CRIME SEEN
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ALAIN PILON

Fate or Foul Play? Chemists Solve the Case

A hospital staffer thought he could kill patients without leaving a trace. A supersensitive new toxicology test proved him wrong.

BRIAN ANDRESEN TURNS TO A refrigerator in his laboratory and pulls out a Plexiglas tray full of vials. Each vial holds an extract of human tissue: heart, liver, spleen and other organs. Twenty trays hold samples from exhumed bodies, one tray for each corpse. The tall, soft-spoken chemist leans over and points to a chart inside a bound lab notebook. "I got a positive on the muscle for this patient," he says, indicating a plus sign. That means the vial for that muscle tissue, like several others in the fridge, contains poison. Together they're proof of a series of murders.

The vials are stored at Lawrence Livermore National Laboratory's Forensic Science Center, a classified-research facility located about an hour's drive inland from San Francisco. The center, which Andresen founded and where he still regularly consults despite being officially retired, is a crack forensics unit for hire. Scientists working there take on cases that have stumped other agencies—cases such as that of a hospital employee who may or may not have been killing patients.

Respiratory therapist Efren Saldivar is now behind bars for six murders identified by the vials in Andresen's fridge, but he played a cat-and-mouse game for years with police in Glendale, California. First he confessed to killing dozens of patients but gave no names and explained that the killings were designed to look natural. Then he said he'd made the whole story up. Without physical evidence or even names to go on, the police were at a loss to figure out which statements were true.

Hospital murders are notoriously difficult to prove. "Many, many patients die in hospitals. How do you identify which ones [were killed]?" Andresen asks. Hospital deaths aren't usually reviewed by a medical examiner, and even if they were, a standard toxicology workup wouldn't test for obscure non-narcotic hospital drugs, the ones most likely to be used by someone in Saldivar's position.

"No local lab had the capacity to deal with a case like this," says former police sergeant John McKillop, who led the investigation of Saldivar. "We were in uncharted territory."

In search of help, McKillop contacted a series of experts, who eventually referred him to Andresen. Saldivar had hinted that he'd killed patients in a number of ways. Andresen told McKillop that at least one poison Saldivar said he had used—Pavulon—might be detectable in the bodies of his victims.

Pavulon is the commercial name for pancuronium bromide, a synthetic

steroid that mimics the action of curare, an extract from a South American vine that is used as an arrow poison. In very low doses, Pavulon has beneficial uses: For example, doctors can use the drug to overcome a patient's gag reflex and insert a breathing tube. But in larger (though still very small) doses, Pavulon can kill. "It would be the most frightening death," Andresen says. "If you get injected with it, it makes it so the muscles can't move." Your lungs would stop working, but you wouldn't be able to signal for help. Your death, when it was discovered, would look natural.

Chemists like Andresen need a license from the Drug Enforcement Agency to buy Pavulon. But at many hospitals, staffers can easily pick it up off a cart or shelf. Hospital administrators keep a close eye on drugs that employees might steal for recreational use. But drugs such as Pavulon, despite being lethal, are often not well guarded.

Experts agree that Pavulon is one of three or four drugs favored by so-called "angels of death," or hospital killers. That's partly because of easy access but also because Pavulon poisoning is hard to spot. When Andresen signed onto the case, the drug had been studied only in live volunteers, using standard blood and urine tests. Figuring out how to detect it in long-buried victims presented a series of problems, from identifying unusual deaths after the fact to getting permission to exhume bodies to actually teasing the drug out of rotting tissue.

One of the biggest obstacles for Andresen was proving that his test results weren't simply an artifact of how a body was prepared for burial or how it subsequently decomposed. "I spent a lot of time with pig livers perfecting the technique," he says, recalling 16-hour workdays that left little time for grocery shopping. "I would go late at night to Safeway. I'd sort of have the smell of death; people would let me go first."

Andresen discovered that he could extract Pavulon from pig livers using polystyrene–divinyl benzene, a polymer that was originally developed to detect chemical-weapons residue in body tissues. The polymer didn't work well as a weapons detector, but it turned out to be good at isolating Pavulon from an organ purée. Once Andresen had perfected his extraction technique, he tested not just the organs of exhumed hospital patients but also soil from near the caskets and every type of embalming fluid that had been used on the bodies.

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Without all these controls, toxicology tests may provide misleading evidence. In one Florida case, police hired a private lab to check for poison in the body of a woman who had been buried several years earlier. Kevin Ballard, a senior scientist at National Medical Services in Pennsylvania, found succinylmonocholine in the woman's embalmed tissue. Succinylmonocholine forms when succinylcholine—a drug similar in effect to Pavulon—breaks down. Based on this evidence, Bill Sybers, the dead woman's husband, was convicted of murder. Later, however, the Florida First District Court of Appeals overturned the conviction, noting that Ballard's lab had not done adequate testing to ensure that the succinylmonocholine hadn't formed as a result of the embalming process or decomposition.

A few months later, National Medical Services advised the court that the test for succinylcholine poisoning was no longer considered reliable, but it was too late for Sybers. Although he insisted on his innocence, he was sick with lung cancer and so had already accepted a "plea of convenience" that reduced the charge from first-degree murder to manslaughter, with a sentence of time served.

In the Saldivar case, Andresen used two methods to verify that the substance he had extracted from the exhumed bodies was indeed Pavulon. First he screened the samples with a gas chromatograph–mass spectrometer, a standard piece of lab equipment that can detect the telltale signatures of the drug's breakdown products.

To confirm that screening test, he teamed up with Armando Alcaraz, a fellow chemist at Livermore's Forensic Science Center. Alcaraz ran the samples through a triple quadrupole mass spectrometer equipped with a high-performance liquid chromatograph. A half-million-dollar, chest-high piece of equipment, it can read the chemical signature of an entire molecule. This second test showed that Pavulon itself—and not just its breakdown products—was present in the samples.

The work led to a renewed confession from Saldivar and provided a map for other toxicologists investigating suspected Pavulon murders. Andresen received his first request for help while he was still on the Saldivar case. "In the middle of the night," he recalls, "I got a call from Poland." He gave some pointers to officials who suspected that ambulance drivers were using Pavulon to kill patients en route to the hospital.

Unfortunately, it's quite likely that criminal investigators will be able to put Andresen's technique to use again soon. Graham Jones, the chief toxicologist in Edmonton, Alberta, confirms that Saldivar-type hospital murders are not uncommon. "I could probably come up with about a dozen in the past ten to twenty years," he says.

"You're going to see more of it," Andresen predicts. He suggests that hospitals should be more careful about storing drugs like Pavulon and that drug companies should add tracers to their products. If would-be killers knew that a quick screening method was available, Andresen says, "I think they would be much more reticent." ■

Robin Mejia has written about forensics for the L.A. Times *and* New Scientist.