

THE
DOCTOR
WILL
SMELL
YOU
NOW

HOW THE
CANINE NOSE
COULD BECOME
A PATIENT'S
NEW BEST
FRIEND

When Stephanie Herfel first got sick, her pet husky, Sierra, knew something was wrong. Credit the strength of the canine nose, which is now at the center of some of today's most exciting medical research.

This Dog Could Save Your Life

An abstract graphic consisting of thin, light blue lines connecting small circular dots. The dots are positioned at various points around the large white text, creating a network-like structure that highlights the letters. Some dots are solid light blue, while others have a yellow outline.

BY LUCINDA HAHN

PHOTOGRAPHY BY
KEVIN J. MIYAZAKI





Stephanie Herfel wants you to know she doesn't see alien spaceships.

She doesn't believe in the healing power of crystals. She doesn't even check her horoscope in the newspaper. (Well, hardly ever.)

Herfel is just a normal American woman who loves country music concerts and enjoys a cocktail every now and again. She's a former Marine and a Midwesterner, and she'll proudly tell you she's "53 years young."

And that her dog sniffed out her ovarian cancer.

She gets that you're skeptical. She knows it's a universally accepted truth that people can be downright daffy when it comes to their dogs and what they can do.

On the other hand, you might be among a growing number of people, including scientists, academics, and doctors, who believe that canine snouts can detect cancers far earlier than physicians are able to now—and, as a result, hold the key to saving hundreds of thousands, maybe millions of lives.

Millions? But we're getting ahead of ourselves. Yes, this is a story about numbers, but the first number is simply one: one divorced mom, one dog and her nose, one stroke of great, good fortune.

1

It begins in 2010, when Herfel's son adopts a puppy soon after enlisting in the Air Force. But months later, when he is ordered to deploy to England, he has to drop the high-spirited husky, Sierra, off with his mom in San Diego. Herfel lays down one condition: The dog stays with her. "You have unlimited visitation, but she needs a stable home. It's not fair to her to keep passing her back and forth." That was the beginning of Sierra and Stephanie.

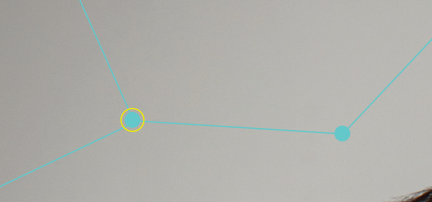
210 •

The following year, Herfel and her new sidekick move to Madison, Wisconsin. "I was a single woman dating in California, only to find materialistic people," she says. "I was ready for a change."

While trying to make friends and date and establish a life in her new city, Herfel notices that she is gaining weight. A lot of weight. She has healthy eating habits, and has always hovered around 145 pounds. Yet the numbers on her scale are marching in one direction. At 160, she thinks, *What the hell?* and tries to exercise more. She's shocked when she hits 180. And a few months later, the flickering red digits settle in at a new high of 210. "I cried—a lot," she says.

A doctor she sees about the weight gain orders blood tests, which come back normal. She takes to wearing stretchy yoga pants all day because she can't button her jeans. There are also so many urinary tract infections that the doctor barely bothers with appointments: She just calls his office, and he prescribes antibiotics over the phone. "He chalked it up to having sex," she says. "But I wasn't having sex, so I knew that wasn't it."

In September 2013, Herfel sits down at her desk, still wearing her trusty yoga pants, and feels a pain radiating from her belly button to her pelvic bone. Later that day, it gets worse, until she's nearly doubled over. Now she is worried. She goes to the emergency room. Eight hours and a CT scan later, she learns she has an ovarian cyst. Nothing to fret about, she's told. A doctor prescribes her something for the pain and says that she should feel better in a few days.



Stephanie Herfel
with Sierra, a very,
very good dog





22,530

In 2019, roughly 22,530 women learned they have ovarian cancer, according to the American Cancer Society. Many of these cases were in stage 3 or 4, when the survival rate can be especially low. The symptoms, if there are any at all, are the routine complaints women contend with during periods, menopause, or just on a bad day: abdominal bloating or pain, weight gain, urinary issues, fatigue.

Early detection can dramatically improve a patient's prospects, but there is no early-screening test for ovarian cancer, a disease Herfel likens to a snake: "Because snakes are quiet, yet they can be deadly. Very deadly."

3 •

After the ER visit, the painkillers do their job. And a few weeks later, when Sierra starts sniffing at her stomach, Herfel thinks nothing of it. "I figured maybe I had crumbs on my pants," she says. The next day, Sierra presses her nose against Herfel's belly again. After the third time, distracted from her work, Herfel grows exasperated. She gently scolds the dog and pushes her away. "I thought she was just being naughty."

A short time later, Herfel looks up from the computer and doesn't see Sierra, who normally lies in the middle of the room. She checks the dog bed in the living room, near the table in the kitchen, the bedroom. Then she gets nervous and starts searching in places where Sierra never ventures. Way back in her bedroom closet, she finds Sierra curled up in a ball.

She kneels down to see if the dog is sick or injured, and that's when she notices Sierra's face. "She had such a look of worry. Her eyebrows were scrunched up so tight. And the fur around her eyes was completely soaked. They say dogs don't cry, but ..."

Herfel experiences then what she can only describe as a "leap of faith." A lightbulb moment. "I knew in my gut Sierra was trying to tell me something. With the CT result and the cyst, I thought, *I need to follow up.*"

• 300,000,000

You and your dog both have olfactory receptor cells inside your nostrils that Hoover up smells. The difference is you have about 6 million; your dog has some 300 million. And your dog's olfactory bulb, the part of the brain dedicated

to processing all the information the nose supplies, is many times larger than yours. All this equips your dog to distinguish and remember a staggering variety of scents. Whereas you can smell a spritz of perfume when you walk into your bedroom, your dog would have no problem smelling it in an enclosed sports stadium—and recognizing the perfume's individual ingredients, too. What's more, your dog has, hidden above the roof of their mouth, what's called a vomeronasal organ. Thanks to evolution, yours has withered to nearly nothing. Your dog's, however, senses the chemicals from hormones that all animals, including humans, give off. This allows your dog to identify aggressors and potential mates, and even to tell if someone is pregnant. Or sick.

15

On Nov. 18, about two months after her emergency room visit, an oncologist at the University of Wisconsin's Carbone Cancer Center makes a 15-inch incision in Herfel's abdomen, starting a nine-hour surgery. The cancer, he discovers, has spread from her ovaries to her spleen and other parts of the abdomen. She has stage 3 ovarian cancer. All the affected areas are removed in what's called, terribly, a "debulking surgery," and Herfel is left to prepare for five months of chemotherapy and radiation.

"I didn't think I was going to survive," she says. "I started thinking about what Sierra had done and wondering if I could find a verse to honor her that could be read at my funeral."

1989 •

Herfel's story about Sierra isn't as unusual as you might think. Google "my dog sniffed my cancer," and brace yourself for the flood of results.

The first recorded instance of a cancer-sniffing dog was published in 1989 by *The Lancet*, a respected British medical journal. In a letter to the editor, two London-based dermatologists described a patient and her pet, a gentle Doberman pinscher-border collie mix with the delightful name of Baby Boo.

The dermatologists wrote that Baby Boo had grown fixated on an area on the back of her owner's thigh. The dog would sniff and snort at it, even when the woman was wearing slacks. One warm day, when she wore shorts,



Dr. Cynthia Otto goes nose-to-nose with a trainee at the Working Dog Center.

Baby Boo jumped up and bit at the back of her leg, nipping again and again, prompting the woman to twist around and find a fairly large, dark bump. It turned out to be a malignant melanoma, which the doctors excised.

Because the tumor was still small enough for it to be easily treated, the dermatologists reported that the dog had saved her owner's life. In conclusion, they suggested in *The Lancet* that "the adjunctive use of animals with highly developed sensory modalities in cancer diagnosis is worth considering ..."

Excited by the possibilities, researchers in the following decades published study after study showing trained dogs detecting various types of cancer using urine, blood, or breath samples. The success rates were astonishing, as the dogs often identified the samples with 90 percent accuracy or better.

5

No one at the Penn Vet Working Dog Center in Philadelphia doubts that dogs can detect cancer. They see it every day. Now I'm here to see it, too. I'm dropped off near the low-slung buildings of a gritty industrial park, a stone's throw from the University of Pennsylvania campus.

Passing under an awning emblazoned with the silhouette of a German shepherd, I find a facility that could rival any Olympic training center. In the large main room, a floor of interlocking blue tiles creates a low-impact surface. Here, puppies play and older dogs learn search-and-rescue skills through various exercises, such as locating a person hidden inside a plastic barrel. Equipment is scattered about. A raised plank resembling a balance beam here, two brightly colored exercise balls there. Barking echoes from nearby rooms, along with the sharp sound of "clickers," handheld devices used by trainers to reinforce praiseworthy behaviors.

The center was founded by Dr. Cynthia Otto, a veterinarian and professor at Penn who was inspired by the heroic search-and-rescue dogs she treated at ground zero following the terrorist attacks on Sept. 11, 2001. Since opening in 2012, the Working Dog Center has honed hundreds of well-trained snouts that will help sniff out bombs, narcotics, disaster victims, and more.

Five of the dogs at the center are known as the "cancer dogs." One, a friendly Dutch shepherd named Lucy, noses my hand until I squat and pet her. "She's a fan favorite around here," says Dr. Jennifer Essler, Lucy's trainer

today. “But she’s a little mischievous.” Even cancer-detecting dogs, it seems, like to get into the trash.

“Ready to work, Lucy?” Essler says brightly. “Go work!”

Lucy trots through the door into a larger room, where there is a stainless-steel flywheel that looks like a giant eight-spoke bicycle wheel. A research assistant has placed glass vials at the end of three of the spokes. One vial contains a speck of blood plasma from an ovarian cancer patient. That’s the one Lucy needs to find. The other two vials contain either healthy plasma or plasma from a patient with a benign ovarian tumor.

As we watch her on a computer monitor in the office, Lucy trots to one vial and sniffs, and then steps to the vial on a neighboring spoke. We know that’s the one containing the blood plasma of the cancer patient, but will Lucy? She pauses, her nose centimeters from the vial’s open top. We watch and wait. She’s not moving. She stands

“frozen” in front of the vial, as trained. Will she change her mind? In the office, Essler waits five seconds and then squeezes her clicker.

Dogs train by using a “scent wheel” that holds different samples.



When the *click* reaches Lucy’s ears, she races back to the office. “Good job, Lucy!” Essler says, tossing her a handful of treats. Again and

again, I watch Lucy choose from among the samples.

Then two German shepherds, Osa and Bobbie, do similar tests.

Each can successfully detect the scent of ovarian cancer in an amount of blood plasma so small I can barely see it when I peer into

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the vial. I sniff the vial myself and smell nothing. So, what are the dogs smelling? Odors are created by volatile organic compounds, or VOCs. Peanut butter's odor has a certain pattern of VOCs; Chanel No. 5 has its own.

Cancer cells are thought to produce an array of VOCs that create scents different from those of healthy cells. "It comes down to the study of proteins," says Dr. Howard Bailey, the director of the Carbone Cancer Center and one of Herfel's oncologists. "Cancer occurs and advances based on some of the abnormal proteins it produces, and differing smells are often a result of different proteins. So, it's not surprising that dogs, which are much more sensitive to smell than we are, could detect a change [in their owner's smell]."

These VOCs—and the many others our bodies produce—are emitted through our blood, urine, and breath. But why the distress in dogs such as Sierra and Baby Boo? "If your spouse came home one day with purple hair, you'd notice that," Otto says. "Dogs sort of 'see' with their noses, and as cancer changes the typical odor within our bodies, the dog is reacting to that change in its owner."

Some private groups are training cancer-detection dogs with an eye toward putting pooches in every hospital and doctor's office. As the joke among scientists goes, "Will there someday be a Lab in every lab?" Probably not. Dogs, as impressive as they are in a controlled environment like Otto's quiet testing room, have limited attention spans. They get hungry, fatigued, and distracted. What's more, the cost and time to train a dog is enormous. "The number of dogs it would take to screen every single woman in this country once a year is insane," Otto says. "That's not our vision."

Instead, she and three other scientists at Penn have built a diagnostic device that mimics the dogs' cancer-detecting abilities.



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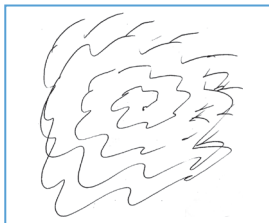
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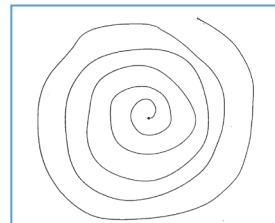
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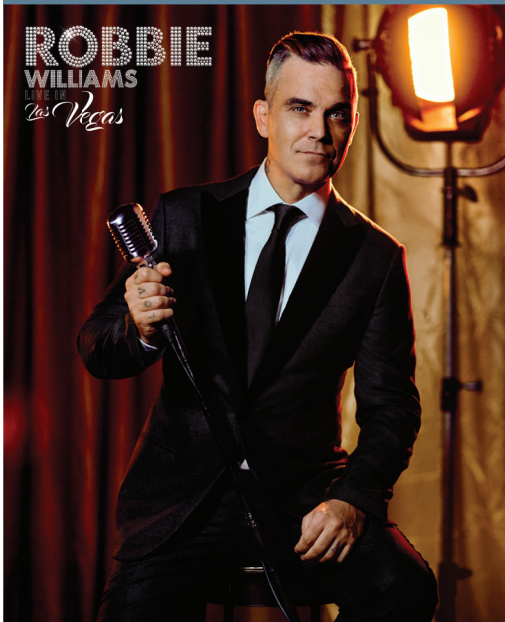
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Eventually, Otto and her cohorts hope it will be used to scan blood samples as a routine screening for ovarian cancer.

To create what's known as an electronic nose, or e-nose, the Penn team first had to identify ovarian cancer's "odor signature"—the exact chemical makeup of the scent the dogs detect in the blood plasma samples. To do so, George Preti, an organic chemist, isolated and identified the VOCs he suspected the samples shared. Then, he sent the VOCs to Otto's dogs to test whether or not they responded.

Guided by the results, Penn physicist Charlie Johnson built the e-nose device. Sitting on a bench in his lab at Penn, he admits that, for now, it looks "a bit like a home science project." Nevertheless, the carbon nanotubes and single-strand DNA that make up the e-nose's sensors do precisely what the dogs do: read the VOCs emanating from cancer patients' plasma samples.

The team won't reveal its results ahead of a paper it expects to publish later this year, but the enthusiasm is palpable. "We've had success with [the sensor] detecting early and late stage cancer, so that makes us very excited that with more refining, this can actually succeed," Johnson says.

Electronic noses are showing promise in labs beyond Penn. Researchers at MIT worked with trained dogs to build one that may detect urological cancer. In South Korea, the Netherlands, and Israel, e-noses are being fine-tuned to diagnose lung, prostate, and other cancers through patients' breath and urine. None has reached the market, though; until they do, Lucy and her tail-wagging assistants are happy to help with cutting-edge cancer research.

2

It takes only two years in Wisconsin for Herfel to fall in love. They meet on eHarmony while her



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cancer is in remission. Jim has a kind heart and a gentle smile and works for a Madison-based chocolate company. Herfel thinks she's hit the jackpot: "He drives semis full of liquid chocolate—a woman's dream!" A few months after their first date at Monk's Bar and Grill downtown, Herfel takes Sierra north for the Fourth of July weekend. At a friend's lakeside cabin, they play by the water. And then Sierra disappears. Herfel finds her in the cabin's loft, curled in the back of a closet. The dog looks terrified. Herfel coaxes her downstairs and tries to comfort her. But after a short time, Sierra returns to the closet.

Herfel's friend tries to reassure her that it's a fluke, that it doesn't necessarily mean the cancer has come back. "But I knew in my heart and gut what Sierra was doing, that she was communicating with me," Herfel says. A CT scan soon after shows an area of suspicion. A liver biopsy confirms it: Her ovarian cancer has returned.

With that news, she tells Jim that she knows cancer is a pretty hefty piece of baggage. She'll set him free. No ill feelings. He looks at her and says, "I'm not going anywhere. We'll cherish every day we have left." On Aug. 26, 2017, Herfel walks down the aisle toward Jim, who's standing at the altar with Sierra by his side.

You don't get cured of ovarian cancer; if you're lucky, you live with it. Over the next two years, Herfel is treated for two more recurrences—both caught early, thanks in part to Sierra hiding each time, under the bed or behind the toilet, in advance of the positive CT scans. Sierra's nose knows. "When my cancer's active, she won't kiss me. She'll be tolerant of me, but she'll constantly try to be away from me. And I grab her little face, and I say, 'I'm listening.'"

Lucinda Hahn is the proud owner of a border collie rescue dog, Pilot. Write letters@southwestmag.com.

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