29th and Grove, Wichita Health Study

Kansas Department of Health and Environment

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Our Vision – Healthy Kansans living in safe and sustainable environments.

Our Mission – To protect and improve the health and environment of all Kansans.

Contents

Executive Summary

The 29th and Grove site is located along the northern part of a Union Pacific Railroad rail yard south of the K-96 Highway, between Highway I-135 and Grove Street, in Wichita, Sedgwick County, Kansas. The 29th and Grove spill likely occurred in the 1990s or earlier, and was discovered by KDHE regulators in 1998. The state investigated the contamination and worked with Union Pacific to clean up and remediate the site from 2004 through 2022. A final Corrective Action Plan showing how the final cleanup from the spill would be completed was drafted and submitted for public comment in 2022.

After a request from the community, KDHE performed the enclosed health study on 2,793 addresses representing the affected area, or the "area of interest." There are many factors that may affect someone's health outcomes, including environment, lifestyle, and family medical history. The analysis presented in this report cannot determine if cancers and other health outcomes found in the community are associated with the spill itself or are influenced by these other factors. **This study can only report on whether an increase was observed, not the cause of the increase.**

Study Findings:

- The rate of **liver cancer[1] was higher** in the area of interest than in Sedgwick County or the state of Kansas.
- In particular, the rate of **liver cancer[1] among non-Hispanic Black persons** in this area was **more than twice the rate** compared to the same population in the state of Kansas.
- Rates of low birthweight among infants in the area of interest were **higher than in the state of Kansas, though those rates decreased** from 2000 to 2021.

The study reviewed rates of other health conditions, including cancers (kidney and renal pelvis, urinary bladder, myeloma, and lymphomas), birth defects, and infants born small for gestational age and found **no other notable increases.**

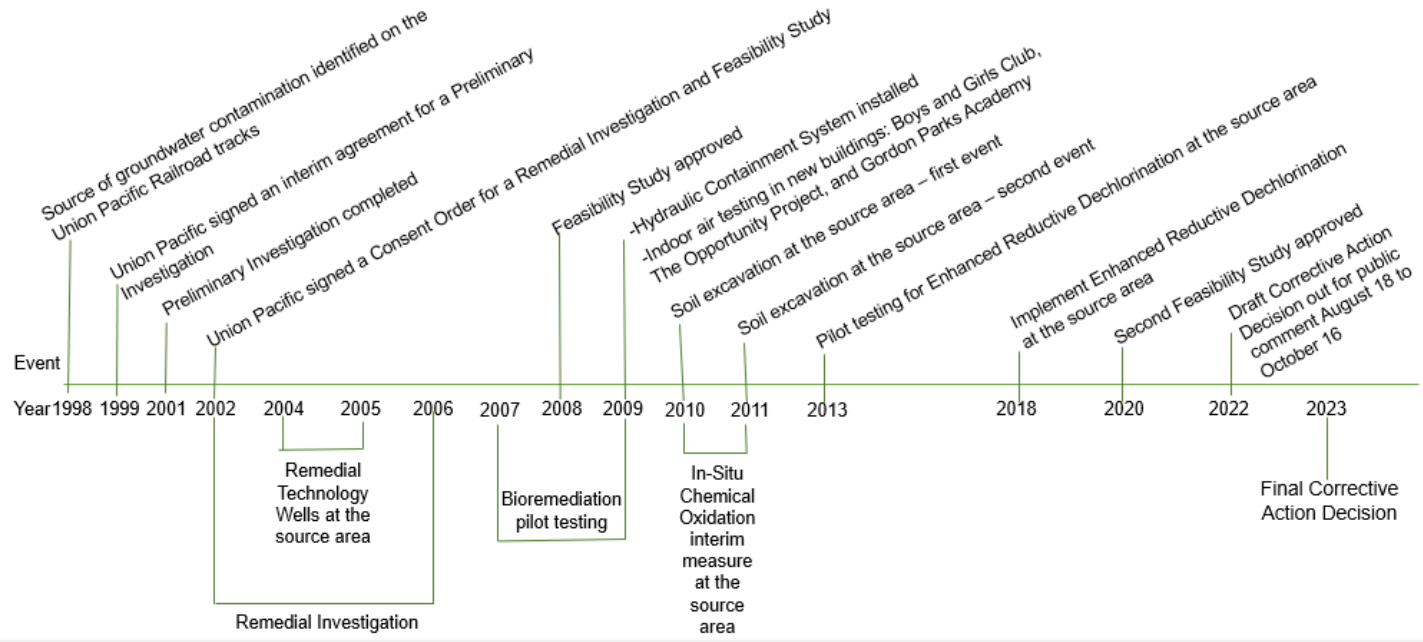
Community members are encouraged to visit the KDHE's webpage on the 29th and Grove site (https://www.kdhe.ks.gov/1938/29th-and-Grove-Site) for background on the incident, information on the Corrective Action Plan, and FAQs about impacts of the contamination on public health.

[1] "Liver cancer" here refers to the liver and biliary tree group of cancers.

Background

The 29th and Grove site is located along the northern part of a Union Pacific Railroad rail yard south of the K-96 Highway, between Highway I-135 and Grove Street, in Wichita, Sedgwick County, Kansas. The contamination was identified in 1998 and is thought to have begun prior to 1994, originating with a leak of chemicals at the Union Pacific rail yard. Since 1998, the Kansas Department of Health and Environment (KDHE) has engaged Union Pacific in investigation and remediation efforts to address the contamination. On September 8, 2022, the Kansas Department of Health and Environment (KDHE) held a public meeting to present a proposed plan for final Corrective Action.

Timeline of events at 29th and Grove site



The contaminants of concern (COCs) are trichloroethene (TCE) and its breakdown products including 1,2-dichoroethene, 1,1-dichlorothene, and vinyl chloride. TCE is a solvent commonly used for metal degreasing. Groundwater sampling shows that TCE has travelled over the years through the soil and into the water table deep below ground (Appendix A). In addition to the chemicals associated with the 29th and Grove spill, testing of the groundwater also detected tetrachloroethene (PCE) which may be due to contamination from six nearby, and now closed, dry-cleaning sites.

During the public comment period for the proposed Corrective Action plan, members of the affected community requested that KDHE conduct a health study to determine if the rates of certain diseases which may be associated with exposure to TCE and PCE are higher in the community. Exposure to contaminants, TCE and PCE in this specific situation, can occur when a person breathes (inhalation), eats or drinks (ingestion), or touches (dermal absorption) the chemicals. City of Wichita records show that all but one of the properties within the

contaminated area were connected to the city's public drinking water system prior to the time when the spill is believed to have occurred.

During the public meeting held on November 5, 2022, a residence was identified that was not connected to the city public water line but was using a private well for household use. This residence was present prior to residential development of the area. This means that only one known private residence in the area of interest has been identified as utilizing contaminated groundwater for drinking, bathing, and other regular use.

However, some lawn and garden wells may have been pulling contaminated groundwater, resulting in potential exposure in certain circumstances. For example, filling a pool with a contaminated lawn and garden well could expose a person who swam in the pool or drank the pool water. Or, if the contaminated lawn and garden well was used for a sprinkler system, individuals may be exposed by breathing in small droplets of contaminated water. Because these chemicals do not build up in fruits and vegetables, as long as any contaminated soil is washed off, using the lawn and garden wells to grow and then eat fruits and vegetables is considered safe.

Even if a person is exposed to certain contaminants, they might not be harmed. Whether or not the contaminants cause harm will depend on a number of factors, including how much of the chemicals a person was exposed to (dose), how long they were exposed (duration), and how they were exposed (inhalation, ingestion, or dermal absorption). The health effects may also depend on other factors such as age, sex, diet, family traits, lifestyle, general health status, and exposure to other cancer-causing agents.

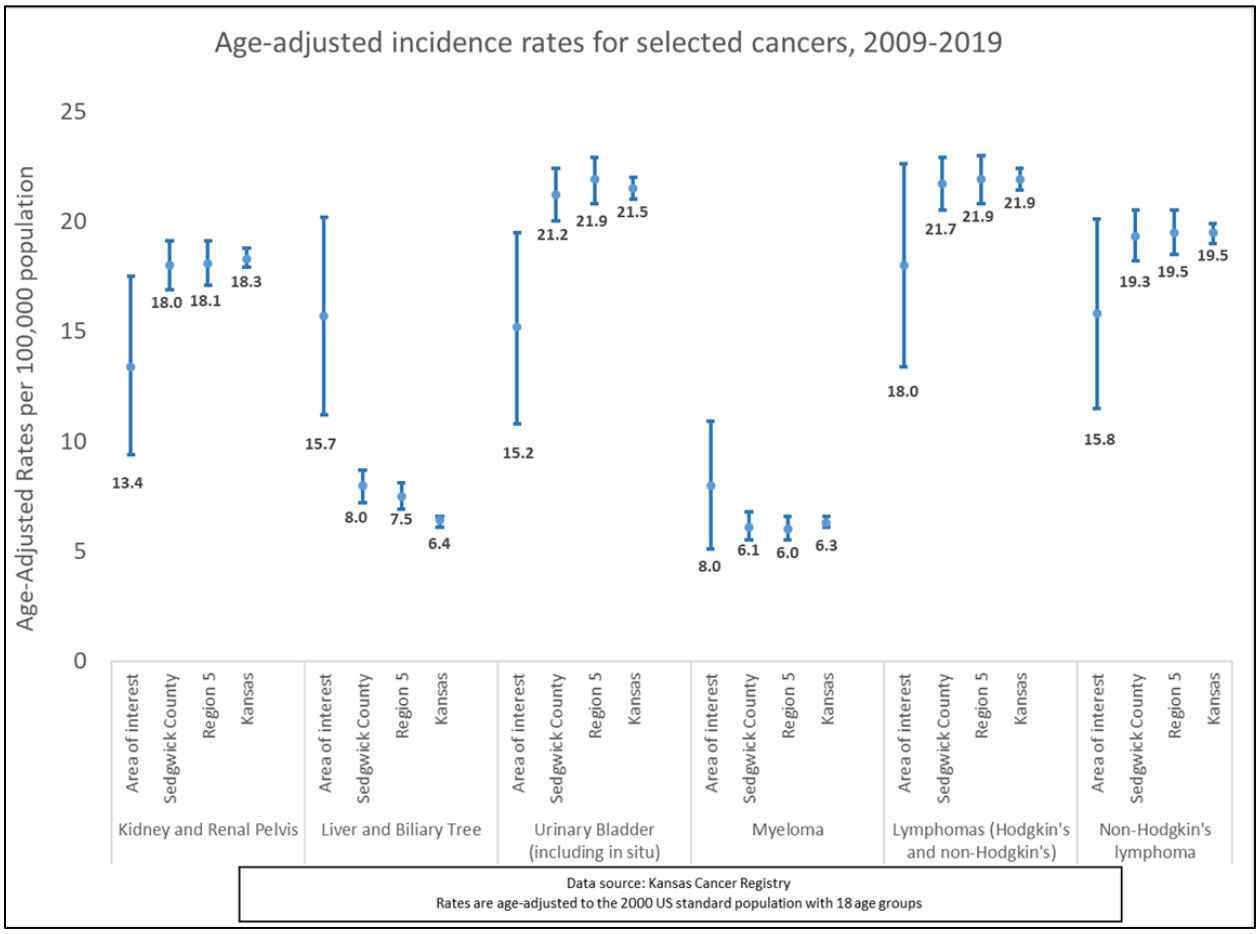
The data and statistical analysis presented in this report cannot determine if cancers and other health outcomes observed in the community are associated with environmental, lifestyle, or other risk factors such as family medical history. This study can only report on whether an increase was observed, not the cause of the increase.

Top Line Findings: Cancer Rates

Based on the scientific literature, certain cancers may be associated with exposure to these chemicals in humans, including kidney and renal pelvis, liver and biliary tree, urinary bladder (including in situ), myeloma, lymphomas (Hodgkin's and non-Hodgkin's combined), and non-Hodgkin's lymphoma separately. We limited our analysis to these cancers.

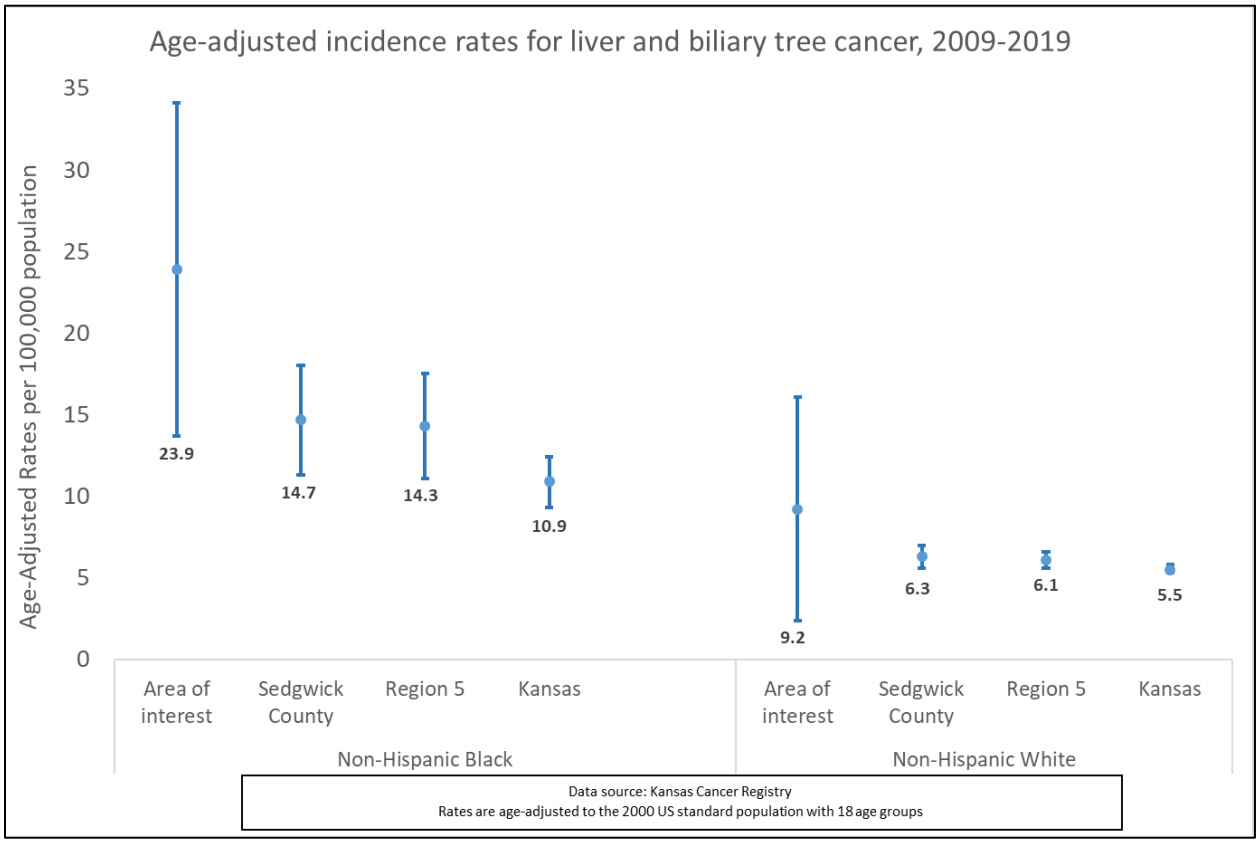
From 2009 to 2019, 212 cancers of interest were diagnosed among people living in the area of interest which represents 0.63% of the cancers of interest diagnosed in the state.

The following chart shows the rates (per 100,000 population) of cancers included in the study. For comparison, rates are also provided for Sedgwick County alone, Region 5 (a combination of Sedgwick, Reno, Harvey and McPherson counties) and Kansas as a whole. In this chart, each dot or point represents the estimated rates and the bars or lines coming off the dots represent the 95% confidence interval. The 95% confidence interval is the range of values that you can be 95% confident contains the true rate. When comparing the rate of one area to another, we look to see if the confidence intervals overlap. If the confidence intervals do not overlap, the rates are said to be statistically significantly different. Within this report, we highlight where a rate for the area of interest is statistically significantly higher compared to another geographic area.



The rate of liver and biliary tree cancer was significantly higher for the area of interest (15.7 cases per 100,000 population) compared to Sedgwick County (8.0 cases per 100,000 population), Region 5 (7.5 cases per 100,000 population) and to Kansas (6.4 cases per 100,000 population) as shown by the confidence intervals that do not overlap. The rates for all other cancers were similar or lower for the area of interest compared to Sedgwick County, Region 5, and Kansas as shown by the confidence intervals that do overlap. See Appendix D for detailed tables of cancer rates and the confidence intervals used to determine statistical significance.

For liver and biliary tree cancer, the following chart shows the rate of cancer by race and ethnicity in the area of interest compared to other geographic areas.



Among non-Hispanic Black persons, the rate of liver and biliary tree cancer in the area of interest (23.9 cases per 100,000 population) was more than twice the rate in Kansas (10.9 cases per 100,000 population); this difference was statistically significant as shown by the confidence intervals that do not overlap. The rate among non-Hispanic Black persons within the area of interest did not differ significantly from the rate for Sedgwick County (14.7 cases per 100,000 population) and Region 5 (14.3 cases per 100,000 population) as shown by the confidence intervals that do overlap. The rate among non-Hispanic White persons within the area of interest (9.2 cases per 100,000 population) did not differ significantly from the rates for Sedgwick County (6.3 cases per 100,000 population), Region 5 (6.1 cases per 100,000

population), and Kansas (5.5 cases per 100,000 population) as shown by the confidence intervals that do overlap.

Top Line Findings: Birth Outcomes

From 2000 to 2021, there were 1,978 in-state live birth and 18 stillbirth records with an area of interest address listed. Among the live births, approximately 7.8% of infants were affected by any birth defect. The observed percentage of major and minor congenital anomalies (birth defects) in the area of interest was consistent with the scientific literature and within the expected range.

The analysis did not show an unusual number of birth defects or an increase in any specific type of birth defect that may be associated with TCE and PCE exposure for the area of interest.

From 2000 to 2021, the overall rates of low birthweight (LBW) in the area of interest decreased; however, the LBW rates in the area of interest, which ranged from about 12% to 21%, were higher than the rates in Wichita, Sedgwick County and Kansas which ranged from about 7% to 9%.

There was no evidence to support that living in the area of interest during pregnancy was associated with having a small for gestational age baby. The overall rate of infants who were small for gestational age (SGA) in the area of interest decreased significantly from 2000 to 2021 with an annual percent change of 3.2%. The rates of SGA in the area of interest were either lower, or similar to, the City of Wichita, Sedgwick County and Kansas.

Methods

KDHE began the health study by defining the geographic area, the time frame, the specific health outcomes, and the statistics to include in this analysis. The analysis focused on 2,793 addresses representing the area of interest where the contaminated groundwater plume has travelled. For comparison purposes, the same cancer statistics were calculated for Sedgwick County, Region 5 (Sedgwick, Harvey, Reno and McPherson counties combined) and Kansas and the same birth outcome statistics were calculated for the City of Wichita, Sedgwick County and Kansas.

The 29th and Grove spill is thought to have occurred at some point prior to 1994. It would take several years for the contamination to seep through the soil into the groundwater. In addition, most cancers, including the ones assessed in this report, take years to develop in the human body before they are diagnosed. For most adult cancers, a period of 10 to 40 years can elapse between the beginning of an exposure to a cancer-causing agent and the development of a clinically diagnosable case of cancer. To account for both the amount of time it would take for the contamination to reach the water table deep underground, and to account for the amount of time it takes for cancers to develop in the human body, the cancer analysis focused on cancers diagnosed from 2009 to 2019.

Data Sources: For the part of the health study looking at cancer, we used data from the Kansas Cancer Registry. The Kansas Cancer Registry collects and maintains a population-based database of all Kansans diagnosed with cancer (https://apps.kumc.edu/kcr/). The most recent year of certified data is 2019. Based on the scientific literature, certain cancers may be associated with TCE and PCE exposure in humans.[1,2] We limited our analysis to these cancers which include kidney and renal pelvis, liver and biliary tree, urinary bladder (including in situ), myeloma, lymphomas (Hodgkin's and non-Hodgkin's combined), and non-Hodgkin's lymphoma separately. We calculated a statistic called the age-adjusted incidence rate which allows us to compare the rate of new cancer cases diagnosed across different geographic areas. We also calculated a statistic called the Standardized Incidence Ratio (SIR) which allows us to determine if the actual number of a specific type of cancer in an area was higher or lower than expected.

Based on the history of environmental contamination with TCE and PCE, the birth outcome analysis focuses on the number and type of birth defects and other adverse birth outcomes such as low birthweight and small for gestational age from 2000 to 2021. For the part of the health study looking at birth outcomes, we used data from in-state live birth and stillbirth (fetal death) records. Maternal residential address at the time of delivery, as reported by the mother and listed on the birth certificate, was used to determine whether the mother lived within the area of interest at the time of delivery. Birth defects have been reported on the Kansas birth certificate since 1979. Since 1985, this information is reported by providers to the Kansas Department of Health and Environment Bureau of Family Health and was used for this analysis. Technical Notes for the cancer and birth outcome analyses can be found in Appendix B and Appendix C.

Results

Cancer Analysis

From 2009 to 2019, there were 212 cancers of interest diagnosed among people living in the area of interest which represents 0.63% of the cancers of interest diagnosed in the state (Appendix D, Table 1).

The age-adjusted incidence rate of kidney and renal pelvis cancer was lower for the area of interest compared to Kansas. This lower rate is considered statistically significant as shown by the 95% confidence intervals which do not overlap (Appendix D, Table 2). The rate for the area of interest was similar to the rates for Sedgwick County and Region 5.

The rate of liver and biliary tree cancer was higher for the area of interest compared to Sedgwick County, Region 5 and to Kansas. This higher rate is statistically significant, as shown by the 95% confidence intervals which do not overlap (Appendix D, Table 3). The rate for the area of interest was nearly double the rate for Sedgwick County and more than double the rates for Region 5 and the state.

The rate of urinary bladder cancer was lower for the area of interest compared to Sedgwick County, Region 5, and Kansas. This lower rate is statistically significant, as shown by the 95% confidence intervals which do not overlap (Appendix D, Table 4).

The rate of myeloma was similar for the area of interest compared to Sedgwick County, Region 5, and Kansas. This is indicated by the 95% confidence intervals which do overlap (Appendix D, Table 5).

Similarly, the rates of lymphomas (Hodgkin's and non-Hodgkin's combined) (Appendix D, Table 6) and non-Hodgkin's lymphoma separately (Appendix D, Table 7) were similar between the area of interest, Sedgwick County, Region 5, and Kansas. This is also indicated by the 95% confidence intervals which do overlap.

The Standardized Incidence Ratios (SIR) showed that the observed number of cancers of the kidney and renal pelvis, bladder, myeloma, lymphomas (Hodgkin's and non-Hodgkin's combined), and non-Hodgkin's separately were similar to the expected number of cases as indicated by the 95% confidence intervals that contain 1.0. The SIR showed that the observed number of liver and biliary tree cancer cases was more than 2.5 times the expected number. This increase in the actual number of cases compared to the expected number is considered statistically significant because the 95% confidence interval did not contain 1.0 (Appendix D, Table 8).

Given the increase in the liver and biliary tree cancer rate within the area of interest, we conducted further analysis by race/ethnicity because the race/ethnicity makeup of the area of

interest may differ from the comparison populations and minority and low-income populations experience disparities in access to screening and treatment. Among only non-Hispanic Black persons, the rate of liver and biliary tree cancer in the area of interest was more than twice the rate in Kansas. This difference is statistically significant, as shown by the 95% confidence intervals which do not overlap (Appendix D, Table 9). The rate among non-Hispanic Black persons within the area of interest is considered statistically similar to the rates for Sedgwick County and Region 5, as indicated by the 95% confidence intervals that do overlap. The rate among non-Hispanic White persons within the area of interest is statistically similar to the rates for Sedgwick County, Region 5, and Kansas (Appendix D, Table 10).

Birth Outcome Analysis

From 2000 to 2021, there were 1,978 in-state live birth and 18 stillbirth records with an address within the area of interest. Among the live births, approximately 7.8% of infants were affected by any birth defect. The observed percentage of major and minor congenital anomalies in the area of interest was consistent with the scientific literature and within the expected range.[3] Examples of major congenital anomalies includes anencephaly, cleft lip with cleft palate, pulmonary valve atresia and stenosis, and ventricular septal defect; and examples of minor anomalies includes congenital pigmentary anomalies of skin, polydactyly of fingers or toes (accessory fingers or toes), and vascular hamartomas. We also looked at specific birth defects that, according to scientific literature, may be associated with TCE and PCE exposure.

Spontaneous abortions (miscarriages): According to the Centers for Disease Control and Prevention (CDC), spontaneous abortion or miscarriage is defined as the loss of pregnancy less than 20 weeks gestation.[3,4] It is estimated that approximately 10% to 15% of all recognized pregnancies end in spontaneous abortion, and approximately 6% to 7% of those that reach 20 weeks gestation end in fetal death.[3] In Kansas, we do not systematically collect information on pregnancies ending prior to 20 weeks gestational age. Therefore, spontaneous abortion (miscarriage) data cannot be compiled to produce statistics.

Congenital heart defects: Even with 5 years of data combined, the number of reported cases was too small to calculate the prevalence of congenital heart defects (the number of babies born with specific heart defect compared to the total number of live births).

Central nervous system defects: Even with 5 years of data combined, the number of reported cases was too small to calculate the prevalence of central nervous system defects (the number of babies born with specific central nervous system defects compared to the total number of live births).

Orofacial defects: Even with 5 years of data combined, the number of reported cases was too small to calculate the prevalence of orofacial defects (the number of babies born with specific oral cleft defects compared to the total number of live births) could not be calculated.

Immune system deficiencies: Kansas Newborn Screening started screening for severe combined immunodeficiencies (SCIDs) in 2017. There were no diagnosed cases within the area of interest based on the mother's residential address reported on the birth certificate at the time of delivery.

Low birthweight: From 2000 to 2021, the overall rates of low birthweight (LBW) in the area of interest decreased, with an annual percent change of 1.8% (Appendix E, Figure 1). However, this decreasing trend was not statistically significant. When comparing the combined three-year rates of LBW in the non-overlapping time periods, the LBW rates in the area of interest were significantly higher than Kansas (Appendix E, Table 12). The LBW rates in the area of interest were also significantly higher than the City of Wichita and Sedgwick County, except in 2019-2021 (Appendix E, Table 12).

Small for gestational age: From 2000 to 2021 (Appendix E, Figure 2), the overall rate of infants who were small for gestational age (SGA) in the area of interest decreased significantly with an annual percent change of 3.2%. When comparing the combined three-year rates of SGA in the non-overlapping time periods, the rates of SGA in the area of interest were either lower or similar to the City of Wichita, Sedgwick County and Kansas.

Additional results are available in Appendix D and Appendix E.

Conclusion

This report found the rate of liver and biliary tree cancer in the area of interest was 15.7 cases/100,000 population. In comparison, the rate for Kansas was 6.4 cases/100,000 population and the rate in the US was 8.6 cases/100,000 population (Appendix D, Table 11). This report also found that the rate of low birthweight babies in the area of interest was higher for the area of interest, ranging from about 12% to 21% each year from 2000 to 2021, compared to the rates in Wichita, Sedgwick County and Kansas which ranged from about 7% to 9% (Appendix E, Table 12).

The data and statistical analysis presented in this report cannot determine if cancers and other health outcomes observed in the community are associated with environmental, lifestyle, or other risk factors such as family medical history. This study can only report on whether an increase was observed, not the reason(s) for the increase. However, we are able to provide some additional analysis of known risk factors that increase the risk of cancer and adverse birth outcomes.

To better address negative trends and disparities in health outcomes in the area of interest, it is important to understand the social determinants that can influence one's ability to thrive in their environment. When social determinants that have a negative effect on health overlap, the risk of negative birth outcomes and chronic diseases, including cancer, can increase.

The U.S. Department of Health and Human Services groups social determinants of health (SDOH) into five areas: Economic Stability, Education Access and Quality, Health Care Access and Quality, Neighborhood and Built Environment, and Social and Community Context. Approximately two-thirds of all live births in the area of interest reported the principal source of payment for the delivery as Medicaid on the birth certificate (Appendix E, Table 14). Collaboration efforts among Medicaid, local and state public health, and the community in the area of interest in providing maternity-related services such as prenatal care, perinatal education, preconception and interconception care for pregnant women are needed to improve the birth outcomes.

Resources

For additional information about the 29th and Grove site, visit the Kansas Department of Health and Environment, "29th and Grove Site," web page at https://www.kdhe.ks.gov/1938/29th-and-Grove-Site.

For additional information about cancer clusters, visit the Centers for Disease Control and Prevention, "About Cancer Clusters," web page at http://www.cdc.gov/nceh/clusters/about.htm.

For additional information on cancer risk factors, visit the American Cancer Society, "What Causes Cancer?" web page at http://www.cancer.org/cancer/cancercauses/index.

Questions or comments regarding this investigation may be directed to Farah Ahmed at Farah.Ahmed@ks.gov.

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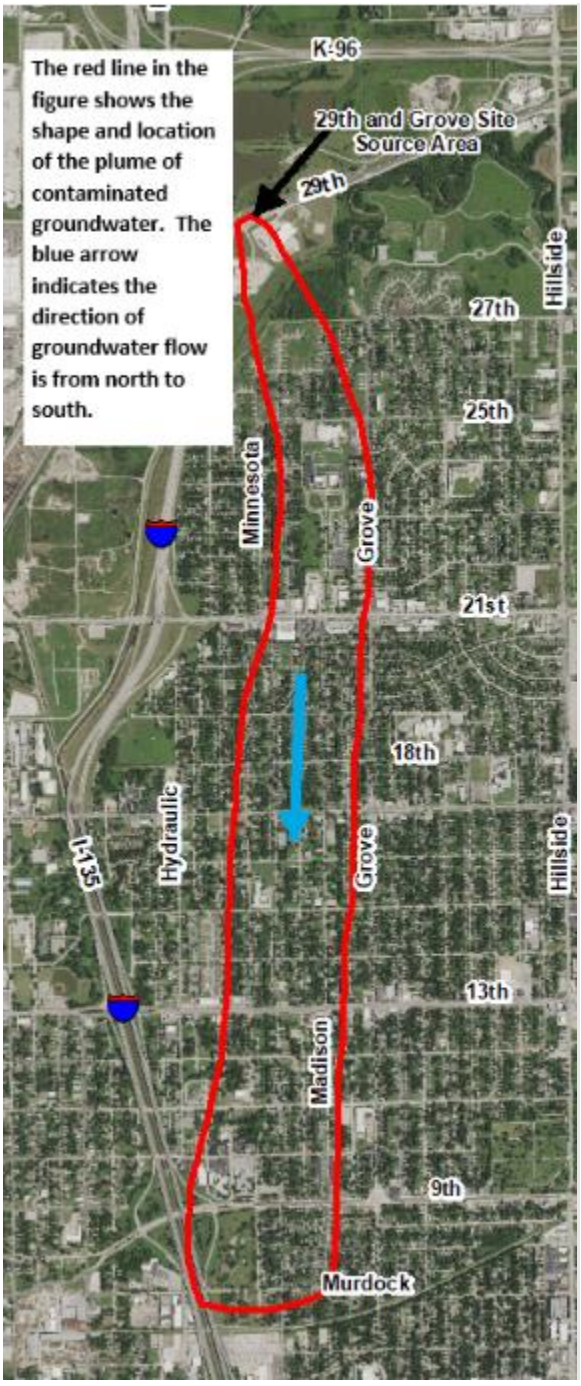
Appendix A: 29th and Grove Trichloroethene Plume



Available at: https://www.kdhe.ks.gov/1938/29th-and-Grove-Site

Appendix B: Cancer Analysis Technical Notes

General information on the Kansas Cancer Registry

The Kansas Cancer Registry (KCR) was one of first 20 statewide cancer registries awarded Centers for Disease Control and Prevention (CDC)/National Program of Cancer Registries (NPCR) funding in 1995 to enhance states' existing cancer registries. KCR is a combination active and passive surveillance system responsible for the collection, maintenance, and dissemination of high-quality population-based cancer data.

Per Kansas statute and administrative regulation, cancer has been a reportable disease in Kansas since 1982. Hospitals and physicians provide information to the KCR on all cancer diagnoses in the state, including type of cancer (primary site), date of diagnosis, and stage at diagnosis. Patient demographics, including sex, age, race/ethnicity, and county of residence, as well as vital status is collected. Kansas residents who are diagnosed or treated with cancer in Missouri, Nebraska, Colorado, Oklahoma, Texas, Washington, and Arkansas are included in the KCR database through data exchange.

The Kansas Cancer Registry is designated by the Secretary of the KDHE for the exclusive purpose of carrying out central cancer registry operations, from grant writing to data collection, data management, education/training, cancer surveillance, cancer information dissemination, and responding to data needs/requests. The KCR team has four operational core units (data collection/quality assurance, training & education, data management, and epidemiology/analysis) and a designated KCR IT staff.

The core functions of KCR are to collect, synthesize, conduct analysis, and disseminate cancer information to sectors of our societies for the purpose of public health, policy, assessment of treatment guidelines and recommendation of appropriate care. KCR provides information on the occurrence of cancer, stage at diagnosis, survival and sub-populations affected by different types of cancer. The published statistics support community interventions and disseminate information to the public for a better understanding of the cancer burden in their communities.

The University of kansas Cancer Center is a National Cancer Institute (NCI) designated cancer center for which KCR has played an important role in providing data and facilitating cancer researchers for NCI funding. KCR played a key role in helping to establish NCI designation of a comprehensive cancer center in Kansas City, desperately needed in the US Heartland and continues to support the NCI designated cancer center in the Kansas City area. The KCR team is leading and collaborating in various health services projects such as screening and treatment guidelines.

Kansas has been in the forefront of establishing cancer reporting legislation. The legislative related activities are outlined below:

1. The cancer reporting Kansas Statutes 65-1, 168 to 174 were enacted in 1997 giving the Kansas Cancer Registry (KCR) the authority to collect confidential data on patients with cancers and an immunity to health care providers for reporting confidential patients' information. Details on who, what, and when cancer information must be transmitted to KCR are described in Kansas Administrative Regulations (KAR) 28-70-1 to 28-70-3. The regulations took effect in 1998.
2. Kansas Statutes 65-1,168 to 169 were amended in 2004 to require outpatient clinics to report cancers due to changes in the health care delivery system at the time. An efficient mechanism was devised to bring outpatient clinics on board for reporting cancer cases.
3. Kansas Administrative Regulations (KAR) 28-70-1 to 28-70-3 were amended in 2005 to reflect the requirement of outpatient physicians in cancer reporting.
4. Kansas Statute 65-1,172 was amended to allow KCR to contact subjects' follow-up for public health purposes in 2007. Participation in follow-up projects is voluntary and may only be conducted with the written consent of the persons. The revision was authorized and implemented in 2008. The KAR 28-70-4 which includes details in conducting follow-up studies took effect in June 2009.
5. The KAR *28-70-2* was expanded to collect cancer screening as a result of KCR's success in securing the NPCR Component 2 funding starting in 2017 to assess mammogram screening in women with breast cancers. Th KAR *28-70-2 was amended in December 2018.*

Data collection, content, and format

KCR collects all NPCR required data items as well as a few state-specific data items. The KCR Coding and Information Manual is consistent with the American College of Surgeon's most recent additions and modifications to the Standards for Oncology Registry Entry (STORE) manual, the North American Association of Central Cancer Registries (NAACCR) data standards and file format. Sources of cancer case reports in Kansas include federal and non-federal hospitals, pathology laboratories, radiation treatment centers, outpatient surgical centers, private physicians and clinics, and data exchange with the neighboring states. Data Modernization (DM) plays a critical role in data collection and Kansas has been a part of the DM initiative since 2021. The electronic reporting is 100% for hospitals, vital records, and data exchange with other state registries. The percent of electronic submission to KCR is at 75% for pathology laboratories and 41% for physician clinics. About 23% and 19% of the data from surgical and outpatient radiation treatment centers respectively are transmitted to KCR electronically.

The Rocky Mountain Cancer Data System database (RMCDS) is used to collect and manage cancer incidence data. Data can be exported in NAACCR record layout for use in SEER*Stat and SAS for analysis. NAACCR and NPCR Cancer Surveillance System (CSS) call for data are automated features of RMCDS software. KCR also uses Electronic Mapping, Reporting, and Coding (eMaRC) to review pathology reports transmitted via the Association of Public Health Laboratories (APHL) Informatics Messaging Services (AIMS) Platform, a part of the Data

Modernization Initiative (DMI). Some pathology reports have been transmitted via Public Health Information Network Messaging System (PHINMS). Other applications such as AutoMatch, SUDAAN, Microsoft Office Suite, ACCESS, Joinpoint, and Publisher have been used for management reports generation and web page maintenance. The AbstractPlus developed by CDC is a free software and it is offered to facilities that do not have commercial software. Training and IT support for use of AbstractPlus has been provided by KCR Database Management Core unit. The RMCDS and KCR related documentations are maintained on a protected encrypted server and administered by KCR IT and KUMC Information Technology (IT). Physical access to the file folders is only available to KCR staff and is controlled by the KUMC IT. KCR data including statewide cancer incidences, mortality, and relative survival in age, sex, racial and/or ethnic groups, and regions are available to all cancer partners to facilitate cancer care in Kansas. Such a close collaboration will be continued for the next five years and beyond. The KCR web site (https://apps.kumc.edu/kcr) offers public information on cancer statistics, publications, and contact information. Access to KCR training materials, videos, and physician listings are available at KCR website and are password protected.

At the state level, KCR data supported efforts related to Kansas cancer prevention and control. The programs include Kansas KS BC, KS CCC, KS CRCCP, KS BRFSS, KS Chronic Diseases Program, Tobacco Free Kansas Coalition, Kansas Cancer Partnership and others. KCR also transmitted de-identified data annually to KDHE Bureau of Health Promotion for advancing their missions such as reducing cancer incidence and disparities. KCR data also supported cancer cluster investigations, the KDHE Bureau of Health Informatics and the Environment Health Tracking Program. KCR data has been an important source of data that were used by health care providers for market share planning. Release of cancer registry data to address public health issues, policy, clinical and epidemiologic research questions, and strategic planning is central. KCR data has been used broadly by users at various levels (e.g., community, statewide, regional, as well as national and international levels).

Case Definition

Incident cases were defined by World Health Organization (WHO) *Classification of Tumours of Haematopoietic and Lymphoid Tissues*, National Cancer Institute (NCI) Surveillance Epidemiology and End Results (SEER) site recode from ICD-O-3/WHO 2008 value. The values for the cancers of interest are as follows:

Type of cancer	**SEER Site Recode**
Kidney and Renal pelvis	29020
Liver and intrahepatic bile duct	21071,21072
Urinary bladder	29010
Myeloma	34000
Lymphomas (Hodgkin's and Non-Hodgkin's)	33041,33042,33011,33012
Non-Hodgkin's lymphoma	33041,33042

All incidence data reflects invasive cancers only, with the exception of bladder cancer, which includes both invasive and in situ cancers. KCR identifies approximately 95% of the expected cases of cancer within 24 months of the close of the year of diagnosis. KCR continues to update the cancer cases from previous years as they are reported to the registry; thus, counts may change slightly over time as the data become more complete.

Methods

We limited our analysis to the cancers most consistently associated in the scientific literature with exposure to TCE and PCE, including kidney and renal pelvis, liver and biliary tree, urinary bladder (including in situ), myeloma, lymphomas (Hodgkin's and non-Hodgkin's combined), and non-Hodgkin's lymphoma separately. Cancers diagnosed between 2009 and 2019 were included in the analysis.

For this analysis, we used standard population counts available through the United States Census Bureau to count the number of people in the two Zip Code Tabulation Areas (ZCTAs 67219 and 67214). We used the same data source to count the number of people in Sedgwick County, Region 5 (Sedgwick, Harvey, Reno and McPherson counties combined) and Kansas for the comparison statistics.

An incidence rate is the rate of occurrence of new cases diagnosed within a specific time period. 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. The incidence rates were calculated using PROC STDRATE procedure in SAS 9.4 and adjusted to U.S. 2000 standard population using direct method based on 19 age groups. 1990-2019 population estimates for Kansas were obtained from the NCI SEER program. The estimates represent a modification of the intercensal and Vintage 2019 annual time series of July 1, county population estimates by age, sex, race, and Hispanic origin produced by the U.S. Census Bureau's Population Estimates Program, in collaboration with the National Center for Health Statistics.

In addition to the age-adjusted incidence rates, 95% confidence intervals are provided for the rates. 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 said to be statistically significantly different. If the confidence intervals do overlap, the rates are said to be similar.

The Standardized Incidence Ratio (SIR) allows us to determine if the observed number of a specific type of cancer in an area was higher or lower than expected. This statistic is useful for assessing specific types of cancer with small numbers of cases. A 95% confidence interval was calculated around the ratios to determine how likely it is that the number of observed cases is high or low by 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, incidence rates from the KCR were used to determine the expected number of cases.

Limitations

It is important to note that the information captured within the KCR is based on residence at the time of diagnosis. As people move, it becomes more difficult to determine whether living in the area of investigation is associated with an excess of cancers, because residential history is not tracked. Latency (the time period between exposure and illness onset) adds to the complexity of this step in the investigation. For most adult cancers, a period of 10 to 40 years can elapse between the beginning of an exposure to a cancer-causing agent and the development of a clinically diagnosable case of cancer. It is possible that former residents who developed cancer no longer lived in the area at the time of diagnosis, and these cases would not be included in this assessment. It is also possible that new people have moved into the area and then were diagnosed with cancer; these cases are included in this assessment.

Appendix C: Birth Outcome Analysis Technical Notes

General Information on the Kansas Birth Defects Information System

The Kansas Birth Defects Information System (KS BDIS) does not currently meet the Centers for Disease Control and Prevention (CDC) standards for an active birth defects surveillance system. Since the mid-1980s, the Kansas Department of Health and Environment (KDHE), Bureau of Family Health assumed responsibility for the Kansas Birth Defects Program (KS BDP), working with hospitals to improve reporting, data entry and linking with the Office of Vital Statistics. Despite these efforts, the KS BDP has been *a passive system*. This means that all reported birth defects are currently being submitted to the KS BDP by a medical entity via an HL7 message through the Kansas Health Information Network (KHIN), birth certificate or a manual entry form. KHIN was implemented in 2018 and is considered a dependable source of birth defects data. Before KHIN, the only two methods of reporting were via birth certificate or a manual entry form, which are subject to under-reporting and poor validity. All reported cases in KS BDIS are considered as *probable* as none reported before March 2022 have been reviewed, abstracted, and confirmed, except a few cases with active case ascertainment of potentially Zika-related birth defects under the short-term support of the CDC Zika Birth Defects Surveillance grant.

Birth defects have been reported on Kansas birth certificates since 1979. From 1985 to 2004, for children *under one year of age*, children were entered into the KS BDIS from data on all children born with congenital defect(s) and/or fetal alcohol syndrome as reported on the birth certificate or case reports via the Congenital Malformations and Fetal Alcohol Syndrome reporting form. In 2004, new statutory authority (K.S.A 65-1,241 through 65-1,246) to the KDHE requires reporting by physicians, hospitals and freestanding birthing centers concerning *all patients under five (5) years of age* with a primary diagnosis of a congenital anomaly or abnormal condition and to establish a comprehensive birth defects information system. In 2010, K.A.R. 28-4-520 and K.A.R. 28-4-521 expanded the list of congenital anomalies reportable to KDHE. In 2022, K.A.R. 28-4-520 and K.A.R. 28-4-521 were amended and effective beginning October 7, 2022.

Since 2005, for children under five (5) years of age, children are entered into the KS BDIS from data on all children born to Kansas residents (in-state and out-of-state births except for identified states listed below) with one of the following conditions: 1) congenital defect(s) and/or fetal alcohol syndrome; 2) Appearance, Pulse, Grimace, Activity, and Respiration (APGAR) score is 5 or less at five minutes; 3) birth weight is 1200 grams or less; 4) a seizure or serious neurologic dysfunction under item 71 of abnormal conditions checked on the birth certificate; and 5) a significant birth injury under item 71 of abnormal conditions checked on the birth certificate. Out-of-state births not included in the system include babies born to Kansas residents in the following states: Alabama, Alaska, California, District of Columbia, Hawaii, Idaho, Illinois, Indiana, Louisiana, Maine, Massachusetts, Mississippi, Montana, New Jersey, New Mexico, New York City, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Virginia, Wisconsin, Wyoming, American Samoa, Virgin Islands, Northern Marianas, Puerto Rico,

and all Canada provinces (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Newfoundland & Labrador, Northwest Territories, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Nunavut, Ontario, Prince Edward Island, Saskatchewan, Yukon Territory, and Quebec).

Notifiable conditions are defined in K.A.R. 28-4-520 and further specified in K.A.R. 28-4-521. A comprehensive list of these conditions is found in the Guidance for Birth Defects Surveillance Reporting Document (https://www.kdhe.ks.gov/DocumentCenter/View/23898/Kansas-Birth-Defects-Surveillance-Reporting-Manual041822) and include the following:

- All conditions listed in the Congenital Malformations, Deformations and Chromosomal Abnormalities chapter within the ICD-10-CM Expert for Physicians code book, 2022 edition (Q00-Q99)
- Neonatal abstinence syndrome (P96.1)
- Select metabolic disorders
- Select functional disorders

General Information on Kansas Live Birth and Stillbirth (Fetal Death)

Revisions of the U.S. standard certificates: live births, stillbirths (fetal deaths), and deaths in 2003 (https://www.cdc.gov/nchs/nvss/revisions-of-the-us-standard-certificates-and-reports.htm), Kansas implemented these standards beginning in 2005. Due to changes in data structure and the collection of data (i.e., differences in definitions and differences in the way the data were collected), especially the race, ethnicity, education, some of the pregnancy related items, including the congenital anomalies of the newborn on certificates, use caution when comparing 2005-2021 data to prior years (2000-2004).

Effective July 1, 2014, the definition of stillbirth changed. The new definition is: Any complete expulsion or extraction from its mother of a product of human conception, the gestation of which is 20 weeks or greater, resulting in other than a live birth, and which is not an induced termination of pregnancy. For the analytical purpose, data for 2000-2021 are based on the new definition.[4]

Case Definition

Birth Defect: The term birth defect encompasses a diversity of conditions including physical malformations, sensory deficits, chromosomal abnormalities, metabolic defects, neurodevelopmental disorders, and complications related to prematurity and low birthweight, among others.[3] "Congenital abnormality", "congenital anomaly", and "congenital malformation" are terms often used as synonyms for "birth defect".[3] For the analytical purpose, the 47 major birth defects recommended by the National Birth Defects Prevention Network (NBDPN) were assessed. According to the NBDPN Guidelines for Conducting Birth Defects Surveillance, these were chosen on the basis of their frequency, their impact on public health, the state of knowledge about their etiologies and risk factors, and risk factors, and other

considerations.[3] The adverse birth outcomes related to trichloroethylene (TCE) and tetrachloroethylene (PCE): major congenital heart defects, central nervous system defects, neural tube defects, and orofacial defects are included the 47 NBDPN birth defects list.

Low birthweight: Birth weight less than 2,500 grams, regardless of gestational age[3,4]

Residence: For analytical purposes, the address at the time of delivery, as reported by the mother and therefore listed on the birth certificate, was used. This may not reflect where the mother lived during the first few weeks of her pregnancy, when the fetus would have been more susceptible to exposure to TCE and PCE. Also, the KS BDIS include all children born (in-state and out-of-state births except for identified states listed above). For analytical purposes, only *in-state live births and stillbirths to Kansas residents* are included in the analysis.

Small for gestational age (SGA): Small for gestational age is when the infant's birth weight is less than the 10th percentile (lowest 9.9 percent of births). These infants may be normal but small or pathologically small (intrauterine growth restriction).[4] SGA data are derived from Kansas birth certificate variable obstetric estimate of gestational age at delivery.

Methods

Live birth data: Maternal residential addresses in the in-state live birth records occurring to all mothers residing in the addresses of interest at the time of delivery for live births occurring in 2000-2021 were obtained from the KDHE, Bureau of Epidemiology and Public Health Informatics, Vital and Health Statistics Data Analysis. The linked data contained assigned unique identifying numbers, which were linked with KS BDIS data.

Stillbirth (Fetal Death) data: In-state stillbirth (fetal death) data to Kansas residents for stillbirths occurring in 2000-2021 linked with the maternal residential addresses of interest at the time of the delivery were obtained from the KDHE, Bureau of Epidemiology and Public Health Informatics, Vital and Health Statistics Data Analysis.

KS BDIS data: Maternal residential addresses of the in-state live-born infants to Kansas residents in the KS BDIS for births occurring in 2000-2021 were linked to the list of addresses in the area of interest. The matched birth defect records were then linked with their respective live birth records and assigned unique identifying numbers by the KDHE, Bureau of Epidemiology and Public Health Informatics, Vital and Health Statistics Data Analysis. Infants with birth defects from more than one defect category were included in each applicable major defect category. Due to small number of reported cases in the area of interest, to estimate the expected occurrence in the area of interest, the national prevalence estimates from the National Population-Based Estimates for Major Birth Defects, 2010-2014[10] or the CDC Data & Statistics on Birth Defects[11] were used. The Poisson distribution was used to determine whether there was a difference between the expected and observed numbers of affected cases in each birth defects.

Based on the history of environmental contamination with TCE and PCE, the study focuses on the number and type of birth defects (live births and stillbirths) and other adverse birth outcomes such as low birthweight and small for gestational age.

Data linkage, data linkage quality check, data cleaning, and data analysis were performed using SAS Version 9.4 (SAS Institute, Cary, NC). In order to account for dependence, differences between the proportions of the area of interest to the City of Wichita, Sedgwick County or Kansas overall were evaluated using a dependent t-test. Differences between the proportions of two non-overlapping periods within the area of interest, within the City of Wichita, within Sedgwick County or within Kansas overall were evaluated using an independent t-test. Joinpoint Trend Analysis Software (Version 4.9.1.0) was used for regression analysis, which provides the number and location of joinpoints (i.e., inflection points) when changes in trend have occurred. The results provide estimates of annual percent change (APC) in low birthweight and small for gestational age.

Limitations

According to the National Birth Defects Prevention Network Guidelines for Conducting Birth Defects Surveillance, "It is well understood that the effects of environmental teratogens occur early in embryogenesis; so assessing the influence of environmental exposures must be related temporally to conception. In addition, potential exposures to teratogenic environmental factors could possibly be misrepresented if examined at delivery rather than around the time of conception." In Kansas, neither KS BDIS nor birth certificate collects the residence of mother at the time of conception. For analytical purposes, the address at the time of delivery, as reported by the mother and therefore listed on the birth certificate, was used. This may not reflect where the mother lived during the first few weeks of her pregnancy, when the fetus would have been more susceptible to exposure to TCE and PCE.

Pre-delivery move out: The process of linking addresses in the area of interest to live births and stillbirths in the Kansas Vital Records System cannot capture cases where the mother lived at one of the addresses in the area of interest during pregnancy but moved outside the area before delivery.

Post-delivery move in: The linking process would also fail if the mother resided in the area of interest at the time of a birth defect was diagnosed (and so is listed in the KS BDIS at an address in the area of interest) but did not reside there at the time of delivery.

Low quality address information: The linking process might also fail if the address provided by the mother was misspelled or improperly formatted.

Appendix D: Cancer Analysis Results

Table 1: Number of new cancer cases diagnosed in the area of interest, 2009-2019			
Sites	**Number of cases identified by address search (area of interest)**	**Number of cases in Kansas**	**Percentage of cases in area of interest**
Kidney and renal pelvis	40	6,540	0.61%
Liver and biliary tree	51	2,429	2.10%
Urinary bladder (including in situ)	47	7,890	0.60%
Myeloma	21	2,303	0.91%
Lymphomas (Hodgkin's and non-Hodgkin's)	53	7,734	0.69%
Non-Hodgkin's lymphoma	46	6,946	0.66%
Total	212	33,842	0.63%

* Data source: Kansas Cancer Registry

Table 2: Incidence rates for kidney and renal pelvis cancer, 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	40	13.4	9.4 - 17.5
Sedgwick County	1,061	18.0	16.9 - 19.1
Region 5	1,388	18.1	17.1 - 19.1
Kansas	6,540	18.3	17.9 - 18.8

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 3: Incidence rates for liver and biliary tree cancer, 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	51	15.7	11.2 - 20.2
Sedgwick County	510	8.0	7.2 - 8.7
Region 5	620	7.5	6.9 - 8.1
Kansas	2,429	6.4	6.1 - 6.6

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 4: Incidence rates for urinary bladder (including in situ) cancer, 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	47	15.2	10.8 - 19.5
Sedgwick County	1,253	21.2	20.0 - 22.4
Region 5	1.729	21.9	20.8 - 22.9
Kansas	7,890	21.5	21.0 - 22.0

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 5: Incidence rates for myeloma, 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	21	8.0	5.1 - 10.9
Sedgwick County	365	6.1	5.5 - 6.8
Region 5	476	6.0	5.5 - 6.6
Kansas	2,303	6.3	6.1 - 6.6

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 6: Incidence rates for lymphomas (Hodgkin's and non-Hodgkin's combined), 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	53	18.0	13.4 - 22.6
Sedgwick County	1,252	21.7	20.5 - 22.9
Region 5	1,656	21.9	20.8 - 23.0
Kansas	7,734	21.9	21.4 - 22.4

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 7: Incidence rates for non-Hodgkin's lymphoma, 2009-2019			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	46	15.8	11.5 - 20.1
Sedgwick County	1,122	19.3	18.2 - 20.5
Region 5	1,487	19.5	18.5 - 20.5
Kansas	6,946	19.5	19.0 - 19.9

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 8. Standardized Incidence Ratios for the area of interest, 2009-2019				
Sites	**Observed number of cases ***	**Expected number of cases †**	**Standardized Incidence Ratio**	**95% Confidence Interval**
Kidney and renal pelvis	40	53.2	0.8	0.5 - 1.0
Liver and biliary tree	51	19.7	2.6	1.9 - 3.4
Bladder (including in situ)	47	60.5	0.8	0.6 - 1.0
Myeloma	21	18.0	1.2	0.7 - 1.8
Lymphomas (Hodgkin's and non-Hodgkin's)	53	63.0	0.8	0.6 - 1.1
Non-Hodgkin's lymphoma	46	55.7	0.8	0.6 - 1.1
All cancers of interest	212	214.4	1.0	0.9 - 1.1

* Observed number of cases in an 11-year period. Data source: Kansas Cancer Registry

† Expected number of cases in an 11-year period. Calculated bases on age-specific cancer incidence rates from the Kansas Cancer Registry

Table 9: Incidence rates for liver and biliary tree among non-Hispanic Black persons			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	29	23.9	13.7 – 34.1
Sedgwick County	79	14.7	11.4 - 18.0
Region 5	81	14.3	11.1 - 17.4
Kansas	205	10.9	9.3 - 12.4

* Data source: Kansas Cancer Registry

* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 10: Incidence rates for liver and biliary tree among non-Hispanic White persons			
Geographical Area	**Total number of cases**	**Age-adjusted rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of interest	12	9.2	2.4 – 16.1
Sedgwick County	332	6.3	5.6 – 7.0
Region 5	431	6.1	5.6 - 6.7
Kansas	1,850	5.5	5.3 - 5.8

* Data source: Kansas Cancer Registry

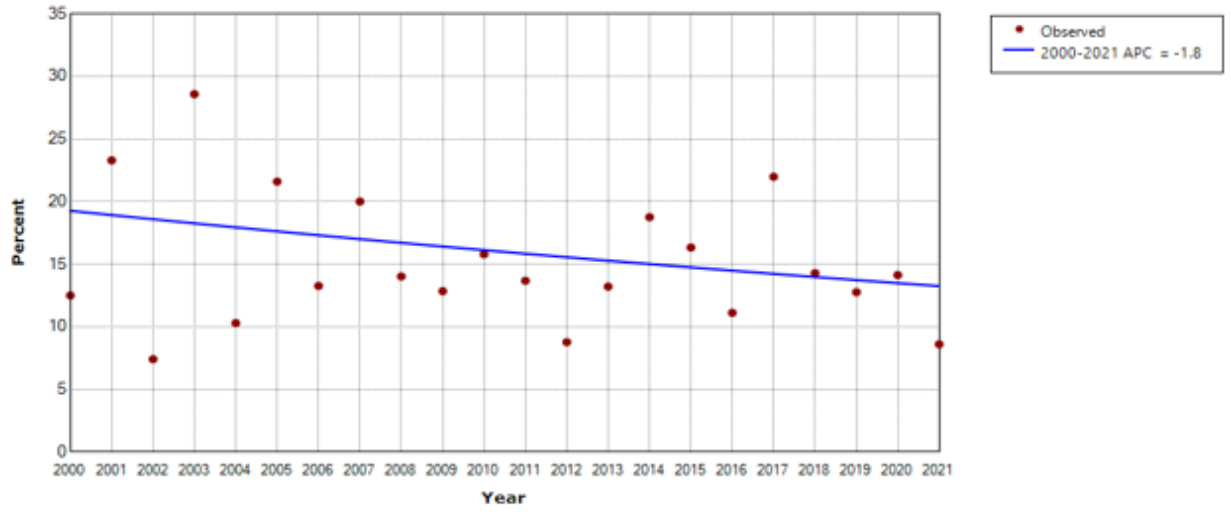
* Rates are age-adjusted to the 2000 US standard population with 18 age groups

Table 11: US national incidence rates for liver and biliary tree cancer by race and ethnicity, 2015-2019			
Race	**Total number of cases**	**Age-Adjusted Rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
US national rates	176,309	8.6	8.6-8.7
Non-Hispanic White	109,858	7.3	7.3-7.3
Non-Hispanic Black	24,024	10.7	10.6-10.8

Data source: U.S. Cancer Statistics Working Group. U.S. Cancer Statistics Data Visualizations Tool, based on 2021 submission data (1999-2019): U.S. Department of Health and Human Services, Centers for Disease Control and Prevention and National Cancer Institute; https://www.cdc.gov/cancer/dataviz, released in November 2022.

Appendix E: Birth Outcome Analysis Results

Figure 1. Trends in low birthweight among infants born in the area of interest, 2000-2021



*Indicates that the Annual Percent Change (APC) is significantly different from zero at the alpha = 0.05 level
Source: Kansas Department of Health and Environment, in-state live births to Kansas residents

Table 12: Percentage[1] of low birthweight (LBW) in the area of interest, Wichita, Sedgwick County, and Kansas, 2000-2003 through 2019-2021 (3-year rolling average)

	2000-2002			**2001-2003**			2002-2004			2003-2005			**2004-2006**			2005-2007			2006-2008		
	n	%	SE[2]	n	%	SE	n	%	SE	n	%	SE	n	%	SE	n	%	SE	n	%	SE
Area of interest	30	15.1	2.54	39	**20.5***	2.93	29	15.7	2.67	44	20.1	2.71	39	**15.4***	2.26	48	18.0	2.36	44	15.4	2.14
Wichita	1,546	7.9	0.19	1,559	8.1	0.20	1,557	8.0	0.19	1,584	8.1	0.19	1,577	7.9	0.19	1,617	8.0	0.19	1,715	8.3	0.19
Sedgwick County	1,736	7.6	0.18	1,751	7.8	0.18	1,768	7.7	0.18	1,802	7.8	0.18	1,815	7.8	0.18	1,849	7.8	0.17	1,943	8.0	0.17
Kansas	7,572	6.8	0.08	7,775	6.9	0.08	7,960	7.0	0.08	8,085	7.1	0.08	8,144	7.1	0.08	8,263	7.0	0.07	8,432	7.0	0.07

Table 12: Percentage[1] of low birthweight (LBW) in the area of interest, Wichita, Sedgwick County, and Kansas, 2000-2003 through 2019-2021 (3-year rolling average) – Cont.

	2007-2009			2008-2010			2009-20011			**2010-2012**			2011-2013			2012-2014			**2013-2015**		
	n	%	SE[2]	n	%	SE	n	%	SE	n	%	SE	n	%	SE	n	%	SE	n	%	SE
Area of interest	45	**15.2***	2.09	41	14.0	2.03	42	13.9	1.99	38	**12.4***	1.88	40	11.9	1.76	42	13.3	1.91	48	**16.0***	2.12
Wichita	1,748	8.4	0.19	1,784	8.7	0.20	1,712	8.5	0.20	1,701	8.6	0.20	1,594	8.3	0.20	1,547	8.3	0.20	1,464	8.1	0.20
Sedgwick County	1,986	8.0	0.17	2,032	8.3	0.18	1,995	8.3	0.18	1,986	8.4	0.18	1,868	8.1	0.18	1,798	7.9	0.18	1,691	7.7	0.18
Kansas	8,551	7.1	0.07	8,478	7.1	0.07	8,358	7.1	0.07	8,189	7.0	0.07	8,009	7.0	0.08	7,888	6.9	0.08	7,679	6.8	0.07

Table 12: Percentage[1] of low birthweight (LBW) in the area of interest, Wichita, Sedgwick County, and Kansas, 2000-2003 through 2019-2021 (3-year rolling average) – Cont.

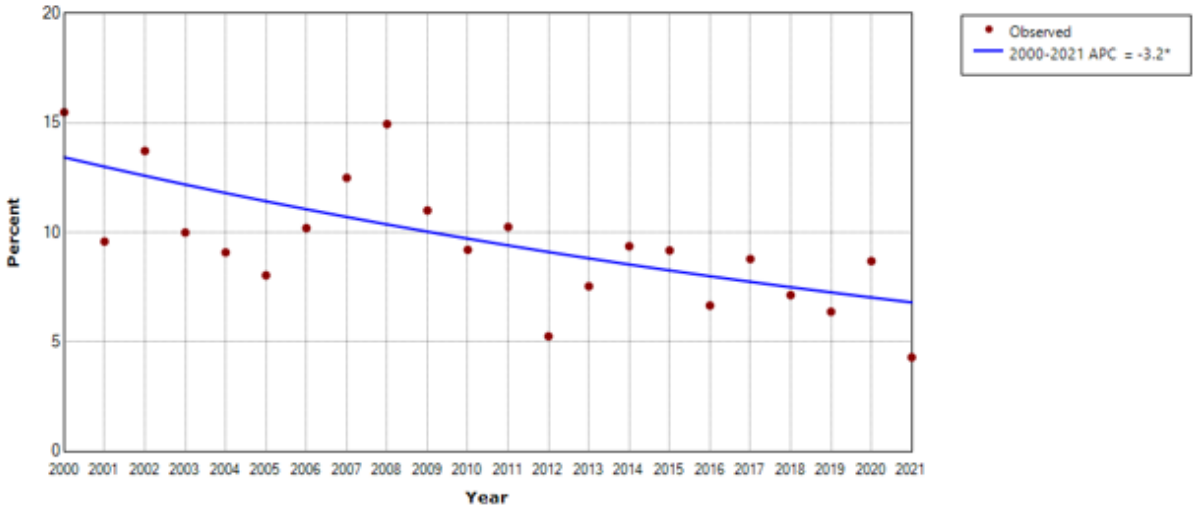
	2014-2016			2015-2017			**2016-2018**			2017-2019			2018-2020			**2019-2021**		
	n	%	SE[2]	n	%	SE	n	%	SE	n	%	SE	n	%	SE	n	%	SE
Area of interest	44	15.5	2.15	46	16.5	2.22	44	**15.8***	2.18	46	16.3	2.19	39	13.7	2.04	33	**11.8****	1.93
Wichita	1,442	8.1	0.20	1,436	8.2	0.21	1,403	8.3	0.21	1,421	8.6	0.22	1,362	8.4	0.22	1,362	8.6	0.22
Sedgwick County	1,677	7.7	0.18	1,679	7.8	0.18	1,660	8.0	0.19	1,681	8.3	0.19	1,604	8.1	0.19	1,614	8.2	0.20
Kansas	7,621	6.8	0.08	7,550	6.9	0.08	7,560	7.1	0.08	7,550	7.3	0.08	7,346	7.2	0.08	7,196	7.2	0.08

[1]LBW rate per 100 live births (the percentage of infants born at less than 2,500 grams or 5 pounds, 8 ounces)
[2]SE: Standard error

*Significantly different from Wichita, Sedgwick County, and Kansas ($p < 0.05$)
**Significantly different from Kansas ($p < 0.05$)

Source: Kansas Department of Health and Environment, in-state live births to Kansas residents

Figure 2. Trends in small for gestational age among infants born in the area of interest, 2000-2021



*Indicates that the Annual Percent Change (APC) is significantly different from zero at the alpha = 0.05 level
Source: Kansas Department of Health and Environment, in-state live births to Kansas residents

Table 13: Number of birth defects in the area of interest, 2000-2021

	Number
Female	60
Male	95
Total	155

Congenital heart defects: The number of reported cases was small, even with 5 years of data combined, the prevalence (the number of babies born with specific heart defect compared to the total number of live births) could not be calculated. According to the National population-based estimates for major birth defects, 2010-2014[10] and the CDC Data & Statistics on Birth Defects[11]:

a. *Common truncus (truncus arteriosus or TA)*: It is estimated that about 1 in every 15,696 babies born in the United States each with common truncus. In the area of interest, there were no cases reported in 2000-2021.
b. *Transposition of the great arteries (TGA)*: It is estimated that about 1 in every 2,695 babies born in the United States each with TGA. In the area of interest, there were no cases reported in 2000-2021.
c. *Tetralogy of fallot (TOF)*: It is estimated that about 1 in every 2,171 babies born in the United States each with TOF. In the area of interest, there were no cases reported in 2000-2021.
d. *Ventricular septal defect (VSD)*: VSD is the most common congenital cardiac anomaly in children.[12] It is estimated that about 1 in every 240 babies born in the United States each year are born with a VSD. In the area of interest, there were 9 cases reported in 2000-2021. The expected or usual number in the area of interest would be about 8-9. The observed number falls within the expected range of 3-15.
e. *Atrial septal defect (ASD)*: ASD is one of the most common types of congenital heart defects, occurring in about 25% of children.[13] It is estimated that about 1 in every 1,859 babies born in the United States each year are born with ASD. In the area of interest, there were no cases reported in 2000-2021.
f. *Atrioventricular septal defect*: It is estimated that about 1 in every 1,859 babies born in the United States each year are born with AVSD. In the area of interest, there were no cases reported in 2000-2021.
g. *Pulmonary valve atresia and stenosis*: It is estimated that about 1 in every 1,052 babies born in the United States each year are born with pulmonary valve atresia and stenosis. In the area of interest, there were 3 cases reported in 2000-2021. The expected or usual number in the area of interest would be about 2. The observed number falls within the expected range of 0-7.
h. *Tricuspid valve atresia and stenosis*: It is estimated that about 1 in every 5,938 babies born in the United States each year are born with tricuspid valve atresia and stenosis. In the area of interest, there were no cases reported in 2000-2021.
i. *Ebstein anomaly*: It is estimated that about 1 in every 13,047 babies born in the United States each year are born with Ebstein anomaly. In the area of interest, there were no cases reported in 2000-2021.

j. *Aortic valve stenosis*: It is estimated that about 1 in every 2,857 babies born[14] in the United States each year are born with aortic valve stenosis. In the area of interest, there were no cases reported in 2000-2021.
k. *Hypoplastic left heart syndrome*: It is estimated that about 1 in every 3,841 babies born in the United States each year are born with hypoplastic left heart syndrome. In the area of interest, there were no cases reported in 2000-2021.
l. *Coarctation of aorta*: It is estimated that about 1 in every 1,795 babies born in the United States each year are born with coarctation of aorta. In the area of interest, there were no cases reported in 2000-2021.
m. *Total anomalous pulmonary venous connection (TAPVC)*: It is estimated that about 1 in every 7,809 babies born in the United States each year are born with TAPVC. In the area of interest, there were no cases reported in 2000-2021.
n. *Single ventricle*: It is estimated that about 1 in every 13,351 babies born in the United States each year are born with single ventricle. In the area of interest, there were no cases reported in 2000-2021.
o. *Interrupted aortic arch (IAA)*: It is estimated that about 1 in every 16,066 babies born in the United States each year are born with IAA. In the area of interest, there were no cases reported in 2000-2021.
p. *Double outlet right ventricle (DORV)*: It is estimated that about 1 in every 5,997 babies born in the United States each year are born with DORV. In the area of interest, there were no cases reported in 2000-2021.

Central nervous system defects: The number of reported cases was small, even with 5 years of data combined, the prevalence (the number of babies born with specific central nervous system defect compared to the total number of live births) could not be calculated. According to the National population-based estimates for major birth defects, 2010-2014[10] and the CDC Data & Statistics on Birth Defects[11]:

a. *Anencephaly*: It is estimate that about 1 in every 4,647 babies born in the United States each year are born with anencephaly. In the area of interest, there were 2 cases including one stillbirth reported in 2000-2021. The expected or usual number in the area of interest would be less than 1. The observed number falls within the expected range of 0-4.
b. *Spina bifida without anencephaly*: It is estimate that about 1 in every 2,758 babies born in the United States each year are born with spina bifida without anencephaly. In the area of interest, there were no cases reported in 2000-2021.
c. *Encephalocele*: It is estimate that about 1 in 10,502 babies born in the United States each year are born with encephalocele. In the area of interest, there were no cases reported in 2000-2021.

d. *Holoprosencephaly*: It is estimate that about 1 in 8,000 to 1 in 10,000 live births and stillbirths. In the area of interest, there were no cases reported in 2000-2021.

Orofacial: The number of reported cases was small, even with 5 years of data combined, the prevalence (the number of babies born with specific oral cleft defect compared to the total number of live births) could not be calculated. According to the National population-based estimates for major birth defects, 2010-2014[10] and the CDC Data & Statistics on Birth Defects[11]:

a. Cleft palate alone (without cleft lip): It is estimated that about 1 in every 1,687 babies born in the United States each year are born with cleft palate alone (without cleft lip). In the area of interest, there was 1 case reported in 2000-2021. The expected or usual number in the area of interest would be about 1. The observed number falls within the expected range of 0-6.

b. Cleft lip alone (without cleft palate): It is estimated that about 1 in every 2,807 babies born in the United States each year are born with cleft lip alone (without cleft palate). In the area of interest, there was 1 case reported in 2000-2021. The expected or usual number in the area of interest would be about 1. The observed number falls within the expected range of 0-6.

c. Cleft lip with cleft palate: It is estimated that about 1 in every 1,600 babies born in the United States each year are born with cleft lip with cleft palate. In the area of interest, there were 2 cases reported in 2000-2021. The expected or usual number in the area of interest would be less than 1. The observed number falls within the expected range of 0-4.

Table 14: Number and percentage of maternal sociodemographic characteristics of live births in the area of interest and Kansas, 2017-2021						
Characteristics	Area of interest			Kansas		
Number of live births	468			170,100		
	Number	Percent	SE[1]	Number	Percent	SE
Demographics						
Mean age at delivery (years)	26.1 years			28.3 years		
<20	53	11.3*	1.46	8,997	5.3	0.05
20-29	288	61.5*	2.25	89,614	52.7	0.12
30-39	121	25.9*	2.02	67,671	39.8	0.12
≥40	6	1.3	0.52	3,809	2.2	0.04
Race and ethnicity						
Non-Hispanic White	68	14.5*	1.63	117,027	68.9	0.11
Non-Hispanic Black	266	56.8*	2.29	11,638	6.8	0.06
Hispanic	116	24.8*	2.00	29,466	17.3	0.09
Non-Hispanic Native American	3	0.6	0.37	718	0.4	0.02
Non-Hispanic Asian	1	0.2	0.21	5,510	3.2	0.04
Non-Hispanic Native Hawaiian and other Pacific Islander	1	0.2	0.21	345	0.2	0.01
Non-Hispanic Multi or other	13	2.8	0.76	5,196	3.1	0.04
Socioeconomic status						
Education						
< High school	127	27.1*	2.06	19,492	11.5	0.08
High school	217	46.4*	2.31	42,549	25.1	0.11
Some college and above	124	26.5*	2.04	107,288	63.4	0.12
Marital status						
No	368	78.6*	1.89	62,031	36.5	0.12
Yes	100	21.4*	1.89	108,040	63.5	0.12
Father listed on certificates						
No	128	27.4*	2.06	15,071	8.9	0.07
Yes	340	72.6*	2.06	155,029	91.1	0.07
Principal source of payment for the delivery						
Medicaid	307	65.6*	2.20	52,757	31.2	0.11
Private	95	20.3*	1.86	93,670	55.4	0.12
Self-pay/Uninsured	63	13.5*	1.58	11,883	7.0	0.06
Indian Health Service	0	0.0	0.00	102	0.1	0.01
Champus/Tricare	2	0.4	0.30	7,888	4.7	0.05

Other government	1	0.2	0.21	1,121	0.7	0.02
Other	0	0.0	0.00	1,545	0.9	0.02
Socioeconomic status						
WIC[2]						
No	218	46.6*	2.31	124,496	73.3	0.11
Yes	250	53.4*	2.31	45,296	26.7	0.11
Prenatal care initiation						
1st Trimester	349	74.6*	2.01	137,385	81.4	0.09
2nd Trimester	80	17.1	1.74	24,591	14.6	0.09
3rd Trimester	21	4.5	0.96	5,186	3.1	0.04
None	18	3.8*	0.89	1,684	1.0	0.02
Later or none	119	25.4*	2.01	31,461	18.6	0.09
Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index[3]						
Adequate Plus	82	17.5*	1.76	50,187	29.8	0.11
Adequate	285	60.9*	2.26	91,222	54.1	0.12
Adequate and Adequate Plus	367	78.4*	1.90	141,409	83.9	0.09
Intermediate	22	4.7	0.98	9,455	5.6	0.06
Inadequate	79	16.9*	1.73	17,746	10.5	0.07
Plurality						
Singleton	451	96.4	0.86	164,819	96.9	0.04
Multiple	17	3.6	0.86	5,274	3.1	0.04
Inter-pregnancy interval						
< 1 year	6	1.8	0.73	1,474	1.4	0.04
12-17 months	49	14.8*	1.95	9,305	8.7	0.09
18-23 months	51	15.4	1.98	15,264	14.3	0.11
24-35 months	62	18.7*	2.14	27,583	25.8	0.13
36+ months	163	49.2	2.75	53,098	49.8	0.15
<18 months	55	16.6*	2.05	10,779	10.1	0.09
18+ months	276	83.4*	2.05	95,945	89.9	0.09
Comorbidities						
Pre-pregnancy body mass index (BMI)						
Underweight (<18.5)	21	4.5*	0.96	4,479	2.6	0.04
Normal weight (18.5-24.9)	157	33.6*	2.19	66,795	39.5	0.12
Overweight (25.0-29.9)	122	26.1	2.03	46,239	27.3	0.11
Obese (30.0+)	167	35.8*	2.22	51,560	30.5	0.11

Overweight and Obese	289	61.9	2.25	97,799	57.8	0.12
Previous preterm birth	23	4.9*	1.00	4,685	2.8	0.04
Previous Cesarean	76	16.2	1.70	25,361	14.9	0.09
Comorbidities						
Hypertension						
Prepregnancy (Chronic)	17	3.6	0.86	3,573	2.1	0.03
Gestational (PHI[4]) preeclampsia	41	8.8	1.31	13,311	7.8	0.07
Eclampsia	0	0.0	0.0	690	0.4	0.02
Diabetes Mellitus						
Prepregnancy	2	0.4	0.30	1,460	0.9	0.02
Gestational	37	7.9	1.25	13,038	7.7	0.06
Substance use - smoking						
Prepregnancy	69	14.7*	1.64	17,191	10.1	0.07
1st Trimester	68	14.5*	1.63	14,497	8.5	0.07
2nd Trimester	67	14.3*	1.62	13,014	7.7	0.06
3rd Trimester	67	14.3*	1.62	12,491	7.4	0.06
Anytime during pregnancy	68	14.5*	1.63	14,694	8.7	0.07

[1]SE: Standard error

[2]WIC: Special Supplemental Nutrition Program for Women, Infant, and Children

[3]Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) Index – A ratio of observed to expected visits is calculated grouped into four categories: Inadequate (received less than 50% of expected visits), Intermediate (50%-79%), Adequate (80%-109%), Adequate Plus (11% or more)

[4]PHI: Pregnancy induced hypertension

*Significantly different from Kansas ($p < 0.05$)

Source: Kansas Department of Health and Environment, in-state live births to Kansas residents

Appendix F: Hepatitis C Virus Infection Analysis Results

Table 15: Rate of hepatitis C virus infections by race, 2009-2019			
	Total number of cases (2009-2019)	**Age-Adjusted Rate (per 100,000 population)**	**95% Confidence Interval (per 100,000 population)**
Area of Interest			
White	247	1984.3	1736.8 - 2231.7
Black	174	1531.8	1304.2 - 1759.4
Sedgwick County			
White	2297	538.4	516.3 - 560.4
Black	468	853.1	775.8 - 930.4
Region 5			
White	3030	555.9	536.2 - 575.7
Black	516	874.4	798.9 - 949.8
Kansas			
White	12,401	484.7	476.2 - 493.2
Black	1645	791.8	753.5 - 830.1

Data source: Kansas Department of Health and Environment, Bureau of Epidemiology and Public Health Informatics