On Washing Hands

One ordinary December day, I took a tour of my hospital with Deborah Yokoe, an infectious disease specialist, and Susan Marino, a microbiologist. They work in our hospital's infection-control unit. Their full-time job, and that of three others in the unit, is to stop the spread of infection in the hospital. This is not flashy work, and they are not flashy people. Yokoe is forty-five years old, gentle voiced, and dimpled. She wears sneakers at work. Marino is in her fifties and reserved by nature. But they have coped with influenza epidemics, Legionnaires' disease, fatal bacterial meningitis, and, just a few months before, a case that, according to the patient's brain-biopsy results, might have been Creutzfeld-Jakob disease—a nightmare, not only because it is incurable

and fatal but also because the infectious agent that causes it, known as a prion, cannot be killed by usual heat-sterilization procedures. By the time the results came back, the neurosurgeon's brain-biopsy instruments might have transferred the disease to other patients, but infection-control team members tracked the instruments down in time and had them chemically sterilized. Yokoe and Marino have seen measles, the plague, and rabbit fever (which is caused by a bacterium that is extraordinarily contagious in hospital laboratories and feared as a bioterrorist weapon). They once instigated a nationwide recall of frozen strawberries, having traced a hepatitis A outbreak to a batch served at an ice cream social. Recently at large in the hospital, they told me, have been a rotavirus, a Norwalk virus, several strains of *Pseudomonas* bacteria, a superresistant *Klebsiella*, and the ubiquitous scourges of modern hospitals—resistant *Staphylococcus aureus* and *Enterococcus faecalis*, which are a frequent cause of pneumonias, wound infections, and bloodstream infections.

Each year, according to the U.S. Centers for Disease Control, two million Americans acquire an infection while they are in the hospital. Ninety thousand die of that infection. The hardest part of the infection-control team's job, Yokoe says, is not coping with the variety of contagions they encounter or the panic that sometimes occurs among patients and staff. Instead, their greatest difficulty is getting clinicians like me to do the one thing that consistently halts the spread of infections: wash our hands.

There isn't much they haven't tried. Walking about the surgical floors where I admit my patients, Yokoe and Marino showed me the admonishing signs they have posted, the sinks

they have repositioned, the new ones they have installed. They have made some sinks automated. They have bought special five-thousand-dollar "precaution carts" that store everything for washing up, gloving, and gowning in one ergonomic, portable, and aesthetically pleasing package. They have given away free movie tickets to the hospital units with the best compliance. They have issued hygiene report cards. Yet still, we have not mended our ways. Our hospital's statistics show what studies everywhere else have shown—that we doctors and nurses wash our hands one-third to one-half as often as we are supposed to. Having shaken hands with a sniffling patient, pulled a sticky dressing off someone's wound, pressed a stethoscope against a sweating chest, most of us do little more than wipe our hands on our white coats and move on—to see the next patient, to scribble a note in the chart, to grab some lunch.

This is, embarassingly, nothing new. In 1847, at the age of twenty-eight, the Viennese obstetrician Ignac Semmelweis famously deduced that, by not washing their hands consistently or well enough, doctors were themselves to blame for childbed fever. Childbed fever, also known as puerperal fever, was the leading cause of maternal death in childbirth in the era before antibiotics (and before the recognition that germs are the agents of infectious disease). It is a bacterial infection—most commonly caused by *Streptococcus*, the same bacteria that causes strep throat—that ascends through the vagina to the uterus after childbirth. Out of three thousand mothers who delivered babies at the hospital where Semmelweis worked, six hundred or more died of the disease each year—a horrifying 20 percent maternal death rate. Of mothers delivering at

home, only 1 percent died. Semmelweis concluded that doctors themselves were carrying the disease between patients, and he mandated that every doctor and nurse on his ward scrub with a nail brush and chlorine between patients. The puerperal death rate immediately fell to 1 percent—incontrovertible proof, it would seem, that he was right. Yet elsewhere, doctors' practices did not change. Some colleagues were even offended by his claims; it was impossible to them that doctors could be killing their patients. Far from being hailed, Semmelweis was ultimately dismissed from his job.

Semmelweis's story has come down to us as Exhibit A in the case for the obstinacy and blindness of physicians. But the story was more complicated. The trouble was partly that nineteenth-century physicians faced multiple, seemingly equally powerful explanations for puerperal fever. There was, for example, a strong belief that miasmas of the air in hospitals were the cause. And Semmelweis strangely refused to either publish an explanation of the logic behind his theory or prove it with a convincing experiment in animals. Instead, he took the calls for proof as a personal insult and attacked his detractors viciously.

"You, Herr Professor, have been a partner in this massacre," he wrote to one University of Vienna obstetrician who questioned his theory. To a colleague in Wurzburg he wrote, "Should you, Herr Hofrath, without having disproved my doctrine, continue to teach your pupils [against it], I declare before God and the world that you are a murderer and the 'History of Childbed Fever' would not be unjust to you if it memorialized you as a medical Nero." His own staff turned against him. In Pest, where he relocated after losing his post in

Vienna, he would stand next to the sink and berate anyone who forgot to scrub his or her hands. People began to purposely evade, sometimes even sabotage, his hand-washing regimen. Semmelweis was a genius, but he was also a lunatic, and that made him a failed genius. It was another twenty years before Joseph Lister offered his clearer, more persuasive, and more respectful plea for antisepsis in surgery in the British medical journal *Lancet*.

One hundred and forty years of doctors' plagues later, however, you have to wonder whether what's needed to stop them is precisely a lunatic. Consider what Yokoe and Marino are up against. No part of human skin is spared from bacteria. Bacterial counts on the hands range from five thousand to five million colony-forming units per square centimeter. The hair, underarms, and groin harbor greater concentrations. On the hands, deep skin crevices trap 10 to 20 percent of the flora, making removal difficult, even with scrubbing, and sterilization impossible. The worst place is under the fingernails. Hence the recent CDC guidelines requiring hospital personnel to keep their nails trimmed to less than a quarter of an inch and to remove artificial nails.

Plain soaps do, at best, a middling job of disinfecting. Their detergents remove loose dirt and grime, but fifteen seconds of washing reduces bacterial counts by only about an order of magnitude. Semmelweis recognized that ordinary soap was not enough and used a chlorine solution to achieve disinfection. Today's antibacterial soaps contain chemicals such as chlorhexidine to disrupt microbial membranes and proteins. Even with the right soap, however, proper hand washing requires a strict procedure. First, you must remove your watch,

rings, and other jewelry (which are notorious for trapping bacteria). Next, you wet your hands in warm tap water. Dispense the soap and lather all surfaces, including the lower one-third of the arms, for the full duration recommended by the manufacturer (usually fifteen to thirty seconds). Rinse off for thirty full seconds. Dry completely with a clean, disposable towel. Then use the towel to turn the tap off. Repeat after any new contact with a patient.

Almost no one adheres to this procedure. It seems impossible. On morning rounds, our residents check in on twenty patients in an hour. The nurses in our intensive care units typically have a similar number of contacts with patients requiring hand washing in between. Even if you get the whole cleansing process down to a minute per patient, that's still a third of staff time spent just washing hands. Such frequent hand washing can also irritate the skin, which can produce a dermatitis, which itself increases bacterial counts.

Less irritating than soap, alcohol rinses and gels have been in use in Europe for almost two decades but for some reason only recently caught on in the United States. They take far less time to use—only about fifteen seconds or so to rub a gel over the hands and fingers and let it air-dry. Dispensers can be put at the bedside more easily than a sink. And at alcohol concentrations of 50 to 95 percent, they are more effective at killing organisms, too. (Interestingly, pure alcohol is not as effective—at least some water is required to denature microbial proteins.)

Still, it took Yokoe over a year to get our staff to accept the 60 percent alcohol gel we have recently adopted. Its introduction was first blocked because of the staff's fears that it

would produce noxious building air. (It didn't.) Next came worries that, despite evidence to the contrary, it would be more irritating to the skin. So a product with aloe was brought in. People complained about the smell. So the aloe was taken out. Then some of the nursing staff refused to use the gel after rumors spread that it would reduce fertility. The rumors died only after the infection-control unit circulated evidence that the alcohol is not systemically absorbed and a hospital fertility specialist endorsed the use of the gel.

With the gel finally in wide use, the compliance rates for proper hand hygiene improved substantially: from around 40 percent to 70 percent. But—and this is the troubling finding—hospital infection rates did not drop one iota. Our 70 percent compliance just wasn't good enough. If 30 percent of the time people didn't wash their hands, that still left plenty of opportunity to keep transmitting infections. Indeed, the rates of resistant *Staphylococcus* and *Enterococcus* infections continued to rise. Yokoe receives the daily tabulations. I checked with her one day not long ago, and sixty-three of our seven hundred hospital patients were colonized or infected with MRSA (the shorthand for methicillin-resistant *Staphylococcus aureus*) and another twenty-two had acquired VRE (vancomycin-resistant *Enterococcus*)—unfortunately, typical rates of infection for American hospitals.

Rising infection rates from superresistant bacteria have become the norm around the world. The first outbreak of VRE did not occur until 1988, when a renal dialysis unit in England became infested. By 1990, the bacteria had been carried abroad, and four in one thousand American ICU patients had become infected. By 1997, a stunning 23 percent of ICU pa-

tients were infected. When the virus for SARS—severe acute respiratory syndrome—appeared in China in 2003 and spread within weeks to almost ten thousand people in two dozen countries across the world (10 percent of whom were killed), the primary vector for transmission was the hands of health care workers. What will happen if (or rather, when) an even more dangerous organism appears—avian flu, say, or a new, more virulent bacteria? "It will be a disaster," Yokoe says.

Anything short of a Semmelweis-like obsession with hand washing has begun to seem inadequate. Yokoe, Marino, and their colleagues have now resorted to doing random spot checks on the floors. On a surgical intensive care unit, they showed me what they do. They walk in unannounced. They go directly into patients' rooms. They check for unattended spills, toilets that have not been cleaned, faucets that drip, empty gel dispensers, overflowing needle boxes, inadequate supplies of gloves and gowns. They check whether the nurses are wearing gloves when they handle patients' wound dressings and catheters, which are ready portals for infection. And of course, they watch to see whether everyone is washing up before patient contact. Neither hesitates to confront people, though they try to be gentle about it. ("Did you forget to gel your hands?" is a favored line.) Staff members have come to recognize them. I watched a gloved and gowned nurse come out of a patient's room, pick up the patient's chart (which is not supposed to be touched by dirty hands), see Marino, and immediately stop short. "I didn't touch anything in the room! I'm clean!" she blurted out.

Yokoe and Marino hate this aspect of the job. They don't want to be infection cops. It's no fun, and it's not necessarily

effective, either. With twelve patient floors and four different patient pods per floor, they can't stand watch the way Semmelweis did, scowling over the lone sink on his unit. And they risk having the staff revolt as his staff did against him. But what other options remain? I flipped through back issues of the *Journal of Hospital Infection* and *Infection Control and Hospital Epidemiology*, two leading journals in the field, and the articles are a sad litany of failed experiments to change our contaminating ways. The great hoped-for solution has been a soap or a hand rinse that would keep skin disinfected for hours and make it easy for all of us to be good. But none has been found. The situation has prompted one expert to propose—only half jokingly—that the best approach may be to give up on hand washing and get people to stop touching patients altogether.

We always hope for the easy fix: the one simple change that will erase a problem in a stroke. But few things in life work this way. Instead, success requires making a hundred small steps go right—one after the other, no slipups, no goofs, everyone pitching in. We are used to thinking of doctoring as a solitary, intellectual task. But making medicine go right is less often like making a difficult diagnosis than like making sure everyone washes their hands.

It is striking to consider how different the history of the operating room after Lister has been from that of the hospital floor after Semmelweis. In the operating room, no one pretends that even 90 percent compliance with scrubbing is good enough. If a single doctor or nurse fails to wash up before coming to the operating table, we are horrified—and certainly not shocked if the patient develops an infection a few days later. Since Lister we have gone even further in our expectations.

We now make sure to use sterile gloves and gowns, masks over our mouths, caps over our hair. We apply antiseptics to the patient's skin and lay down sterile drapes. We put our instruments through steam heat sterilizers or, if any are too delicate to tolerate the autoclave, through chemical sterilizers. We have reinvented almost every detail of the operating room for the sake of antisepsis. We have gone so far as to add an extra person to the team, known as the circulating nurse, whose central job is, essentially, to keep the team antiseptic. Every time an unanticipated instrument is needed for a patient, the team can't stand around waiting for one member to break scrub, pull the thing off a shelf, wash up, and return. So the circulator was invented. Circulators get the extra sponges and instruments, handle the telephone calls, do the paperwork, get help when it's needed. And every time they do, they're not just making the case go more smoothly. They are keeping the patient uninfected. By their very existence, they make sterility a priority in every case.

Stopping the epidemics spreading in our hospitals is not a problem of ignorance—of not having the know-how about what to do. It is a problem of compliance—a failure of an individual to apply that know-how correctly. But achieving compliance is hard. Why, after 140 years, the meticulousness of the operating room has not spread beyond its double doors is a mystery. But the people who are most careful in the surgical theater are frequently the very ones who are least careful on the hospital ward. I know because I have realized I am one of them. I generally try to be as scrupulous about washing my hands when I am outside the operating room as I am inside. And I do pretty well, if I say so myself. But then I blow it. It

happens almost every day. I walk into a patient's hospital room, and I'm thinking about what I have to tell him concerning his operation, or about his family, who might be standing there looking worried, or about the funny little joke a resident just told me, and I completely forget about getting a squirt of that gel into my palms, no matter how many laminated reminder signs have been hung on the walls. Sometimes I do remember, but before I can find the dispenser, the patient puts his hand out in greeting and I think it too strange not to go ahead and take it. On occasion I even think, Screw it—I'm late, I have to get a move on, and what difference does it really make what I do this one time?

A few years ago, Paul O'Neill, the former secretary of the Treasury and CEO of the aluminum giant Alcoa, agreed to take over as head of a regional health care initiative in Pittsburgh, Pennsylvania. And he made solving the problem of hospital infections one of his top priorities. To show it could be solved, he arranged for a young industrial engineer named Peter Perreiah to be put on a single forty-bed surgical unit at a Pittsburgh veterans hospital. When he met with the unit's staff, a doctor who worked on the project told me, "Peter didn't ask, 'Why don't you wash your hands?' He asked, 'Why can't you?' " By far the most common answer was time. So, as an engineer, he went about fixing the things that burned up the staff's time. He came up with a just-in-time supply system that kept not only gowns and gloves at the bedside but also gauze and tape and other things the staff needed, so they didn't have to go back and forth out of the room to search for them. Rather than make everyone clean their stethoscopes, notorious carriers of infection, between patients, he arranged

for each patient room to have a designated stethoscope on the wall. He helped make dozens of simplifying changes that reduced both the opportunities for spread of infection and the difficulties of staying clean. He made each hospital room work more like an operating room, in other words. He also arranged for a nasal culture to be taken from every patient upon admission, whether the patient seemed infected or not. That way the staff knew which patients carried resistant bacteria and could preemptively use more stringent precautions for them—"search-and-destroy" the strategy is sometimes called. Infection rates for MRSA—the hospital contagion responsible for more deaths than any other—fell almost 90 percent, from four to six infections per month to about that many in an entire year.

Two years later, however, despite encouragement and exhortation, the ideas had spread to only one other unit in the hospital. Those other units didn't have Perreiah. And when he left the original unit for a different project elsewhere, performance on that unit began to slide, too. O'Neill quit as head of the health care initiative in frustration with its lack of progress. Nothing fundamental had changed.

The belief that something could change did not die, however. Jon Lloyd, a surgeon who had helped Perreiah on the project, continued to puzzle over what to do, and he happened across an article about a Save the Children program to reduce malnutrition in Vietnam. The story seemed to Lloyd to have a lesson for Pittsburgh. The antistarvation program, run by Tufts University nutritionist Jerry Sternin and his wife, Monique, had given up on bringing outside solutions to villages with malnourished children. Over and over, that strategy had failed. Although the know-how to reduce malnutrition

was long established—methods to raise more nourishing foods and more effectively feed hungry children—most people proved reluctant to change such fundamental matters as what they fed their children and when just because outsiders said so. The Sternins therefore focused on finding solutions from insiders. They asked small groups of poor villagers to identify who among them had the best-nourished children—who among them had demonstrated what the Sternins termed a "positive deviance" from the norm. The villagers then visited those mothers at home to see exactly what they were doing.

Just that was revolutionary. The villagers discovered that there were well-nourished children among them, despite the poverty, and that those children's mothers were breaking with the locally accepted wisdom in all sorts of ways—feeding their children even when they had diarrhea, for example; giving them several small feedings each day rather than one or two big ones; adding sweet potato greens to the children's rice despite its being considered a low-class food. And the ideas began to spread. They took hold. The program measured the results and posted them in the villages for all to see. In two years, malnutrition dropped 65 to 85 percent in every village the Sternins had been to.

Lloyd was bitten by the positive deviance idea—the idea of building on capabilities people already had rather than telling them how they had to change. By March 2005, he and Perreiah persuaded the veterans hospital leadership in Pittsburgh to try the positive deviance approach with hospital infections. Lloyd even convinced the Sternins to join in. Together they held a series of thirty-minute, small group discussions with health care workers at every level: food service

workers, janitors, nurses, doctors, patients themselves. The team began each meeting saying, in essence, "We're here because of the hospital infection problem and we want to know what *you* know about how to solve it." There were no directives, no charts with what the experts thought should be done. "If we had any dogma going in," Jerry Sternin says, "it was: Thou shalt not try to fix anything."

Ideas came pouring out. People told of places where hand-gel dispensers were missing, ways to keep gowns and gloves from running out of supply, nurses who always seemed able to wash their hands and even taught patients to wash their hands, too. Many people said it was the first time anyone had ever asked them what to do. The norms began to shift. When forty new hand-gel dispensers arrived, staff members took charge of putting them up in the right places. Nurses who would never speak up when a doctor failed to wash his or her hands began to do so after learning of other nurses who did. Eight therapists who thought wearing gloves with patients was silly were persuaded by two of their colleagues that it was no big deal. The ideas were not terribly new. "After the eighth group, we began to hear the same things over and over," Sternin says. "But we kept going even if it was group number thirty-three for us, because it was the first time those people had been heard, the first time they had a chance to innovate for themselves."

The team made sure to publicize the ideas and the small victories on the hospital Web site and in newsletters. The team also carried out detailed surveillance—taking nasal cultures from every hospital patient upon admission and upon discharge. They posted the monthly results unit by unit. One

year into the experiment—and after years without widespread progress—the entire hospital saw its MRSA wound infection rates drop to zero.

The Robert Wood Johnson Foundation and the Jewish Healthcare Foundation recently launched a multimillion-dollar initiative to implement this approach in ten more hospitals across the country. Lloyd cautions that it remains to be seen whether the Pittsburgh results will last. It also remains to be seen if the success can be duplicated nationally. But nothing else has worked, and this is the most fascinating idea anyone has had to solve the problem in a century.

At one point during my tour with Yokoe and Marino, we walked through a regular hospital unit. And I finally began to see the ward the way they do. Flowing in and out of the patients' rooms were physical therapists, patient care assistants, nurses, nutritionists, residents, students. Some were good about washing. Some were not. Yokoe pointed out that three of the eight rooms had bright yellow precaution signs because of patients inside with MRSA or VRE. Only then did I realize we were on the floor of one of my own patients. One of those signs hung on his door.

He was sixty-two years old and had been in the hospital for almost three weeks. He had arrived in shock from another hospital, where an operation had gone awry. I performed an emergency splenectomy for him and then had to go back in again when the bleeding still didn't stop. He had an open abdominal wound and could not eat. He had to receive his nutrition intravenously. He was recovering, though.

Three days after admission, he was out of the intensive care unit. Initial surveillance cultures were completely negative for resistant organisms. New cultures ten days after admission, however, came back positive for both MRSA and VRE. A few days after that, he developed fevers up to 102 degrees. His blood pressure began dropping. His heart rate climbed. He was septic. His central line—his lifeline for nutrition—had become infected, and we had to take it out.

Until that moment, when I stood there looking at the sign on his door, it had not occurred to me that I might have given him that infection. But the truth is I may have. One of us certainly did.