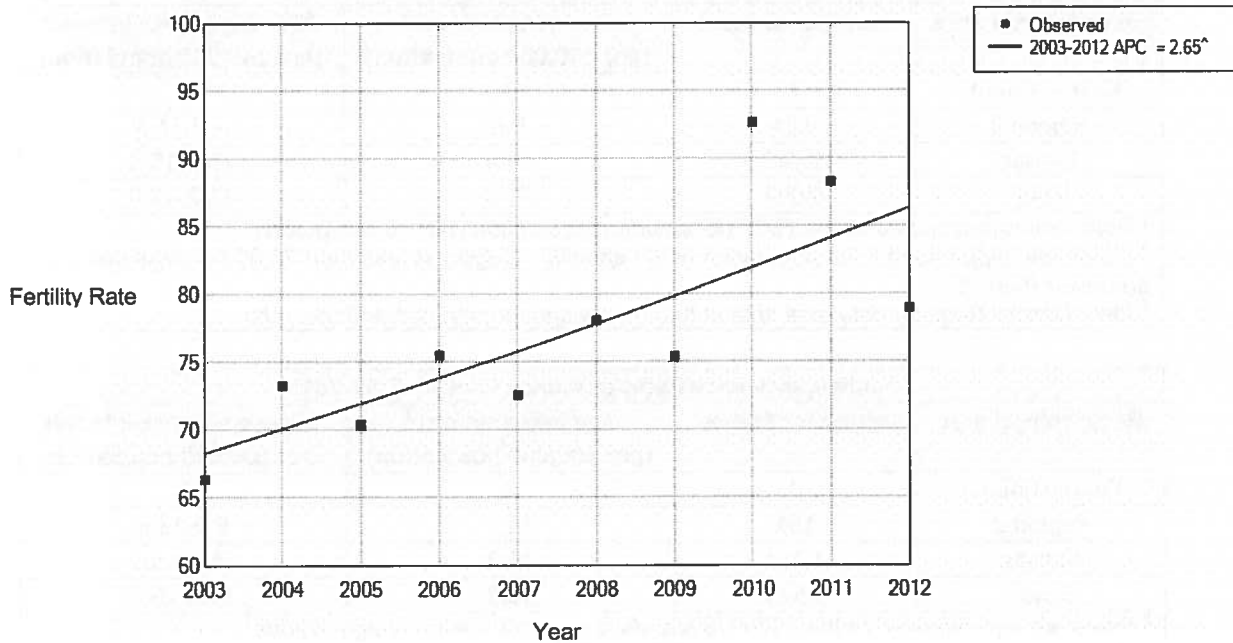
Table 4. Incidence Rates of Kidney Cancer, 2001-2010			
Geographical area	Number of cases	Age adjusted rate[§] (per 100,000 population)	95% confidence interval (per 100,000 population)
Kearny County	4	*	*
Region 2	151	11.7	9.9-13.6
Kansas	4,221	15.7	15.2-16.1
Iowa [†]	5,519	16.3	15.8-16.7

[§] Rates are age-adjusted to the 2000 US standard population with 19 age groups
* Rates are suppressed if the population of the specific category is less than 20,000 or case counts are fewer than 16
[†] Iowa Cancer Registry data available at <http://www.cancer-rates.info/ia/index.php>

Table 5. Fertility Rate [§] Per Year Kearny County, Kansas, 2003-2012			
Year	Number of births	Number of females ages 15-44 years	Fertility rate (per 1,000 females ages 15-44 years)
2003	62	934	66.4
2004	70	955	73.3
2005	65	923	70.4
2006	67	887	75.5
2007	56	771	72.6
2008	59	755	78.1
2009	58	769	75.4
2010	65	701	92.7
2011	62	702	88.3
2012	55	696	79.0

[§] Births per 1,000 female population ages 15-44
Data source: Kansas Department of Health and Environment, Bureau of Epidemiology and Public Health Informatics

Figure 1. Trend in the Fertility Rate (births per 1,000 female population ages 15-44)
Kearny County, Kansas, 2003-2012



[^] The Annual Percent Change (APC) is significantly different from zero at alpha = 0.05
Data source: Kansas Department of Health and Environment, Bureau of Epidemiology and Public Health Informatics

ⁱ U.S. Environmental Protection Agency. Uranium, October 1, 2012. Available at <http://www.epa.gov/rpdweb00/radionuclides/uranium.html#inbody>. Accessed on 7/17/2014.

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- ⁱⁱ U.S. Environmental Protection Agency. *Basic Information about the Radionuclides Rule*, March 6, 2012. Available at <http://water.epa.gov/lawsregs/rulesregs/sdwa/radionuclides/basicinformation.cfm>. Accessed on 7/17/2014.
- ⁱⁱⁱ Scarfee, J. Kansas Masons, KU researchers help relieve cancer concerns in Scott County. KU Endowment Association, May 29, 2003. Accessed on 7/18/2014 at <http://archive.news.ku.edu/2003/03N/MayNews/May29/scott.html>
- ^{iv} Centers for Disease Control and Prevention (CDC). *Technical Notes: Statistical Methods: Suppression of Rates and Counts*. United States Cancer Statistics. Available at: http://www.cdc.gov/cancer/npcr/uscs/technical_notes/stat_methods/suppression.htm and accessed on August 21, 2014.
- ^v World Health Organization (WHO). *Uranium in Drinking-Water: Background document for development of WHO Guidelines for Drinking-water Quality*, 2012. WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland.
- ^{vi} Centers for Disease Control and Prevention (CDC). *Radioisotope Brief: Uranium. Radiation Emergencies*, August 18, 2004.
- ^{vii} Agency for Toxic Substances and Disease Registry (ATSDR). *Uranium: Health Effects*. Available at: <http://www.atsdr.cdc.gov/ToxProfiles/tp150-c3.pdf> and accessed on 7/18/2014.
- ^{viii} Centers for Disease Control and Prevention (CDC). *Investigating Suspected Cancer Clusters and Responding to Community Concerns: Guidelines from CDC and the Council of State and Territorial Epidemiologists*. MMWR September 27, 2013 / 62(RR08);1-14.
- ^{viii} Agency for Toxic Substances and Disease Registry (ATSDR). *Public Health Statement for Uranium*. February 2013. <http://www.atsdr.cdc.gov/phs/phs.asp?id=438&tid=77>
- ^{ix} National Research Council. National Academy of Sciences. *Risk Assessment of Radon in Drinking Water*. September 15, 1998. <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=6287>; <http://water.epa.gov/lawsregs/rulesregs/sdwa/radon/nas.cfm>; <http://water.epa.gov/lawsregs/rulesregs/sdwa/radon/upload/Initial-EPA-Perspectives-on-NAS-Report.pdf>
- ^x National Birth Defects Prevention Network. *Hydrocephalus*. http://www.nbdpn.org/archives/2007/2007pdf/hydrocephaly_Eng.pdf

