

The Victims: Cause and Time of Death

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Introduction

Tragically, two people died as a result of the collapse of the Mall.

Doloris Perizzolo was 74 years old at the time of her death. She was born in Kirkland Lake, Ontario. She moved with her parents to Serpent River, Ontario, and then, in 1957, to Elliot Lake. She had three daughters and a son. She worked as a waitress and then, for 22 years, as a cook in the kitchen at St. Joseph's Hospital. She retired in 1994. Her husband, Giuseppe "Joe" Perizzolo, died on May 22, 2011. She is survived by her daughters Teresa Perizzolo of Elliot Lake, Cindy Lee Allan of Guelph, and Roberta Rayburn of Hamilton, and was predeceased by her son, Norman.¹

Lucie Aylwin was born on March 28, 1975, and moved to Elliot Lake with her parents when she was a year-and-a-half old. She lived her entire life in Elliot Lake. She worked for Collège Boréal as an employment counsellor and part-time at the ticket kiosk in the Mall. She is survived by her parents, Rachele Aylwin and Réjean Aylwin, her younger brother, Stéphane, and her fiancé, Gary Gendron.²

Although it appears very clear that Doloris Perizzolo died almost instantly after the collapse, the evidence does not allow as certain a conclusion about Lucie Aylwin. She probably lived for some time after the initial collapse.

Doloris Perizzolo

Capt. John Thomas of the Elliot Lake Fire Department found Mrs. Perizzolo's body at 4:30 p.m. on June 23. He could see a hand and foot extending from the rubble. He checked her wrist. It was cold to the touch, and there was no pulse. He asked the paramedics to confirm that there were no vital signs, and they did.³

Dr. Marc Bradford, the coroner, was at the Mall at 8:40 a.m. on June 27. He was shown Mrs. Perizzolo's body close to the wall of the Mall, near some pay phones. Debris was leaning against her, and some concrete was beside the debris. Dr. Bradford made the formal pronouncement of death at the scene of the collapse, before Mrs. Perizzolo's body had been removed, at 8:45 a.m. on June 27.⁴ More debris was removed, and Dr. Bradford returned to the site at 9:14 a.m. He noticed an obvious ankle fracture that Mrs. Perizzolo had suffered. Although he could not determine the cause of her death at that time, he testified that he was "very suspicious that trauma was involved" – that she had been struck by a large amount of debris.

The bodies of both Mrs. Perizzolo and Ms. Aylwin were sent on June 27 to Dr. Martin Queen, a forensic pathologist, at Health Sciences North in Sudbury. Dr. Queen received his medical degree from the University of Toronto in 1981 and practised as a family physician in Toronto and Nova Scotia before returning to Toronto in 1988 to begin training as a pathologist. He studied at a number of hospitals in Toronto and, in 1992, received a fellowship from the Royal College of Physicians and Surgeons in anatomical pathology and became a diplomate of the American Board of Pathology in anatomical pathology. "Anatomical pathologists" generally analyze specimens and tissues from live patients, in order to aid in diagnoses. Forensic pathology is a subspecialty that deals with the investigation of deaths. Forensic pathologists perform autopsies and post-mortem examinations to determine the cause of death.⁵

Dr. Queen worked as an anatomical pathologist in Toronto until 1995, when he received a fellowship in forensic pathology at the Office of the Chief Medical Examiner in Baltimore, Maryland. In 1996, he became a diplomate of the American Board of Pathology in forensic pathology. He worked as a forensic pathologist at the Office of the Chief Coroner for Ontario from 1996 to 1999, and has worked as a forensic pathologist at Health Sciences

North since May 1999. Since 2010, he has been the director of the Northeastern Regional Forensic Pathology Unit in Sudbury. He is also an adjunct professor in the Department of Forensic Science at Laurentian University in Sudbury. Dr. Queen is clearly a highly qualified and experienced forensic pathologist.⁶

Dr. Queen worked into the early hours of June 28 conducting his initial post-mortem examination. At 2:43 a.m., he sent an email to Dr. Michael Pollanen, the chief forensic pathologist for the Province of Ontario, and Dr. Craig Muir, the local regional coroner. He wrote with respect to Mrs. Perizzolo:

Greetings at 2 in the morning. We just finished both cases. Here's what I have so far:

Jane Doe #1 – PERRIZZOLO [*sic*], Doloris, DOB Jan 12, 1938 (74 yo)

- determined to be deceased shortly after the event, scene photos show entrapment under tons of debris
- PM [post-mortem] shows obviously rapidly fatal massive blunt force head injury with vault and basal hinge fractures, brain trauma, carotid artery laceration and exsanguination
- I don't see any obvious reason why her body couldn't be released later today.
- ...
- interestingly neither body showed any signs of decomposition despite an apparent post-mortem interval of 4 days for both.⁷

As the coroner, Dr. Bradford's role is to determine what he called the "five questions": who died, when they died, where they died, how, and by what means – accident, homicide, suicide, or undetermined. In some cases, such as the deaths of Mrs. Perizzolo and Ms. Aylwin, it is necessary for him to obtain assistance from a forensic pathologist.⁸

On June 28 at 4:28 p.m., Dr. Bradford spoke to Mrs. Perizzolo's daughters and told them (as is set out in a contemporaneous email) that their mother's cause of death was massive trauma especially to the head, and that "their mother died almost instantly and didn't suffer."⁹

A coroner is required to issue a report, entitled "The Coroner's Investigation Statement," answering the five questions. Dr. Bradford issued a preliminary report dated October 31, 2012. At that time, Dr. Queen had not yet produced a formal autopsy report, and all that Dr. Bradford had received from him was the email of June 28 and information in a subsequent telephone conversation.¹⁰ Dr. Bradford wrote:

Dr. Queen performed a very thorough autopsy that demonstrated massive blunt trauma including massive trauma to her head and a carotid artery laceration.

Given the evident debris overlying Mrs. Perizzolo, as well as the severity of her injuries found at autopsy the strong balance of probability favours massive blunt trauma as a cause of death that occurred almost instantly at the time of the rood [*sic*] collapse on June 23, 2012.¹¹

Dr. Bradford was asked during his testimony to be more precise about the time of death than he had seen in that report. He testified that he would defer to Dr. Queen for a more accurate answer, but that he believed that the chance of Mrs. Perizzolo surviving 20 minutes was less than her surviving 10 minutes, and greater than her surviving one hour.¹²

Dr. Queen's autopsy report for Mrs. Perizzolo, dated December 4, 2012, noted a number of injuries, of which the most specific was described by him as a "hinge fracture through middle cranial fossae [the cavity in the skull which houses the temporal lobes of the brain], L>R, with laceration of left carotid artery, decreased intravascular blood volume and absent post mortem lividity." Dr. Queen testified that the injury he described was the result

of application of blunt force at the base of the skull under the brain. This injury lacerated the left carotid artery, which is one of the two main arteries pumping blood from the heart into the brain. This laceration would have produced, as Dr. Queen testified, “massive instant bleeding.” The blood loss would have been so great that there was no “lividity,” the marking or bruising of the body at its lowest point, caused by the gravitational settling of the blood in the deceased person.¹³

Dr. Queen’s autopsy report also described severe fractures to the ribs, from the top of the chest to about two-thirds of the way down the chest and a fracture high up in the lumbar spine (slightly above the navel), which was caused by pressure rather than a bending of the spine. Mrs. Perizzolo also suffered fractures to her pelvis and her ankle. The report concluded:

At postmortem examination there were both definitively and additional potentially fatal blunt force injuries. Most proximate to the death was a severe fracture through the base of the skull with tearing of the left carotid artery.

The resulting mechanism of death was rapid exsanguination [loss of blood]. This injury is not survivable and death would have been inevitable and near-immediate.¹⁴

Dr. Queen testified that Mrs. Perizzolo would have been unconscious immediately and dead within a few minutes of her injuries.¹⁵

I accept Dr. Queen’s opinion. It is clear to me that Mrs. Perizzolo died, as he put it, almost immediately after the Mall collapse, which caused her significant injuries. The medical evidence is unequivocal. It is corroborated by the signs noted by Capt. Thomas two hours after the collapse. Mrs. Perizzolo’s death was a tragedy. It may be a small mercy that it was quick.

Mrs. Perizzolo’s death was a tragedy. It may be a small mercy that it was quick.

Lucie Aylwin

Dr. Bradford and Cst. Dale Burns, the OPP photographer, entered the area of the rubble pile where Ms. Aylwin’s body was located at approximately 1 p.m. on June 27. Dr. Bradford testified that there was a large slab of concrete lying on top of Ms. Aylwin, with debris scattered around her body. He marked the location of her body on a photograph taken at 1:06 p.m. It appears, from viewing the photograph, to be several feet west of the area where Mrs. Perizzolo was located.¹⁶

After the debris had been lifted from Ms. Aylwin, Dr. Bradford was able to see that she was surrounded by a scattering of lottery tickets and that she was curled up on her left-hand side, with her hands curled in front of her, very close to her face, approximately on her chin, just below her mouth. He noted that there was a space around her face, and it was not completely covered in crumbled material or dust bits. He concluded, as a result of this observation, that she had been located in a “void.”¹⁷

Dr. Bradford checked to see if there was any evidence from the scene that Ms. Aylwin had struggled to escape, but he found none. He noted that the scene had been so disturbed that any such marks may have been obliterated. He observed that Ms. Aylwin had some trauma to her nose, some edema (swelling) about her face, and a large laceration of her left knee. He suspected that her death was caused by what he described as a “massive trauma” – being hit by a large amount of debris.¹⁸

Physicians' initial opinions as to time of death: probably very quick, but not certain

Dr. Queen's email to Dr. Pollanen and Dr. Muir, sent at 2:43 a.m. on June 28, after he completed his initial post-mortem review, had the following comments about Ms. Aylwin:

- scene photos also show entrapment under tons of debris.
- PM shows no definitive fatal injury, however severe posterior rib fracturing, anterior chest wall hemorrhage and florid conjunctival, facial, peri-orbital and oral mucosal petechiae strongly support a diagnosis of asphyxia due to chest compression.
- despite the media reports of possible "signs of life" up to 48 hours after the collapse, I am highly skeptical and believe that this victim also died very quickly (her fingernails are totally intact and very clean showing no evidence of [having] tried to "claw her way out").
- some pending studies include 1) microscopic examination of some of the skin injuries and rib #'s to r/o [rule out] a vital reaction; 2) histology of the lungs to rule out fat emboli; 3) histology of the kidneys to r/o rhabdomyolysis [*sic*]; 4) vitreous chemistry to r/o dehydration and/or renal failure, I don't think I will find any of these things.
- ...
- interestingly neither body showed any signs of decomposition despite an apparent post-mortem interval of 4 days for both.¹⁹

At approximately 8 p.m. on June 28, Dr. Bradford spoke with Réjean Aylwin, Ms. Aylwin's father, and told him that his daughter's death had been caused by crush injuries to her chest so that her death was "quick." He said that they did not know when she had died and some investigations were still pending. Mr. Aylwin, who had spent his working life in underground mines, asked whether his daughter had died after some of the structure moved following a few days of survival.²⁰

Dr. Bradford's preliminary report, prepared October 31, 2012, with respect to Ms. Aylwin, stated:

Dr. Queen performed an autopsy that found severe posterior rib fractures and facial and oral petechiae implying asphyxia as the cause of death. Given the amount of debris at the scene and the autopsy findings the balance of probabilities strongly favours that Ms. Aylwin expired very rapidly after the collapse.²¹

Dr. Bradford's final report, however, prepared after he reviewed Dr. Queen's autopsy report of December 4, 2012 (which I will describe below), was not so categorical. It stated:

An autopsy, in conjunction with radiological investigations, revealed evidence of severe fracturing of thoracic vertebrae and multiple posterior ribs in addition to stigmata of asphyxia. The cause of death was concluded to be crush asphyxia by the forensic pathologist. Consideration of the scene circumstances and analysis of anatomic, histologic, neurologic and biochemical evidence did not support any significant post-injury survival time.²²

When asked to explain the difference in language between the two reports, Dr. Bradford testified: "[T]o be blunt, I was being more careful." It was his evidence that he did not know when the crushing injury which caused Ms. Aylwin's death occurred. He testified that it was possible "but very unlikely" that she had sustained some injury as a result of the collapse, found herself in a void, and was crushed later by a subsequent shift of the debris under which she was located. He explained that he thought this possibility very unlikely because he relied on Dr. Queen's report for his conclusions, and Dr. Queen described the injuries as occurring all at the same time. He acknowledged, however, that it is possible that she sustained some crush injury at the time of the collapse which would not have caused her death right away, and then survived for a period of time.²³

Palms in a wet environment

Dr. Queen's autopsy report for Ms. Aylwin, dated December 4, 2012, noted that there was wrinkling on both of her palms. Dr. Queen testified that wrinkling is typically seen in a wet environment, such as when someone has been pulled from a bathtub or a swimming pool or other very wet environment, and is sometimes called "washer woman's hands."²⁴

Severe fracture of thoracic vertebrae – not the cause of death

The report also noted that Ms. Aylwin had suffered a "severely comminuted and displaced Chance type fracture at T8 and T9." A comminuted fracture means that the bone has fractured into multiple fragments, and a displaced fracture means that the bone is not in its normal location. "T8" and "T9" refer to the eighth and ninth thoracic vertebrae, located on the back of the chest, below the neck and above the lumbar area. Dr. Queen explained that a Chance fracture (named after Dr. G.Q. Chance, the first physician to describe it) is a compression injury to the front and a transverse fracture through the back. It occurs when someone is forced to suddenly bend forward in a violent way, fracturing the backbone. This action causes the front part of the vertebral bodies to get compressed, and the back part to fracture. It was most often seen in motor vehicle collisions when passengers wore only a lap belt and not a chest belt, so that when a car struck an object in front of it, the passengers would be flexed forward with their hips restrained by the belt.²⁵

Dr. Queen testified that the Chance fracture did not cause Ms. Aylwin's death and does not tell us anything about the time of her death. He also testified that he thought it likely that the fracture happened when she was standing at the ticket kiosk in the Mall and struck by concrete from the original collapse, causing her to flex forward. He volunteered, however, that if after she was trapped her upper body still had some room for movement, and if there was some kind of secondary shift or smaller collapse, it was possible that the Chance fracture occurred at that time.²⁶

Lacerations to left knee and right shin – no more than a little longer than three hours before death, and more than minutes or a few hours before the body was recovered

Dr. Queen noted a deep laceration of Ms. Aylwin's left knee and a laceration of her right shin. Analysis of skin and subcutaneous tissue taken from those areas showed that the blood cells had not yet begun to break down. Dr. Queen testified that blood cell breakdown begins between 12 and 48 hours after an injury if the victim is still alive.²⁷ Consequently, the injuries to the left knee and right shin would have occurred at the time of, or up to 48 hours before, Ms. Aylwin's death. Had she survived for longer than that period of time, there should have been an indication of blood cell breakdown.

The microscopic analysis of the skin and tissue also showed no inflammatory or reparative reaction. Dr. Queen explained that the body will react to an injury by sending in white blood cells as long as the person is still alive. When asked how long after an injury it would be before such a reaction can be seen, he testified that it could not "be quantified in an exact way because there are so many variables, and there are so many unknowns." In some cases, some changes in the white blood cells are seen as early as 30 minutes after an injury, although most cases take somewhat longer – perhaps three hours or "possibly a little longer." The fact that no such reaction had occurred here led him to conclude that Ms. Aylwin did not live a long time after the knee and shin injuries – perhaps a little longer than three hours at most.²⁸

The analysis of the samples from the left knee and right shin laceration also showed “well-established cutaneous and subcutaneous [at and below the skin] postmortem [after death] bacterial overgrowth.” Dr. Queen explained that, very shortly after death, bacteria escapes from the body and multiplies, often quite rapidly. He testified that he could not quantify how long it would take for bacterial growth of the type seen at the site of the lacerations to Ms. Aylwin’s knees and shin, other than to say that she died earlier than “minutes or a few hours before her body was recovered.”²⁹

Ms. Aylwin also suffered fractures of a number of her ribs. Analysis of cell samples from the fractures of her right seventh and eighth ribs showed, as with the knee and shin lacerations, no red blood cell breakdown and no inflammatory or reparative reaction. Bacterial overgrowth like that seen on the knee and shin lacerations was not found, but Dr. Queen explained that this area was more protected from bacterial contamination.³⁰

I note, however, that, like the Chance fracture, these findings are not determinative of the time of Ms. Aylwin’s death. The left knee and right shin lacerations and the rib fractures could have occurred well after the initial collapse if there had been a secondary shift or smaller collapse that had caused the Chance fracture and/or those injuries. If so, she could have died within a few hours of those injuries and more than a few hours before her body was recovered. If that had happened, the blood cells would not have begun to break down, the reparative reaction would not have begun, and the bacterial growth could have begun.

Hands cupped in front of her face, catching blood from above

A photograph taken of Ms. Aylwin on June 27 at 1:33 p.m., before her body was moved, shows her semi-prone, facing down on her left side, with her knees bent at almost 120 degrees to her thighs, and her abdomen bent forward at an angle of approximately 135 degrees to her thighs. Her elbows are bent with her forearms pushed up tight against her face. Dr. Queen testified that the photograph was consistent with her hands being in front of her face at the time she was put in that position.³¹ This statement accords with Dr. Bradford’s description of Ms. Aylwin at the scene before her body was moved – her hands were curled in front of her face, just below her mouth, with a space around her face.

The notes Dr. Queen made when he initially examined Ms. Aylwin’s body described no lacerations on her right hand. A photograph taken shortly after her recovery showed blood on her right hand. Dr. Queen testified that that blood was not from cuts to her right hand, because it washed off. It was from a different source. Dr. Queen testified that the blood on her right hand was consistent with the blood from her nose having leaked onto her hand if the right hand was close to the lower portion of her face. The same photograph shows significant bleeding from Ms. Aylwin’s nose. A close-up photograph of her hands taken at 1:43 p.m. on June 27, just less than 10 minutes after she was removed from the scene, shows that the blood on her right hand was wet. Dr. Queen described the blood as “relatively fresh.”³²

A photograph taken June 27 at 10:02 p.m. shows a significant abrasion or laceration on the right side of Ms. Aylwin’s forehead extending from halfway across her right eyebrow back below the hairline, measured by Dr. Queen to be 9 centimetres long by 3 centimetres wide. Dr. Queen took no cellular sample from this injury. He testified that he did not know whether this injury occurred at the same time as the injuries to the shin, knees, and ribs.³³

I conclude that, after the collapse, Ms. Aylwin had her hands cupped in front of her face and that blood from her nose and, potentially, from the laceration on the right side of her forehead, leaked onto her right hand.

Cause of death: crush asphyxia

Dr. Queen noted that he observed, as “indicators of asphyxia,” “florid periorbital and facial petechial hemorrhages” and “florid bilateral subconjunctival petechial hemorrhages.” He explained that asphyxia in its broadest terms means lack of oxygen, which could be caused by many things. Petechiae are tiny red spots caused by the bursting of very small blood vessels – minor hemorrhages. They can be seen in many different situations and are thus “nonspecific,” but are one of the indicators of asphyxia. “Periorbital” is the area around the eyes, and “florid” means that the spots were prominent. The conjunctiva is the thin layer on the surface of the eyeball, and “subconjunctival” means the area underneath that layer. These entries in Dr. Queen’s autopsy report thus indicated that these small blood vessels had burst in an obvious way in the area in and around the eyes. He also noted edema, or swelling, around the eyes, and some petechiae on the inside lining of the mouth.³⁴

Dr. Queen noted that Ms. Aylwin’s nose was blocked by blood, mucus, and debris. This blockage could have contributed to asphyxia. He found generalized congestion, or excessive fluid, in the organs and tissues, which tends to be prominent in crush asphyxia.³⁵

Dr. Queen concluded in his autopsy report that the cause of Ms. Aylwin’s death was “crush asphyxia.” He wrote:

Postmortem examination showed significant blunt force / crush injury to the posterior chest, including severe fracturing of thoracic vertebrae and multiple posterior ribs. Along with less severe blunt force / crushing injury to the anterior chest and florid stigmata of asphyxia, this constellation of findings is typical of death due to “crush asphyxia” (also known as compressive or traumatic asphyxia and Perthe’s syndrome). The findings in this specific case are most consistent with the deceased terminating in a more or less prone position.

Mechanisms of death in crush asphyxia include prevention of breathing movements and mechanical limitation of lung expansion as a result of active chest compression and rapid increase in intrathoracic pressure such that it exceeds that of venous return. Blood cannot re-enter the chest. In these circumstances, innumerable postcapillary venules burst under hydrostatic pressure, producing the most florid physical signs of raised intravenous pressure.³⁶

Dr. Queen explained that he came to this conclusion because Ms. Aylwin suffered a quite significant blunt force or crushing injury to her back, including various lacerations and abrasions and indentations of the skin of her back, and, underneath that, multiple fractures of her spinal column and multiple severe fractures of her ribs at the back. These injuries led him to infer that something blunt very forcefully struck her back and caused her to flex forward, causing a compression or squeezing. Ms. Aylwin would not have been able to move her ribcage, which normally acts as a bellows to bring air in and blow it back out. Without this ability, air cannot move in and out of the lungs. Ms. Aylwin would also not have been able to move her diaphragm, a muscle separating the chest from the abdomen that helps lungs contract and expand to move air in and out. Finally, the increased pressure on her chest would create significantly increased pressure inside the chest. Blood returns to the heart through veins, which are at relatively low pressure and run through the chest. If the pressure inside the chest increases so that it is greater than the pressure of the blood in the veins, the blood cannot return to the heart. Therefore, no blood can flow from the heart out to the rest of the body. The failure of the heart to work increases the pressure in other organs and tissues, causing small blood vessels to burst and others to leak fluid and cause congestion.³⁷

Dr. Queen's opinion as to time of death: "near-immediate"

Dr. Queen concluded that Ms. Aylwin's death was "most likely near-immediate, and inevitable after the crushing forces were applied."³⁸

Dr. Queen testified that his conclusion that Ms. Aylwin died of crush asphyxia does not assist me, in and of itself, in determining whether the injury that caused her death occurred at the time of the collapse or some time later.³⁹

Dr. Queen's autopsy report, immediately preceding its conclusion, set out the factors that did lead him to his conclusion as to the time of death. I will deal with each of them in turn.

Clean fingernails, so no escape attempt – but this opinion is not in Dr. Queen's area of expertise

Dr. Queen wrote:

The fingernails of the deceased were clean with no evidence of fresh damage, suggesting the lack of or inability to mount any attempt to "claw" her way out of the situation.⁴⁰

Dr. Queen testified that this opinion was not based on his credentials as a forensic pathologist. "[F]or me," he said, "that was just sort of common sense." He thought that, for someone in a situation where his or her oxygen supply is diminishing and the person is starting to lose consciousness, it would be a "reflexive thing" to try to claw a way out.⁴¹ I have no reason to disagree with Dr. Queen's common sense opinion, but I am aware that I have not heard contradictory or confirmatory expert evidence on point.

No inflammatory or reparative reaction – but this observation does not mean that crush injury occurred at time of collapse

Dr. Queen wrote:

Microscopic examination of representative skin lacerations and rib fractures shows no evidence of any inflammatory or reparative reaction (which would be expected in the event of a significant survival interval).⁴²

Dr. Queen agreed that this observation was based on his evidence of the examination of the samples he took from the left knee, the right shin, and the ribs. As I have indicated, that examination, as explained by Dr. Queen, showed that those injuries probably occurred within approximately three hours of death. He agreed, however, that the crush injury which caused the asphyxia would have "certainly" caused the chest and rib injuries, and that, while the injuries were presumably caused by being struck by some debris, he could not say for sure whether it was the same debris as had caused the Chance fracture. A photograph of Ms. Aylwin taken after the concrete which had been covering her was removed showed that her right shin had been under the slab that had been lying on top of her.⁴³ If the crush injury had occurred at the same time as her shin, knee, and rib were injured, all that the absence of inflammatory or reparative reaction at those sites can tell us is that those injuries occurred within a few hours of her death. That conclusion does not assist in determining whether those injuries occurred at the time of the original collapse or later.

No evidence of survival after traumatic brain injury – but Ms. Aylwin did not suffer a traumatic brain injury

Dr. Queen wrote:

Separate examination of the brain by a neuropathologist (Dr. S. Graham) shows no evidence of changes that may be seen when there is a survival interval following hypoxic-ischemic or traumatic brain injury (no hypoxic-ischemic encephalopathy or diffuse axonal injury).⁴⁴

He testified that, by this entry, he meant there was no evidence of changes in the brain that might be seen if Ms. Aylwin had suffered those specific types of brain injuries and survived for a period of time. He also testified, however, that Ms. Aylwin did not have those types of brain injuries. (This statement was confirmed by a report from Dr. Silvia Gaytan-Graham, a neuropathologist.) Consequently, as Dr. Queen testified, this conclusion gave him no information that could assist in determining the issue of time of death.⁴⁵

No evidence of dehydration or hyperglycemia – but low glucose levels are of no help in determining cause of death, and the time for dehydration to be apparent in body fluids is unknown

Dr. Queen wrote:

Biochemical analysis of vitreous (eye) fluid shows no evidence for dehydration, hemoconcentration or hyperglycemia (some or all of which would be expected in the event of a significant survival interval, particularly in a diabetic with no fluid intake).⁴⁶

This issue was dealt with at length in Dr. Queen's evidence.

Vitreous fluid is found in the eye. Dr. Queen testified that pathologists consider it, rather than blood, for some tests because blood cells start breaking down shortly after death and the blood becomes contaminated. Vitreous fluid, however, is not cellular and is in a protected environment. It is much less likely to be contaminated after death.⁴⁷

Some of the things tested for by pathologists remain in the same concentration for up to 120 hours after death as before death, among them sodium chloride creatinine and urea nitrogen. Glucose, however, is different. Immediately after death, the glucose level in the vitreous fluid starts to drop. Consequently, a low sugar level in the vitreous fluid cannot be relied on to reach any conclusion about the sugar levels before death. A high sugar level in the vitreous fluid, however, can be used as a basis to conclude that the sugar level was high before death, because it would have been dropping since the time of death.⁴⁸

The analysis of the vitreous fluid showed sodium levels of 129, chloride levels of 105, glucose of less than 1.1, urea nitrogen levels of 5.2, and creatinine levels of 153. The unit of measurement for all those levels is millimoles per litre. Dr. Queen testified that the glucose level was low, which, as explained above, means that it was of no value in determining the time of death.⁴⁹

The sodium and chloride levels were at the lower levels of normal, and the urea nitrogen levels were normal. Dr. Queen testified that these results meant that Ms. Aylwin had not been dehydrated at the time of death. If she had been, the effect would have been to elevate the levels of these substances in a given volume of fluid. Removal of water from a fluid in which substances are present results in an increased concentration of those substances. Dr. Queen testified that, from his review of some of Ms. Aylwin's medical records, he noted that she had suffered from diabetes and been insulin dependent since at least December 1988. She had frequent testing done to measure her sugar control, and the records showed that frequent attempts had been made to adjust her insulin doses. Dr. Queen indicated that Ms. Aylwin was "somewhat of a brittle diabetic" – a patient whose diabetes was not well controlled, and subject to hypo- and hyperglycemia (low and high blood sugar). It was Dr. Queen's evidence that a person with such a condition in the situation of Ms. Aylwin – trapped in the debris, not getting insulin, fluids, or food, and having been subjected to serious injuries – would be under tremendous physiological and psychological stress. He believed that such stress would cause her sugar levels to rise – creating more urine and resulting in dehydration. Because there was no evidence of dehydration, he concluded that Ms. Aylwin's survival time after the collapse was quite limited. When asked how long he would expect it to

take for a loss of bodily water to be reflected in an increased concentration of these substances, he testified that “there’s absolutely no way to quantify that. There [are] just too many variables . . . too many unknowns.” He had carried out a detailed literature search in an attempt to locate any research that could assist in answering that question, and he could find nothing.⁵⁰

Dr. Queen testified, however, that if counsel were to suggest some lengthy time periods, he “might be willing to shoot them down.” He then testified that, in his view, it was not possible that Ms. Aylwin could have survived 24 hours after the collapse and that 20 hours was highly unlikely. When asked the basis on which he came to that conclusion, however, he testified that his research had failed to provide any information to assist him with this issue – his evidence was simply based on his “experience and belief.”⁵¹

As Commissioner Stephen Goudge noted in his *Report of the Inquiry into Pediatric Forensic Pathology in Ontario*, evidence of this sort, which places emphasis on authoritative claims based on personal experience that can seldom be quantified or independently validated, is problematic. He suggested, and I agree, that it would be better if forensic pathologists adopted an approach based on empirical evidence – and its scope and limits – as established in large measure by the peer-reviewed medical literature and other reliable sources.⁵² I note that Dr. Queen had attempted to find an evidence-based source for his opinion of the length of time following the collapse Ms. Aylwin could have survived and was unable to do so. I must take that into consideration when assessing the weight which should be given to his unsubstantiated opinion.

Dr. Queen’s conclusion: death most likely “near-immediate”

Dr. Queen’s opinion is best summarized in his autopsy report, where he wrote:

Combined consideration of the scene / circumstantial information, gross morphological findings, microscopic morphological findings, neuropathological findings and vitreous biochemistry results mitigates the likelihood of any significant post-injury survival time. Death was *most likely* near-immediate, and inevitable after the crushing forces were applied.⁵³ [Emphasis added.]

“Death was most likely near-immediate, and inevitable after the crushing forces were applied.”

– Dr. Queen

His evidence was that he could not “say 100 per cent for certain” when the crushing forces were applied. He testified that, “looking at the entire case, I think it’s probable that the crushing forces were applied at the time of the original collapse.” His evidence in support of that belief was, he said, set out in the first sentence of the paragraph I have just quoted.⁵⁴ He agreed that his language in the last sentence of his conclusion was used advisedly. It can be compared with his language in Mrs. Perizzolo’s autopsy report, where he opined that “death *would have been* inevitable and near-immediate” [emphasis added]. Dr. Queen agreed that the different language used was an indication that the strength of his conclusion with respect to the time of Ms. Aylwin’s death was less certain than with respect to the time of Mrs. Perizzolo’s death.⁵⁵

Dr. Queen was taken through each of the reasons set out in the above paragraph for his conclusion about time of death. He testified:

1. The “scene / circumstantial information” referred to photographs and videos that the police supplied to him.⁵⁶
2. The “gross morphological findings” referred to
 - (a) the absence of damage to the fingernails and fingers; and
 - (b) the Chance fracture, which in his opinion most likely occurred while Ms. Aylwin was standing and was struck from behind, most logically at the time of the initial collapse.⁵⁷

3. The “microscopic morphological findings” referred to the analysis which showed that there was no reparative reaction of the cells in the injuries to the right knee, the left shin, and ribs which would have been expected if Ms. Aylwin had survived for a long period of time after those injuries.⁵⁸
4. The “vitreous biochemistry” refers to the sodium, chloride, and urea nitrogen levels, which showed no dehydration after the injury. He would have expected to see dehydration, particularly in a diabetic, if she had lived for a significant period of time after the collapse.⁵⁹

I note, with respect to each of these issues, the following:

1. Dr. Queen testified, at the outset of his evidence about Ms. Aylwin’s death, that his answer to the question “did they [the photographs and videos of the scene] tell you anything about the time of death,” was “no”; he later said, however, that

[i]t set the scene that this was a circumstance where you would expect the mortality rate to be high, so it doesn’t mean that someone can’t survive . . . People have survived situations like this, but certainly you’re starting with the impression that a mortality rate here would be high.⁶⁰

Commissioner Goudge warned of the dangers of forensic pathologists using circumstantial evidence and noted that, while it was appropriate to do so to some degree, the pathologist should be careful to ensure that he or she is not, “under the guise of scientific opinion . . . simply presenting a conclusion drawn from the circumstantial evidence.”⁶¹ Dr. Queen does not have expertise in the area of survival rate in structural collapses. Since it is clear that persons trapped in structural collapses can and do survive, as I will discuss below, it is not safe, in my view, to conclude from the nature of the collapse that death would have been immediate.

2. Dr. Queen testified that his opinion that there ought to have been damage to the fingernails and fingertips was based on “common sense” and not his credentials as a forensic pathologist. As I have indicated, I have heard no expert evidence affirming or contradicting this point.
3. Dr. Queen’s evidence was that the Chance fracture did not cause Ms. Aylwin’s death. He admitted that the Chance fracture was not a crush injury, caused by a force which was applied to crush Ms. Aylwin’s chest and back. He testified that the Chance fracture was right next to the rib injuries and that it was “just logical to assume that probably they all happened at the same time,” but he could not rule out two separate injuries.⁶²
4. The microscopic morphological findings were not inconsistent with Ms. Aylwin having suffered the crushing injury at some point after the initial collapse but within a few hours of her death.
5. Dr. Queen testified that Ms. Aylwin’s fingers showed wrinkling commonly known as “washer woman’s hands,” which indicated that she had been in water. It was clear from other evidence, as I discuss below, that (a) there was a great deal of water on the rubble pile caused by a broken water pipe at the time of collapse, by hoses during the beam cutting on June 24, and by significant amounts of rain on June 23 and 24; (b) Ms. Aylwin’s hands, at the time she was found, were cupped under her mouth in a position that would have allowed her to drink; (c) the blood on her right hand had been transferred from somewhere else and appeared to have been wet or, as Dr. Queen testified, “relatively fresh.” Dr. Queen testified that, “hypothetically,” if Ms. Aylwin had been trapped under rubble but near water and able to drink it, that water would have relieved the dehydration. In any event, as I have noted, Dr. Queen admitted that he did not know when dehydration would start to be manifested in concentration levels.⁶³

I note also that Dr. Queen testified that the inability to move one's ribcage or diaphragm as a result of a crushing injury, as he determined was the cause of death, can be less than complete – it might result in only partial obstruction. In those cases, death would be less rapid than if the obstruction was complete. Some people are crushed in this way and survive.⁶⁴ Consequently, even if the crushing injury was caused by the initial collapse, the objective evidence relied on by Dr. Queen is not inconsistent with Ms. Aylwin surviving for at least “a little over three hours” following the initial collapse.

High creatinine levels – not of assistance in determining the cause or time of death

During the course of the hearing, an issue arose about the levels of creatinine in Ms. Aylwin's vitreous fluid at the time of her autopsy. After all the evidence on this issue was heard, it became apparent that the creatinine levels were of no assistance in determining Ms. Aylwin's cause or time of death. Because this issue was explored, however, I believe it is important that I explain the basis for that conclusion.

Creatinine is a chemical waste molecule that is generated from muscle metabolism and processed through the kidney. The levels of creatinine in bodily fluids can be affected by kidney problems or hydration issues. The creatinine levels in Ms. Aylwin's vitreous fluid were 153 millimoles per litre. Dr. Queen testified that that was about 150 percent higher than normal levels. He agreed that this level was an indication of either dehydration or renal (kidney) dysfunction. As I have indicated, he ruled out dehydration because of the normal levels of sodium, chloride, and urea nitrogen. It was his evidence that, as a result, “you've really only got one thing left. You've got kidney disease ...” He testified that, because Ms. Aylwin was highly prone to kidney disease, and because of the potential for a laboratory error in the sampling or testing, “the creatinine could be a bit of an outlier, but it really doesn't bother me.”⁶⁵

On further questioning, Dr. Queen agreed that the high creatinine levels could have been the result of kidney dysfunction that was caused by Ms. Aylwin being under the pile of rubble for some length of time before the crush injury that caused fatal asphyxia (which would support a conclusion that Ms. Aylwin survived for some time after the collapse).⁶⁶ He was shown a chart that summarized creatinine tests in Ms. Aylwin's blood since 1991. The levels had been tested 40 times, at least once annually in most years. Every test was within the normal range of 53 to 115 millimoles per litre. The last test, on April 20, 2012, some two months before the collapse, showed levels of 71 millimoles per litre. The autopsy test of 153 millimoles per litre was more than twice that level; the highest creatinine level found in Ms. Aylwin's blood before the autopsy was 95 millimoles per litre in June 2008, four years earlier.⁶⁷

When asked to give an opinion on the reason for this significant increase in creatinine levels, Dr. Queen testified:

So the possibilities are that she had a sudden decomposition of her renal function and certainly diabetics can do that, or the other possibility is what I mentioned before. There's some kind of technical issue around the fact that this sample was suboptimal or some issue in the laboratory.⁶⁸

It was his opinion that, based on the “entire picture” and “all of the evidence,” the sudden increase in creatinine levels was not the result of kidney dysfunction after the initial collapse and before the injury that caused crush asphyxia.⁶⁹

Commission counsel sought out further expert evidence to deal with the issue of the abnormally high levels of creatinine. Dr. Gerald Posen is a retired nephrologist (a medical specialist in diseases of the kidney) with a long and distinguished career. He reviewed Dr. Queen's autopsy report and Ms. Aylwin's medical records. He was asked to consider whether the high creatinine level was the result of acute renal failure after the accident, which would imply that the person was alive for some time after the crush injury. He concluded that the high creatinine levels could not support that conclusion.⁷⁰

Ms. Aylwin had suffered from diabetes since the age of 13. On April 20, 2012, the last visit to her physician before the collapse, her blood pressure was higher than recommended for a diabetic. Her physician increased her dosage of Fosinopril, a drug that is used to lower blood pressure in diabetics. One of the side effects of this drug is to increase creatinine levels in the blood, particularly when the kidneys have been affected by diabetes. The microscopic examination of the kidneys done during the autopsy showed that Ms. Aylwin's kidneys had been affected by her diabetes. It was therefore Dr. Posen's opinion that the increased dosage may have contributed to Ms. Aylwin's increased creatinine level.⁷¹

Dr. Posen explained that, although an increase in creatinine in the blood or vitreous fluid can be caused by renal failure, suggesting that Ms. Aylwin may have lived a significant period of time after the renal failure and before her death, he would also expect to see an increase in the urea nitrogen levels if that had been the case. Ms. Aylwin's urea nitrogen levels were normal at the autopsy. Furthermore, if the creatinine levels had been caused by the crush injury and Ms. Aylwin had survived for a significant period of time after that injury, he would have expected to see increased levels of myoglobin, a protein found in muscle tissue. The autopsy tests of kidney cells and urine showed no signs that would be associated with increased myoglobin. He concluded, as a result, that the increased creatinine levels were not due to acute kidney failure but to other factors, and that Ms. Aylwin died very soon after the crush injury.⁷²

Dr. Posen was asked whether he had any opinion about how long after the Mall collapse Ms. Aylwin suffered the crush injury. He testified that he could not give an opinion on that subject, because it was outside his area of expertise. In cross-examination, he noted that her urea nitrogen levels were normal so she was not dehydrated, but that there may have been water available. He testified that he could only say that her kidneys were functioning before the crush injury, but that he could not say how long that was.⁷³

Dr. Feldman's evidence: Persons trapped in structural collapses can survive for periods of time

Dr. Queen testified that one of the reasons he concluded that Ms. Aylwin's death occurred at or nearly immediately after the time of the original collapse was the nature of the collapse – that the mortality rate would be high.⁷⁴ Dr. Michael Feldman, the emergency room physician assisting the Heavy Urban Search and Rescue (HUSAR / TF3) team, made it clear that persons trapped in such a collapse can survive. As I have indicated, he emailed Capt. Tony Comella and Cmdr. Michael McCallion at 10:54 a.m. on June 25, writing that “a rule of thumb is that a trapped person can survive 3 days without water” and that, if there were no more signs of life detected by 72 hours after the collapse, it would be acceptable medically to consider it a body recovery operation following that point. He testified that the content of this email was based on his knowledge as an emergency physician, his training at the disaster medical specialist course, his reading of some of the literature about the kinds of things that one might encounter, and his inspection of the rubble pile.⁷⁵

An article published in 2005 in the journal *Prehospital and Disaster Medicine*, entitled “Surviving collapsed structure after earthquakes: A ‘Time-to-Rescue’ Analysis” was referred to by Dr. Feldman in a presentation he made about the Mall collapse and response. He asserted that it was a reputable source. The authors conducted a study of medical journal articles and media articles in an attempt to determine the range of survival times in earthquakes that caused collapsed-structure entrapment. After studying 34 earthquake events and 48 medical articles, the authors reported that the longest time to rescue a trapped survivor was between 13 and 19 days; the second-longest time was 8.7 days (209 hours). Twenty-five medical articles reported multiple rescues after 48 hours. Media reports described rescues occurring beyond Day 2 in 18 of 34 earthquakes, with the two longest reliably-reported survival times being 14 and 13 days after impact. The average maximum times reported from the 18 earthquakes was 6.8 days, and the median 5.75 days. The authors noted that, although

the data were not necessarily applicable to non-earthquake collapsed-structure events, the study findings may be useful for post-impact decision making and in establishing or revising incident priorities as the response evolves. An earlier literature search, in 1991, had indicated a dramatic drop-off in live finds during the 24 to 48 hours post-earthquake, which resulted in that time period being used as the “golden 48 hours” in early training for US Urban Search and Rescue teams. However, non-American teams operate under the “rule of fours,” which postulates that a victim can survive four minutes without air, four days without water, and four weeks without food. The authors concluded that, while their study’s findings do not contradict earlier impressions of a drop-off in the number of successful rescues after 48 hours, the many rescues accomplished after that time, particularly up to five days post-impact, suggest that the “intense rescue phase” should continue at least through this period. Dr. Feldman testified that he referred to the 2005 article in his post-event presentation because he thought it was “provocative” in extending the time for survival beyond the view, held by some, that the chance of rescue beyond 48 hours was low, and because he wanted to make people aware that the time could be extended in some circumstances.⁷⁶

I conclude that the nature of the collapse does not assist me in determining when Ms. Aylwin died.

There were voids in the rubble pile

If Ms. Aylwin survived for a period after the collapse, she would have had to have been in a “void” – a space surrounded by pieces of concrete and rubble which would have allowed her to breathe. It is clear that there were such voids.

Cst. Ryan Cox gave evidence about the training he and other members of the OPP’s UCRT (Urban Search and Rescue and Chemical, Biological, Radiological, Nuclear and Explosive Response Team) received at Texas A&M University, in conformity with Standard 1670 of the National Fire Protection Association (NFPA). Annex J of that standard includes descriptions and depictions of different types of building collapses. Cst. Cox testified that the Mall collapse was of a type called a “pancake” collapse. Standard 1670 says this about a pancake collapse:

A pancake is formed when the bearing wall(s) or column(s) fails completely and an upper floor(s) drops onto a lower floor(s) causing it to collapse in a similar manner. Potential areas where victims might be located are under the floors and in voids formed by building contents and debris wedged between the floors.⁷⁷

Cst. Cox agreed that there is always potential for small voids, although the probability of voids in a pancake floor collapse is lower than in other types of collapses. He was shown photographs of the rubble pile on June 23, before the crane had begun to remove any of the large pieces of concrete. He agreed that the photographs showed potential for a number of voids.⁷⁸

Capt. Thomas of the Elliot Lake Fire Department testified that there were a “lot of voids” in the rubble pile, of different sizes. He said that he went into voids – which he described as a space between objects which had fallen – in the rubble pile, and that half of his body fit into some.⁷⁹ It was his evidence that the sound he heard that he described as a “muffled noise” at 3:28 p.m. on June 23, which I discuss below, was coming from a void.⁸⁰

Although Capt. Darren Connors of the Elliot Lake Fire Department told the OPP that “there were no voids anywhere,” he explained that he meant that there were no voids that the firefighters could gain access to – “no simple void that any of us could crawl into to look, like a tunnel, per se, you know, nothing larger than being able to reach in with your arm or stick your face into.”⁸¹ OPP Sgt. Jamie Gillespie testified that, at the time work was suspended on June 25, they had been able to see clothing fabric with a search camera which had been used to gain access through small voids.⁸²

Photographs of the rubble pile introduced into evidence show that the pieces of concrete which formed the rubble pile were piled on top of each other at varying angles, producing many potential voids.⁸³ Figure 2.8.1 shows members of the Elliot Lake Fire Department looking in voids shortly after the collapse.⁸⁴ Photographs of Ms. Aylwin's body under the last two pieces of concrete show that she was lying under a slab of concrete that was at an approximately 25-degree angle (but higher at her head). A plastic chair or small table at the level of her upper back was not crushed. She was clearly caught by the concrete and would have been unable to move, but there appears to be a space that, if she had been alive, would have allowed her to breathe.⁸⁵



Figure 2.8.1 Firefighters examine voids in the rubble pile

Source Exhibit 7933

No evidence of shifting of the rubble pile after the first four or five hours, but one incident of vibration

Capt. Thomas testified that the building was moving – that there were things dropping all around them “so obviously something is moving or settling.”⁸⁶ Later he testified that, in the first four or five hours, “the pile was settling and shifting.”⁸⁷

Sgt. Gillespie testified that in the initial response, he heard

very small material, like small gravelly material sliding and then either I blocked it out or I didn't hear it anymore, but I didn't – I never once saw any real movement of the material within the pancake of the collapse. That, to me, there was no movement whatsoever.⁸⁸

Cst. Patrick Waddick, Cst. Cox, and Capt. Comella all testified that they did not see any movement of the slabs in the pile while they were removing the concrete pieces with the crane.⁸⁹ Cst. Waddick also testified, however, that, just because he had not seen any movement with the structure around him, it did not mean there had not been movement.⁹⁰

Don Sorel (Toronto Water / HUSAR), who was doing the rigging work on Sunday evening June 24, into the following morning, also testified that there was no shifting of the pile. He did testify, however, that, when he and Cst. Waddick were working on the pile, he felt a very slight vibration passing through the pile from south to north. He said that Cst. Waddick told him that he had felt it too, and they asked Capt. Chris Rowland, a team leader, if his team had done anything to cause it. Capt. Rowland replied that they had not – that his team was building laced-posts.⁹¹

There was extensive evidence of water available to Ms. Aylwin

Capt. Thomas testified that when the firefighters arrived at the scene shortly after the collapse, one of the “big pipes inside the mall” had been sheared off and the water was pouring out.⁹² Capt. Connors gave similar evidence, testifying that a 3- or 4-inch pipe was sheared off and fully flowing water onto the pile.⁹³

Capt. Comella testified that, when HUSAR/TF3 arrived, there was “a lot of rain.”⁹⁴ He also testified that the notes he was making as the work was being done were getting “ruined by rainwater,” and that they had to go to Sgt. Gillespie’s truck to communicate the plan to him and to engineers Roger Jeffreys and James Cranford to “get out of the pouring rain.”⁹⁵ Staff Insp. William Neadles gave similar evidence, saying that “it was absolutely pouring rain” when they arrived, and that the notes that he had been writing “absolutely got drenched in the rain.”⁹⁶ Staff Insp. Neadles emailed Dr. Feldman at 4:18 a.m. on June 24 (shortly after HUSAR/TF3 had arrived), writing: “Just started to rain hard.”⁹⁷ Capt. Martin McRae also testified that when they arrived in Elliot Lake, it was “raining fairly hard,” so that his notes got wet and were difficult to read.⁹⁸

Sgt. Gillespie testified that it rained the first night; he did not believe that it did the second night. He said that he did not recall the rain being “excessive by any means.” As far as he could see, it did not accumulate in the collapse area. However, when asked whether someone could access the water and “rehydrate themselves,” he said, “Anything is possible.”⁹⁹

A note in the HUSAR/TF3 record attributed to Capt. Comella indicated that, at 12:25 a.m. on June 25, it was “still raining.”¹⁰⁰ When I asked him whether it had been raining continuously, he replied that “[i]t sure felt like it,” and that “shortly after arrival on scene it was coming down in buckets with moderate winds . . . [I]t really didn’t let up much for a very long time and . . . my recollection is that it got better over time, but through the night it was coming down quite hard.”¹⁰¹

Cmdr. McCallion testified that it was “pouring rain” when HUSAR/TF3 arrived.¹⁰² Mr. Cranford, in contrast, testified that it was raining, but that he did not recall it being overly heavy, although he was inside for a portion of the evening.¹⁰³ Dr. Feldman’s email of June 25 to Cmdr. McCallion and Capt. Comella referred to “puddles” and stated that there may be access to rainwater / spilled water / drinks in the food court.¹⁰⁴

Capt. Connors testified that he was standing on the second floor of the Mall, spraying water while the beam cutting was going on. He was aiming the water toward the underside of the beam where they were cutting, trying to get the water over the hole so it would not fill it with water.¹⁰⁵ The videos of that process show clearly that, while some of the water made its way across the hole to land on the second-floor food court across from where Capt. Connors was standing, much of the water fell into the hole and onto the pile. The spraying continued for more than 28 minutes.¹⁰⁶

“Signs of life”

I heard evidence of a number of “signs of life” between the initial collapse at 2:18 p.m. on June 23 and 5:30 a.m. on June 25. It is necessary for me to consider this evidence in order to attempt to estimate how long Ms. Aylwin may have remained alive after the collapse.

Dr. Queen testified that, if his opinion was correct that Ms. Aylwin died very quickly, with the possibility of a short survival interval, “by definition” the signs of life would have to be incorrect.¹⁰⁷ He gave the following evidence:

- Q. Doctor, one of the things that the Commissioner is going to be asked to determine is this very issue, and I’m wondering if you can assist in telling us how your opinion is consistent, that is, that on the balance of probabilities she was likely – Ms. Aylwin was likely to have died near the time of the collapse – how that is consistent with the fact that all of those indications of life, of which I’ve

described to you, were in the very location where her body was located? In other words, that seems to be, on one view of it, a coincidence which can be explained by some or all of the signs of life being accurate or simply as a fluke. Can you give us any explanation to assist?

A. Well, I'm obviously not an expert on this LifeLocator machine, and I'm not an expert on dogs.

If I was looking into it, though, I would have some very pointed questions.

I would want to know what is the specificity of these different techniques, or another way to phrase it is what is the false positive rate of these techniques.

Has anyone ever actually scientifically demonstrated what the false positives are in these techniques?

So does anybody have a clue, objectively and scientifically, of what the validity is of any of those techniques? And as far as some of the other things with – I understand, tapping and mumbling, again, that's not really in the area of forensic pathology. I would talk to a psychologist and ask them, you know, "How do people react in these kinds of situations? Is there an overwhelming wishful thinking going on? Is it easy to misinterpret things in a noisy chaotic scene?" So, I mean, there's a lot of questions I would have. I don't know any of the answers.

What I can tell you is that some of the things that I've done do have some scientific, objective, factual basis. They're not perfect, but I think when you take that and you look at everything together, my opinion remains the same, that I think she most likely died very quickly, but I can't rule out a short survival interval.¹⁰⁸

Dr. Queen's final opinion can be compared with his opinion sent to Dr. Muir and Dr. Pollanen at 2:43 a.m. on June 28, after his initial review and before he had the analyses of the sodium, chloride, and urea nitrogen levels. At that time he had no cellular analyses available. Nor did he know anything about the signs of life other than what he had read or seen in the media. As noted above, he wrote:

despite the ... possible "signs of life" up to 48 hours after the collapse, I am highly skeptical and believe that this victim also died very quickly (her fingernails are totally intact and very clean showing no evidence of [having] tried to "claw her way out").¹⁰⁹

His conclusion set out in his autopsy report some six months later was that the death was "most likely near-immediate ... after the crushing forces were applied." In his testimony before me, he made it clear that, in his view, those crushing forces were probably applied at or near the time of the collapse. His initial opinion, based almost entirely on the circumstantial evidence and his gross findings, was formed at an early stage and was not changed by later scientific analysis. The signs of life do not appear to have played any role in his conclusion.

Commissioner Goudge noted that forensic pathologists should be careful to avoid "confirmation bias" – "the situation that occurs when anyone, including pathologists, tends to seek out evidence to support or confirm an investigative theory or an expert opinion and excludes other theories or possible opinion."¹¹⁰ I am alive to the possibility that Dr. Queen's opinion may have unconsciously been, to some extent, affected by an inclination to conform to his initial opinion, but I cannot express my concern in more specific or confident terms.

June 23, 3:28 p.m. – muffled voice

Capt. Thomas testified that, at about 3:28 p.m. on June 23, he called out on the rubble pile: "Fire Department, can you hear me?" He said he heard a noise that he described as sounding like a muffled voice. He called out, "Can you give me your location?" and heard another muffled voice that sounded to him "like somebody responding, like a muffled voice." He called out and got responses back between six and 10 times over a 20-minute period. Although he got responses every time he asked a question, he could not make out what the person was saying. He thought that the sound was coming from a hole or void not large enough to get his hand into. He marked the approximate location (within 5 feet) of the hole by drawing a rectangle on a photograph of the scene of the collapse. That marked-up photograph was made an exhibit.¹¹¹

June 23, 3:30 p.m. – communication

Capt. Connors testified that he took over communication with the victim from Capt. Thomas at about 3:30 p.m. on June 23. He heard sounds in the same opening in the rubble pile as Capt. Connors had heard. Capt. Connors and Chief Paul Officer had the following recorded radio conversation, which was played at the Inquiry:

[Captain Connors] I think I'm managing to communicate with her and I am almost certain that she said she is a staff member from Dollarama so I don't know if we can get ahold of the Dollarama manager ... find out his schedule see who is unaccounted for and maybe that can help us better identify who we are dealing with and who we can talk to. [Chief Officer] Yeah, do you have a name? [Capt. Connors] No, Chief, most of it is just like really hard to understand so I get her to say yes I try to get her to say it twice and I am thinking that that is what she is trying to do with me.¹¹²

Capt. Connors testified that he was trying to have a simple conversation. He and the person did not exchange actual words. He received a response after 10 to 15 seconds, and it felt to him like it was a response to his question, not a noise from something else. He said that he did not think that it could have been anything other than him communicating with a live person. He asked about five questions, repeated two or three times each. At some point, he stopped the communication, but he could not recall whether he stopped hearing the sound or whether it stopped when he was asked to take a break and he handed off the job to someone else. He could not say how long he had been communicating with the person. He marked the approximate location of the sound on another copy of the photograph used by Capt. Thomas.¹¹³

June 24, 9:30 a.m. – tapping

Sgt. Scott Fowlds and Sgt. Jim Lawson walked into the second floor of the Mall, above the rubble pile, at 9:30 a.m. on June 24. Sgt. Lawson called out: “[I]f you can hear me call out to my voice, make a sound.” Sgt. Fowlds heard “a tapping sound.” Sgt. Lawson called for “all quiet” so nobody else would talk, and then called out again: “[I]f you can hear our voice call out or make a sound.” Sgt. Fowlds testified that he heard another single tap. Sgt. Lawson then said: “[I]f you can hear my voice tap twice shortly after I stop talking.” Sgt. Fowlds then heard two taps. Sgt. Lawson then asked for three taps, and Sgt. Fowlds heard three taps. Sgt. Lawson then asked for another tap, but Sgt. Fowlds heard no more sounds. He described the “taps” as “a very hollow sound like when you tap on concrete,” not like concrete hitting concrete but like flesh hitting concrete. He could not indicate exactly where on the rubble pile the noise was coming from, other than to say that it came from the collapse zone, not the side areas.¹¹⁴

June 24, 12:10 p.m. – indication of live victim from canine Ranger

At 12:10 p.m. on June 24, Sgt. Fowlds, a trained canine handler, entered the building with his dog, Ranger, trained as a “live victim” rescue dog. Ranger ran up on the pile and searched it in a zigzag pattern. The dog started to bark, giving the indication that he had found a live victim. On another copy of the photograph marked by the other five witnesses whose evidence is set out in this section, Sgt. Fowlds marked the area in which the dog gave that indication. Ranger had cut himself above and to the side of his left eye as a result of jamming his head into the concrete, trying to reach the trapped person.¹¹⁵

June 24, 9:30 p.m. – indication of live victim from canine Dare

Cst. Dan Bailey, also a trained canine handler, introduced his dog, Dare, into the Mall at 9:30 p.m. on June 24. Cst. Bailey was not allowed into the area of the rubble pile on the ground floor, so he asked Cst. Cox and Sgt. Gillespie to watch Dare from the second level of the Mall while Dare searched the pile. Dare moved around the pile, and Cst. Cox told Cst. Bailey that Dare had stopped and was sniffing into a void. Cst. Bailey then heard Dare bark “a couple of times.” Cst. Cox told Cst. Bailey that Dare was trying to crawl into the void. Cst. Bailey concluded that Dare was indicating a live victim trapped within the rubble.¹¹⁶

Cst. Cox, also a trained canine handler, was standing on the second level of the Mall, and saw Dare enter and search the pile very thoroughly. Cst. Bailey could not see Dare. The dog went under a number of slabs and climbed up the escalator and back down onto the pile. Cst. Cox testified that Dare “showed a little bit of interest” right along the wall near the centre of the collapse, but did not give the signs used to indicate that a live victim has been found. Cst. Cox drew a line on another copy of the photograph marked by others to indicate this area. The dog then went to another location and, in Cst. Cox’s opinion, “caught an odour.” Dare’s head popped up, he walked in a circle, sat down, and barked twice. Dare was putting his nose in a small void between pieces of concrete. Cst. Cox marked that point with a dot on the photograph, and marked with a circle the general area where the dog walked in a circle and sat down.¹¹⁷ Dare was trained to search for both live victims and dead victims. Cst. Cox also testified that there is a “gray area” where the odour is confusing to dogs, when the chemical reaction following death starts taking place. He thought that this confusion may have been an explanation for why Dare did not give a definite sign against the wall (the location where Mrs. Perizzolo’s body was located). There is nothing in Cst. Cox’s notes about this incident. He testified that this activity took place on June 23, but Cst. Bailey’s notes clearly indicate, and he testified, that it happened on June 24. I am satisfied that Cst. Cox got the date wrong when he testified without benefit of a note as to the incident or the date.¹¹⁸

June 24, 11:30 p.m. – sign of breathing from LifeLocator device

At approximately 11:30 p.m. on June 24, Cst. Steve Hulsman deployed the LifeLocator at a spot where Sgt. Gillespie told him that the canine unit had given a sign of life. He placed the device on the concrete in four different spots in that general area, lowering it until it came into contact with the concrete. He marked three of those spots on another copy of the photograph used by the others.¹¹⁹ Cst. Hulsman received four positive indications of breathing from the LifeLocator. The indications were sporadic, with reported depths of between 2.7 and 6.2 metres. His evidence was that the body was located approximately 2 metres below the top of the rubble pile. He could not adequately explain the difference in the reported depths or why the device was indicating a heartbeat some 4 metres below the concrete floor. He acknowledged that the machine was not being operated according to the manufacturer’s specifications in that there were people within 15 metres of the machine.¹²⁰

Cst. Cox saw Cst. Hulsman deploy the LifeLocator device on June 24. His notes indicate that, at 11:30 p.m., Cst. Hulsman said that the device indicated a heartbeat (Cst. Cox’s word, not Cst. Hulsman’s) in a specific area near the centre of the pile.¹²¹ Cst. Cox testified that the LifeLocator was placed “almost dead on exact” where Dare had barked.¹²² Capt. McRae also saw Cst. Hulsman use the device. He marked on another copy of the photograph others had used the location of the device at the time that Cst. Hulsman announced the positive result. Capt. McRae also testified that people were within 15 metres of the device when it was being used, contrary to the manufacturer’s instructions.¹²³

June 25, 5:03 a.m. – possible sign of deceased victim from canine Dare, but no sign from canine Ranger

On June 25 at 5:03 a.m., Cst. Bailey was asked to have his canine search the rubble again, after several large concrete slabs had been removed. He went on to the pile with Dare, who was off his lead. Dare sniffed and made a “muffled sound” “like a bark” and stood looking down into the pile. The dog started to show indications of the way he acted when he found a cadaver. Cst. Bailey testified: “At this point now I’m starting to believe I don’t think he’s indicating on a live victim; ... it’s kind of – now we’re at the 50/50.” Later he testified that, because of the weak bark and the dog’s behaviour in sitting and looking and not the loud, sure barks and tail-wagging given to indicate a live victim, he believed that the victim being indicated was deceased. This indication was in “roughly the same location” in which Dare had earlier indicated a live victim. Cst. Bailey was shown a photograph of the pile that was taken on June 25 at 10:48 a.m. He testified that this photograph was consistent with his recollection

of the pile earlier that day, when Dare had carried out his search. Cst. Bailey marked the photograph where Dare had given his indication.¹²⁴

As I have indicated above, Sgt. Fowlds deployed his dog, Ranger, off lead after Dare left. Although Ranger continued to work the area with a lot of interest, he did not give any indication. He was pulled off the pile after about 10 minutes.¹²⁵

June 25, 5:30 a.m. – sign of breathing from LifeLocator device

At approximately 5:30 a.m. on June 25, Cst. Hulsman used the LifeLocator again. He placed it at approximately the same location he had the previous evening. Again, it was not operated according to the manufacturer's specifications. The machine indicated breathing at somewhere between 2.7 and 4.3 metres below it. Cst. Hulsman testified that the machine did not indicate that anyone was moving.

In January 2013, Cst. Hulsman spoke to the LifeLocator's manufacturer, GSSI. GSSI had examined data files sent by Cst. Hulsman. The data file that GSSI reported on indicated motion as well as breathing. This indication did not really resolve anything because it was never established that the file GSSI analyzed in its report was a file from the Elliot Lake deployment. Cst. Hulsman was told that the analysis showed that people were moving between 4 and 10 metres from the unit. That discrepancy was never resolved, and I am consequently left in some doubt about the accuracy of the LifeLocator or the manner in which it was operated.¹²⁶

Marked photographs show the same location for signs of life – where Ms. Aylwin's body was located

The photographs marked by the witnesses to indicate the location on the rubble pile of the sounds, canine signs, and LifeLocator indications show a remarkable congruence. All the witnesses marked a spot within a few feet of each other. The location marked by each of the witnesses on these photographs was in the very location where Lucie Aylwin's body was located. This congruence is clearly shown by comparing Exhibit 9277, a photograph taken on June 27 at 1:06 p.m. and marked by Dr. Bradford to indicate the location of Ms. Aylwin's body before it was removed, with each of the photographs marked by the witnesses.

Canine signs of life and death can be relied on

I heard evidence from Staff Sgt. Wayde Jacklin of the OPP about the reliability of dogs trained to find live victims and human remains. He is the training coordinator for the OPP canine program. Staff Sgt. Jacklin became a canine handler for the OPP in 1996. From 2000 to 2005, he was the training coordinator for the canine handlers, and in 2005 he was promoted to staff sergeant as the canine supervisor. He oversees all the operations of the OPP canine program. I am satisfied that he is highly trained and experienced with respect to the training and use of dogs for police operations, including search and rescue.¹²⁷

Staff Sgt. Jacklin testified that there are two recognized standards for dog training: the Canadian National Standard and the US Federal Emergency Management Agency (FEMA) Standard. He assisted with the development of the Canadian National Standard.¹²⁸

Certification of a dog for search and rescue requires extensive training and testing, over a three-year period, to establish that the dog can search independently, show commitment to a live victim, and give focused barks on victims with no false alerts. Dogs have to be re-certified each year. OPP canine officers all undergo a one-week dog-handling course at Texas A&M University as well as taking the Texas A&M collapsed-structure course.¹²⁹

Dogs who find live victims are required under the FEMA standard to bark a minimum of six times, interspersed with digging in an attempt to penetrate to the victim. Staff Sgt. Jacklin testified, however, that the fact that a dog barks once, twice, or six times does not have any meaning in terms of what the dog has found; the requirement is that the dog commits to the victim to show that there is a live victim.¹³⁰

There is a certification process for cadaver dogs as well, with an initial six-week course and then a week of training annually, in house at the OPP facility in Bolton. Staff Sgt. Jacklin described the OPP program as the “pinnacle of cadaver training.” Dogs who find human remains are required to give a passive indication – to sit or lie down on the site.¹³¹

The OPP had decided, before the Elliot Lake deployment, to stop training dogs to find both live victims and human remains. They had learned from their own experience and that of their colleagues in the United States that, when a dog was trained for both purposes, it was sometimes difficult to distinguish between the two – particularly in a situation where there may be both live victims and deceased persons in the same location.¹³²

Staff Sgt. Jacklin explained that there is no clear answer to how long it takes for the scent from a person who has died to change significantly enough so that a dog can differentiate between a live person and human remains. There is a time after death when a dog could be indicating one way or the other, even though the person has died.¹³³ Staff Sgt. Jacklin was asked to comment about the general reliability of dogs. He testified that the use of dogs to detect scents is widespread and has increased in the years after September 11, 2001. “Nothing is perfect,” he said, “but given the right circumstances and the right training, you would be foolish not to appreciate the amazing work that dogs do.”¹³⁴

Staff Sgt. Jacklin described Dare as a “Lamborghini” dog – a “very, very good dog, was really in his prime at this point.”¹³⁵ Dare had never failed a certification. He was certified for both live victim location and cadaver identification.¹³⁶ The officer also testified that when Dare’s behaviour changed from barking when first on the pile at 9:30 p.m. on June 24 to not barking at 5:03 a.m. on June 25, it could have been because of a change in the odour after death. As he put it, the certainty was the location:

I am certain, and I know he [Cst. Bailey] was too, this was the spot. The reason the dog’s barking is a – that’s a time period again. Is there somebody there that’s alive or is there somebody there that’s not alive? So the dog in the early, early stages may indicate, even if a person is deceased, could be indicating by barking. As time progressed, that gap has gotten bigger and the dog is not barking any more. So there could be that – it’s not confusion, it is this time lapse of a response ...” There could have been a switch between the first deployment and the second deployment.¹³⁷

Sgt. Fowlds testified as well – about the training of service dogs in general, and Ranger specifically. He and his dog work in the Toronto Police Service and so do not come under the OPP program. Ranger was taken into the HUSAR/TF3 unit in February or March 2009, after originally being trained as a general service dog. He received further training for search and rescue, which involved agility on uneven surfaces, climbing up and down ladders, and searching on rubble piles, including the pile in Bolton owned by the OPP. That training, which was full time five days a week, started in September or October 2009 and finished in December of that year. Ranger was certified to Level 1 of the Canadian National Standard, which requires that the dog find two victims, with no false indications. Level 2 certification requires that the dog find all but one of a group of up to six victims. Ranger was certified to Level 2 in September 2012. The delay in certification was not because Ranger was not adequately skilled, but because the certification, which takes place in Brandon, Manitoba, was not available until September 2012. In addition to the certification, the dogs undergo ongoing training and exercises.¹³⁸

Conclusion: Ms. Aylwin probably survived for some period of time after the collapse, but had likely died by 5:00 a.m. on June 25

As Dr. Queen acknowledged, if Ms. Aylwin had died “near-immediate[ly]” after the initial Mall collapse, all the signs of life would have had to be incorrect.

There is no doubt that Capts. Thomas and Connors were certain in their belief that the sounds they heard were made by a trapped victim. The radio transmission between Capt. Connors and Chief Officer is clear evidence of how firmly Capt. Connors held that view. Similarly, Sgt. Fowlds clearly described three ascending numbers of taps in response to his instructions.

I have no reason to doubt the evidence I have heard of the clear indications of a live victim given on June 24 by Ranger at 12:10 p.m. and Dare at 9:30 p.m. Staff Sgt. Jacklin’s evidence that we do not know how long it takes after death for the scent of a live victim to dissipate and the scent of a deceased person to begin does, however, weaken the strength of that evidence. Similarly, the problems with the deployment of the LifeLocator device affect its reliability.

All the indications were in the same place, and that place was where Ms. Aylwin’s body was ultimately located. It is highly improbable that all the signs of life were incorrect and yet, by complete coincidence, all in the same place and where the victim was found.

One thing is clear, however. All the indications were in the same place, and that place was where Ms. Aylwin’s body was ultimately located. It is highly improbable that all the signs of life were incorrect and yet, by complete coincidence, all in the same place and where the victim was found. I can only conclude that at least some of those signs of life were probably accurate.

The sign that Dare gave at 5:00 a.m. on June 25 was ambiguous. It has been interpreted by Cst. Bailey as probably being an indication of a deceased victim. Staff Sgt. Jacklin agreed that this indication was possible. This sign occurred approximately 39 hours after the initial collapse. At about the same time, Ranger, trained to indicate a live victim, gave no sign.

Ms. Aylwin’s death before that time would not be inconsistent with any of the objective medical indicia discussed by Dr. Queen. He could not say when dehydration of a live victim would be indicated by concentration in the vitreous fluid of the substances for which he tested. He also testified, as did Dr. Feldman, that dehydration could be avoided if the victim had access to water, as Ms. Aylwin clearly did. Her hands were cupped as they would have been if she was trying to drink water puddled beneath her.

As a result, I conclude that it is probable (though by no means certain) that Ms. Aylwin lived for some period of time after the initial collapse. By 5:00 a.m. on June 25, however, it is probable that she had died.

Notes

- ¹ Perizzolo testimony, August 7, 2013, pp. 19861–3.
- ² Aylwin testimony, August 7, 2013, pp. 19961–4.
- ³ Thomas testimony, August 15, 2013, pp. 21055–7.
- ⁴ Exhibit 9237; Bradford testimony, August 29, 2013, p. 23173.
- ⁵ Queen testimony, September 20, 2013, pp. 26449–51.
- ⁶ Queen testimony, September 20, 2013, pp. 26451–3.
- ⁷ Exhibit 9235.
- ⁸ Bradford testimony, August 29, 2013, pp. 23138, 23143–6.
- ⁹ Bradford testimony, August 29, 2013, p. 23219, Exhibit 9254; Exhibit 9246, p. 02.
- ¹⁰ Bradford testimony, August 29, 2013, pp. 23224–5.
- ¹¹ Exhibit 9258.
- ¹² Bradford testimony, August 29, 2013, pp. 23230–1.
- ¹³ Exhibit 9259; Queen testimony, September 20, 2013, p. 26464.
- ¹⁴ Exhibit 9259.
- ¹⁵ Queen testimony, September 20, 2013, p. 26468.
- ¹⁶ Bradford testimony, August 29, 2013, pp. 23181–2; Exhibit 9277.
- ¹⁷ Bradford testimony, August 29, 2013, pp. 23190–1.
- ¹⁸ Bradford testimony, August 29, 2013, pp. 23193–5.
- ¹⁹ Exhibit 9235.
- ²⁰ Exhibit 9246, p. 02.
- ²¹ Exhibit 9247.
- ²² Exhibit 9233.
- ²³ Bradford testimony, August 29, pp. 23295–7.
- ²⁴ Exhibit 9260, p. 04; Queen testimony, September 20, 2013, p. 26470.
- ²⁵ Queen testimony, September 20, 2013, pp. 26470–3.
- ²⁶ Queen testimony, September 20, 2013, pp. 26474–5.
- ²⁷ Queen testimony, September 20, 2013, pp. 26476–80, 26486–7.
- ²⁸ Queen testimony, September 20, 2013, pp. 26480–2, 26486–7.
- ²⁹ Exhibit 9260, pp. 09–10; Queen testimony, September 20, 2013, pp. 26486–7.
- ³⁰ Exhibit 9260, p. 09; Queen testimony, September 20, 2013, pp. 26487–8.
- ³¹ Exhibit 9245, p. 008; Queen testimony, September 20, 2013, p. 26496.
- ³² Exhibit 9240, p. 59; Exhibit 9674, pp. 004, 006; Queen testimony, September 20, 2013, pp. 26495, 26497.
- ³³ Exhibit 9674, p. 010; Queen testimony, September 20, 2013, p. 26499.
- ³⁴ Exhibit 9260, p. 05; Queen testimony, September 20, 2013, pp. 26459, 26507.
- ³⁵ Exhibit 9260, p. 006; Queen testimony, September 20, 2013, pp. 26508–9.
- ³⁶ Exhibit 9260, p. 010.
- ³⁷ Queen testimony, September 20, 2013, pp. 26511–15.
- ³⁸ Exhibit 9260, p. 010.
- ³⁹ Queen testimony, September 20, 2013, p. 26517.
- ⁴⁰ Exhibit 9260, p. 010.
- ⁴¹ Queen testimony, September 20, 2013, p. 26519.
- ⁴² Exhibit 9260, p. 010.
- ⁴³ Exhibit 9245, p. 008; Queen testimony, September 20, 2013, p. 26521.
- ⁴⁴ Exhibit 9260, p. 010.
- ⁴⁵ Exhibit 9261; Queen testimony, September 20, 2013, pp. 26521–4.
- ⁴⁶ Exhibit 9260, p. 010.
- ⁴⁷ Queen testimony, September 20, 2013, pp. 26525–6.
- ⁴⁸ Queen testimony, September 20, 2013, pp. 26526–7.
- ⁴⁹ Exhibit 9245, p. 009; Queen testimony, September 20, 2013, pp. 26528–9.
- ⁵⁰ Queen testimony, September 20, 2013, pp. 26527–34.
- ⁵¹ Queen testimony, September 20, 2013, pp. 26533–5.
- ⁵² Ontario, *Report of the Inquiry into Pediatric Forensic Pathology in Ontario* (Toronto: Ontario Ministry of the Attorney General, 2008), vol. 3, 408 (Commissioner Stephen T. Goudge).
- ⁵³ Exhibit 9260, p. 010.
- ⁵⁴ Queen testimony, September 20, 2013, pp. 26552–3.
- ⁵⁵ Queen testimony, September 20, 2013, pp. 26565–6.
- ⁵⁶ Queen testimony, September 20, 2013, p. 26553.
- ⁵⁷ Queen testimony, September 20, 2013, pp. 26554–5.
- ⁵⁸ Queen testimony, September 20, 2013, p. 26556.
- ⁵⁹ Queen testimony, September 20, 2013, pp. 26530–3; 26545.
- ⁶⁰ Queen testimony, September 20, 2013, pp. 26553–4.
- ⁶¹ Ontario, *Report of the Inquiry into Pediatric Forensic Pathology in Ontario* (Toronto: Ontario Ministry of the Attorney General, 2008), vol. 3, 422 (Commissioner Stephen T. Goudge).
- ⁶² Queen testimony, September 20, 2013, p. 26556.
- ⁶³ Queen testimony, September 20, 2013, p. 26551.
- ⁶⁴ Queen testimony, September 20, 2013, pp. 26515–16.
- ⁶⁵ Queen testimony, September 20, 2013, pp. 26545–6.
- ⁶⁶ Queen testimony, September 20, 2013, p. 26551.
- ⁶⁷ Exhibit 9675.
- ⁶⁸ Queen testimony, September 20, 2013, p. 26549.
- ⁶⁹ Queen testimony, September 20, 2013, pp. 26549–51.
- ⁷⁰ Posen testimony, October 4, 2013, pp. 28244–8.
- ⁷¹ Exhibit 9893; Posen testimony, October 4, 2013, pp. 28248–58.
- ⁷² Exhibit 9893; Posen testimony, October 4, 2013, pp. 28258–63.
- ⁷³ Posen testimony, October 4, 2013, pp. 28263–6.
- ⁷⁴ Queen testimony, September 20, 2013, pp. 26553–4.
- ⁷⁵ Exhibit 7781; Feldman testimony, September 18, 2013, p. 26031.
- ⁷⁶ Exhibit 9589; Feldman testimony, September 18, 2013, pp. 26049–52.
- ⁷⁷ Exhibit 7834, p. 084.
- ⁷⁸ Cox testimony, August 26, 2013, pp. 22230–3.
- ⁷⁹ Thomas testimony, August 20, 2013, pp. 21223–4.
- ⁸⁰ Thomas testimony, August 15, 2013, p. 21043.
- ⁸¹ Connors testimony, August 21, 2013, pp. 21423–4.
- ⁸² Gillespie testimony, September 3, 2013, p. 23681.
- ⁸³ Exhibits 7932, 7933.
- ⁸⁴ Exhibit 7933.
- ⁸⁵ Exhibit 9245.
- ⁸⁶ Thomas testimony, August 20, 2013, p. 21225.
- ⁸⁷ Thomas testimony, August 20, 2013, p. 21200.
- ⁸⁸ Gillespie testimony, September 3, 2013, p. 23646.
- ⁸⁹ Waddick testimony, August 23, 2013, pp. 22018–19; Cox testimony, August 26, 2013, p. 26; Comella testimony, September 5, 2013, p. 24331.
- ⁹⁰ Waddick testimony, August 23, 2013, p. 22074.
- ⁹¹ Sorel testimony, October 1, 2013, pp. 27583–4.
- ⁹² Thomas testimony, August 20, 2013, p. 21197.
- ⁹³ Thomas testimony, August 21, 2013, p. 21570.
- ⁹⁴ Comella testimony, September 4, 2013, p. 23920.
- ⁹⁵ Comella testimony, September 4, 2013, p. 24040; September 5, 2013, p. 24121.
- ⁹⁶ Neadles testimony, September 10, 2013, pp. 25239, 25280.
- ⁹⁷ Exhibit 6725.
- ⁹⁸ McRae testimony, September 25, 2013, p. 27178.
- ⁹⁹ Gillespie testimony, September 3, 2013, pp. 23714–15.
- ¹⁰⁰ Exhibit 6393, p. 7.

- ¹⁰¹ Comella testimony, September 5, 2013, p. 24206.
- ¹⁰² McCallion testimony, September 6, 2013, pp. 24390, 24412.
- ¹⁰³ Cranford testimony, September 9, 2013, p. 24866.
- ¹⁰⁴ Exhibit 7781.
- ¹⁰⁵ Connors testimony, August 21, 2013, pp. 21431–2.
- ¹⁰⁶ Exhibits 7828, 7829.
- ¹⁰⁷ Queen testimony, September 20, 2013, p. 26561.
- ¹⁰⁸ Queen testimony, September 20, 2013, pp. 26559–26661.
- ¹⁰⁹ Exhibit 9235, p. 02.
- ¹¹⁰ Ontario, *Report of the Inquiry into Pediatric Forensic Pathology in Ontario* (Toronto: Ontario Ministry of the Attorney General, 2008), vol. 3, 424 (Commissioner Stephen T. Goudge).
- ¹¹¹ Thomas testimony, August 15, 2013, pp. 21041–7; Exhibit 8104.
- ¹¹² Exhibit 6296.
- ¹¹³ Connors testimony, August 20, 2013, pp. 21381–90.
- ¹¹⁴ Fowlds testimony, September 19, 2013, pp. 26315–26.
- ¹¹⁵ Fowlds testimony, September 19, 2013, pp. 26330–5.
- ¹¹⁶ Bailey testimony, August 27, 2013, pp. 22739–49; Exhibit 6374.
- ¹¹⁷ Exhibit 9265.
- ¹¹⁸ Exhibit 6377 and Exhibit 6374, p. 02; Cox testimony, August 26, 2013, pp. 22331–42; Bailey testimony, August 27, 2013, pp. 22735–46.
- ¹¹⁹ Exhibit 9276.
- ¹²⁰ Hulsman testimony, August 28, 2013, pp. 23005–30.
- ¹²¹ Exhibit 6377.
- ¹²² Cox testimony, August 26, 2013, p. 22342.
- ¹²³ McRae testimony, September 25, 2013, pp. 27232–5.
- ¹²⁴ Bailey testimony, August 27, 2013, pp. 22758–61; Exhibit 9266.
- ¹²⁵ Fowlds testimony, September 19, 2013, pp. 26341–7.
- ¹²⁶ Hulsman testimony, August 28, 2013, pp. 23032–46.
- ¹²⁷ Jacklin testimony, August 27, 2013, pp. 22499–502.
- ¹²⁸ Jacklin testimony, August 27, 2013, pp. 22531–2.
- ¹²⁹ Jacklin testimony, August 27, 2013, pp. 22537, 22551.
- ¹³⁰ Jacklin testimony, August 27, 2013, pp. 22533–4, 22537, 22548–9.
- ¹³¹ Jacklin testimony, August 27, 2013, pp. 22549, 22564–5.
- ¹³² Jacklin testimony, August 27, 2013, pp. 22594–7.
- ¹³³ Jacklin testimony, August 27, 2013, pp. 22598–601.
- ¹³⁴ Jacklin testimony, August 27, 2013, pp. 22607–8.
- ¹³⁵ Jacklin testimony, August 27, 2013, p. 22586.
- ¹³⁶ Jacklin testimony, August 27, 2013, pp. 22591–2.
- ¹³⁷ Jacklin testimony, August 27, 2013, pp. 22635–8.
- ¹³⁸ Fowlds testimony, September 19, 2013, pp. 26295–304.