pennsylvania
DEPARTMENT OF HEALTH

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SUBJECT: Review of Cancer Burden at the PA State Correctional Institute - Fayette

TO: Martin Ranicwski, MA
Deputy Secretary for Health Planning & Assessment

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Per the request of the Pennsylvania Department of Corrections, Bureau of Health Care Services, through Christopher H. Oppman, MBA, MHA, Director Department of Corrections, Bureau of Health Care Services, the Pennsylvania Department of Health was asked to evaluate the cancer concerns of inmates and advocacy groups regarding cancer risks at the State Correctional Institute-Fayette. In response, PADOH/ Bureau of Epidemiology developed the attached report. We believe the findings serve as an objective assessment of the cancer burden and risk at the facility. A summary of the findings appear on the last page of the text.

If you have any questions, please contact Dr. Gene Weinberg (gweinberg@pa.gov).

REVIEW OF THE CANCER BURDEN AT THE PENNSYLVANIA *STATE CORRECTIONAL INSTITUTION FAYETTE*

Background

In August 2013 the *Human Rights Coalition, Center for Coalfield Justice, and the Abolitionist Law Center* of western Pennsylvania began an investigation of health conditions of prisoners at the Commonwealth of Pennsylvania, Department of Corrections (PADOC), *State Correctional Institution - Fayette* (SCI Fayette). The need for an investigation was prompted by reports of a pattern of declining health among inmates with a variety of symptoms and diseases believed to be possibly linked to exposures to toxic coal waste surrounding the facility. Health problems were described as; respiratory throat and sinus conditions, skin irritation and rashes, gastrointestinal tract problems, pre-cancerous growths and cancers, thyroid disorders, eye problems, headaches, dizziness, hair loss, weight loss, fatigue, and loss of mental focus and concentration. That investigation resulted in the report, "***No Escape: Exposure to Toxic Coal Waste at State Correctional Institution Fayette***". The report included a description of the ambient environment and health problems. It led the PADOC to seek the expertise of the Pennsylvania Department of Health (PADOH) to review the content related to cancer rates.

In response, the Bureau of Epidemiology (BOE) carried out a cancer incidence analysis. The PADOH is sensitive to concerns of individuals with cancer whether they are residents of a municipality, a neighborhood, or an institution. The types of cancer, relative frequencies, in addition to incidence rates or risks were ascertained for inmates of the SCI Fayette facility using the files of the *Pennsylvania Cancer Registry* (PCR). The PCR was utilized rather than "self-reports" to assure all cancers (cases) diagnosed among inmates were counted and the most accurate information was used.

The Pennsylvania Department of Corrections state prison is a maximum security facility for males located in the community of LaBelle in Luzerne Township, Fayette County. It is situated on land formerly used as a dump for coal waste in the form of "*coal refuse*" (waste produced when coal is cleaned and graded before it is burned), and "*coal ash*" (waste produced

by burning coal in power plants throughout the region). In 1996 the owners of the coal waste disposal facility which originally occupied 1,357 acres transferred 237 acres to the Commonwealth of Pennsylvania for the construction of the SCI Fayette prison completed in September 2003. The prison is currently surrounded by approximately 40 million tons of waste, two coal slurry ponds, and millions of cubic yards of coal combustion waste. Concern about the ambient environment coupled with inmates' health problems lead prisoners, human rights groups, prisoners' rights groups, and environmental justice groups to question the health effects of pollutants from the waste facility, and to conduct an ***investigation*** of health effects.

That investigation was based on a mailed questionnaire to prisoners. Survey questions addressed individual health problems, and environmental conditions at the facility. As of July 2014, 152 surveys had been sent, with 63 prisoners responding and another 12 prisoners writing separately to describe their health "*situation*", with an additional four prisoners interviewed directly by an investigation team member. Study findings reported 17 prisoners died at the SCI Fayette facility, eleven from cancer. Cancer cases identified by prisoners or described by the medical management of the PADOC included these cases; 3 lung, 2 brain, 2 colon-rectum, 2 tongue and mouth, 1 tonsil, 1 stomach, 2 liver, 1 bladder, 1 prostate, 1 lymphoma, and 1 leukemia for a total of 17 cancer cases.

While the information is valuable, self-reported diseases can be problematic. First, if reports are not validated using information found in medical records there is no way to know if the reported case is actually cancer and the exact type. This requires microscopic determination from tissue samples. Most new tissue growths (neoplasms) aren't cancer, rather are benign but can include precancerous lesions. Histological examination of tissue specimens is the only valid way to determine if cells of a neoplasm are malignant. Additionally, self-reported cancers typically describe the organ site lesions were found, but often it is independent of the standard classification system which is based on *site of origin.* For example, cancers of the stomach may often evolve from the organ's lymph tissue, but because lymph tissue develops from a distinct class of embryonic cells and lymphocytes are so specialized, they are classified as a distinct group of cancers, and are organized based on histological characteristics rather than anatomical location, consequently are generally considered and counted as a type of *non-Hodgkin's lymphoma* (NHL).

Additionally, misclassification can occur if a cancer arises at a single organ site and spreads to adjacent or more distant organs. Though it spread to other organs, a cancer will still retain the cellular characteristics of the tissue of origin but is considered *metastatic*. As such, it should be ascribed to the organ of origin as the primary site, not the site to where it spread. Self-reported cancers frequently are not correct if they are metastatic lesions. For example, if malignant lung tissue is discovered in the brain it should be labeled as such, i.e., *"metastatic adenocarcinoma of the lung"*, not brain cancer.

Any determination of a population's risk needs to be based on ***incidence rates***, or the rate *new cases* develop in the population during a defined period of time. This is not the same as counting *all* inmates in the prison who had ever been diagnosed with a particular cancer, or ***prevalence***. In any group the number of persons living with cancer is always larger than the number of new cases diagnosed, as prevalence includes both *new* and *old* cases, and often can be large. While the total number of men who have had cancer is an important measure of the disease burden, it is not considered a measure of risk. The determination of factors responsible for the development of a type of cancer is generally linked to the *incidence rate.* When the number of new cases is divided by the number of individuals at risk - typically the population studied- the incidence rate is created. Commonly, reports of persons diagnosed with cancer who ever lived in a community are considered a measure of risk when it is a measure of prevalence.

The PADOH report, *"Review of the Cancer Burden at the Pennsylvania State Correctional Institution Fayette"* [*study*] was designed to provide objective measures of cancer risk for inmates of SCI Fayette relative to all Pennsylvania males. To best determine incidence and rates among inmates, the Pennsylvania Cancer Registry (PCR) was used. This provided the most complete and accurate measures of cancer rates or risks in the population. Both the numbers and types of new cases diagnosed among inmates were determined, and the rates for individual cancer types were calculated and compared to the statewide experience of all men.

Methods

Case Ascertainment

Cancer cases were defined as inmates of PADOC, SCI Fayette who had been diagnosed with cancer between September 1, 2003 and December 31, 2012; from initial occupancy at the

prison (September 2003) through the most current calendar year cancer incidence reporting was complete and data were verified - 2012. Based on this time period, the files of the PCR were searched for all cancer cases that ever showed any of the following for **residence at diagnosis** for any reason; *"SCI Fayette", "SCI Fayette County," 50 Overlook Drive", "421 LaBelle Rd", " SCI Labelle", " La Belle", "LaBelle"* and a zip code of 15450. The diagnosis data examined included the following residence items; *"DxCity", "DxNumberAndStreet", "DxPostal"*, in addition to **current address** information, including; *"CurrCity", "Currsupp", "CurrPostalZip"*. This identified any man who had ever been diagnosed either at the facility or whose *current* address was the prison following a diagnosis.

Description of Cases

Ascertained cases were sorted according to the anatomical and histological classification scheme defined by the World Health Organization, *WHO International Classification of Disease for Oncology*, Third Edition, 2000. A total of 45 incident cancers met the inclusion criteria. These were diagnosed among 41 prisoners; one prisoner had been diagnosed with three malignancies, two others were each diagnosed with two cancers, and 38 prisoners diagnosed with one cancer each. Table 1 shows the distribution of these cases by type for prisoners compared to all adult Pennsylvania male cases. Comparisons were based on the statewide distribution during the three-year period 2007-2009 (approximate mid-period). This represented 114,630 incident cases or about 38,200 new diagnoses among Pennsylvania males annually.

The PADOH determined the cancer risk of prisoners by a method called *indirect* age-adjustment which is particularly suited for studying small numbers of health events. The incidence rate for prisoners was compared to the rate for all Pennsylvania males and expressed as the ratio of the two, called the Standardized Incidence Ratio or *SIR*. It is equivalent to the number of cases observed / cases expected. Ratios were created by comparing the numbers of cancers reported to the registry for the prison population to the number that would be expected in this population if it had experienced the same cancer risks as all men in the state. Here the PADOH applied *Pennsylvania's* statewide incidence rates for men over age twenty to the numbers of prisoners at risk in the prison to determine the numbers of cancers *expected.* Cases expected were based on Pennsylvania's rates rather than U.S. rates for two reasons. The PADOH routinely uses statewide rates for population studies, thus making risk comparisons between the current

findings and other studies possible; and, second, interpreting results is easier as the characteristics of Pennsylvania are generally better understood than the entire U.S.

Specifically, the numbers of cancer cases *expected* for a cancer type was derived by multiplying the population of inmates in each age group by the *cancer-specific* statewide male incidence rate for the same age-group. Ten 5-year age groups were used; 20-24, 25-29, 30-34 . . . 55-59, 60-64, and 65+. Cancer risks for white, black and Hispanic males can differ considerably. To control for differences, the state's age-specific rate for each group was weighted by the proportion of the prison population represented by each group to produce a weighted white-black-*Hispanic male age-specific incidence rate*. Proportions used to weight age-specific rates for whites, blacks, and Hispanics were, p_1=0.394, p_2=0.494, and p_3=0.112, respectively; where $p_1 + p_2 + p_3$=1.000. For each cancer type, the numbers of cancer cases expected for each age group were summed across ages to obtain the total number of cases expected in the prison population. When cancer risks were the same for prisoners as men statewide, then observed numbers of cases should be the same as the number expected. Thus, an SIR close to 1.00 indicates the incidence rate or risk experienced by inmates is the same as other men living in the state. An SIR greater than 1.00 [Obs./Exp. >1.00] suggests the cancer rate is elevated relative to the state, and similarly a ratio less than 1.00 indicates the study group's risk is lower than male residents of Pennsylvania.

Results

Table 1 shows both the distribution of all 45 cases diagnosed between September 2003 and December 2012, and 114,630 statewide cases for the 2007-2009 three years period. The four leading types diagnosed for state males were colon & rectum, bronchus & lung, prostate and urinary bladder. Together they accounted for 67,747 cases or 59.1 percent of total cancers, while among inmates 25 cases or 55.5 percent. Though the numbers of cases diagnosed for prisoners were small their distribution was similar to all Pennsylvania males. Percentages varied from the state by less than 2.0 percent for eleven types; esophagus, stomach, pancreas, larynx, bronchus & lung, urinary bladder, prostate, brain/CNS, thyroid, NH lymphomas, leukemia. Only for liver cancer was the proportion of cases greater than five percent (8.9 % versus 2.0%) compared to Pennsylvania.

Table 2 shows the SIR values for 17 individual cancer types and All Cancers combined. For nearly every type, the numbers of cases diagnosed for prisoners were fewer than expected based on statewide incidence rates for men. But significantly lower rates were found only for colon-rectum (SIR=0.51, 3 obs./5.85 exp.), bronchus & lung (*SIR=0.76*, 6 obs./7.93 exp.), and prostate cancer (*SIR=0.62*, 12 obs./19.26 exp.)), in addition to All Cancers (*SIR=0.70*, 45 obs./64.7 exp.). Whereas significantly elevated rates were seen for only liver cancers (*SIR=1.52*, 4 obs. / 2.63 exp.). While incidence ratios exceeded 1.00 for urinary bladder (*SIR=1.76*), Hodgkin's lymphoma (*SIR=2.67*), and leukemia (*SIR=1.32*) these were not statistically significant.

Discussion

This study was conducted with the purpose of defining the cancer burden among inmates examining the types of cancer, their relative frequencies, and the incidence rates or risks. Based on the medical and epidemiological literature several well established risk factors causally linked to specific cancers can likely explain the variations in rates from expectation based on risk factors associated with some prisoners. These are discussed in the medical and public health literature and summarized here.

Bronchus, Lung and Other Respiratory Cancers

The rate of lung cancer appears to be about 24 percent lower than Pennsylvania males (SIR=0.76). If these inmates were long time cigarette smokers, it's fairly certain their behavior was responsible for their disease. Tobacco smoke causes 85 to 90 percent of all bronchus and lung cancer cases therefore when cancer rates differ between populations, it can be attributed to differences in smoking prevalence rather than other sources of carcinogens. In addition nasal, oral, and laryngeal cancers are directly caused by cigarettes too. The types and proportions of cases attributable are; mouth [0.65], larynx [70.]; where a history of excessive alcohol consumption adds to the risks.

Tobacco smoke is a major source of pollution. It contains 7,000 chemicals, 250 are very harmful and affect every system of the body. Health affects occur from their absorption through tissues lining the respiratory and digestive tracts and from chemicals transported to other organs through the blood. Toxic substances include; 1) metals, comprising arsenic, beryllium, cadmium, chromium, and nickel, 2) radioactive elements polonium-210 and lead-210 metals and

radon, 3) toxic hydrocarbons including very potent carcinogens; 1,3 butadiene, vinyl chloride, in addition to formaldehyde, benzo-*a*-pyrene and toluene .

Urinary Bladder, Kidney, Pancreas, Esophagus, Liver

In addition to respiratory cancers, other types caused from tobacco smoke and the percent of cases attributable are; pancreas - 22%, Liver – 15%, kidney-27%, urinary bladder-40%, and esophagus up to 70 % when combined with long term heavy alcohol consumption. Together there were 12 tobacco-related cancer cases diagnosed among these inmates. If long-term smoking was characteristic of each case then it would be reasonable to expect at least half or six occurred from tobacco use (cigarettes, cigarillos, cigars).

Colon-rectum

Three cases were diagnosed during the 2003-2012 period. While several risk factors are recognized, it is not clear the magnitude of the risk conveyed. Diets high in fat and/or low in fiber content are associated. Other high-risk conditions include history of adenomatous polyps, familial polyposis syndrome, and inflammatory bowel disease. Environmental carcinogens have been explored primarily in relation to food consumption. Animal and experimental studies show that heterocyclic aromatic amines (HAA) serve as mutagens and are the result of both the type of foods consumed and how they are prepared. Sources include heating of fats, as well as meats and fish that are smoked, barbecued or cured. However, these food sources alone do not seem to account for the higher rates that we see in Pennsylvania. Other important factors include calcium consumption (preventative), vitamin D consumption (preventative), as well as alcohol consumption (promotion), and obesity (promotion). Pollution, however, has not been linked to bowel cancers.

Liver

The most common risk factor for liver cancer is chronic (long-term) infection with hepatitis B virus (HBV) or hepatitis C virus (HCV). These infections lead to cirrhosis of the liver. People infected with both viruses have a high risk of developing chronic hepatitis, cirrhosis, and liver cancer. Cirrhosis is a disease in which liver cells become damaged and are replaced by scar tissue, which in turn is linked with an increased risk of liver cancer. The risk is even higher if they are heavy drinkers (at least 6 standard drinks a day). Alcohol abuse is a leading cause of cirrhosis in the United States, and being very overweight increases the risk of

liver cancer. This is probably because it can result in fatty liver disease and cirrhosis. Type 2 diabetes has been linked with an increased risk as well. Infection with these viruses and alcohol consumption are also linked to behavioral determinants. Environmental agents long recognized as carcinogens for this cancer include *aflatoxins* made by a fungus that contaminates peanuts, wheat, soybeans, ground nuts, corn, and rice. Storage in a moist, warm environment can lead to the growth of this fungus. Exposures to high concentrations of work-related plastic solvents is a risk factor, as are anabolic steroids, male hormones used by some athletes to increase their strength and muscle mass increase risk. Drinking water contaminated with naturally occurring arsenic, such as that from some wells, over a long period of time increases the risk of some types of liver cancer, though the arsenic species responsible for elevating liver cancer risk is not common in the U.S. and is not present in domestic or environmental water at the prison.

Prostate

The most important risk factors for prostate cancer are *age* and *race*. While only one in 10,000 men under age 40 will be diagnosed with the cancer, the rate increases dramatically with age so that one in 15 men in their 60s will be diagnosed. African American men are approximately 60 percent more likely to develop prostate cancer in their lifetime than Caucasian or Hispanic men, and there were 26 percent more Black prisoners than whites leading to larger numbers of cases. Men don't always demonstrate special symptoms leading to their diagnosis, rather screening reveals large numbers of cases and can affect the disease rate in a population. In Pennsylvania as elsewhere other factors contributing to risk include family history where men are twice as likely to develop the disease if an immediate blood relative, such as a father or brother, had prostate cancer. Other risk factors include a diet high in saturated fat, as well as obesity, and use of testosterone therapy. The ambient environment including pollution is not recognized as a source of carcinogens though.

Lymphomas

Four lymphomas were identified from the Pennsylvania Cancer Registry among inmates; two cases of Hodgkin's disease (HD) or Hodgkin's lymphoma and two cases of non-Hodgkin's lymphoma (NHL). Neither of these types is linked to ambient pollution. Risk factors for Hodgkin's lymphoma or Hodgkin's disease (HD) are largely unknown. There is no established association with tobacco use, diet, or alcohol, though hormones may play a role. An infectious

origin has been suggested, particularly the role of the DNA Epstein-Barr virus (EBV), and the risk of HD is somewhat higher in people who have been infected with it. However, the virus' role still is uncertain, though the HIV is a risk factor for NHL. Studies of lymphomas show little or no evidence to support the idea they are caused by toxic waste sources.

Leukemia

Leukemia have received much attention when concerns arise about environmental toxins There are several established agents for the leukemia, however they account for a small proportion of all cases. The cause(s) of most leukemia cases remain largely unknown. The role of viruses in animals has been established for a long time. More recently, the human T-cell lymphotropic virus (HTLV-1), the AIDS virus, and the Epstein-Barr virus (EBV) have been shown to cause some adult T-cell leukemia. In addition, therapeutic agents such as chemotherapy (alkylation agents) can cause leukemia. Several sources of x-radiation have been shown to cause the disease, however doses must be relatively large; as with diagnostic x-rays and long-term exposures to high levels of radiation. For non-ionizing radiation, there are no proven excesses from electromagnetic fields. Cigarette smoking does support an elevated risk of leukemia, but alcohol consumption data is conflicting. In addition some genetic syndromes increase lifetime risk.

Several types of cancer aren't discussed in this report as little is known about their etiology. It would not be constructive to ascribe a cause without a body of supporting evidence from recognized scientific institutions such as the National Cancer Institute, Centers for Disease Control and Prevention, National Institute of Medicine, or U.S. Preventative Services Task Force.

While controlling large amounts of fly ash is an important environmental management issue and populations can be vulnerable to its irritant effects on the skin and body membranes, including the respiratory tract, the medical and epidemiological literature does not support the idea that exposure to this material creates an excess cancer risk. Its inflammatory effects on people from its physical properties and interactions with chemical constituents do not increase the risks of cancer, and interactions with chemical constituents including toxic hydrocarbons also have not been shown to increase cancer risks.

Summary

The purpose of this study was to: 1) understand the types of cancer affecting men ate the prison, 2) evaluate the rates of occurrence, and 3) assess whether the ambient environment of the facility could have contributed to the incidence over time. The creation of rates was based on the premise that any stay at the SCI facility could elevate an inmate's risk and would be measureable if inmates were followed long enough. Follow-up is important to obtain most reliable measure of risk (rates), because cancers have very long "incubation" periods and since small numbers of inmates were studied. A limitation of this study was the inability to link inmate identifiers to the cancer registry over a longer period of time. It would have been most effective to trace all inmates over time by linking them to the PCR as well as other cancer registries in neighboring states where they might have resided, in order to obtain the best measure cancer occurrence after leaving SCI Fayette. For these reasons the determination of rates in this study is less precise. Just the same this examination of incidence in these men provides an important picture of the magnitude of cancer in the prison population.

The Department of Health is sensitive to concerns about disease clusters in all communities, including residents of SCI Fayette. In an effort to provide the most current assessment of the cancer burden and risk, the types of cancer, the relative frequencies and incidence rates were examined through 2012. This *study* was not designed to be an etiological investigation; to determine whether a particular pollutant in the environment is a carcinogen. Answers to this question require analytical designs that are beyond the scope of work of the PADOH. Studies of etiology are the responsibility of the National Cancer Institute (NCI), and the Centers for Disease Control (CDC), and universities. These institutions have already been important resources for examining the potential for fly ash to cause cancer.

This study provides objective measures of cancer incidence rates compared to all men in Pennsylvania. ***Based on the types of cancer observed and the rates, there isn't an indication the environment contributes to the risk, and there are no environmental data demonstrating that there are human exposures to significant levels of carcinogens that could increase the cancer risk.***

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Table 1

Distribution of Incident Cancer Cases by Type, Male Inmates SCI-Fayette Facility
Diagnosed from 2003 to 2012 and Male PA Residents from 2007 to 2009

	SCI Fayette [2003-2012]		Pennsylvania [2007-2009]	
	Percent	Cases	Percent	Cases
All Cancers	100.0	45	100.0	114,630
Mouth & Pharynx	0.0	0	2.9	3,350
Esophagus	0.0	0	1.7	1,968
Stomach	2.2	1	1.8	2,020
Colon - Rectum	6.7	3	9.8	11,200
Liver	8.9	4	2.0	2,248
Pancreas	2.2	1	2.5	2,835
Larynx	2.2	1	1.3	1,451
Bronchus & Lung	13.3	6	14.7	16,894
Malignant Melanonma - Skii	0.0	0	3.9	4,437
Kidney	0.0	0	4.0	4,593
Urinary Bladder	8.9	4	7.6	8,663
Prostate	26.7	12	27.0	30,990
Brain & Nervous System	2.2	1	1.4	1,590
Thyroid	0.0	0	1.5	1,768
Non-Hodgkin's Lymphoma	4.4	2	4.3	4,917
Hodgkin's Lymphoma	4.4	2	0.6	684
Leukemia	4.4	2	2.7	3,146
Other & Unknown	13.3	6	11.9	11,876

Pennsylvania Department of Health

Table 2

Observed * and Expected ** Cancer Cases, and Risk Ratios [SIR]
Inmates of Pennsylvania State Correctional Facility Fayette, for 2003-2012

CANCER	Cases		Risk Ratio [SIR]	
	Observed	Expected	Obs. / Exp. Cases	
	A	B	A // B	Sig.
All Cancers	*45*	64.70	*0.70*	*sig*
Mouth & Pharynx	0	2.29	0	ns
Esophagus	0	0.84	0	ns
Stomach	1	1.33	0.75	ns
Colon-Rectum	3	5.85	0.51	*sig*
Liver	4	2.63	1.52	*sig*
Pancreas	1	1.49	0.67	ns
Larynx	1	1.40	0.71	ns
Bronchus & Lung	6	7.93	0.76	*sig*
Malig. Melanoma-Skin	0	1.32	0	ns
Kidney	0	3.15	0	ns
Urinary Bladder	4	2.27	1.76	ns
Prostate	12	19.26	0.62	*sig*
Brain & Nervous Sys.	1	1.08	0.93	ns
Thyroid	0	1.11	0	ns
Non-Hodgkin's Lymphoma	2	3.11	0.64	ns
Hodgkin's Lymphoma	2	0.75	2.67	ns
Leukemia	2	1.51	1.32	ns
Other & Unknown	6	-	-	

* Observed based on incidence during or after prison stay.
** Based on standardized rates; adjusted by age, race/Hispanic .
sig Rate statistically significant.
ns Rate not statistically significant.

Pennsylvania Department of Health.