Toxic Trails: Tracing Toxicology Clues in a True Life Murder Mystery

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1. Background on Eric Miller - Victim in Case Study

Personal History of Eric Miller – Indiana Native

BORN & RAISED IN CENTRAL INDIANA

- Born in 1970 in Cambridge City, Indiana to Verus and Doris Miller.
- Salt-of-the-earth family.
- Attended Lincoln High School in Cambridge City.
- Vice President of his class, a tennis star, National Honor Society.
- Popular, very likable, friendly, funny, hardworking, motivated.

COLLEGE YEARS – PURDUE UNIVERSITY

- Attended Purdue and graduated with honors in Biology.
- Met his future wife, Ann Brier, at Purdue.
- Eric and Ann married on February 27, 1993 in Cambridge City.

Move to North Carolina – A Star on the Rise

NORTH CAROLINA – PhD PROGRAM & DAUGHTER

- Eric and Ann moved to North Carolina to pursue doctoral degrees at NC State.
- Eric obtained a PhD in Biochemistry in 1999.
- Post-Doctoral position as a pediatric AIDS researcher at UNC Chapel Hill.
- Daughter, Clare Elise Miller, was born on January 17, 2000.

By 2000, Eric was at a highpoint in his life and appeared to be on a trajectory to great personal and professional success.

2. An Unexpected Turn in the Life of Eric Miller

Sudden Illness When Bowling – November 15, 2000

Question for class -- What do you think are possible causes for Eric's sudden illness?

BOWLING OUTING

- Guys night out.
- Eric went bowling with his wife's male coworkers.
- Eric became ill a few hours after drinking some beer.

SYMPTOMS

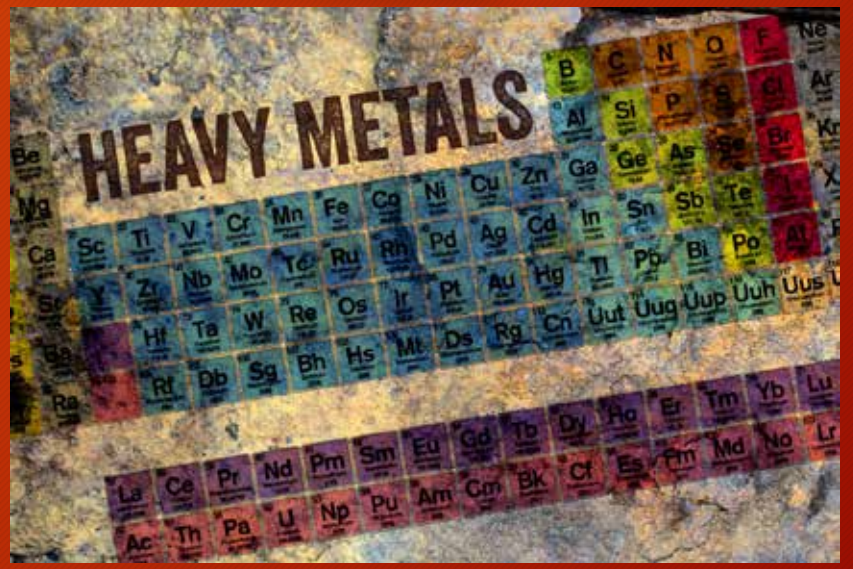
- Overall weakness, nausea, vomiting, stomach pain, delirium – "Flulike" symptoms.

Hospitalization – REX Hospital in Raleigh, NC

- Eric's condition deteriorated and he went to the ER late on November 16.
- After a long wait, admitted to hospital early November 17.
- Condition continued to worsen and admitted to ICU.
- Standard medical tests and bloodwork could not diagnose this sudden, mysterious illness.
- "Virus" or "flu" was initial suspected diagnosis.

REX ICU – Diagnosis – November 20, 2000

- A skeptical physician, Dr. William Berry, suspected some type of poisoning and ordered a heavy metals test (blood).
- On November 20, the test results came back and showed a high level of arsenic in Eric's blood (0.93 mg/L).
- Implications of the test results were not immediately recognized.



LESSON IN HINDSIGHT: The high levels of arsenic in Eric's blood are not common and should have been a "red flag," something to immediately question and explore root causes of such an unusual exposure event.

November 21, 2000 – Hospital Transfer
November 24, 2000 - Release

- Eric's condition continued to deteriorate, so on 11/21, he was transferred to UNC-Chapel Hill Hospital, which has more resources to offer a higher level of care.
- Urine was collected for arsenic testing at UNC-CH Hospital, but results would not be available until early December.
- Eric's condition gradually improved and he was released on 11/24.

LESSON IN HINDSIGHT: Eric's transfer to a new hospital complicated the continuity of his care and attention to the details surrounding the initial arsenic test results.

After Initial Improvement, Eric is Readmitted to REX Hospital on December 1, 2000

INITIAL IMPROVEMENT

- After discharge from UNC Chapel Hill Hospital, Eric recuperated at home in the presence of his parents, his wife and daughter.
- On November 30, 2000, Eric reported his appetite was coming back; he took his first short walk outside since he became ill. Personal physician examined Eric this day and thought he was on way to recovery.

SUDDEN DOWNWARD SPIRAL

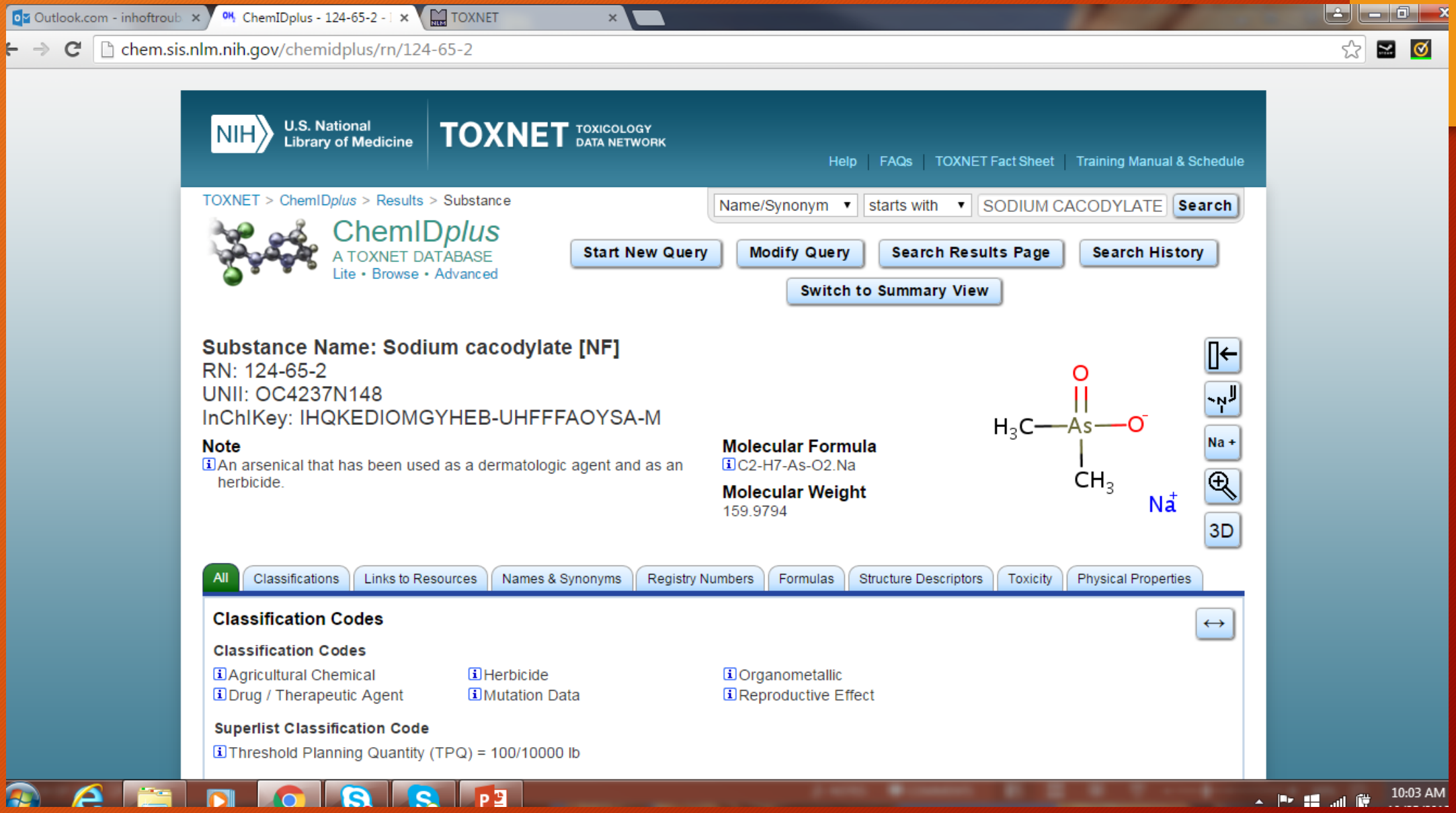
- On December 1, 2000, Eric became violently ill AGAIN with similar symptoms that led to his first hospital stay (stomach cramps, nausea, vomiting). He was readmitted to REX Hospital.
- Results of the UNC-CH urine testing are released and showed high level of arsenic in urine when Eric was at UNC-CH (11/21 – 11/24).

Implications of Arsenic Exposure Finally Recognized, But Eric Dies on December 2, 2000

- Only after receiving the urine test results on 12/1, did UNC-CH Hospital doctors contact REX Hospital doctors to discuss the implications of the high arsenic levels in Eric's blood and urine.
- Eric passed away in REX Hospital ICU on 12/2 at 2:50 a.m.
- Office of the Chief Medical Examiner performed an autopsy and determined the cause of death as arsenic poisoning.

3. Exploring the Human Toxicity of Arsenic

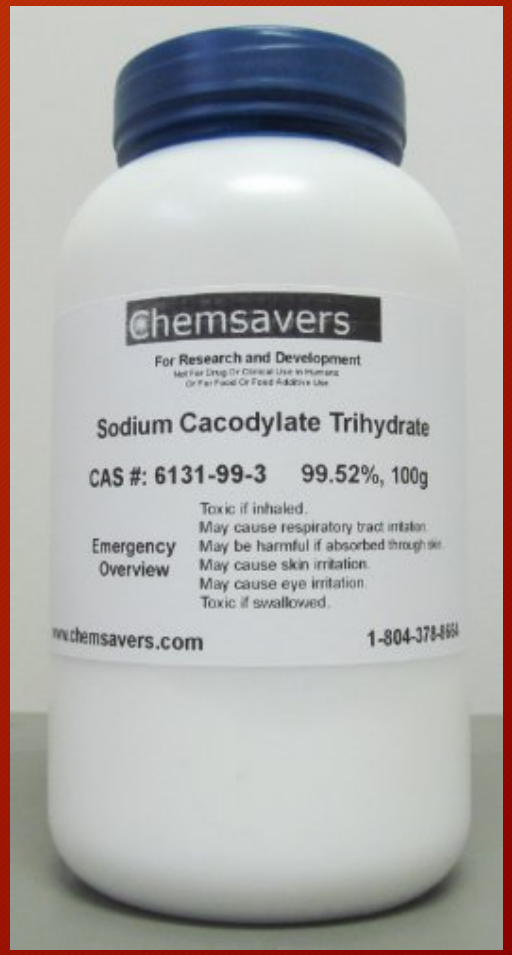
The U.S. National Library of Medicine's ChemIDplus and TOXNET websites are great resources for chemical and toxicology information. These are publicly available resources.



Sodium Cacodylate (Sodium Dimethyl Arsenate) was Used in Eric Miller's Poisoning

CHEMICAL DESCRIPTION AND USES

- Organic, pentavalent arsenic compound: As(V) or arsenate or a +5 oxidation state.
- It is a white or yellow powder or crystalline solid which may be odorless or have a faint odor.
- Once used in herbicides.
- Currently used in preparation and fixation of biological samples for electron microscopy.



Human Toxicity of Sodium Cacodylate (Sodium Dimethyl Arsenate)

FATE IN BODY AFTER INGESTION (ORAL EXPOSURE)

- Gastric acid in stomach causes rapid release of inorganic arsenic in the form of arsenate.
- Acute arsenic ingestion generally produces symptoms within 30 to 60 minutes, but onset may be delayed for several hours if ingested with food.

OBSERVABLE PHYSIOLOGICAL EFFECTS

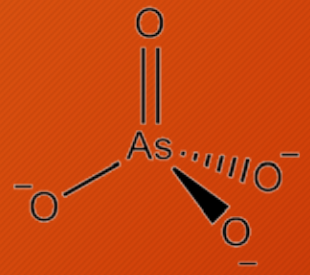
- Ingestion causes irritation of stomach and intestines with nausea, vomiting, diarrhea, shock, rapid pulse, low blood pressure.
- Strong garlic odor may be imparted to breath, sweat and urine.

TARGET ORGANS AFTER ORAL EXPOSURE TO HIGH AMOUNT OF ARSENATE

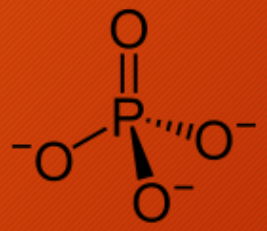
- GI tract, heart, brain, kidneys.
- Subsequently, the skin, bone marrow and peripheral nervous system may be damaged.

Absorption and Distribution

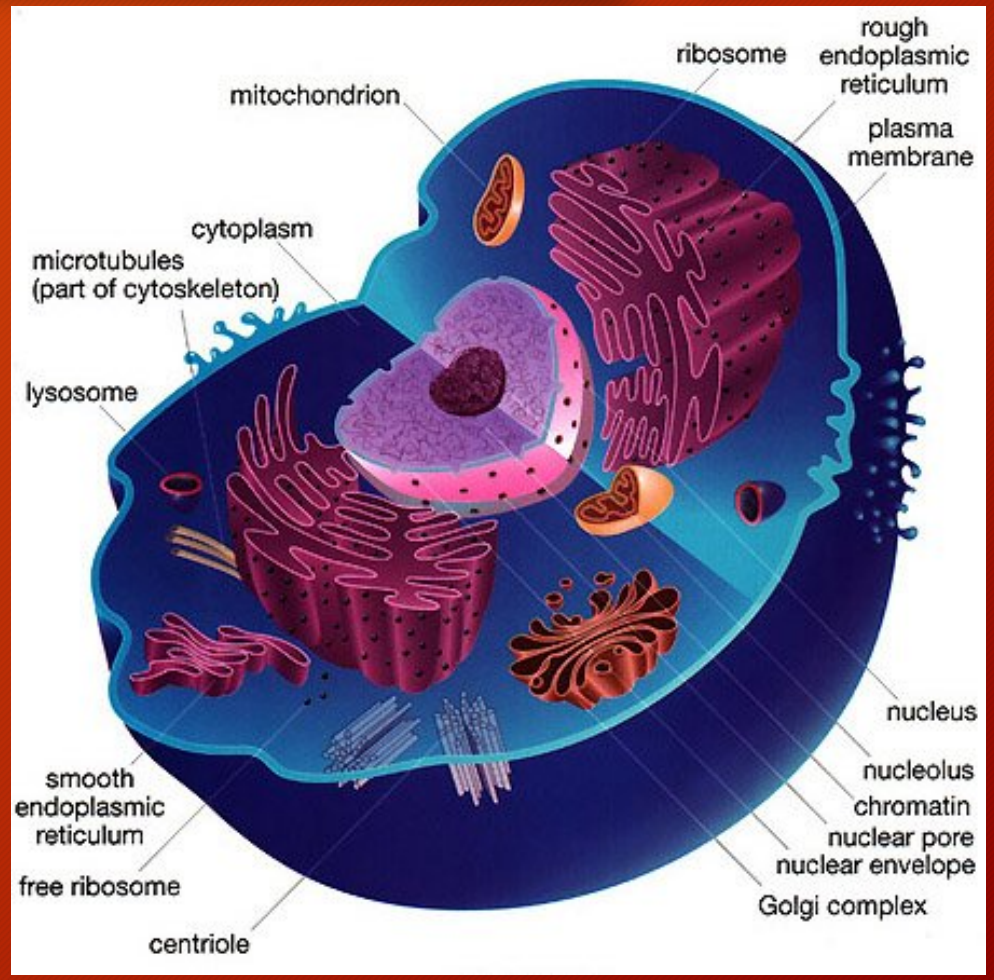
- Arsenate is absorbed in GI tract into the blood stream at the cellular level (80-90% absorption).



- Arsenate is structurally similar to phosphate and uses phosphate transporters to enter cells.

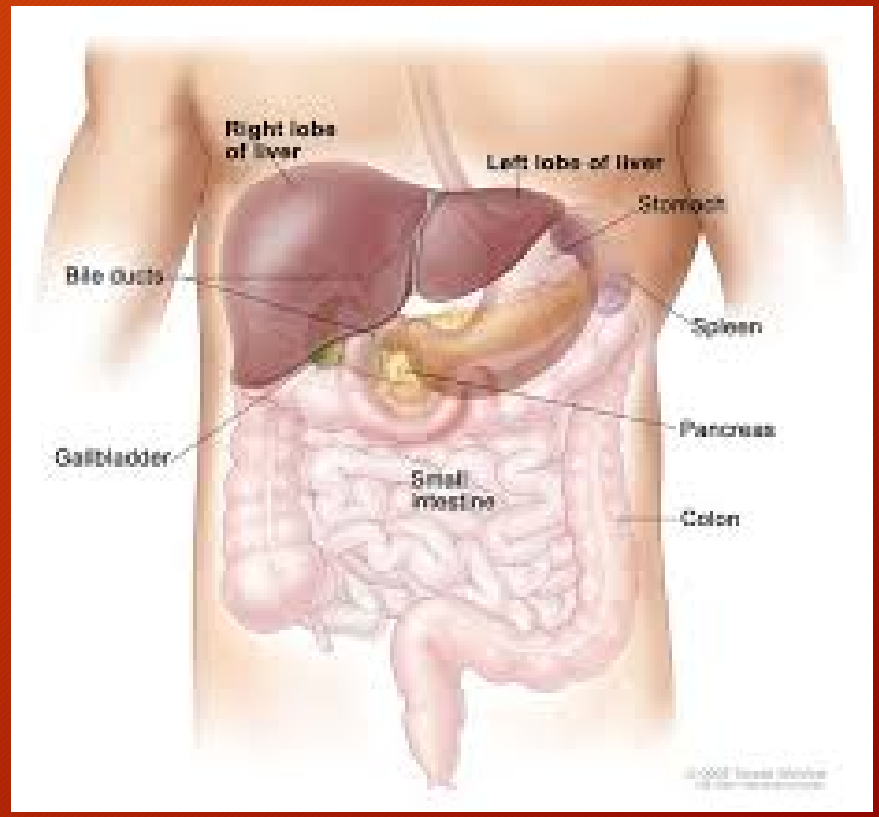


- Distributed throughout body.



Metabolism & Excretion

- The body reduces arsenate (As V) to arsenite (As III) which is a necessary step before further metabolism can occur.
- As(III) is progressively metabolized through methylation (methyl groups added) in the liver.
- Major metabolites are monomethyl arsenic (MMA) and dimethyl arsenic (DMA). Less reactive and less toxic than arsenate.
- MMA and DMA mostly excreted by kidneys through the urine.



Mechanism of Arsenate Toxicity

- What if the liver is overwhelmed with too much arsenate / arsenite and the detoxification enzymes are overwhelmed?
- Arsenate continues to circulate in the body.
- Arsenate is capable of replacing the phosphate group of many metabolic pathways.
- Presence of arsenate in cells interferes with the production of ATP (which provides energy/fuel in the cell).
- Also leads to increase in hydrogen peroxide and reactive oxygen species.

4. We Know *What* Caused Eric's Death. But Who, Where, Why, How?

Suicide or Accident?

- Early in their investigation, Raleigh police and detectives ruled out a suicide attempt and an accidental poisoning.
- Interviews with friends, family and coworkers revealed that Eric was very happy and had no emotional instability.
- Review of Eric's e-mail accounts (work and personal) were purely work-related or focused on his baby daughter, Clare. No unusual web searches or files found on his computers.
- Although Eric worked with hazardous chemicals in his research laboratory at UNC-CH, no arsenic compounds were found in his workplace.

Suspect #1: Derril Willard

- Coworker of Ann Miller at GlaxoSmithKline.
- Phone records showed a large number of phone calls between Derril Willard and Ann Miller late in the evening or early in the morning. Some calls lasted over 30 minutes.
- E-mail records between Derril and Ann were of a flirtatious nature and suggestive of a romantic relationship.
- Derril was one of three of Ann's coworkers who went bowling with Eric on November 15, 2000.
- Derril had access to arsenic at work.
- Derril's house was searched on January 21, 2001. He committed suicide the next day, January 22, 2001.
- Suicide note stated that he was "not responsible for the death of anyone" other than himself.

Suspect #2: Ann Miller (Eric's Wife)

- Investigators found that Ann Miller led a double life, in contrast to the prim and proper façade she showed to most people.
- Ann was found to be engaged in 2 extramarital affairs at the time of Eric's death.
- Within days of Eric's death, Ann hired two high powered defense attorneys. She refused to answer questions from the police department.
- Ann's workplace used arsenic substances.

Ann Becomes the Main Suspect, But the Case is Stalled for Years

- The Raleigh Police Department only had circumstantial evidence against Ann. The local District Attorney's office would not move the case forward based on the available evidence.
- The DA's office and Raleigh PD used some creative thinking to break this case open. Legal maneuvers were pursued that permitted Derril Willard's attorney to break attorney-client privilege, but only to the extent that it shared information to could help solve the case.
- This process takes a few years.

Resolution

- On May 7, 2004, the NC Supreme Court ordered Derril Willard's attorney, Rick Gammon, to disclose any key facts that could help solve Eric Miller's case.
- On May 27, 2004, Mr. Gammon disclosed the following conversation:

Derril told Mr. Gammon that Ann revealed to him that she took a syringe and needle from her purse and injected the contents into Eric's IV during his last hospital stay (December 1, 2000). The syringe contained a substance that Ann had taken from her workplace.

Nearly Five Years After Eric's Death, Ann Admits to Killing Him

In November 2005, Ann pleaded guilty to second-degree murder and conspiracy to commit first-degree murder.

Ann was sentenced to 25 to 31½ years in prison for poisoning her husband.

Ann has never publicly revealed her motive for the murder. We can only speculate …