Inside the DEA: A chemist's quest to identify mystery drugs

December 21 2016, by Erika Kinetz

In this Aug. 9, 2016, photo, forensic chemist Emily Dye handles evidence, seized in drug raids, which contains fentanyl analogs at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. A novel class of deadly drugs is exploding across the country, with many manufactured in China for export around the world. The drugs, synthetic opioids, are fueling the deadliest addiction crisis the U.S. has ever seen. (AP Photo/Cliff Owen)

No one knew what was in the baggie. It was just a few tablespoons of crystalline powder seized back in April, clumped like snow that had partially melted and frozen again.

Emily Dye, a 27-year-old forensic chemist at the Drug Enforcement Administration's Special Testing and Research Laboratory, did not know if anyone had died from taking this powder, or how much it would take to kill you.

What she did know was this: New drugs were appearing in the lab every other week, things never before seen in this unmarked gray building in Sterling, Virginia. Increasingly, these new compounds were synthetic opioids designed to mimic fentanyl, a prescription painkiller up to 50 times stronger than heroin.

This, Dye realized, could be one of them.

The proliferation of rapidly evolving synthetic opioids has become so fierce that the DEA says they now constitute an entire new class of drugs, which are fueling the deadliest addiction crisis the United States has ever seen.

The fentanyl-like drugs are pouring in primarily from China, U.S. officials say—an assertion Beijing maintains has not been substantiated. Laws cannot keep pace with the speed of scientific innovation. As soon as one substance is banned, chemists synthesize slightly different, and technically legal, molecules and sell that substance online, delivery to U.S. doorsteps guaranteed.

More Americans now die of drug overdoses than in car crashes. Almost two-thirds of them, more than 33,000 in 2015 alone, took some form of opioid—either heroin, prescription painkillers or, increasingly, synthetic compounds like U-47700 and furanyl fentanyl, manufactured by nimble

chemists to stay one step ahead of the law.

It is now forensic chemists like Dye who are on the front line of the nation's war on drugs, teasing out molecular structures of mystery drugs so they can be named, tracked and regulated.

Dye held the baggie of powder in her gloved hand.

In this Aug. 9, 2016, photo, a bag of 4-fluoroisobutyrylfentanyl, which was seized in a drug raid, is displayed at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. A novel class of deadly drugs is exploding across the country, with many manufactured in China for export around the world. The drugs, synthetic opioids, are fueling the deadliest addiction crisis the U.S. has ever seen. (AP Photo/Cliff Owen)

"Man," she said. "I've got to figure out what this is."

A NEW CLASS OF DEADLY DRUGS

Dye had an idea where to start. The sample came in tagged as suspected fentanyl. Dye picked up a vial with 2 milligrams of fentanyl from her long, clean lab bench. The container looked empty. Up close, squinting, she could see a spray of white dust clinging to its sides. The contents of that vial will kill 99 percent of the people who take it.

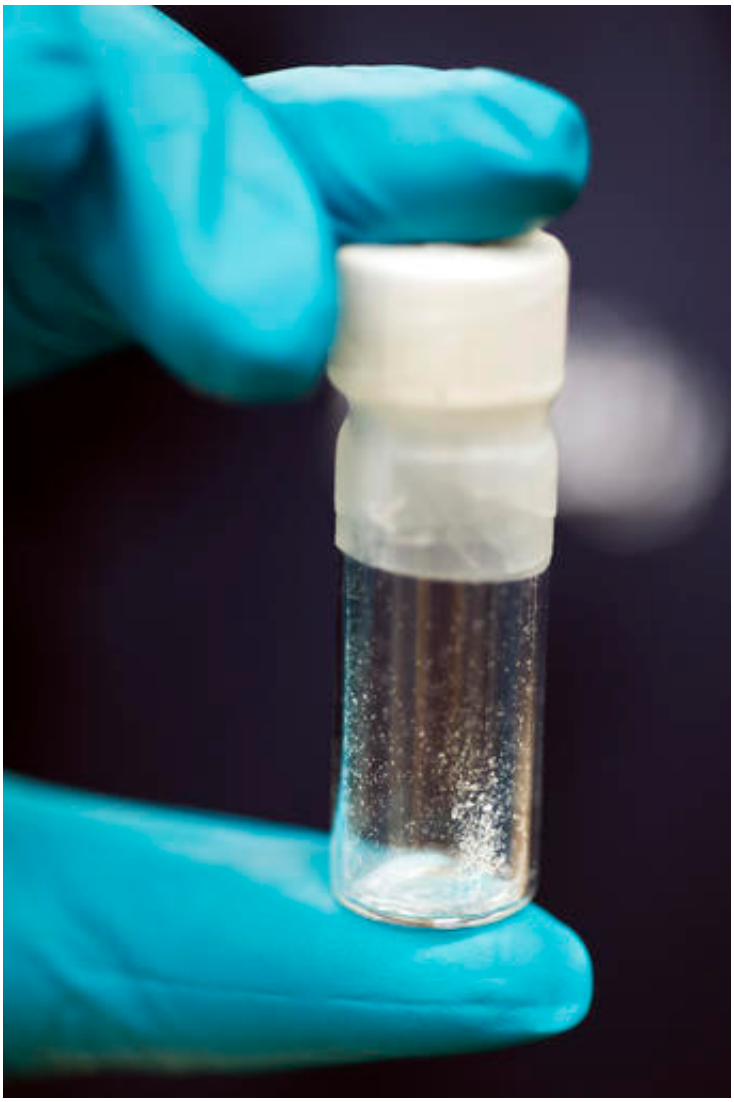
Dye first handled fentanyl three years ago. If she breathed it or touched it, she could die. It was nerve-wracking then—and still is.

The vial was made of glass. Dye had drop-tested it and knew that if it rolled off and hit the hard floor, it would not shatter. She rapped the vial against the benchtop, trying to make the powder inside more visible. Bang, bang, bang. It was still invisible.

"There's nothing more terrifying than dealing with a lethal dose of material," she said. Her hands were steady. Dye won modeling competitions for poise while she was at Graham High School in Bluefield, Virginia, a town of some 5,000 people on the eastern edge of Appalachian coal country.

Dye's mother is a nurse who also deals with hazardous material. Mother and daughter both know that risk is not something to worry about, it's something to manage. Dye has recommitted to every safety protocol she was ever taught. One, safety glasses. Two, lab coat, buttoned. Three, powder-free disposable nitrile gloves. Four, face mask. She placed an emergency naloxone injection kit—an antidote for opioid overdose—near her workspace. Just in case. And, on samples like this, she never works alone.

The Special Testing Laboratory is one of eight forensic chemistry labs the DEA runs. Focused on research, it has a worn functionality that gives it an academic feel. Down echoing hallways are labs packed with fume hoods and high-tech machines sprouting tubes and wires. Beakers dry by the sinks. "Safety First" signs have been taped to the doors. Mostly, it is silent.



In this Aug. 9, 2016, photo, a vial containing 2mg of fentanyl, which will kill a human if ingested into the body, is displayed at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. A 2mg dose of fentanyl is fatal to 99 percent of humans. A novel class of deadly

drugs is exploding across the country, with many manufactured in China for export around the world. The drugs, synthetic opioids, are fueling the deadliest addiction crisis the U.S. has ever seen. (AP Photo/Cliff Owen)

Forty chemists work here. Their job is to identify substances seized by law enforcement in the field before they kill or kill again. One of the compounds they identified is carfentanil, which is so potent it was used as a chemical weapon before it hit the North American drug supply over the summer.

"Right now we're seeing the emergence of a new class—that's fentanyl-type opioids," Dye's boss, Jill Head, explained. "Based on the structure, there can be many, many more substitutions on that molecule that we have not yet seen."

Entrepreneurial chemists have been creating designer alternatives to cannabis, amphetamine, cocaine and Ecstasy for years. But this new class of synthetics is far more lethal.

Back in 2012 and 2013, when reports of fentanyl derivatives started coming in to the U.N. Office on Drugs and Crime in Vienna, chemists chucked them in the "other" category. Today those "other" substances are one of the fastest-growing groups of illicit chemicals tracked by the agency.

"New opioids keep emerging," said Martin Raithelhuber, an expert in illicit synthetic drugs at the U.N. They deserve their own category, he added, but that will take time.

Once, forensic chemists like Dye confronted a familiar universe of methamphetamine, cocaine and heroin. Drug dealers, users and DEA

agents generally knew what substance they were handling.

Today, things are different. This is a golden age of chemical discovery—and subterfuge. Dealers may not know that the high-purity heroin from Mexico they're selling has been laced with fentanyl. Users may not realize the robin's-egg-blue oxycodone tablets they're taking are spiked with acetylfentanyl.

If field agents bust a clandestine drug lab and see a cloud of white powder in the air, they no longer assume it's cocaine. They run.

"Had I come on board at a time when everything was cocaine and heroin and meth and marijuana, it's not an exciting day," Dye said. "Now I come to work and see something that's never been seen."

In this Aug. 9, 2016, photo, forensic chemists working with evidence containing fentanyl, seized in drug arrests, always have a naloxone auto injector nearby in case of accidental exposure at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. The Special Testing Laboratory is one of eight forensic labs run by the DEA. Focused on research, it has a worn functionality that gives it an academic feel. (AP Photo/Cliff Owen)

"And it can kill somebody," she added.

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SEEDS OF A NEW INDUSTRY

The sprint to market unregulated chemicals is driven by demand in the U.S., where users gobble up 80 percent of the world's opioids, according to the DEA.

Dye was just 6 years old when Purdue unveiled OxyContin as a breakthrough drug, a powerful yet supposedly nonaddictive opioid that would revolutionize pain management.

Instead, aggressive marketing and unscrupulous doctors helped push a generation of people into addiction.

Dye saw them all around her in Bluefield. Her dad's pharmacy was her window on the crisis.

"People used to break into his store and steal Oxys," Dye said. "He became friends with a lot of cops." She did, too.

In high school, Dye fell in love with chemistry. Drawn to linearity and logic, she found beauty in the way equations yielded answers.

In this Aug. 9, 2016 photo, Forensic Chemist Emily Dye works at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. The Special Testing Laboratory is one of eight forensic labs run by the DEA. Focused on research, it has a worn functionality that gives it an academic feel. Forty chemists work at the lab. Their job is to identify substances seized by law enforcement in the field before they kill too many people. (AP Photo/Cliff Owen)

The year Dye graduated, 2007, Purdue Pharma and its executives paid more than $630 million in legal penalties for willfully misrepresenting the drug's addiction risks.

By then it was too late.

The seeds of a new industry had already taken root. Today, it is almost as easy to order synthetic opioids on the open internet as it is to buy a pair of shoes, The Associated Press found in an investigation published in

October . Payments can be made by Western Union, MoneyGram or Bitcoin, and products are shipped by DHL, UPS or EMS—the express mail service of China's state-run postal service. As the lines between licit and illicit commerce blurred, it became possible for just about anyone with internet access to score an ever-changing array of lethal chemicals.

By the time Dye was in college studying forensic chemistry, U.S. regulators were cracking down on prescription drug abuse. Users turned from pills to heroin, which was cheap and relatively easy to get. Between 2010 and 2014 heroin overdoses in the U.S. tripled, according to the Centers for Disease Control and Prevention. Three-quarters of today's heroin users first used prescription opioids, a JAMA Psychiatry study showed.

Drug dealers soon learned that if they cut potent synthetic opioids, like fentanyls, into drugs like heroin, they could make vastly more money. Overdose deaths from synthetic opioids—a category dominated by illicit fentanyl—more than tripled from 2013 to 2015, hitting 9,580 last year, CDC data show.

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A DISCOVERY

On June 28, two months after the singer Prince died of a fentanyl overdose, Dye walked down a long, white hallway, past a heavy metal grate and into a dim room known as "the vault." She was surrounded by packages of evidence, seized from the field and waiting for analysis. She checked out an envelope wrapped in plastic wrap and yellow tape that had come in on April 13, and placed it in a steel lockbox with her name on it.

Back in the lab, Dye unwrapped the package and found a silver pouch

the size of a small handbag. Inside that was a palm-size baggie.

In this Aug. 9, 2016, photo, stainless steel lockboxes contain evidence, seized in drug arrests, while they await forensic testing at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. The Special Testing Laboratory is one of eight forensic labs run by the DEA. Focused on research, it has a worn functionality that gives it an academic feel. (AP Photo/Cliff Owen)

She scooped up a dot of powder from the baggie with a thin metal spatula and gingerly placed it in a small glass crimp vial. As she worked, she treated the material as if it were radioactive, twisting the spatula around with her fingers to avoid contamination. Using a glass pipette, she transferred a few drops of methanol into the vial and clamped it shut.

Dye dropped the sample into a mass spectrometer. The machine sucked the evidence through a copper-colored wire and bombarded it with electrons. That broke it up into many different small pieces. "Kind of like when you drop a puzzle," she said.

The resulting pattern of peaks is akin to a chemical fingerprint. Dye compared the result with the lab's library of approximately 1,500 known drugs.

None matched. This was new.

Dye had made a discovery.

China has banned many synthetic drugs, but new chemicals continue to sprout like weeds. In October and November, the AP identified 12 Chinese vendors hawking furanyl fentanyl and U-47700—drugs that are not banned in China—as substitutes for blacklisted drugs. All offered their products via the Korean business-to-business platform EC21.com.

"Most customers choose the U-47700 now," a man from XiWang Chemical Co. who called himself Adam Schexnayder emailed. "Although U-47700 is weaker than fentanyl. But it is a good opioid product. You can try it. How about it?"

Contacted by the AP, Schexnayder responded with a graphic Chinese obscenity, but said nothing more. The site has since vanished.

EC21 blocked searches for furanyl fentanyl and U-47700 after the AP called to ask about the chemicals, though "heroinn" still yielded results on Wednesday. The site has banned more than 768 search terms and is working with a developer to block changing patterns of forbidden terms more effectively, said Kim Min-Jeong, a service team manager. "We spend a significant amount of operating costs and labor on auditing."

In this Tuesday, Aug. 9, 2016 photo, Drug Enforcement Administration (DEA) Forensic Chemist Emily Dye, prepares a control reference sample of fentanyl at the DEA's Special Testing and Research Laboratory in Sterling, Va. A novel class of deadly drugs is exploding across the country, with many manufactured in China for export around the world. The drugs, synthetic opioids, are fueling the deadliest addiction crisis the U.S. has ever seen. (AP Photo/Cliff Owen)

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'ASK TO DIE'

The closest match to Dye's evidence in the lab's database was a compound called butyryl fentanyl. But it wasn't the same. In her sample, distinctive small peaks kept popping up after taller ones.

She and her colleagues ran the evidence through a nuclear magnetic resonance spectrometer, which pulses samples with a magnetic field to help map the position of different atoms. Then they guessed. They bought a sample of the compound they thought they had from a legitimate research chemical company and used it to test their theory.

On July 26, Dye ran the reference standard they'd purchased through the mass spectrometer. The result matched their evidence exactly. Now they knew what they had on their hands.

"It's 4-fluoroisobutyrylfentanyl," Dye said.

Case closed.

What had Dye discovered?

4-fluoroisobutyrylfentanyl—4-FIBF for short —has exactly the same weight and chemical composition as one of the compounds China banned in October 2015. The only difference is the arrangement of three carbon atoms.

In this Aug. 9, 2016, photo, forensic chemist Emily Dye talks about protective measures she takes while handling evidence containing fentanyl at the Drug Enforcement Administration (DEA) Special Testing and Research Laboratory in Sterling, Va. A novel class of deadly drugs is exploding across the country, with many manufactured in China for export around the world. The drugs, synthetic opioids, are fueling the deadliest addiction crisis the U.S. has ever seen. (AP Photo/Cliff Owen)

Long before Dye made her discovery, Chinese vendors were offering 4-FIBF for sale.

Shanghai Xianchong Chemical Co., a trading company that operates from a small, spare office on a leafy street in central Shanghai, was one of them. Shanghai Xianchong started fielding requests for 4-FIBF around April, according to the manager, a clean-cut man in a white polo shirt named Jammi Gao.

Gao said in an email that he could sell 4-FIBF for $6,000 a kilogram, though he later denied ever brokering a deal.

He refused to ship opioids, like the ultrapotent carfentanil, that are banned from general use in the U.S. But 4-FIBF is so new to the street it is not a controlled substance in either the U.S. or China.

Drug users yearn for better chemistry, for highs with incredible analgesic power that go on and on. 4-FIBF showed promise. It was strong and cheap and though it produced little euphoria, it lasted a long time, users reported in online forums. Several said it could be used like methadone, to control opioid withdrawal symptoms. One user-turned-dealer called 4-FIBF "a miracle molecule."

But 4-FIBF was so strong that getting the dose right was a problem. "Eyeball this, ask to die. 'nuff said," one user noted in March.

None of the users replied to AP's requests for comment.

Back in the lab, Dye peeled off her gloves and tossed them into a hazardous waste container. She didn't know users were already warning each other not to go overboard chasing a heroin high that never kicked in with 4-FIBF. She didn't know about the rough dosing schedules addicts had worked out. And she didn't know that 4-FIBF gave some people satisfying, sleep-through-the-night results when they stuck it up their rectum.

Dye would go home, safe, to her dog. Maybe tomorrow she would find the next new thing in an evidence bag on her bench. User forums were already buzzing with talk of things like cyclopentyl fentanyl and acryl fentanyl.

But elsewhere, all across America, people would not make it through the

night. By the time Dye finished work the next day, another 90 Americans would be dead of opioid overdoses.