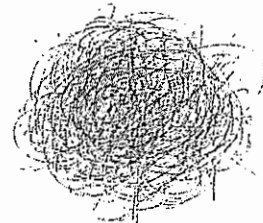


# Nonsense



THE POWER OF NOT KNOWING



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why, on the morning of April 19, armored vehicles punctured the walls of the Mount Carmel Center and tear gas was pumped into the compound. That's why FBI covert listening devices recorded, over the course of that morning, these ominous phrases:

"Pablo, have you poured it yet?"

"You got to get the fuel ready."

"The fuel has to go all around to get started."

"Give me the match."

"Is it lit?"

"Let's keep that fire going."

FIVE

## Overtested USA

WHEN TO RESIST MOMENTUM

IN LATE JUNE 2004, a fifty-two-year-old woman with short auburn hair and glasses noticed a lump on her torso. Her name was Trisha Torrey, and she was living in Baldwinsville, New York, north of Syracuse, running her own marketing company. The lump she discovered was about the size of a golf ball, firm, but not painful. Torrey's doctor couldn't be sure what it was without a test. So he referred her to a surgeon, who removed the lump that same afternoon and sent the tissue off for analysis.

One week passed. When Torrey still hadn't heard back about the results, she called the surgeon herself to check. The delay, he told her, was due to the long Fourth of July weekend. The lab doing the analysis was short-staffed. So Torrey waited some more, another week, until the surgeon finally called with the results. He delivered bad news. Apparently she had a very rare cancer called subcutaneous panniculitis-like T-cell lymphoma. Known as SPTCL, this particular cancer is so rare that the lab had ordered that the results be confirmed at a second lab. The doctor promised to make an oncol-

ogy appointment for her as soon as possible. She would need chemotherapy.

Torrey hung up the phone. She tried, as one does in vain at moments like these, to wrap her mind around what the diagnosis meant. From what she was able to learn online, SPTCL was a death sentence. Her oncologist, Dr. Weiss (not his real name), was straightforward and frighteningly blunt. Without chemotherapy, he said, she wouldn't make it to the end of the year. He sent Torrey off for a CT scan and blood work. The results were negative. Still, he insisted that the positive results from the previous lab tests trumped these newer results. Besides, he told her, her records indicated that she had hot flashes and night sweats, and hot flashes and night sweats are classic signs of lymphoma. "But I'm fifty-two!" she protested. "At fifty-two, all women have night sweats and hot flashes!" Weiss assured her that her symptoms were unrelated to menopause.

She didn't tell many people about her diagnosis at first. Although she had health insurance, it didn't fully cover all the doctor visits and tests that she would need. She felt, moreover, that the diagnosis didn't make any sense. She was playing golf regularly. She felt perfectly healthy. Was she in denial? Torrey put off treatment for a few weeks. But she was spending so much time worrying that her marketing business was suffering. August came, and she had to make a final decision about chemotherapy. By that time, Weiss had taken sick and his partner (let's call him Dr. Bateman) had taken over Torrey's case. He pressed her to start treatment at once.

Several days after her run-in with Bateman, Torrey was out with a few business acquaintances. "I had way too much to drink," she recalled. Tipsy, she told them about her diagnosis and her search for a second opinion. One of her dinner companions happened to have an oncologist friend who, it would emerge the next day, was already treating someone with SPTCL. (Weiss and Bateman had

never treated such a patient before.) Torrey's friend helped her set up an appointment the following week. To speed things along and avoid any delays in transferring the paperwork, Torrey asked Weiss and Bateman's office for her medical records.

She picked up her records and waited for her new appointment. Then Torrey did something that most patients rarely do. She decided to carefully analyze her results. Page by page, she read through the records. She researched new medical terms and learned how to google Greek letters. When she looked closely at the two lab reports that led to her diagnosis, she noticed that neither seemed definitive. "One of the lab reports," she told me, "said 'most suspicious for,' and the other one said 'most consistent with.'" Were these hedges simply the way that the labs protected themselves against lawsuits? Or did they imply a very real uncertainty?

Torrey's new oncologist sent the biopsy tissue to Elaine Jaffe, a highly respected pathologist at the National Cancer Institute. On September 20, 2004, at a little before noon—halfway into her supposedly remaining six months—Torrey received a fax with the results. "I was standing right there at my fax machine," she said. "I didn't even understand it at first. It didn't say, you don't have SPTCL, which is what I expected. It said, basically, that there was no sign of malignancy." She didn't have cancer.

Her misdiagnosis would end up unexpectedly changing her life. For years afterward, she suffered from symptoms of post-traumatic stress disorder (PTSD). She would break down in tears at odd moments, sometimes after a mere mention of cancer on the evening news, other times while watching a movie character face a completely unrelated hardship. One fact in particular was hard to shake: the misdiagnosis had almost not been caught at all. She would have gone through chemotherapy and lost her hair. She would have gotten sick from the chemo, lost weight from not eating, and aged more

rapidly. And—this was the most infuriating thought of all—had she survived the treatment, her doctors would have told her that she was now cancer free, all thanks to them.

After doing some research online, Torrey discovered that what might have happened to her *had* actually happened to others. In one heartbreaking case, a woman had died from her chemotherapy, only to have her husband learn, from a private autopsy, that she had never had cancer in the first place.

MISDIAGNOSES ARE DISMAYINGLY common. As symptoms can be ambiguous, important clues are too often missed or ignored. Delayed, botched, and missed diagnoses can affect 10 to 20 percent of cases. Every year, there are between forty thousand and eighty thousand preventable deaths in the United States from missed diagnoses alone, by one estimate. Given the faith we put in modern medicine, the numbers can feel a little bewildering. A 2014 study found that one in five breast cancers discovered by mammography and treated wasn't actually a health threat. In another study, pathologists identifying tissue samples as either normal, cancerous, or precancerous got it wrong up to nearly 12 percent of the time. In yet another study, radiologists judging chest X-rays disagreed with one another 20 percent of the time. Worse, when one of the radiologists reexamined the same X-rays later on, he contradicted *himself* up to 10 percent of the time. E. James Potchen, the study's author, wrote that observers tend to have "a characteristic way in which they manage the threshold of uncertainty in making decisions." Most disturbingly, some of the most poorly performing observers were also the most confident.

There's even evidence that doctors' diagnostic accuracy rates haven't improved in some areas of medicine. In the 1980s, research-

ers at Boston's Brigham and Women's Hospital compared missed diagnoses discovered in autopsies before the invention of ultrasound, CT, and radionuclide scanning. The researchers found that these new technologies hadn't seemed to improve matters. Whatever the decade—the 1960s, 1970s, or 1980s—about 10 percent of the time, physicians still missed major diagnoses that, if caught, could have prolonged patients' lives. Another 12 percent of the time, they missed diagnoses that wouldn't have changed the prescribed treatment. In 1996, in another study of autopsies, Wilhelm Kirch and Christine Schafii looked at diagnostic errors in 1959, 1969, 1979, and 1989. They found that misdiagnoses held steady at between 7 and 12 percent of cases over that time, and that false negatives (where the autopsy discovered a previously unknown diagnosis) remained between 22 and 34 percent. Autopsies aren't performed randomly among all deaths, of course, and our tools to detect mistakes have improved over time. But these are still startling numbers. In another sample of patients, the use of CT scans or ultrasound to diagnose appendicitis increased from under 10 percent at the start of the 1980s to over 30 percent at the end of the 1990s. But the rate of misdiagnosed cases held steady at around 15 percent.

Given the progress in medical science, how could doctors still be making so many mistakes? For one, doctors have to cope with an increasingly overwhelming amount of information. We have more knowledge and tools than ever before, and the challenge now is to develop systems to manage the complexity and uncertainty that this new knowledge brings. A related problem is that it's not always clear in precisely which circumstances a particular treatment is appropriate or not, as adequate research may not exist. As medical researcher David Naylor once put it, while it would be simpler if new technologies were "always appraised in rigorous studies . . . current data are often insufficient to guide practice." Combine technologies, Naylor

pointed out, and the result is a “Malthusian growth of uncertainty.” Two technologies can be used together to treat a patient in 2 different sequences. But five technologies can be used in 120 sequences. The surgeon and author Atul Gawande summed up the broader issue in 2002:

The core predicament of medicine—the thing that makes being a patient so wrenching, being a doctor so difficult, and being a part of a society that pays the bills they run up so vexing—is uncertainty. With all that we know nowadays about people and diseases and how to diagnose and treat them, it can be hard to see this, hard to grasp how deeply uncertainty runs. As a doctor, you come to find, however, that the struggle in caring for people is more often with what you do not know than what you do. Medicine’s ground state is uncertainty. And wisdom—for both patients and doctors—is defined by how one copes with it.

And yet, as professors of medicine Vera Luther and Sonia Crandall pointed out in 2011, “the culture of medicine has little tolerance for ambiguity and uncertainty.” As others have, Luther and Crandall argued that ambiguity deserves a special place in medical education, for the simple reason that it causes “significant anxiety, frustration, disillusionment, self-doubt, and feelings of inadequacy.” Even doctors don’t like to think of themselves as artists who must improvise a fabric from ambiguous threads. It’s more comforting for all of us to conceptualize medical practice as akin to repairing watches. Yet in reality, its certainties represent, to borrow a phrase from theorist Donald Schön, a “high, hard ground overlooking a swamp.”

In a 2011 book on overdiagnosis, Gilbert Welch, Lisa Schwartz, and Steven Woloshin used the analogy of car warning lights to describe another dilemma of new medical technologies. Welch’s first

car, a ’65 Ford Fairlane wagon, had only two engine sensors: oil pressure and temperature. But his ’99 Volvo was another creature entirely. It was filled with diagnostic electronics. The only problem was, the warning lights didn’t work perfectly. One told him that something was wrong with his coolant system every time it hit a big bump. There was even one that went off if another sensor wasn’t sensing properly. His mechanic confessed that most of the lights should be ignored. As diagnostic technology grows more sensitive, the point was, our modern medical testing regime has more and more in common with Welch’s Volvo—and the problems are proliferating.

TRISHA TORREY PENNED a letter to the thirteen doctors involved in her misdiagnosis. The letter was ten pages long by the time she was finished. She detailed what each doctor’s role had been in her misdiagnosis and how it had affected her. Part of the problem, she suspected, was old-fashioned greed. In the United States, one of the only medical specialties that allows physicians to personally sell drugs to patients is oncology. That’s one reason why so many oncologists have their own infusion centers. Torrey felt that Weiss and Bateman’s certainty was motivated at least in part by the bottom line.

By the end of 2004, Torrey had grown passionate about the state of health care in the United States. She had read news article upon news article. She discovered an Institute of Medicine report indicating that as many as ninety-eight thousand Americans die each year because of medical errors. She began blogging on medical issues. She would read some news item and share her point of view. At one point, she even detailed her own story. The *Syracuse Post-Standard* came across it and ran a story about her. Before long, she was being asked to speak to the pharmaceutical industry about the patient’s

perspective. She became part of what's called the empowered-patient movement, helping others navigate their own health-care crises. The issue, she told me, is that "no one has ever expected us, nor helped us, to learn the skills to get the best out of the system."

The patient empowerment movement represented a seismic shift in the patient-doctor relationship. Through the 1970s and into the 1980s, most patients tended to regard doctors as ultimate authorities. People didn't question doctors' instructions, but simply followed directives. Doctors sometimes wouldn't inform patients of what the diagnosis was or even what drugs had been given. Patients didn't have access to their own medical records. In a 1984 landmark book, *The Silent World of Doctor and Patient*, Jay Katz emphasized how unethical it could be to leave patients out of medical decision making. By the 1990s, medical schools had begun training doctors to respect patient autonomy. When the Internet exploded, patients had ready access to medical information for the first time. By 2005, according to one poll, roughly half of the patients diagnosed with cancer were presented by their doctors with multiple treatment options. A third of those patients made the treatment decision themselves. In general, it has been a valuable shift. Informed patients do often have a better chance of making the right decisions in light of their particular circumstances. But the patient empowerment movement has also complicated the medical decisions currently facing both doctors and their patients.

Now patients, in addition to doctors, have to be aware of how ambiguity can undermine rational analysis. About two-thirds of primary care patients show up at their doctors' offices at some point with symptoms that remain inexplicable or ambiguous even after examination and testing. Patients who describe unclear symptoms to their physicians, as you might guess, can strain the patient-doctor relationship. One of the most telling experiments on the issue was

published in 2005 by a group led by the University of Rochester's David Seaburn. Seaburn and his colleagues wanted to see how primary care physicians treated patients who reported medically confusing symptoms. Using detailed scripts and multiple test interviews, the researchers trained actors to describe specific symptoms. The researchers then recruited a group of local physicians and arranged for two different actor confederates to visit the doctors' practices unannounced. The visits were secretly audio-recorded.

Each physician saw one patient, either a man or a woman, who described the classic symptoms of gastroesophageal reflux. The first "patient" told the doctors that they suffered chest pains at night. They said that antacids helped a little bit and that different foods affected the pain in various ways. The second patient each physician saw described the symptoms unclearly: some emotional stress, dizziness, fatigue, and chest pains that were recounted in rather mysterious language. Seaburn and his colleagues transcribed these patient-doctor encounters and then categorized the interactions.

Clear patterns emerged from the twenty-three interviews with the second, ambiguous patient. Twenty-two percent of the time, the physicians simply ignored the ambiguity. For instance, after a patient described "vague symptoms of general chest pain," the doctor would respond with a statement of "fact": "Your pain is caused by gastroesophageal reflux." The researchers who later analyzed the interactions described most of these visits as "physician driven." The doctor was in charge, and the patient wasn't invited to offer much input. The patient was passive—the opposite of empowered.

But Seaburn's study revealed another troubling issue. Many of these doctors weren't just ignoring the ambiguous symptoms; 77 percent of the time, they *acknowledged* that the symptoms were unclear, only to follow up with a directive. For instance, in a sample dialogue provided in Seaburn's study:

Patient: What do you think this is?

Doctor B: I'm not sure what's causing the pain, so I think we should do an endoscopy to see if there is an ulcer or a tumor.

Ordering a test to get further information wouldn't be especially worrying, except for one small, incriminating detail. In only three instances did the physicians attempt to pry additional information from the patients who described the vague symptoms. Only three times out of twenty-three visits did the physicians continue prompting the patient to clarify the symptoms.

Ordering a test provided an escape from thinking about ambiguity. Tests, at least in this study, provided doctors an all-too-easy retreat from puzzling further over the patient's problems. In her book *Every Patient Tells a Story*, Lisa Sanders confirmed this premature rush toward closure: "By far the most common diagnostic error in medicine is premature closure—when a physician stops seeking a diagnosis after finding one that explains most of or even all the key findings, without asking . . . what else could this be?" When technology enters the picture, as Seaburn's experiment implies, the dilemma grows more vexing.

IN 2011, THE *New York Times* reported on a clever quasi-experiment run by James Andrews, a famous sports medicine orthopedist. Andrews has treated the likes of Drew Brees, Peyton Manning, Emmitt Smith, Charles Barkley, Michael Jordan, Roger Clemens, and Jack Nicklaus. Thinking that MRI scans might be giving doctors misleading results, Andrews took a group of thirty-one professional baseball players, all pitchers, and gave them MRIs. In twenty-seven

of those pitchers, the MRI revealed abnormal rotator cuff damage. Twenty-eight of the pitchers showed abnormal shoulder cartilage. The problem was that the pitchers were all healthy. Andrews had deliberately selected players who weren't injured and hadn't reported any pain. It turns out that MRIs are extraordinarily good at detecting abnormalities but not always very good at revealing whether those abnormalities actually pose a problem.

"If you want an excuse to operate on a pitcher's throwing shoulder, just get an MRI," Andrews said. The story pointed to a critical downside of highly sensitive diagnostic tests. Pitchers, like all of us, have various physical flaws. But although the majority of these flaws are completely benign, the test's hyperactive warning lights go off.

Patients are practically drowning in diagnostic tests. And yet in too many cases, the results simply don't justify the rising number of CT, MRI, and PET imaging tests. In her 2007 book *Overtreated*, health policy expert Shannon Brownlee (and my colleague at New America) argued that "for every scan that helps a physician come to the right decision, another scan may cloud the picture, sending the doctor down the wrong path."

Seaburn and his colleagues showed that ordering a test can be a cheap response to unclear symptoms, providing a false sense of short-term closure. But if the test results are themselves unclear—if the warning lights aren't always working—couldn't that help propel a never-ending cycle of testing? A 2013 experiment run by Sunita Sah, Pierre Elias, and Dan Ariely suggests it could.

Sah speculated that ambiguous test results might lead doctors to order another test. In the case of the prostate-specific antigen (PSA) test for prostate cancer, she wondered, could an inconclusive result lead to another, more risky, test? Sah, Elias, and Ariely recruited a group of over seven hundred men between the ages of forty and seventy-five and randomly assigned them to one of four experimen-

tal conditions. The first group received information about the risks and benefits of a prostate biopsy. Then they were asked whether they would have a biopsy and how certain they were about their decision. The other three groups read about the risks and benefits of biopsies, too, but they also received background on the PSA screening test (which informs the decision of whether to have a biopsy) and were asked to imagine one of three PSA results: normal, elevated, or inconclusive. An inconclusive test result, subjects were informed, "provides no information about whether or not you have cancer." The men then had to decide whether they would proceed with the hypothetical prostate biopsy.

In theory, an inconclusive PSA result shouldn't make someone more or less likely to proceed with a risky biopsy. But that's not what Sah and her colleagues found. Only 25 percent of subjects who weren't given PSA screening results chose to proceed with the prostate biopsy. But 40 percent of subjects who received inconclusive PSA test results opted for the procedure. That's a fairly large increase among those who received a result clearly explaining that it "provides no information." Somehow, the very idea of not knowing something led to a panicky commitment to more invasive testing.

Since prostate biopsies are not only risky but also costly, the increased call for the biopsy is not insignificant. Sah described the problem as one of "investigation momentum." In this and other analogous cases, we commit to an investigative course of action and receive ambiguous results, and since we're especially averse to ambiguity under stress, we proceed with riskier diagnostic testing in the hopes of finding clear, anxiety-reducing answers.

Self-propelling momentum, Sah told me, results in "additional, potentially excessive diagnostic testing when you get a result that's ambiguous." She doesn't deny that there are many other causes of overtesting in the United States. The financial incentives involved

are obviously a mammoth issue, as is *defensive medicine*, where doctors treat patients to avoid potential lawsuits. But one important and overlooked cause, Sah said, is the self-propelling cascade of tests encouraged because of inconclusive results, ambiguity aversion, and a disproportionate faith in testing. To the same point, in 2013 Deborah Grady cited evidence that in a US Department of Veteran Affairs (VA) medical center, the use of myocardial perfusion scans was inappropriate in about 20 percent of cases. That's roughly the same rate as in other practices. But Grady, an editor at *JAMA Internal Medicine* (formerly *Archives of Internal Medicine*), was pointing out that VA physicians are on salary and malpractice suits are rare. The matching rates imply that overtesting has deeper roots than financial incentives or defensive medicine.

In the past several years, medical journals have increasingly reported on instances where inconclusive test results led to additional risky tests or treatments. In one case, a man in his fifties with mild asthma needed hernia surgery. A preoperative evaluation came back normal, but as an extra precaution for a man of his age with asthma, a chest X-ray was ordered. It revealed a seven-millimeter *nodule*, a tiny mass of tissue, in the lung, which led a radiologist to order a CT scan. The lung nodule didn't show up on the CT scan, but the scan revealed a different nodule in the man's right adrenal gland. The radiologist then ordered another CT scan that was specifically focused on this area. The adrenal CT scan showed that the nodule was nothing to worry about. By the time he had his surgery, the man had endured the pain of a hernia for an extra six months, not to mention the worry that he might have cancer. What makes his case even worse is that the value of the first chest X-ray for patients fitting his profile has never been established. Yet the test spawned two additional tests, perfectly illustrating Sah, Elias, and Ariely's concept of investigation momentum.



MEDICAL PROFESSIONALS ARE aware of the overtesting problem and its various causes and are working to correct it. Roughly \$200 billion may be wasted in the United States annually on over-treatment, by one recent estimate. In a 2014 survey of physicians, 73 percent said that unnecessary tests and procedures are a serious health-care issue. Asked why they might occasionally make the mistake themselves, 36 percent said it was “just to be safe.” To be sure, medical uncertainties are especially emotional. The stakes are high, and we all know of situations in which persistent advocacy has paid off. The instinct to test “just in case” can’t and shouldn’t be entirely demonized. But we need a clearer weighing of risk and reward and a better balance between caring and overtreatment.

Leading the way, in 2010 *JAMA Internal Medicine* began running a series called Less Is More, detailing precisely when reducing medical care can have better health outcomes. The editors singled out diagnostic testing as one critical problem area. They know that abnormal but ultimately harmless findings on one test can lead to more testing and that every additional test or procedure imposes a psychological burden and carries a risk, often from complications or by exposing patients to radiation. As they put it in 2011, “no test (not even a non-invasive one) is benign, and often less is more.”

The difficulty of helping doctors make smarter choices also speaks to the limitations of patient empowerment. If well-meaning and pure-hearted doctors struggle with when and how to apply certain tests, how can we possibly expect patients to do better? Even Trisha Torrey, by 2007, had begun to see the drawbacks of the movement. She had met several people who told her that they wanted to take more control over their health care, but that they were too sick to do it themselves. In many cases, patients who would have benefited

the most from learning how to better navigate the system hadn’t had the time or resources for it. And many patients aren’t in the right psychological state to take full responsibility for their health-care decisions.

Beyond spreading awareness of how ambiguity can interfere with effective diagnosis and treatment, the simplest—not to say the easiest—answer is to provide the right resources to both patients and doctors. In Minnesota, for example, the cooperative HealthPartners noticed annual 15 to 18 percent increases in MRI and CT scans. So they started a program in which the national radiology guidelines appear on patients’ electronic medical records every time a doctor orders a scan. After two years and change, the program had helped avoid an estimated 20,000 unnecessary tests and saved \$14 million. Ratcheting up its less-is-more approach, *JAMA Internal Medicine* published top-five lists from the National Physicians Alliance, highlighting the key areas in which care could be markedly improved by less intervention. The lists are available online and often propose surprising don’ts. For instance, did you know that kids shouldn’t take cough and cold medications? There’s apparently little evidence that these over-the-counter medications reduce a cough or even shorten the duration of a cold. Yet one in ten American children takes these medications weekly. Initiatives like these are adding critical lessons that we, as a society, have already begun to acknowledge: that frequent mammograms aren’t always needed, for instance, or that the dangers of certain drugs can outweigh their benefits.

Other recommendations speak directly to the epidemic of over-testing: don’t automatically order diagnostic scans for kids’ minor head injuries, don’t order Pap tests for women under twenty-one years old, don’t order annual electrocardiograms for patients with low risk for coronary heart disease, and unless there are red flags, don’t do imaging for lower back pain within the first six weeks. The

ABIM Foundation, a nonprofit established by the American Board of Internal Medicine, set up a campaign called Choosing Wisely. The campaign asks various medical specialty societies to contribute top-five lists of things physicians and patients should question. So far, over sixty-five societies have helped identify more than 325 overused tests and procedures.

These efforts have been so successful that the Canadian Medical Association launched Choosing Wisely Canada in the spring of 2014. They've emphasized that the choice of fewer tests isn't about rationing. Rather, it's about the need to challenge the more-is-better mantra—about recognizing that despite technological advances, ordering tests isn't always the best way to resolve a problem. Far too often, tests are a harmful crutch. In 2013, one study of resident doctors revealed that computers garnered over three times more face time than patients did. Yet many diagnoses can be made simply by talking. As tempting as technological "certainty" feels, it's usually wiser to treat the patient instead of the scan.

MEDICINE IS NOT the only area in which new technologies appear to provide shortcuts out of uncertainty. Emerging technologies are often hailed as cure-alls, especially in the "developing" world. The One Laptop per Child program, which has distributed over two million laptops in thirty-six countries, provides an extreme example. It's comforting to presume that access to information (as opposed to deeply entrenched weaknesses in state institutions) is the primary barrier to empowering children who grow up in poor countries. A study of the program showed that while Peruvian students given laptops showed some improvements in general cognitive skills, they didn't attend classes at higher rates, spend more time on schoolwork,

or improve their math and language skills. Similarly, the promise of free online education through MOOCs (massive online open courses) has been held up as a tool for social advancement. But for all antipoverty programs and social work, there are never any silver bullets.

Health-care technologies, especially imaging technologies, may be particularly tempting solutions to medical dilemmas because they promise to let us see previously hidden parts of the human body. We feel as though we've finally discovered a window into how things work, regardless of how blurry the picture is. But (despite the car warning lights analogy I borrowed earlier) the body and mind are not machines that we can simply hook up to a computer to determine what's wrong. Neither strictly follows the simple cause-and-effect rules of car parts.

The machine analogy has also led to serious problems in another field harnessing new technologies. *Neurolaw* applies brain imaging to criminal law. Neuroimaging evidence showing brain abnormalities has helped spare murderers from the death penalty. Evidence from neuroscience, according to a database created by Nita Farahany, of Duke University School of Law, was considered in at least 1,600 cases between 2004 and 2012. One San Diego defense attorney even boasted of introducing a PET scan as evidence of his client's moral innocence: "This nice color image we could enlarge. . . . It documented that this guy had a rotten spot in his brain. The jury glommed onto that."

Without question, scientists are learning a great deal using brain scans. We've covered some of their breakthroughs in this book. But images of the brain, like those of the rest of the body, do not always imply one-to-one causal relationships. Like lung nodules, brain abnormalities don't mean that anything is necessarily wrong. In a history of *neurolaw*, the University of Maryland's Amanda Pustilnik

compared neurolaw to phrenology, Cesare Lombroso's biological criminology, and psychosurgery. Each theory or practice, Pustilnik wrote, "started out with a pre-commitment to the idea of brain localization of violence." But the causes of violence, like the causes of poor health, do not usually begin in the body. They pass through it, and the marks they leave are often subtle and vague.

James Fallon, a neuroscientist at the University of California at Irvine, has studied the brain scans of psychopathic murderers. He is skeptical of applying brain scans to criminal cases. "Neuroimaging isn't ready for prime time," he told me. "There are simply too many nuances in interpreting the scans." In an odd twist of fate, Fallon once subjected himself to a PET scan because his lab needed images of normal brains to contrast with abnormal ones. To his surprise, his prefrontal lobe scan looked the same as those of the psychopathic killers he'd long studied. The irony wasn't lost on him. That Fallon never hurt anyone isn't the core of the problem; it's that one nonviolent person's scan looked no different from a violent person's.

No one can blame doctors, scientists, or policymakers for their enthusiasm and excitement over new technological tools. But our new ways of seeing aren't necessarily clearer ways of seeing, and sometimes, the illusion of knowing is more dangerous than not knowing at all.

IN APRIL 2013, Trisha Torrey found another mysterious golf-ball-size lump. This one was low on her back hip, below the skin. It was round and hard as a stone, but this time the growth was painful, perhaps because of its proximity to more sensitive nerves and muscles. For a short period, for the first time in years, her PTSD symptoms reappeared, and panic set in. Then she reminded herself how much

she'd changed since the first time around. If it wasn't cancer the last time, why should it be this time?

Torrey now had a different primary care doctor, Dr. Jennie Brown (actually her real name). Although a CT scan indicated that the lump probably wasn't cancerous, Brown said that small tumors can sometimes grow on the colon. She wanted to send Torrey to a general surgeon just in case.

But Torrey didn't remain passive: "I just said, 'I would rather not. Let's just see what happens if we don't do anything.'" Besides, Torrey added, "If I see a surgeon, he's just going to tell me I need surgery, right?" Brown laughed. "I can't argue with you there." Through all her experiences, Torrey has never, remarkably, received a correct diagnosis of the lumps. "No one knows," she told me. "Nobody can put a name to it." Yet she knew enough to suspect that the lump probably wasn't harmful and that it might simply go away. So instead of surgery, Torrey asked Brown whether there were any other feasible alternatives they might try out first. Brown prescribed a three-week course of antibiotics, and they waited to see what happened to the lump.

It was gone by the end of those three weeks.