

# Cancer Cluster or Coincidence?

by

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## Part I – Cause for Concern?\*

It was the first warm spring day in Carson, Ohio and Dr. Holmes was walking through the metro park enjoying the magnolias in bloom and the cheering crowds attending the local little league games. The city of Carson, located in Southeastern Ohio, had a well-managed park system with many trails and served as the most popular outdoor recreational area for the city. The Parks and Recreation Department of Carson organized events for the community's children like youth soccer, softball leagues, and many other activities on the park grounds. Due to Carson's small population of approximately 6,000, the sense of community was very strong and whenever there was an event most of the inhabitants attended. Dr. Holmes had seen many springs in Carson, and at age 60 he had spent the majority of his life practicing there as a family physician. With so many years invested in the community he had seen multiple generations of the families and as a consequence his relationship with his patients had evolved into close friendships.

Carson was a predominantly blue collar community with one industry, Home Aid Appliances, providing the majority of jobs for the close-knit town. Home Aid Appliances was founded in 1954 and was the region's largest manufacturer of refrigerators and washing machines. The city of Carson had greatly benefitted and grown in parallel with Home Aid Appliances. Not surprisingly, almost all of Dr. Holmes' patients were employed by Home Aid Appliances and like most of the other residents of the community, were grateful for providing them and their families with stable income. However, there had always been a small group of residents with serious concerns regarding the waste disposal practices employed by Home Aid. They strongly believed that the company had taken some short cuts especially during the starting years with regard to waste disposal as part of cost saving strategy. It was suspected that most of the waste still lay buried beneath the metro park, as the land used to develop the park had been a generous donation by Home Aid to the community.

Dr. Holmes typically stopped by the little league games to catch up with his friends and to get updates on town events. However, this evening he was lost in his thoughts and did not want to make small talk, and headed towards the sitting area by the duck pond where he could go over some of the cases that had been bothering him. In the last three years, three of his patients had been diagnosed with brain tumors, one of which had already been fatal. Samuel was six years old and had never had any medical concerns before he started having frequent headaches. Dr. Holmes could still remember vividly the day of the diagnosis when he had to inform Samuel's parents of the heartbreaking news. The tumor was malignant and had already spread to the other parts of the body and Samuel passed away three months after the diagnosis. Two years later, Amy, an eight-year-old patient came in complaining about a stiff neck that wouldn't go away for over a week. After the preliminary examinations and continuation of the same symptoms, a CAT scan revealed a growth in her brain. Amy had developed a brain tumor and underwent chemotherapy following a successful surgery to remove the tumor mass. Despite having two children with similar diagnoses, Dr. Holmes had not been concerned about a possible trend and had assumed that it was an unfortunate coincidence. But today, Dr. Holmes had diagnosed Sarah, another eight-year-old patient, with a brain tumor. A third patient within three years showing similar symptoms was the cause for concern for Dr. Holmes as he sat pondering over the case histories of all three patients.

## Questions

1. Is Dr. Holmes' concern justified? Why or why not?
2. What would be your next step if you were Dr. Holmes?

\*Although inspired by facts, the city and individuals named in this case study are fictional.

## Part II – Is It a Cluster?

A couple of months later, Dr. Holmes sat in his office looking over the case notes from the three cancer patients. He was trying to make sense of the three cases, wondering if they were related or just a coincidence. Despite the small number of cases, he wasn't able to overlook the similarities. With word of Sarah's diagnosis, people in the community were talking about a possible cancer cluster. Not wanting to jump to conclusions, he had started investigating the hospital's medical records and looking into the case histories of patients with brain tumors within a twenty-five mile radius of Carson from the previous years. Apart from his three patients, he was able to identify eighteen cases of childhood cancers in the preceding fifteen years. Further investigation revealed that six of these cases were reported in a six block area of Carson adjacent to the park and most of the cases were diagnosed in a ten year window from 1996–2006. For Dr. Holmes, so many cases of childhood cancers in a small city during the past fifteen years did not seem coincidental. He had always had concerns about Home Aid Appliances and its history of alleged improper disposal of waste materials.

At this point, Dr. Holmes realized that it might be a good idea to enlist the help of the county health official, Dr. Johanna Garcia, who specialized in identifying cancer clusters. Wasting no more time, Dr. Holmes called to set an appointment with Dr. Garcia and forwarded the case histories to her. One week later, Dr. Holmes walked into Dr. Garcia's office.



*Dr. Holmes:* Good Morning Dr. Garcia, did you get a chance to review the case histories I sent you?

*Dr. Garcia:* I did. I can see a cause for your concern. However, we still need to confirm the numbers and investigate the cause for the alleged spike in the number of cancer cases.

*Dr. Holmes:* I don't see any reason to hesitate in calling it a cancer cluster. The numbers are clear and I think provide sufficient evidence.

*Dr. Garcia:* The number of cases is just a part of the story. We have to examine more closely if the so called spike is statistically significant.

*Dr. Holmes:* Since talking with you I have been able to contact the families of twelve of the twenty-one children identified with cancers and gather information regarding the type of cancer and the age of diagnosis. Here is the data I was able to gather so far.

*Table 1. Childhood Cancers in Carson, Ohio*

<i>Cancer Site/Type</i>	<i>1996–2008</i>	<i>Percent</i>
Brain and other central nervous system	4	34%
Ewing's sarcoma (soft tissue)	1	8%
Hodgkin's Lymphoma	1	8%
Leukemias	2	18%
Osteosarcoma (bone)	1	8%
Pancreas	1	8%
Rhabdomyosarcoma	1	8%
Testis	1	8%
All	12	100%

*Dr. Garcia:* In such cases it always looks like the numbers are high but it is not as simple as it appears. We should take into account other variables for the region, such as the number of expected childhood cancers, to compare with the actual numbers. We also need to do statistical analysis to determine if the spike in the number of childhood cancers in Carson is significant and only then we can justify opening a formal investigation to identify any potential causative agent.

*Dr. Holmes:* I did some reading regarding the waste disposal at the appliance factory; although my research is preliminary, I suspect that vinyl chloride may be the carcinogen. Vinyl chloride is a known carcinogen that can cause liver cancer, brain cancer and some cancers of the blood. The Centers for Disease Control and Prevention (CDC) warns that infants and young children are more susceptible to vinyl chloride-induced cancer.

*Dr. Garcia:* Yes. Vinyl chloride is a Group A human carcinogen but most of the research links it to liver cancer. There have not been a lot of studies linking it to cancer in the brain.

*Dr. Holmes:* I know the most direct connection is to liver cancer, but some studies have linked cases of brain cancer to long-term exposure to vinyl chloride. Vinyl chloride is also a microbial degradation product of trichloroethylene in ground water. As you know trichloroethylene is also a human carcinogen.

*Dr. Garcia:* It's always good to have some background information regarding what we are examining, but I have to warn you again that this is where we need a lot more data to confirm anything. This table shows some of the data from the cancer cluster investigation in Toms River, New Jersey. This should help you understand some of the analysis we need to do with the data and how it helps us confirm if the region is a cancer cluster.

*Table 2. Toms River Census Tracts: Summary of Select SIRs*

<i>Study Period: 1979–1995</i>						
<i>Cancer Type</i>	<i>Age Group</i>	<i>Sex</i>	<i>Number Observed</i>	<i>Number Expected</i>	<i>SIR</i>	<i>95% CI Lower–Upper</i>
All Types	0–19	Both	24	14.4	1.7*	1.07–2.49
All Types	0–4	Both	12	3.4	3.6*	1.84–6.22
All Types	0–4	Female	10	1.5	6.5*	3.13–12.0
Brain/CNS	0–4	Both	4	0.6	7.0*	1.87–17.8
Brain/CNS	0–4	Female	3	0.3	11.3*	2.27–33.0
Astrocytoma	0–4	Both	2	0.2	8.9*	1.00–32.1
Acute Lymphocytic Leukemia	0–4	Female	4	0.4	9.4*	2.52–24.0

*SIR:* A Standardized Incidence Ratio is used to determine if the occurrence of cancer in a relatively small population is high or low. An SIR analysis can tell us if the number of observed cancer cases in a particular geographic area is higher (\*) or lower than expected, given the population and age distribution for that community.

*CI:* The 95% CI (Confidence Interval) as a test for statistical significance may still lead to results that are due to chance alone. By definition, if a SIR is statistically significantly elevated with 95% confidence, there is still a five percent chance that the increase is due to chance alone.

## Questions

1. Describe in your own words what a cancer cluster is.
2. What is the evidence that is driving Dr. Holmes to believe this is a cancer cluster?
3. What are the factors that Dr. Garcia is looking at that make her skeptical of Carson being a cancer cluster?
4. Taking into consideration the data from a successful cluster investigation of Toms River (Table 2), list the additional data and statistics Dr. Holmes will need to strengthen his case about Carson.

## Part III – Lessons from the Past

*Dr. Holmes:* We can start collecting the additional data right away and run the necessary statistical tests. You should launch the investigation without any further delay so that we can confirm the cluster and identify the carcinogen responsible for this tragedy.

*Dr. Garcia:* I can understand your frustration and urgency with the case. But, these investigations are very expensive and usually drag on for several years. So, before we jump to this plan of action, we need to think about all of the other possible explanations as well. To give you a better idea of what an investigation entails, please read this article.

Dr. Garcia handed over the following excerpt from *The Philadelphia Inquirer*.

One of the many lessons of the cancer cluster in Toms River—the subject of a new book, *Toms River: A Story of Science and Salvation*, by journalist Dan Fagin—is how hard it is to prove that one exists, or to pinpoint a cause.

The task is time-consuming, expensive, and often inconclusive.

After a \$10 million investigation, scientists found a link to both the Toms River plant and a nearby farm where chemicals were illegally dumped. A confidential settlement—estimated at more than \$35 million—with some of the families of cancer victims was reached in 2001.

The difficulty of proving a cancer cluster—as shown in two ongoing Pennsylvania cases—is a cautionary tale for all who live in today’s chemical-laced world, many say.

Why is it so difficult?

For one, cancer is common. Just because someone sees a lot of it doesn’t mean there’s a cluster.

In the United States, half of all men and one in three women will be diagnosed with cancer. Nearly 80,000 Pennsylvanians and 50,000 New Jerseyans will be diagnosed this year, the American Cancer Society estimates.

Cancer isn’t just one disease, but many, with different causes. Most cancer is caused by life choices: smoking, obesity, not exercising, excess drinking.

Exposure to pollutants is thought to cause few cancer deaths—4 percent from occupational exposures, 2 percent from chemicals and other carcinogens, including naturally occurring radon.

Even so, when a pollution-related cluster exists, the effects can be horrific. In Toms River, at least 69 children developed illnesses, such as leukemia and brain cancer. Some died.

Some links are known; when a lung cancer called mesothelioma is diagnosed, asbestos is the likely cause.

Other links—proving that X chemical caused Y cancer—are elusive.

Worst of all is when you have disease and must search for a cause, said Trevor Penning, a cancer expert at the University of Pennsylvania. “Then you begin to have an expensive conversation.”

Toms River officials didn’t know at first what chemicals were involved—even in the drinking water from municipal wells.

Even with a known exposure, some will get cancer, and some won’t.

It can take a long time for cancer to develop, so re-creating a person’s exposure—from drinking water to pesticides—is like “looking for footprints in the sand 10 to 20 years after the wind has stopped blowing,” said Boston University epidemiologist Richard Clapp, who was on the Toms River case. ...

One lesson of Toms River is that we need to know more about how carcinogens cause cancer, said Timothy Rebbeck, a Penn cancer epidemiologist.

Conversely, even if a cluster can’t be proved, it doesn’t mean there’s not a problem—say, contaminated drinking water—said Daniel Wartenberg, a Rutgers University epidemiologist.

*Excerpted from S. Bauers, Cancer clusters or chance? The Philadelphia Inquirer May 12, 2013.*

*Dr. Holmes:* I didn't realize so much time and money are involved in these investigations. But I still don't see any alternative other than starting an investigation.

*Dr. Garcia:* Of all the cancer cluster investigations conducted in this country, only three have been successful in identifying the environmental agent responsible for the cluster—Toms River, NJ, Woburn, MA and Charleston, SC. The rest of the investigations, more than four hundred, failed to link a possible carcinogen to a cancer cluster. This is why we need to decide if launching an investigation is warranted or justified.

### Questions

1. With this background information about cluster investigations, outline two pros and two cons to pursuing an investigation in this case.
2. In reviewing the pros and cons from the previous question, decide as a group what you would do if you were in Dr. Holmes' shoes.