

Participatory Mapping of Occupational Hazards and Disease among Asbestos-exposed Workers from a Foundry and Insulation Complex in Canada

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A study of former asbestos-exposed foundry and insulation workers was carried out in Sarnia, Ontario, home to Canada's petrochemical industry, using participatory mapping to document past exposures and subsequent diseases. Before it closed, government inspectors had monitored the use of asbestos at the facility, documenting levels that were thousands of times above the current legal limit. The study was undertaken by the Occupational Health Clinics for Ontario Workers (OHCOW) and Canadian Auto Workers (CAW) to provide evidence for worker compensation claims. Using facilitated hazard mapping, former Holmes workers graphically reconstructed their workplaces and detailed their exposures. Using facilitated body mapping, workers recorded and displayed their health problems. The study uncovered a grim pattern of occupational diseases. Following the release of the results, coupled with clinically confirmed diagnoses and corroborating evidence of exposure, hundreds of former Holmes employees and their families received compensation for occupational diseases that had previously gone unrecognized. *Key words:* body mapping; hazard mapping; participatory; asbestos; foundry; insulation; occupational disease; cancer; mesothelioma; Canada.

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A study of former asbestos-exposed Holmes Foundry, Caposite and Insulation workers was carried out using participatory mapping to gather and present evidence of past exposures and related diseases in support of claims for workers' compensation. It was a collaborative effort involving the Occupational Health Clinics for Ontario Workers (OHCOW) and the Canadian Auto Workers union (CAW).

The study took place in a small community in Southwestern Ontario, more than 1,000 kilometers from the nearest asbestos mine, where record numbers of asbestos-exposed workers have been diagnosed as

having asbestos related diseases.¹ Like the current recipients of imported asbestos in developing countries, workers in Sarnia-Lambton became the unwitting victims of asbestos that was brought into their community by their employers.²

Sarnia-Lambton is situated on the St. Clair River about midway through the Great Lakes system. The city of Sarnia and the surrounding county of Lambton have a combined population of approximately 127,000. A thriving petrochemical industry was established following the 1851 discovery of petroleum "gum beds" in the area.³ The abundance of crude oil and the proximity to the United States and a major steamship route made Sarnia an ideal site for doing business. By 1893, the Sarnia area was the major supplier of crude and petroleum products for Canada.⁴

Many companies have come and gone over the years; some have undergone name and ownership changes. Bayer Rubber, Nova Chemicals, Imperial Oil, Shell, and Dow are among the large multinational petrochemical producers currently operating in the Sarnia area. The various industries use each other's products and byproducts. A broad array of consumer and industrial goods is produced.⁵

Throughout the past century, there have also been some smaller operations, which served both the petrochemical industry and the auto industry. Ethyl Corporation produced tetra-ethyl lead additive for gasoline, Prestolite produced auto parts, Holmes Foundry made engine blocks and munitions, Holmes Caposite plant produced asbestos insulation products, and Owens-Corning produced fiberglass products.

One characteristic of almost all of the industries in Sarnia is their extensive use of asbestos. Asbestos lined the foundry ovens, asbestos products were produced and exported, and asbestos insulation covered the miles of pipes that interweave the chemical valley. The Sarnia-Lambton area has been cited as having the highest rates of pleural mesothelioma in Ontario.^{6,7} Between 1986 and 1993 there was a fourfold excess incidence of mesothelioma in Lambton County compared with the rest of Ontario; 74% of the cases were among former workers from either the Sarnia petrochemical industry or the Holmes Foundry complex.⁸

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As Table 1 shows, the age-adjusted hospitalization rate for mesothelioma among males in Lambton County was over five times the provincial rate in 1992 to 1998; the rate for asbestosis among males was nine times the provincial rate.¹ There were elevated rates of several other respiratory diseases, including cancers that are associated in the literature with exposure to asbestos.⁹

A recent study of the Sarnia area reported by Health Canada¹⁰ found increased rates of specific cancer morbidity and mortality. For example, there was a statistically significant fourfold excess mortality from non-Hodgkin's lymphoma among men aged 25–44 years.

While the health statistics are not attributed to any particular cause, it is not unreasonable to speculate that industrial emissions and occupational exposures have played a role in some of Sarnia–Lambton's ill health.^{11,12} In the year 2000, industry in the Sarnia area reported the highest toxic air releases in Canada.¹³ The largest hazardous waste operation in Canada, euphemistically named "Safety-Kleen" (and more recently "Clean Harbours") operates in the Sarnia area, not only storing and incinerating the area's toxic waste, but importing waste from all parts of Canada and the United States. Safety-Kleen ranked as the highest releaser of carcinogenic pollutants in the country in 2001; it also ranked number one for releases of reproductive and developmental toxicants.¹⁴

Sarnia lacks industrial diversification; it is very dependent on the petrochemical and related industries for its economic well-being. Although there was a significant downsizing of the petrochemical industry in the 1980s and 1990s, in 2002, 44% of employment in Sarnia's manufacturing sector was still in the petrochemical industry.¹⁵ This dependency hampers worker and community occupational and environmental health reform efforts. Yet, it was in this period of economic restructuring that one of the most significant occupational health and safety stories of the past decade emerged in Canada—the story of the Holmes Foundry, Caposite, and Insulation complex, which had closed a decade earlier. Participatory mapping played a significant role in the emergence of an ultimately broad-based, successful campaign for occupational health services and compensation.

HOLMES FOUNDRY, CAPOSITE AND INSULATION COMPLEX

The Holmes Foundry, Caposite, and Insulation complex opened in Sarnia in 1918.¹⁶ The foundry cast automobile engines for Ford Motor Company and parts for the agricultural and defence industries. It made extensive use of asbestos. The Holmes Insulation plant produced rock wool products. The Caposite production facility produced asbestos products for the petrochemical industry and beyond, using amosite asbestos.¹⁷ The Caposite plant closed in 1974 and the foundry closed

TABLE 1. Hospital Morbidity Data, Lambton County, 1992–1998*

Disease	Males	Females	Both
All cancers	1.34* (4,443)	1.28* (3,896)	1.31 (8,339)
Lung cancer	1.50* (768)	1.39* (423)	1.46* (1,191)
Mesothelioma	5.33* (37)	N/A (4)	3.92* (41)
Asbestosis	8.97* (10)	N/A (0)	8.93 (10)
Nasopharynx	3.59* (9)	N/A (0)	2.52 (9)
Esophagus	1.41* (79)	1.18 (26)	1.35* (105)
Asthma	1.22* (869)	1.16* (869)	1.18* (1,738)
Emphysema	1.38*(89)	1.32 (59)	1.31*(148)

*Age-adjusted standard morbidity ratio (SMR) compared with the Ontario rate. Statistically significant differences with the province are indicated by asterisks.

Source: Lambton Public Health Unit, March 21, 2000.

in 1988.¹⁶ The Holmes Insulation plant was sold and began operations under new ownership at another location. During its full production years, the Holmes complex employed 300 to 625 workers at a time.¹⁸

The Occupational Health Clinics for Ontario Workers in neighboring Windsor, Ontario (approximately 160 kilometers from Sarnia) began to provide medical diagnostic services to workers in the Sarnia community in 1993. Satellite clinic days were held only once or twice per month as very few Sarnia workers were coming forward at that time with their occupational health concerns.

The Windsor clinic staff first heard of the illnesses and deaths among former Holmes workers in the mid-1990s when Bob Clarke, a former union plant chairperson and member of the Canadian Auto Workers (CAW) union, approached the clinic staff with a list of his co-workers who had died of cancers he believed to be work-related. He explained that he and his former co-workers at the now-closed Holmes Foundry and associated Caposite and rock wool Insulation plants in Sarnia had been exposed to high levels of asbestos dust in the course of their employment.¹⁹ Clarke had earlier supported 51 successful compensation claims on behalf of Holmes workers,¹⁶ many of which had been submitted following disease detection by the provincial government's Occupational Chest Disease Service mobile surveillance x-ray unit.

The Canadian Auto Workers union represented the Holmes Foundry workers; the Caposite and Insulation workers were not unionized. There are accounts of an 11-day labor dispute in 1937 in which workers, seeking to unionize, occupied the plant demanding improved health and safety conditions.²⁰ At the time, most of the Holmes workers were first-generation immigrants. Fuelled by anti-union and ethnic tensions, violence erupted against the strikers and their families. The union was broken and the striking foundry workers were permanently replaced. This event may have helped to set the stage for the ensuing Holmes occupational health and safety tragedy. The resulting intim-

idation may have discouraged workers' efforts to successfully address the unsafe conditions that existed for the remainder of the plant's operating years.

COLLABORATIVE OCCUPATIONAL HEALTH STUDY

Following the revelations brought forward by Bob Clarke regarding the apparently high incidence of occupational disease among former Holmes workers, the occupational health clinic staff and the CAW agreed to collaboratively conduct an investigation to: identify former Holmes workers who were suffering from occupational disease or injury; identify surviving family members of former Holmes workers who had died from occupational disease; and gather evidence to support compensation claims for Holmes victims.

It was agreed that the occupational health clinic would gather evidence and provide medical diagnostic services. The union would take responsibility for contacting former Holmes workers and family members and would support compensation claims on their behalf.

HAZARD MAPPING OF THE HOLMES COMPLEX

The process of gathering evidence regarding occupational exposures began in 1998 with a series of hazard-mapping sessions. Hazard mapping is a process whereby workers collectively draw their workplaces, including personnel, processes, and hazards.^{21,22} A study conducted by workers at a Fiat plant in Turin, Italy, during the 1960s, is one of the earliest recorded examples of worker-driven occupational health and safety research using mapping.^{23,24} Fiat workers used colors and symbols on blueprint drawings of the workplace to locate and identify hazards.^{25,26} Outside experts subsequently verified the problems identified by the Fiat workers through the lay process of mapping.

In the case of Holmes, hazard mapping was used to gather and record the workers' collective recollections of their working conditions, as they had existed in decades past.

The initial hazard-mapping process took place with former Holmes Caposite and Insulation workers in one workshop room and the Holmes Foundry workers in another. Facilitated by occupational health clinic staff, the workers created retrospective hazard maps for their respective workplaces on large sheets of craft paper posted on the wall. Because most of the Holmes buildings are no longer standing, the facilities and features had to be drawn strictly from memory. The Holmes workers' collective memories provided very detailed descriptions of the workplace layouts, processes, controls, and worker exposures.

Holmes Foundry

The workers described the foundry as it had existed during various time periods. They described how "operations moved around." They remembered that they "used to store piles of raw asbestos and silica sand in the yard—left uncovered." The asbestos and silica would be gathered in scoops and placed into open dump trucks "two or three times a week" and would be transported "uncovered." They recalled that in the foundry "the smoke was often so thick workers couldn't breathe—especially in the summertime"; "workers would run outside to get a breath of air."

The workers drew and described the characteristics of the core room where isocyanates were used, the shake-out room where shot blast was used, the mill room, the iron-pouring area, molding areas, grinding departments, the paint room, and the shipping department. One of the dirtier processes included chipping metal from the engine blocks. They agreed that smoke, silica, and asbestos dust were everywhere, as were numerous chemicals (see Figure 1).

Holmes Caposite

The Caposite workers drew the exterior grounds and interior of the facility on a large wall-sized map. They included railway tracks and truck paths upon which asbestos materials were imported, exported, or transported from building to building. They reported that the materials were often left uncovered during transport and would blow loose from the rail cars and truck trailers. Workers described the manufacturing process whereby asbestos was dumped from bags into hoppers, then fed onto conveyors, which led to forming areas, and so on. One worker described the appearance of asbestos dust in the air as looking like "feathers floating" or "diamonds sparkling in the sunshine." "During the day you would have a light dust on you." The dust was "worse at night" after it had been cleaned off machinery by two men whose regular job it was to dust using a "two-inch air hose." After the blowing, it "looked like a bad snowstorm." Workers said there was "at least half an inch of dust" on their shoulders, which they brushed off. Some used the air hose to clean the dust off themselves.

They recalled that workers would "cut with a miter saw out in the open" and there was "no ventilation over the saw." The sawing operation was "later moved to the warehouse." There were "no real partitions" between work areas and no local ventilation; "the hood for the ventilation was high." The asbestos area was so thick where it was dumped into the hoppers that "in the hopper area it was the same as night." The work process included an oiling area where "oil was sprayed in the open." Workers remembered that they would often "eat lunch at their work stations" or would sometimes go



Figure 1—Holmes Foundry hazard mapping.

into the Holmes foundry lunchroom to eat. They recalled that they had “no respirators” and were “not told that asbestos was dangerous.”

Holmes Insulation

The workers drew the Holmes rock wool insulation production facility adjacent to the other Holmes facilities. It was comprised of “two domed buildings.” They explained that the insulation fibers were “made from rock.” In the yard were a “stone pile,” a “slag pile,” a “coke pile,” “scrap from rock wool,” and “foundry castings.” The rock was loaded onto a conveyor and carried into a processor, where it was “melted” and then mixed with “resin.”

Insulation “batts” were created on a production line generating “heavy dust” and were subsequently packaged using a “baler.” Some of the rock wool fibers were left in the form of “loose wool.” “Granulated wool” was produced by adding a “binder.” The loose and granulated product was fed into a “bagger” and “sold in small bags,” which were stitched closed in the “sewing machine” area. The production process created considerable “dust inside and out.”

HAZARD-MAPPING REPORT

Following the initial hazard-mapping sessions, occupational health clinic nursing and administrative staff conducted four additional sessions with two dozen former Holmes workers to provide more detailed retrospective exposure profiles. According to the workers who participated in the detailed hazard-mapping sessions, asbestos dust was ubiquitous:

. . . the workers carried asbestos from the insulation plants to the foundry. Huge piles of asbestos waste were piled directly outside the foundry, allowing the winds to carry it into the plant and, in fact, all over the surrounding neighbourhood. The plants were so hot in the summer that both the insulation plant and the foundry were forced to keep their doors open. This allowed not only air into the foundry but unfortunately, since the plants were so close, asbestos as well. One practice of the insulation plant was that of blowing the asbestos off the equipment with air hoses. This of course increased the amount of airborne asbestos particles.¹⁸

The hazard-mapping data gathered during the initial sessions, along with the more comprehensive information from the detailed mapping sessions, formed the basis of a descriptive report of the processes carried out in the Holmes complex and workers’ subjective recollections regarding exposures.¹⁸ This collective account of exposures was subsequently accepted as evidence in support of workers’ compensation claims.²⁷

VALIDATION OF HAZARD-MAPPING DATA

The participatory nature of mapping is arguably its greatest strength. Mapping involves the direct input of those who are most intimately familiar with their workplace and its functions. When created collectively, hazard mapping has an intrinsic validity check. Collective hazard mapping results in a product that includes not only the input, but also the scrutiny of the co-participants. In other words, the information was validated by the Holmes workers themselves through a process called “consensual validation”; workers, within homogeneous

discussion groups, agreed that the information provided was accurate according to their collective experience.^{28,29}

The hazard-mapping data were further validated by evidence of exposures provided by other sources: published interviews, government documents, and a peer-reviewed published mortality study.

The descriptions provided during the hazard-mapping sessions were similar to those later reported in articles and books:

Asbestos was everywhere in the Holmes facilities. Former Holmes workers tell horror stories of asbestos in the air so thick they could hardly see, of asbestos on the floor that billowed up whenever anyone walked through, and of asbestos on machines and on shelves. There was asbestos dust on the workers, on clothing, on exposed skin and in their hair.³⁰

Ralph Crevier, one of the participants in the Caposite hazard mapping sessions, said in a published interview: "You couldn't even see about three feet in front of you. . . . On top of your hair, it used to be pure white; you would think you were going white. It used to be like cotton candy, used to fly around in the air."³¹ His father and two brothers, all former Holmes workers, had died of asbestos-related cancer. Ralph Crevier died of cancer in 2002.

The son of another stricken Holmes worker wrote:

We lived only a few short minutes away from the Holmes Foundry where my father worked . . . my father took one of the most disliked jobs at the insulation plant . . . he was a charger and therefore likely one of the people most highly exposed to asbestos. I remember when he came home from work, his face was black, so were his clothes and then, of course, there was the dust in which he was covered. He hung up his clothes and I marvelled at the "twinkle" of the dust in the air that surrounded his clothes.³²

The working conditions and exposures described by the workers during the hazard mapping sessions were also corroborated by historical government inspection reports. The executive director of the occupational health clinic encouraged the CAW to utilize "freedom of information" legislation to obtain all the existing inspection and industrial hygiene reports that had been stored in a government archive. Occupational health clinic staff reviewed the documents and reported that extraordinarily high levels of asbestos and other cancer-causing agents had been present throughout the years of production.³³

Inspection documents revealed that, during the 16-year period when the government conducted air sampling at Caposite, it was reported that asbestos "counts were the highest ever encountered by this Branch in any of the plants in Ontario." In fact, the Ministry stated that at least one of its samples was "probably the highest asbestos fibre concentration ever recorded."¹⁹

In 1958, Holmes and the Ontario Ministry of Health exchanged letters acknowledging the potential health hazards of asbestos exposure. When inspectors conducted air sampling later that year they found levels that were 28 times over the standard. This would translate into exposures that were as high as 6,720 times above the current Ontario legal limit for asbestos. The government issued no directions or orders and did not return to the plant for another nine years. When the government inspectors finally returned in 1967, they estimated the total production at the Caposite plant at 10,000 pounds per day of asbestos insulation. The government inspectors took 34 air samples, of which only five were below the legal limit then in place. The average sample was 2.7 times the standard of the day. The ministry issued nine directions to the company regarding ventilation and asbestos handling. These directions were not enforced. Government inspectors did not return to check the asbestos levels at the Caposite and Holmes Insulation plant until 1972.

Between 1972 and 1973 the ministry measured asbestos as high as 852 fibers per cubic centimeter of air and issued 29 orders and directions. Finally, in 1973, the ministry issued an order to "cease" production at the facilities, only to discover on their follow-up visit that the company had ignored the order.

Besides the government documents, there is a small published epidemiologic study of the Holmes Caposite plant.¹⁵ The study found excess cancers, including lung cancer and mesothelioma, and asbestosis among exposed workers.

BODY MAPPING AT HOLMES COMPENSATION INTAKE CLINIC

Body mapping was used to gather health data from former Holmes workers or their proxies (surviving family members). Body mapping is essentially a health survey instrument that uses graphic images, colored marking pens, and stickers to elicit and record responses.^{22,34} Body mapping, as an occupational health and safety tool, was first used to identify repetitive strain injuries and ergonomic issues.³⁵⁻³⁷ It is now being used to collect all manner of work-related injury and disease data.^{22,38}

Former Holmes workers with occupational disease and their family members were invited to attend a compensation intake clinic sponsored by the CAW, the Ontario Federation of Labour, and the occupational health clinic. Over 260 former Holmes workers and their families attended. Occupational health clinic staff and volunteer compensation advocates conducted confidential interviews with each attendee to gather work and medical histories.

Workers were then invited to participate in a body mapping exercise. There were 120 participants, representing approximately half the attendees. Because the union and the occupational health clinic had not antic-

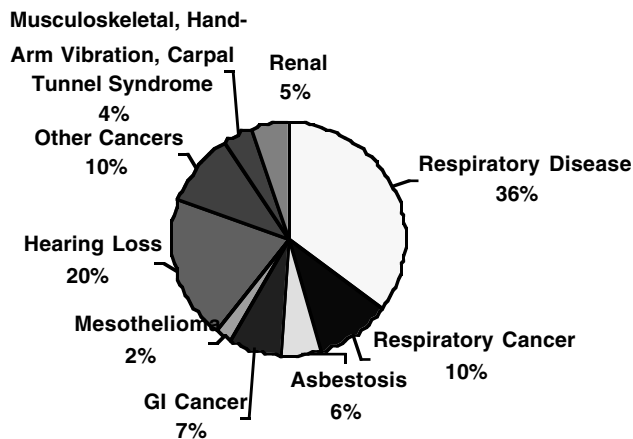


Figure 3—Holmes body-mapping data.

The men went to work every morning, proud to earn a livelihood for their families, and they came back each evening carrying death on their clothes. The women shook out the clothes and washed and ironed them, and were proud to be taking care of their families. Asbestos was so thick at the Holmes Caposite plant in Sarnia that shipping doors at both ends of the factory would be opened to clear the dust. It blew so thickly into the street that the traffic would come to a halt. In the park, across the street where the children played, the benches were coated with a layer of asbestos dust.⁴²

There was a resulting broad-based outcry for occupational health services in the Sarnia community. In particular, the community demanded its own full-time local occupational health clinic. The community-based lobby included injured workers and widows, the local news media, local politicians, and the unions. A group of widows and injured workers calling itself Victims of Chemical Valley (VOCV) actively advocated for a clinic and for local compensation services.⁴¹ With the support of the unions, members of the group took their demands directly to the provincial government legislature.⁴²

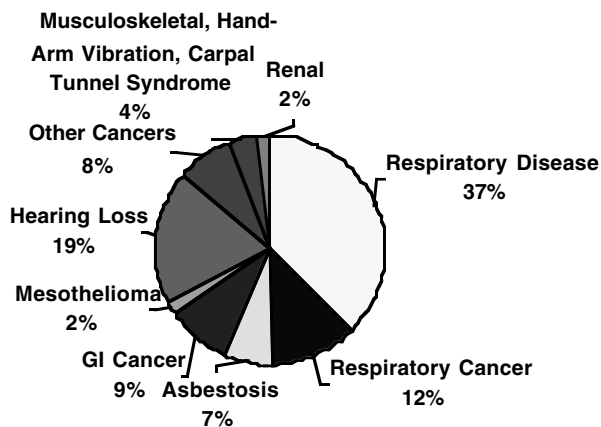


Figure 4—Medically supported compensation claims filed.

In response to the community's demands, the government and compensation board representatives agreed to fund an occupational health clinic in Sarnia. Another precedent-setting outcome was the establishment by the Workplace Safety and Insurance Board [workers' compensation board] of a special task force to review evidence for the Holmes compensation claims in order to streamline the process of determining work-relatedness. The task force was comprised of members of the compensation board, the Office of the Worker Advisor [workers' compensation advocates], representatives from the Occupational Health Clinics for Ontario Workers, and the CAW. Several presentations summarizing medical and scientific literature were made to the task force by the Sarnia occupational health clinic staff. They included evidence of associations between foundry work and bladder cancer, pancreatic cancer, and heart disease.⁴³⁻⁴⁵

RESULTING COMPENSATION CLAIMS VALIDATE BODY MAPPING

Following the Holmes intake clinic, ensuing publicity, and the establishment of a local clinic, hundreds more former Holmes workers registered to be medically assessed. After gathering occupational histories and medical evidence, conducting diagnostic tests, and evaluating over 500 Holmes workers, by 2003 the clinic nurses, hygienists, and physicians had supported 326 compensation claims for a range of diseases, as shown in Figures 3 and 4 and Table 2.

Figures 3 and 4 show a simple comparison of the original self-reported body-mapping data gathered during the intake clinic in 1998 versus the compensation claims supported by the physicians at the Sarnia occupational health clinic by 2003.

Table 2 provides the breakdown of health problems, showing actual numbers and percentages in each category. Some individuals may have had more than one health problem. Each health problem is included separately.

The illnesses and injuries reported during body mapping are grouped according to the compensation claim categories. Notice that not all health problems recorded during body mapping are included, as many are not considered to be compensable under the current compensation board criteria. For example, the body-mapped heart disease is not included in the comparison as it is still generally considered by the compensation board to be *a disease of everyday life*. Heart disease is usually considered to be compensable only if a direct contemporaneous association with an etiologic agent can be demonstrated, such as a heart attack directly associated with an acute exposure.

Interestingly, the pattern of diseases initially revealed through the process of body mapping closely resembles the patterns seen in the clinically validated

Table 2. Comparison of Mapped Problems and Medically Supported Claims Submitted for Holmes Workers

	Body-mapped Health Data (from Maps) N=139		Compensation Claims Submitted N=326	
	No.	%	No.	%
Respiratory disease	49	36	122	37
Respiratory cancer	14	10	40	12
Asbestosis	8	6	23	7
Gastrointestinal cancer	10	7	29	9
Mesothelioma	3	2	6	2
Hearing loss	28	20	62	19
Other cancers	14	10	25	8
Musculoskeletal injuries, hand-arm vibration, carpal tunnel syndrome	6	4	14	4
Renal disease	7	5	5	2

diagnoses of Holmes workers whose claims have been submitted for compensation. There are almost three times as many clinically validated claims as self-reported body-mapped health problems. However, the proportional similarities contribute to the argument that self-reported body-mapped data provide a reliable gross indicator of occupational health problems.

According to Dr. Abraham Reinhartz, a physician at the Sarnia occupational health clinic:

The ailments documented by the mapping process closely resembled the overall pattern of diagnoses we made upon examination of the patients and review of their medical records. A search of the medical literature regarding occupational diseases and injuries associated with foundry work and similar exposures corroborated our own clinical findings.⁴⁶

Based on the combined evidence of mapping results, scientific literature, government inspection reports, job records, and medical diagnoses, many of the workers or their surviving family members were granted compensation. In the summer of 2003, it was reported that:

Success with Holmes Foundry, Sarnia, Ontario, claims for workers who suffered from occupational diseases from exposure to asbestos, silica, and other harmful substances continues with total claim payouts approaching \$16,000,000 in lump sum payments and \$1,115,000 per year in monthly benefits.⁴⁷

Compensation claims continue to be filed as new cases of occupational disease arise among the surviving former Holmes workers. The union attributes the success of the compensation claims to the collaborative investigative effort launched in 1998:

I can tell you categorically that our success to date would not have been possible without their [occupational health clinic] efforts. And here is why. The clinic first alerted us to the immensity of the problem at Holmes and assisted in bringing to light, documenting and analyzing the exposures at the Holmes facilities.⁴⁸

DISCUSSION

Bob Clarke, who initiated the collaborative investigation of the Holmes workers, was not able to experience the bittersweet satisfaction of seeing some justice finally brought to his stricken co-workers and family members. He died of cancer in the fall of 1998 before he could witness the results of the effort he had helped to launch.⁴¹

The Sarnia occupational health story is ongoing. Revelations of the Holmes tragedy have shaken the foundations of a historically trusting, culturally conservative community. The full ramifications of the Holmes story are yet unknown, but it is evident that a sea change has taken place locally. An editorial in the *Sarnia Observer* attributed emerging community distrust for industry to the exposé of the Holmes tragedy. He called it the “Holmes Foundry factor.” This distrust has carried over to related community environmental issues:

... we understand it was a mistake to trust Holmes. If we forget, we can visit our relatives' fresh graves, or ask the former employees of Holmes who are not quite dead yet, although they have to remove their oxygen masks to reminisce how they were naively working in asbestos years after government inspectors knew about the danger.⁴⁹

The Holmes story has also had effects far beyond the Chemical Valley. As a social worker who has been dealing with Sarnia's stricken families observed:

I think people are looking at Sarnia and initially thinking of it as an isolated incident but as the story unfolds recognizing that the Sarnia experience is alive in their own community. I think that is evidenced just in the number of calls that the clinic gets or I have gotten at home from people in other communities who have read articles and are thinking about their own work experience, their own exposure or those of family members.⁴⁰

CONCLUSION

There are several lessons to be drawn from the Holmes experience in Sarnia.

It is apparent that institutional occupational health and safety practices largely failed the Holmes workers. The government inspectors who visited the facilities throughout its operating years did not enforce orders that could have prevented exposures and subsequent disease. The one epidemiologic study that was conducted of the Caposite workers, suggesting that they were suffering from asbestos-related disease, took place after the facility closed—too late to protect them.¹⁷ While 51 workers were compensated following disease detection by the Occupational Chest Disease Service mobile surveillance x-ray unit, the majority of the Holmes workers with occupational disease were not compensated until the collaborative study was undertaken.

The Holmes case study also demonstrates the successful use of participatory mapping as an alternative method for exploring the health impacts on workers from past exposure. Mapping proved to be an effective tool for data gathering. The hazard mapping recreated on paper the intricate details of an industrial complex that no longer exists in brick and mortar. The body mapping created an eye-opening collective health profile of a workforce subjected to life-threatening industrial exposures. The process proved to be empowering; it helped to mobilize workers and community members to join in advocating for occupational health services and fair compensation.

The threat of asbestos-related disease continues to dominate worker and public health concerns in Sarnia. Because of latency, these diseases will likely continue to emerge over the next decade and beyond. Today there are more building trades and petrochemical workers registered with the occupational health clinic in Sarnia than former Holmes workers. Over 500 have radiographic evidence of asbestos exposure. The dark shadow cast by the Holmes experience should awaken governments throughout the world about the dangers of asbestos. Anything short of a global ban is bound to cost human lives.⁵⁰

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References

1. Lambton Public Health Unit. Correspondence to Chemical, Energy and Paperworkers (CEP) union regarding Lambton County hospital morbidity data, 1992 to 1998, dated March 21, 2000.
2. Keith M, Brophy J. Presentation: Sarnia tragedy. Canadian asbestos—A Global Concern Conference, West Block Parliament, Ottawa, ON, Canada, September 12–14, 2003.
3. Ford RW. A History of the Chemical Industry in Lambton County. Sarnia–Lambton Environmental Association and Society for Industrial Archeology, 2000.
4. Tourism Sarnia Lambton. Oil Heritage District. <<http://www.tourism-sarnia-lambton.com/main/ns/5/doc/21>> (retrieved: 09/28/03).
5. Tourism Sarnia Lambton. Sarnia/St.Clair River. <<http://www.tourism-sarnia-lambton.com/main/ns/3/doc/20>> (retrieved: 09/26/03).
6. Finkelstein M. Mesothelioma in oil refinery workers. *Scand J Work Environ Health*. 1996; 22:67.
7. Marrett LD, Swift MB, Reynolds DL, Clarke EA. Geographic distribution of cancer in Ontario: Vol 1. Toronto, ON, Canada: Ontario Cancer Treatment and Research Foundation. 1991.
8. Health Canada. Correspondence to J. Brophy with report from Surveillance and Risk Assessment Division by Robert Semenciw, Ottawa, dated October 23, 2003.
9. Selikoff IJ, Hammond EC, Seidman H. Mortality experience of insulation workers in the United States and Canada, 1943–1976. *Ann NY Acad Sci*. 1979; 330:91-116.
10. Health Canada. St. Clair River Area of Concern: Health Data and Statistics for the Population of Sarnia and Region (1986 to 1992). Great Lakes Health Effects Program. Technical report for the RAP Committee, 1998.
11. Gilbertson M, Brophy J. Community health profile of Windsor, Ontario, Canada. *Environ Health Perspect*. 2001; 109(suppl 6): 827-43.
12. Gilbertson M. Male cerebral palsy hospitalization as a potential indicator of neurological effects of methylmercury exposure in Great Lakes communities. *Environ Res*. (2003; in press).
13. Pollution Watch. Pollution Rankings. <www.scorecard.org/pollutionwatch/> (retrieved: 06/13/01).
14. Pollution Watch. Pollution Rankings. <www.pollutionwatch.org> (retrieved: 10/25/03).
15. Industry Canada. Sarnia—A Leading Investment Location for the Chemical Sector. <<http://strategis.ic.gc.ca/epic/internet/inchemicals-chimiques.nsf/vwGeneratedInterE/bt01202e.html>> (retrieved: 10/22/03).
16. Smith D. Consulted to Death. Winnipeg, Canada: Arbeiter Ring Publishing, 2000: 78-101.
17. Finkelstein M. Mortality among employees of an Ontario factory manufacturing insulation materials from amosite asbestos. *Am J Ind Med*, 1989, 15:477-81.
18. Mayville K, Gilroy M. Holmes production exposure profile. Occupational Health Clinics for Ontario Workers—Sarnia, 1999.
19. Brophy J, Parent M. Documenting the asbestos story in Sarnia. *New Solutions*, 1999; 9: 297-316.
20. Snow D. The Holmes Foundry Strike of March 1937: "We'll give their jobs to white men!" Toronto, ON, Canada: Ontario Historical Society, 1977: 3-31.
21. Keith M, Cann B, Brophy J, et al. Identifying and prioritizing gaming workers' health and safety concerns using mapping for data collection. *Am J Ind Med*, 2001; 39:42-51.
22. Keith M, Brophy J, Kirby P, Rosskam E. Barefoot Research: A Work Security Manual for Workers. Geneva, Switzerland: International Labor Organization, 2002.
23. Reich MR, Goldman RH. Italian occupational health: concepts, conflicts, implications. *Am J Ind Med*. 1984; 74:1031-41.
24. Loewenson R, Laurell AC, Hogstedt C. Participatory Approaches in Occupational Health Research. Sweden: Arbete Och Halsa, 1994.

25. Mujica J. Coloring the hazards: risk maps research and education to fight health hazards. *Am J Ind Med.* 1992; 22:767-70.
26. Firth M, Brophy J, Keith M. *Workplace Roulette: Gambling with Cancer.* Toronto, ON, Canada: Between the Lines, 1997.
27. Brophy J. Correspondence to Ken Signoretti, president of the Occupational Health Clinics for Ontario Workers Board, and others regarding meeting with Workplace Safety and Insurance Board (WSIB) and CAW union representatives, January 22, 1999.
28. Misiti R, Bagnara S. Participation in health control at the workplace: the Italian experience. In: Bagnara S, Misiti R, Wintersberger H (eds), *Work and Health in the 1980's. Experiences of Direct Workers' Participation in Occupational Health.* Berlin, Germany: Science Centre, 1985: 31-55.
29. Laurell AS, Noriega M, Martinez S, Villegas J. Participatory research on workers' health. *Soc Sci Med.* 1992; 34:603-13.
30. McLaughlin J. *Compensating for the Past.* OHS Canada, December 1999, p. 29.
31. Smith D. *Consulted to Death.* Winnipeg, Canada: Arbeiter Ring Publishing, 2000: 82-3.
32. Sharpe J. Letter to the editor: Holmes story is personal tragedy. *OHS Canada.* March 2000: 6.
33. Brophy J, Keith M. Executive Summary of Holmes Caposite Government Records. <www.hazards.org/diyresearch/holmesreport.doc> (retrieved: 10/22/03).
34. Keith M. Workplace health and safety mapping: the why and how of body mapping. *Occup Health Rev.* 2003; 102:31-3.
35. Corlett E, Bishop R. A technique for assessing postural discomfort. *Ergonomics.* 1976; 19:175-82.
36. Moir S, Vogel M, Azaroff L, O'Donnell. Master ergonomics training: using popular education to train workers and supervisors to solve ergonomic problems on construction sites. *Construction Occupational Health Project (COHP) at University of Massachusetts Lowell and the Massachusetts Building Trades Council, AFL-CIO,* 1998.
37. Habes DJ, Wigmore D. Health Hazard Evaluation Report No. HETA 98-0085-2715, Aurora Casket Company. Cincinnati, OH: Hazard Evaluations and Technical Assistance Branch, NIOSH, U.S. Department of Health and Human Services, 1998.
38. *Hazards Magazine.* Body of Evidence. *Hazards.* 1998; 61.
39. Brophy J. Report to Managing Director of Occupational Health Clinics for Ontario Workers regarding Holmes Intake Clinic, dated September 20, 1998.
40. Shrigley S. Interviewed by Margaret Keith for article on post traumatic stress in the Sarnia community, 2002.
41. O'Neill R. Workers are catching disease epidemics overlooked by official safety agencies. *Workers' Health International Newsletter.* 1999; 55:1.
42. Landsberg M. The tragic legacy of Sarnia's white death. *Toronto Star.* November 14, 1999.
43. Brophy J, Reinhartz A, Keith, M. Perspectives on bladder cancer and occupation. Unpublished presentation to the Workers Safety and Insurance Board Taskforce, 1999.
44. Brophy J, Reinhartz A, Keith M. Perspectives on cardiovascular disease and foundry work. Unpublished presentation to the Workers Safety and Insurance Board Taskforce, 2000.
45. Brophy J, Reinhartz A, Keith, M. Perspectives on pancreatic cancer and occupation. Unpublished presentation to the Workers Safety and Insurance Board Taskforce, 2001.
46. Keith M. Mapping for change: a picture is worth a thousand words. Part one. *Occup Health Rev.* 2003; 101:13-16.
47. Canadian Auto Workers (CAW). Holmes Foundry: \$16 million for asbestos victims. *CAW Health, Safety and Environment Newsletter.* 2003; 11:July/August.
48. DeCarlo N. Letter to the editor: Local OHCOW clinic effective. *Sarnia Observer.* December 19, 2001.
49. DeGurse C. Fear of Safety-Kleen fuelled by Holmes Foundry death list. *Sarnia Observer.* December 1, 1999.
50. Collegium Ramazzini. Call for an international ban on asbestos. *Am J Ind Med.* 1999; 36:227-9.