



New York State Department of Health  
Center for Environmental Health

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**Health Outcomes Review:  
Hospitalizations for Selected Outcomes, 1982-2005**

**Van der Horst Area, City of Olean  
Cattaraugus County, New York**

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## INTRODUCTION

This health outcomes review was conducted by the New York State Department of Health (NYS DOH) in response to concerns about potential environmental exposures and the health of residents near the former Van der Horst Corporation plants in Olean, Cattaraugus County. This review compares rates of hospitalizations among residents of this area to rates of hospitalizations in the comparison area.

*A health outcomes review uses information from already existing sources, such as hospitalization records, to compare rates of health outcomes among residents of a specific area to rates of those same outcomes in residents of a comparison area.*

This type of review cannot prove whether there is a causal relationship between specific exposures and health outcomes in a community, nor can it determine the cause of any specific individual's health problems. The findings of this type of review may be used, together with findings from other

similar investigations, to suggest hypotheses for more in-depth research studies. The study may also be useful to residents because it provides them with general information about rates of health outcomes in their area.

## BACKGROUND

The Van der Horst Corporation operated two electroplating plants (called Plant #1 and Plant #2) in Olean, Cattaraugus County, from the 1940s until 1987. Contamination issues led to both plant sites being listed on New York State's Inactive Hazardous Waste Site Registry, and most of the site clean-up activities were completed by 1997. In the summer of 1999, excavation of chromium-contaminated subsurface soils resulted in community concerns about exposures to vapors and dust associated with the Plant #1 site. A public meeting to address residents' complaints was held in August 1999, and two elected officials requested that the New York State Department of Health conduct a health study for residents of the affected area. This current health outcomes review was conducted because of these requests. The review was designed to address chronic exposures and long-term health effects that may have occurred from exposures during plant operations through 1987 and exposures that may have occurred from contaminated residential soils prior to the remediation completed in 1997.

Plant #1 airborne emissions of arsenic, lead and chromium led to contamination of residential surface soil which was removed during 1994 and 1995. Plant #2 operations led to contamination of on-site soil with chromium and barium near homes and areas used by children. Groundwater was contaminated with chromium, lead and volatile organic compounds, but there were no residents using private wells near the site (NYS DEC 1996, NYS DEC 1998). (For recently updated information on the sites, see <http://www.dec.ny.gov/cfm/external/derexternal/haz/details.cfm>.)

Two prior health investigations were conducted among residents of the area. A cancer incidence study of the City of Olean was completed in May 1990 for cancers diagnosed from 1976 through 1986 (NYSDOH 1990) and a health survey of respiratory problems was conducted in the area in 1989 (NYSDOH 1989). The cancer incidence study showed no statistically significant elevations of cancer in the study area, which included the City of Olean. Because only 30% of residents in the respiratory health survey returned questionnaires, this study was not able to draw conclusions about respiratory disease rates in the area.

The study area for the current investigation of hospitalizations was developed using the residential area selected for the 1989 respiratory health study. This is a relatively small area near the two plants which are on the northern boundary of the City of Olean (Figure 1). The area includes approximately 2,000 people and the boundaries are defined by four Census block boundaries. (A separate cancer incidence study has been conducted as a companion study to the current study. It also includes the small area near the plants and covers the years 1993-2002.) This hospitalization review includes all the years for which hospitalization data were available when the study data were acquired (1982-2005).

The contaminants of primary concern are chromium and arsenic. Exposures to chromium, arsenic, and other contaminants may have occurred from breathing contaminated air and from skin contact with and ingestion of contaminated soil while playing or working outdoors (e.g., gardening). Studies of relatively high-level occupational exposures to chromium and arsenic have shown effects on the skin, the respiratory system, and the digestive system. Effects on blood cells, the liver, kidney, eyes, and nervous system have also been reported. Cardiovascular disease has been associated with arsenic exposures in some studies but not with chromium exposures. (ATSDR 2000, ATSDR 2008).

## **METHODS**

The goal of this review of hospitalizations in the area near the former Van der Horst plants is to provide general information about the pattern of hospitalizations in this area and to also provide, if possible, information about hospitalizations for specific diagnoses that have been associated with chromium and/or arsenic exposures in other studies. In order to provide this information, we compared rates of hospitalizations in the study area to rates in the comparison area (Cattaraugus County, excluding the study area). These rates were adjusted by sex and age.

Hospitalization data are useful for assessing the burden of disease, and are frequently used to assess respiratory and cardiovascular disease burden in communities. These data are not a comprehensive measure of disease incidence, however, because some people with these conditions or diseases may not be hospitalized. In addition, the hospitalization data may include multiple admissions for the same individual for the same disease. Hospitalization data for all of NYS are compiled in a statewide database, the Statewide Planning and Research Cooperative System (SPARCS). We acquired the data for this investigation from SPARCS after acquiring approval for the data from the SPARCS Data Protection Review Board.

The first outcomes included in this review are general disease categories organized by body organ system. This set comprises nine groups and provides information on the overall pattern of hospitalizations in the study area. The second set of outcomes includes more specific subsets of the general disease categories. These outcomes include specific disease(s) that have been associated with chromium and/or arsenic exposures in other studies. There are a number of symptoms and conditions associated with chromium and/or arsenic exposure that are not included in this review because they would not be expected to lead to a person being hospitalized. For example, this review did not attempt to quantify and compare hospitalizations for symptoms associated with eye irritation. Appendix Table 1 lists the general disease categories and Appendix Table 2 lists the specific disease(s) included in the analyses.

Cattaraugus County, excluding the study area, was selected as the comparison area based on consideration of characteristics of the study area and potential comparison areas. The local county comparison area was selected after consideration of three potential comparison areas:

- (1) 40 non-urban counties of NYS, and
- (2) the six non-urban counties closest to Cattaraugus County, and
- (3) Cattaraugus County excluding the study area.

We considered factors such as the age, sex, and race distribution of the study area and comparison area populations, as well as median income and percent population below poverty. Appendix Table 3 shows these demographics. Median household income and % below poverty were considered because hospitalization rates are known to be influenced by socio-economic status. For many types of diagnoses categories, people with lower incomes are more likely to be hospitalized than people with higher incomes.

In both the 1990 and 2000 Census data, the median income level for the study area is lower than the median income in the three potential comparison areas. The difference is greatest between the study area and the 40 non-urban counties, with median income in the Van der Horst study area in 1990 being 19% lower, and in 2000, 27% lower, than in the 40 county comparison area. These Census data indicate that the Van der Horst study area appears to be most similar to the Cattaraugus County comparison area in terms of median income.

Cattaraugus County is also an appropriate comparison area because it represents the same local area as the study area. There may be regional differences in hospitalization rates within NYS related to medical practice and hospital-specific practices and preferences. A more local comparison group can better control for these types of differences.

In order to account for possible differences between the study and comparison area in terms of age and sex, the population numbers by sex and age group are used to calculate the rates of hospitalizations. These rates are "adjusted" for sex and age in both the study and comparison areas. To account for the slight differences in percentages of minorities between the study area and comparison area, the analyses were restricted to the white population only. Because the percent minority in the study area is relatively low, this is considered to be an adequate, if not ideal, way to control for differences between the study and comparison populations.

The total time frame for the investigation is 24 years, 1982 ó 2005. Analyses were also conducted for three separate time periods that reflect the history of declining potential exposures in the area:

- (1) 1982 -1987 (6 years): 1982 is the first year of SPARCS data, and the plants no longer operated after 1987. This is assumed to be the time period of potentially elevated levels of exposure to airborne emissions and contaminated soils associated with the Van der Horst facilities.
- (2) 1988 -1997 (10 years): The plants were closed after 1987, and most site clean-up activities were completed by 1997. This time period is assumed to have variable potential exposures to contaminated soil before, during and after clean-up, but no airborne emissions as the facility ceased to operate.
- (3) 1998 ó 2005 (8 years): This time period is assumed to represent minimal exposures to site related contaminants.

The statistical analyses compare the observed and expected numbers of hospitalizations by calculating **standardized incidence ratios** and **confidence intervals**.

The **Standardized Incidence Ratio (SIR)** is the adjusted hospitalization rate in the study area divided by the adjusted hospitalization rate in the comparison area. An SIR of 1.00 means the two rates are the same. If the rate in the study area is higher than in the comparison area, the SIR is above 1.00. If the rate in the study area is lower than in the comparison area, the SIR is below 1.00.

The **95% Confidence Interval (CI)** helps us decide whether or not the estimated difference between the two rates is likely due to chance. If the range of numbers in the CI excludes 1.00, the SIR is considered to be statistically significant. If the CI includes 1.00, the SIR is not statistically significant.

## RESULTS

Results of the comparison of the Van der Horst study area with Cattaraugus County are presented for the general disease categories in Table 1 and for more specific disease categories in Table 2. Each table provides the outcome category, the total number of hospitalizations for that category in the Van der Horst Study area for the entire 24-year study period, and the SIRs and CIs for each of the time frames.

General Disease Categories :	Total Number of Hospitalizations in Study Area	Standardized Incidence Ratios (95% Confidence Intervals) by Time Period			
		1982-2005	1982 - 1987	1988 – 1997	1998 - 2005
Endocrine, nutritional, metabolic & immunity	268	1.20 (0.89-1.60)	<b>1.37 (1.03-1.78)*</b>	1.14 (0.83-1.52)	1.16 (0.86-1.54)
Blood and blood-forming organs	70	1.21 (0.61-2.13)	1.03 (0.54-1.78)	1.27 (0.65-2.23)	1.32 (0.65-2.39)
Nervous system & sense organs	285	1.31 (0.96-1.76)	<b>1.27 (1.03-1.54)*</b>	<b>1.64 (1.16-2.26)*</b>	0.84 (0.43-1.47)
Circulatory system (cardiovascular)	1501	1.04 (0.91-1.17)	1.09 (0.97-1.22)	0.91 (0.80-1.04)	<b>1.16 (1.02-1.32)*</b>
Respiratory system	713	1.01 (0.84-1.20)	<b>1.16 (1.00-1.33)*</b>	0.87 (0.72-1.05)	1.04 (0.86-1.25)
Digestive system	819	1.07 (0.90-1.26)	1.11 (0.97-1.26)	1.01 (0.84-1.20)	1.10 (0.91-1.33)
Genitourinary system	423	0.97 (0.76-1.21)	0.94 (0.78-1.12)	0.98 (0.77-1.23)	1.00 (0.74-1.32)
Skin & subcutaneous tissue	93	1.11 (0.66-1.75)	0.74 (0.43-1.19)	1.33 (0.82-2.04)	1.25 (0.70-2.06)
Musculoskeletal system	273	0.92 (0.68-1.22)	0.95 (0.73-1.21)	0.91 (0.66-1.23)	0.91 (0.66-1.22)

\*Statistically significantly elevated.

Table 1 shows that for the overall time period, 1982-2005, there were no statistically significant elevations or deficits of hospitalizations for any of the general categories. During the period when the plant was still operating, three types of hospitalization categories show statistically significant elevations in the Van der Horst study area, endocrine, nervous system and respiratory diagnosis categories. During the next time period, when clean-up activities were being conducted, from 1988 to 1997, nervous system hospitalizations are again elevated. In the final time period, circulatory system hospitalizations are statistically significantly elevated. Five of the general categories show no statistically significant elevations in any of the time periods, blood, digestive, genitourinary, skin and musculoskeletal system, while four categories show elevations in at least one time period.

Specific Disease(s):	Total Number of Hospitalizations in Study Area	Standardized Incidence Ratios (95% Confidence Intervals) by Time Period			
		1982-2005	1982-1987	1988-1997	1998-2005
		Anemia	15	0.88 (0.07-3.64)	0.61 (0.02-3.15)
Chronic tonsillitis	21	0.80 (0.24-1.94)	0.95 (0.56-1.53)	0.25 (0.00-1.80)	---
Upper respiratory tract	38	0.78 (0.34-1.53)	0.92 (0.61-1.34)	0.34 (0.05-1.17)	1.14 (0.06-5.30)
Digestive symptoms	27	2.17 (0.70-5.08)	1.37 (0.22-4.44)	1.67 (0.44-4.32)	<b>3.15 (1.37-6.15)*</b>
Urinary disease(s)	143	1.00 (0.66-1.46)	1.16 (0.82-1.59)	0.91 (0.59-1.34)	0.97 (0.58-1.51)
Renal disease(s)	18	0.71 (0.14-2.15)	0.45 (0.06-1.58)	0.56 (0.07-1.99)	1.14 (0.33-2.85)
Liver disease(s)	21	1.02 (0.29-2.56)	0.50 (0.09-1.56)	1.17 (0.33-2.95)	1.37 (0.47-3.10)
Colitis	93	1.42 (0.82-2.28)	1.38 (0.93-1.99)	1.45 (0.81-2.40)	1.44 (0.69-2.66)
Duodenal ulcer	22	1.13 (0.31-2.86)	1.36 (0.54-2.84)	1.03 (0.29-2.57)	0.96 (0.12-3.48)
Gastritis	57	1.17 (0.57-2.14)	1.44 (0.87-2.25)	1.05 (0.51-1.92)	0.92 (0.26-2.32)
Gastrointestinal hemorrhage	16	0.68 (0.11-2.15)	0.90 (0.22-2.43)	0.85 (0.16-2.54)	0.34 (0.02-1.52)

\*Statistically significantly elevated.

Table 2 shows the results of analyses for the specific disease(s) that other studies suggest might be due to chronic chromium or arsenic exposures. The second column shows that these categories include very small numbers of hospitalizations over the 24 year study period. Urinary disease(s) is the only category that includes more than four hospitalizations on average per year. Table 2 shows only one statistically significant finding, for digestive symptoms in the most recent time period, 1998 through 2005.

## STRENGTHS AND LIMITATIONS

The strength of hospitalization data is that they are collected routinely and comprehensively for the entire population of the state. Gathering information in other ways, from individuals by telephone or mail for example, has become increasingly difficult as people are unlikely to respond to surveys or return questionnaires for health studies. For this reason, existing hospitalization data were used for this investigation. The individual-level information in the hospitalization data on age, sex, and race, is useful for conducting comparative analysis.

Some of the limitations of hospitalization data were described in the Methods section of this report. An important limitation is that there are many conditions that lead to hospitalization only for some individuals, so the hospitalization data do not capture the incidence of the condition in the entire population. Hospitalization data may be most useful for capturing the community's relative disease burden for the more common cardiovascular and respiratory categories that include acute events that usually require hospitalization. The hospitalization data for other types of outcomes, however, particularly more rare outcomes, may produce misleading findings due to

repeat hospitalizations for the same individual or other factors that affect disease severity and likelihood of hospitalization. The lack of individual-level risk factor information, such as smoking or occupation, is another important limitation of the hospitalization data.

Another limitation of this investigation is that the numbers of hospitalizations are relatively small for conducting statistical analyses of the specific outcome groups (Table 2). This issue, low statistical power, makes it very difficult to draw any conclusions for the categories in Table 2, with the exception of urinary disease and colitis. Another statistical issue to consider is that the large number of statistical tests conducted for both the general categories and specific categories of hospitalizations increases the likelihood of producing statistically significant findings that are entirely due to chance.

## CONCLUSIONS

Taking into consideration the strengths as well as the limitations of the use of hospitalization data for assessing the relative disease burden in a relatively small community, the findings of the analyses presented in this report must be interpreted with great caution. While there is evidence of elevations of hospitalizations for some of the broad outcome groups, the endocrine, nervous system, and respiratory categories (Table 1), during the time period 1982-1987, when the plants were operating, the more specific outcome groups (Table 2) do not show a pattern of elevations in this time period.

Regarding the types of outcomes associated with exposures in other studies, the broad groupings may capture the variety of types of health problems that are potentially associated with chromium and/or arsenic exposures. However, these broad categories include relatively common outcomes, such as respiratory outcomes. While industrial pollutant exposures may have played a role in the hospitalization rate elevations, the rates for respiratory outcomes are likely to depend largely on known risk factors, such as tobacco use, that could not be included in this review.

Occupational exposures must also be considered as a possible explanation for elevations because plant workers may live in the study area. Another possible explanation of the findings is the lower median income of the study area population compared to the rest of Cattaraugus County. Lower income populations are likely to experience more severe disease and higher hospitalization rates because they have reduced access to adequate prevention and treatment in non-hospital settings.

This report's results do not provide definitive information about any specific long-term health consequences associated with the past exposures to chromium or arsenic in the Van der Horst study area. This evaluation of hospitalization rates for a variety of types of diagnoses among a population with a specific exposure history provides an example of the use of routinely gathered hospitalization records to assess potential health effects of environmental exposures. The analyses of general disease categories suggest some possible associations between chromium and/or arsenic exposures and hospitalizations for endocrine, nervous system, and respiratory disease(s), but the findings are by no means definitive.

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**Appendix Table 1: General Disease Categories**

<b>General Disease Category</b>	<b>Included ICD-9 Codes</b>	<b>Description</b>
Endocrine, Nutritional, and Metabolic Diseases, and Immunity disorders	240 - 279	Endocrine, nutritional, and metabolic diseases and immunity disorders excluding endocrine and metabolic disturbances specific to the fetus and newborn
Diseases of the blood and blood-forming organs	280 - 289	Diseases of the blood and blood forming organs excluding anemia complicating pregnancy or the puerperium
Nervous system and sense organs	320 - 389	Diseases of the nervous system and sense organs (includes inflammatory diseases of the central nervous system)
Circulatory system (cardiovascular)	390 - 459	Diseases of the circulatory system
Respiratory system	460 - 519	Diseases of the respiratory system including acute respiratory infections, other diseases of upper respiratory tract, pneumonia and influenza, chronic obstructive pulmonary disease and allied conditions, pneumoconiosis, and other respiratory diseases due to external agents; other diseases of respiratory system
Digestive system	520 - 579	Diseases of the digestive system (includes diseases of oral cavity, salivary glands, jaws, esophagus, stomach, duodenum, appendix, large intestine, small intestine, peritoneum, rectum, anus, gallbladder, bile ducts, liver, pancreas, etc.)
Genitourinary system	580 - 629	Diseases of the genitourinary system (includes diseases of kidney, ureter, bladder, urethra, genital organs, etc.)
Skin and subcutaneous tissue	680 - 709	Diseases of the skin and subcutaneous tissue (includes infections of skin and subcutaneous tissue, diseases of hair, hair follicles, sebaceous glands, etc.)
Musculoskeletal system	710 - 739	Diseases of the musculoskeletal system and connective tissue

**Appendix Table 2: Specific Disease(s)**

Specific Disease(s)	Included ICD-9 Codes	Description
Anemia	280	Iron deficiency anemia
Chronic tonsillitis	474	Chronic diseases of tonsils and adenoids, including chronic tonsillitis
Upper respiratory tract	470 - 478	Disease of upper respiratory tract excluding acute respiratory infections
Digestive symptoms	787	Symptoms involving digestive system (excludes constipation, pylorospasm, and congenital)
Urinary disease(s)	590 - 593 or 599	Hydronephrosis, infections of kidney, calculus of ureter and/or kidney, other disorders of kidney and ureter (cyst/ hypertrophy/ stricture/ obstructions/ hydroureter/ vesicouretral reflux/ etc.) other disorders of urethra and urinary tract (UTI unspecified site/ urethral fistula/ diverticulum/ etc.)
Renal disease(s)	580 -589	Nephritis, nephrotic syndrome, and nephrosis (excludes hypertensive renal disease)
Liver disease(s)	570 - 573	Acute and sub-acute necrosis of liver, chronic liver diseases and cirrhosis, liver abscess and sequelae of chronic liver disease, other disorders of liver (including chronic passive congestion of liver, hepatitis, hepatic infarction, etc.)
Colitis	558	Noninfectious gastroenteritis and colitis (due to radiation/ toxic cause/ allergic/ dietetic/ not otherwise specified/ etc.)
Duodenal ulcer	532	Duodenal ulcer includes acute erosion of duodenum, peptic ulcer (duodenum and postpyloric); excludes peptic ulcer not otherwise specified
Gastritis	535	Gastritis and duodenitis
Gastrointestinal hemorrhage	578	Gastrointestinal hemorrhage includes hematemesis and blood in stool. Excludes GI hemorrhage with mention of angiodysplasia/ diverticulitis/ diverticulosis/ gastritis/ duodenitis/ ulcer

**Appendix Table 3: Demographics of the Van der Horst Study Area and Three Comparison Areas (Cattaraugus County, Six Local Counties, and 40 Upstate, Non-Urban Counties): 1990 and 2000**

Demographics	1990				2000			
	Study area	Cattaraugus County	Six Local Counties	40 Non-Urban Counties	Study area	Cattaraugus County	Six Local Counties	40 Non-Urban Counties
Total Population	2080	84284	480694	2654479	2019	83961	480110	2692704
Males	47.3	48.5	49.1	49.4	46.6	49	49.6	49.8
<b>Age (years)</b>								
<6	8.5	9.2	8.6	8.6	7.1	7.5	7.1	7
6-19	18.3	22.1	21.4	20.7	19.4	21.9	21.5	21
20-64	52.9	54.6	55.9	57.2	55.9	56	57	58.1
>64	20.4	14	14	13.4	17.6	14.6	14.4	13.9
<b>Race and ethnicity</b>								
White	97.9	96.3	96.5	95.5	94.5	94.6	94.7	93.5
Black	1.1	0.9	1.7	2.6	2.8	1.1	2.1	3
Native American	0.5	2.2	0.6	0.5	0.2	2.6	0.7	0.5
Asian*	0.1	0.4	0.5	0.7	0.5	0.5	0.6	0.9
Pacific Islander*					0	0	0	0
Other	0.4	0.2	0.7	0.7	0.2	0.2	1	1
Multi-Racial**					1.7	1		1.2
Percent Minority	2.6	4.1	4.2	5.5	6.5	6	6.4	7.9
Percent Hispanic	0.9	0.6	1.5	1.9	1.8	0.9	2.2	2.7
<b>Income</b>								
Median household income	22,082	23,415	25,426	27,220	27,042	33,341	35,318	36,958
% below poverty level	11.4	14	12.7	11.7	15.3	13.7	12.9	12.4

\* Asian and Pacific Islander categories are combined for 1990 Census.

\*\* Multi-Racial category not available in 1990 Census.

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Figure 1: Study Area

