4. A Crisis in the ER

On West Harrison Street in Chicago, two miles west of the city's downtown, there is an ornate, block-long building designed and built in the early part of the last century. For the better part of one hundred years, this was the home of Cook County Hospital. It was here that the world's first blood bank opened, where cobalt-beam therapy was pioneered, where surgeons once reattached four severed fingers, and where the trauma center was so famous — and so busy treating the gunshot wounds and injuries of the surrounding gangs — that it inspired the television series ER. In the late 1900's, however, Cook County Hospital started a project that may one day earn the hospital as much acclaim as any of those earlier accomplishments. Cook County changed the way its physicians diagnose patients coming to the ER complaining of chest pain.

Cook County's big experiment began in 1996, a year after a remarkable man named Brendan Reilly came to Chicago to become chairman of the hospital's Department of Medicine. The institution that Reilly inherited was a mess. As the city's principal public hospital, Cook County was the place of last resort for the hundreds of thousands of Chicagoans without health insurance. Resources were stretched to the limit. The hospital's cavernous wards were built for another century. There were no private rooms, and patients were separated by flimsy plywood dividers. There was no cafeteria or private telephone — just a pay-phone for everyone at the end of the hall. In one possibly apocryphal story, doctors once trained a homeless man to do routine lab tests because there was no one else available.

"In the old days," says one physician at the hospital, "if you wanted to examine a patient in the middle of the night, there was only one light switch, so if you turned on the light, the whole ward lit up. It wasn't until the mid-seventies that they got individual bed lights. Because it wasn't air-conditioned, they had these big fans, and you can imagine the racket they made. There would be all kinds of police around because Cook County was where they brought patients from the jails, so you'd see prisoners shackled to the beds. The patients would bring in TVs and radios, and they would be blaring, and people would sit out in the hallways like they were sitting on a porch on a summer evening. There was only one bathroom for these hallways filled with patients, so people would be walking up and down, dragging their IVs. Then there were the nurses' bells that you buzzed to get a nurse. But of course there weren't enough nurses, so the bells would constantly be going, ringing and ringing. Try listening to someone's heart or lungs in that setting. It was a crazy place."

Reilly had begun his medical career at the medical center at Dartmouth College, a beautiful, prosperous state-of-the-art hospital nestled in the breezy, rolling hills of New Hampshire. West Harrison Street was another world. "The first summer I was here was the summer of ninety-five, when Chicago had a heat wave that killed hundreds of People, and of course the hospital wasn't air-conditioned," Reilly remembers. "The heat index inside the hospital was a hundred and twenty. We had patients — sick patients — trying to live in that environment. One of the first things I did was grab one of the administrators and just walk her down the hall and have her stand in the middle of one of the wards. She lasted about eight seconds."

The list of problems Reilly faced was endless. But the Emergency Department (the ED) seemed to cry out for special attention. Because so few Cook County patients had health insurance, most of them entered the hospital through the Emergency Department, and the smart patients would come first thing in the morning and pack a lunch and a dinner. There were long lines down the hall. The rooms were jammed. A staggering 250,000 patients came through the ED every year.

"A lot of times," says Reilly, "I'd have trouble even walking through the ED. It was one gurney on top of another. There was constant pressure about how to take care of these folks. The sick ones had to be admitted to the hospital, and that's when it got interesting. It's a system with constrained resources. How do you figure out who needs what? How do you figure out how to direct resources to those who need them the most?" A lot of those people were suffering from asthma, because Chicago has one of the worst asthma problems in the United States. So Reilly worked with his staff to develop specific protocols for efficiently treating asthma patients, and another set of programs for treating the homeless.

But from the beginning, the question of how to deal with heart attacks was front and center. A significant number of those people filing into the ED — on average, about thirty a day — were worried that they were having a heart attack. And those thirty used more than their share of beds and nurses and doctors and stayed around a lot longer than other patients. Chest-pain patients were resource-intensive. The treatment protocol was long and elaborate and — worst of all — maddeningly inconclusive.

A patient comes in clutching his chest. A nurse takes his blood pressure. A doctor puts a stethoscope on his chest and listens for the distinctive crinkling sound that will tell her whether the patient has fluid in his lungs — a sure sign that his heart is having trouble keeping up its pumping responsibilities. She asks him a series of questions: How long have you been experiencing chest pain? Where does it hurt? Are you in particular pain when you exercise? Have you had heart trouble before? What's your cholesterol level? Do you use drugs? Do you have diabetes (which has a powerful association with heart disease)? Then a technician comes in, pushing a small device the size of a desktop computer printer on a trolley. She places small plastic stickers with hooks on them at precise locations on the patient's arms and chest. An electrode is clipped to each sticker, which "reads" the electrical activity of his heart and prints out the pattern on a sheet of pink graph paper. This is the electrocardiogram. In theory, a healthy patient's heart will produce a distinctive — and consistent — pattern on the page that looks like the profile of a mountain range. And if the patient is having heart trouble, the pattern will be distorted. Lines that usually go up may now be moving down. Lines that once were curved may now be flat or elongated or spiked, and if the patient is in the throes of a heart attack, the ECG readout is supposed to form two very particular and recognizable patterns. The key words, though, are "supposed to." The ECG is far from perfect. Sometimes someone with an

ECG that looks perfectly normal can be in serious trouble, and sometimes someone with an ECG that looks terrifying can be perfectly healthy. There are ways to tell with absolute certainty whether someone is having a heart attack, but those involve tests of particular enzymes that can take hours for results. And the doctor confronted in the emergency room with a patient in agony and another hundred patients in a line down the corridor doesn't have hours. So when it comes to chest pain, doctors gather as much information as they can, and then they make an estimate.

The problem with that estimate, though, is that it isn't very accurate. One of the things Reilly did early in his campaign at Cook, for instance, was to put together twenty perfectly typical case histories of people with chest pain and give the histories to a group of doctors — cardiologists, internists, emergency room docs, and medical residents — people, in other words, who had lots of experience making estimates about chest pain. The point was to see how much agreement there was about who among the twenty cases was actually having a heart attack. What Reilly found was that there really wasn't any agreement at all. The answers were all over the map. The same patient might be sent home by one doctor and checked into intensive care by another. "We asked the doctors to estimate on a scale of zero to one hundred the probability that each patient was having an acute myocardial infarction [heart attack] and the odds that each patient would have a major life-threatening complication in the next three days," Reilly says. "In each case, the answers we got pretty much ranged from zero to one hundred. It was extraordinary."

The doctors thought they were making reasoned judgments. But in reality they were making something that looked a lot more like a guess, and guessing, of course, leads to mistakes. Somewhere between 2 and 8 percent of the time in American hospitals, a patient having a genuine heart attack gets sent home — because the doctor doing the examination thinks for some reason that the patient is healthy. More commonly, though, doctors correct for their uncertainty by erring heavily on the side of caution. As long as there is a chance that someone might be having a heart attack, why take even the smallest risk by ignoring her problem?

"Say you've got a patient who presents to ER complaining of severe chest pain," Reilly says. "He's old and he smokes and he has high blood pressure." There are lots of things to make you think, "Gee, it's his heart." But then, after evaluating the patient, you find out his ECG is normal. What do you do? Well, you probably say to yourself, This is an old guy with a lot of risk factors who's having chest pain. I'm not going to trust the ECG." In recent years, the problem has gotten worse because the medical community has done such a good job of educating people about heart attacks that patients come running to the hospital at the first sign of chest pain. At the same time, the threat of malpractice has made doctors less and less willing to take a chance on a patient, with the result that these days only about 10 percent of those admitted to a hospital on suspicion of having a heart attack actually have a heart attack.

This, then, was Reilly's problem. He wasn't back at Dartmouth or over in one of the plush private hospitals on Chicago's north side, where money wasn't an issue. He was at Cook County. He was running the Department of Medicine on a shoestring. Yet every year, the hospital found itself spending more and more time and money on people who were not actually having a heart attack. A single bed in Cook County's coronary care unit, for instance, cost roughly $2,000 a night — and a typical chest pain patient might stay for three days — yet the typical chest pain patient might have nothing, at that moment, wrong with him. Is this, the doctors at Cook County asked themselves, any way to run a hospital?

"The whole sequence began in 1996," Reilly says. "We just didn't have the number of beds we needed to deal with patients with chest pain. We were constantly fighting about which patient needs what." Cook County at that time had eight beds in its coronary care unit, and another twelve beds in what's called intermediate coronary care, which is a ward that's a little less intensive and cheaper to run (about $1,000 a night instead of $2,000) and staffed by nurses instead of cardiologists. But that wasn't enough beds. So they opened another section, called the observation unit, where they could put a patient for half a day or so under the most basic care. "We created a third, lower-level option and said, 'Let's watch this. Let's see if it helps.' But pretty soon what happened is that we started fighting about who gets into the observation unit," Reilly went on. "I'd be getting phone calls all through the night. It was obvious that there was no standardized, rational way of making this decision."

Reilly is a tall man with a runner's slender build. He was raised in New York City, the product of a classical Jesuit education: Regis for high school, where he had four years of Latin and Greek, and Fordham University for college, where he read everything from the ancients to Wittgenstein and Heidegger and thought about an academic career in philosophy before settling on medicine. Once, as an assistant professor at Dartmouth, Reilly grew frustrated with the lack of any sort of systematic textbook on the everyday problems that doctors encounter in the outpatient setting — things like dizziness, headaches, and abdominal pain. So he sat down and, in his free evenings and weekends, wrote an eight-hundred-page textbook on the subject, painstakingly reviewing the available evidence for the most common problems a general practitioner might encounter. "He's always exploring different topics, whether it's philosophy or Scottish poetry or the history of medicine," says his friend and colleague Arthur Evans, who worked with Reilly on the chest pain project. "He's usually reading five books at once, and when he took a sabbatical leave when he was at Dartmouth, he spent the time writing a novel."

No doubt Reilly could have stayed on the East Coast, writing one paper after another in air-conditioned comfort on this or that particular problem. But he was drawn to Cook County. The thing about a hospital that serves only the poorest and the neediest is that it attracts the kinds of nurses and doctors who want to serve the poorest and neediest — and Reilly was one of those. The other thing about Cook County was that because of its relative poverty, it was a place where it was possible to try something radical —and what better place to go for someone interested in change?

Reilly's first act was to turn to the work of a cardiologist named Lee Goldman. In the 1970s, Goldman got involved with a group of mathematicians who were very interested in developing statistical rules for telling apart things like subatomic particles.

Goldman wasn't much interested in physics, but it struck him that some of the same mathematical principles the group was using might be helpful in deciding whether someone was suffering a heart attack. So he fed hundreds of cases into a computer, looking at what kinds of things actually attack, and came up with an algorithm — an equation —that he believed would take much of the guesswork out of treating chest pain. Doctors, he concluded, ought to combine the evidence of the ECG with three of what he called urgent risk factors: (1) Is the pain felt by the patient unstable angina? (2) Is there fluid in the patient's lungs? and (3) Is the patient's systolic blood pressure below 100?

For each combination of risk factors, Goldman drew up a decision tree that recommended a treatment option. For example, a patient with a normal ECG who was positive on all three urgent risk factors would go to the intermediate unit; a patient whose ECG showed acute ischemia (that is, the heart muscle wasn't getting enough blood) but who had either one or no risk factors would be considered low-risk and go to the short-stay unit; someone with an ECG positive for ischemia and two or three risk factors would be sent directly to the cardiac care unit — and so on.

Goldman worked on his decision tree for years, steadily refining and perfecting it. But at the end of his scientific articles, there was always a plaintive sentence about how much more hands-on, real-world research needed to be done before the decision tree could be used in clinical practice. As the years passed, however, no one volunteered to do that research — not even at Harvard Medical School, where Goldman began his work, or at the equally prestigious University of California at San Francisco, where he completed it. For all the rigor of his calculations, it seemed that no one wanted to believe what he was saying, that an equation could perform better than a trained physician.

Ironically, a big chunk of the funding for Goldman's initial research had come not from the medical community itself but from the navy. Here was a man trying to come up with a way to save lives and improve the quality of care in every hospital in the country and save billions of dollars in health care costs, and the only group that got excited was the Pentagon. Why? For the most arcane of reasons: If you are in a submarine at the bottom of the ocean, quietly snooping in enemy waters, and one of your sailors starts suffering from chest pain, you really want to know whether you need to surface (and give away your position) in order to rush him to a hospital or whether you can stay underwater and just send him to his bunk with a couple of Rolaids.

But Reilly shared none of the medical community's qualms about Goldman's findings. He was in a crisis. He took Goldman's algorithm, presented it to the doctors in the Cook County ED and the doctors in the Department of Medicine, and announced that he was holding a bake-off. For the first few months, the staff would use their own judgment in evaluating chest pain, the way they always had. Then they would use Goldman's algorithm, and the diagnosis and outcome of every patient treated under the two systems would be compared. For two years, data were collected, and in the end, the result wasn't even close. Goldman's rule won hands down in two directions: it was a whopping 7o percent better than the old method at recognizing the patients who weren't actually having a heart attack. At the same time, it was safer. The whole point of chest pain prediction is to make sure that patients who end up having major complications are assigned right away to the coronary and intermediate units. Left to their own devices, the doctors guessed right on the most serious patients somewhere between 75 and 89 percent of the time. The algorithm guessed right more than 95 percent of the time. For Reilly, that was all the evidence he needed. He went to the ED and changed the rules. In 2001, Cook County Hospital became one of the first medical institutions in the country to devote itself full-time to the Goldman algorithm for chest pain, and if you walk into the Cook County ER, you'll see a copy of the heart attack decision tree posted on the wall.

5. When Less Is More

Why is the Cook County experiment so important? Because we take it, as a given, that the more information decision makers have, the better off they are. If the specialist we are seeing says she needs to do more tests or examine us in more detail, few of us think that's a bad idea. But what does the Goldman algorithm say? Quite the opposite: that all that extra information isn't actually an advantage at all; that, in fact, you need to know very little to find the underlying signature of a complex phenomenon. All you need is the evidence of the ECG, blood pressure, fluid in the lungs, and unstable angina.

That's a radical statement. Take, for instance, the hypothetical case of a man who comes into the ER complaining of intermittent left-side chest pain that occasionally comes when he walks up the stairs and that lasts from five minutes to three hours. His chest exam, heart exam, and ECG are normal, and his systolic blood pressure is 165, meaning it doesn't qualify as an urgent factor. But he's in his sixties. He's a hard-charging executive. He's under constant pressure. He smokes. He doesn't exercise. He's had high blood pressure for years. He's overweight. He had heart surgery two years ago. He's sweating. It certainly seems like he ought to be admitted to the coronary care unit right away. But the algorithm says he shouldn't be. All those extra factors certainly matter in the long term. The patient's condition and diet and lifestyle put him at serious risk of developing heart disease over the next few years. It may even be that those factors play a very subtle and complex role in increasing the odds of something happening to him in the next seventy-two hours. What Goldman's algorithm indicates, though, is that the role of those other factors is so small in determining what is happening to the man right now that an accurate diagnosis can be made without them. In fact, that extra information is more than useless. It's harmful. It confuses the issues. What screws up doctors when they are trying to predict heart attacks is that they take too much information into account.

The problem of too much information also comes up in studies of why doctors sometimes make the mistake of missing a heart attack entirely — of failing to recognize when someone is on the brink of or in the midst of a major cardiac complication. Physicians, it turns out, are more likely to make this kind of mistake with women and minorities. Why is that? Gender and race are not irrelevant considerations when it comes to heart problems; blacks have a different overall risk profile than whites, and women tend to have heart attacks much later in life than men. The problem arises when the additional information of

gender and race is factored into a decision about an individual patient. It serves only to overwhelm the physician still further. Doctors would do better in these cases if they knew less about their patients — if, that is, they had no idea whether the people they were diagnosing were white or black, male or female.

It is no surprise that it has been so hard for Goldman to get his ideas accepted. It doesn't seem to make sense that we can do better by ignoring what seems like perfectly valid information. "This is what opens the decision rule to criticism," Reilly says. "This is precisely what does don't trust. They say, 'This process must be more complicated than just looking at an ECG and asking these few questions. Why doesn't this include whether the patient has diabetes? How old he is? Whether he's had a heart attack before?' These are obvious questions. They look at it and say, 'This is nonsense, this is not how you make decisions.'" Arthur Evans says that there is a kind of automatic tendency among physicians to believe that a life-or-death decision has to be a difficult decision. "Doctors think it's mundane to follow guidelines," he says. "It's much more gratifying to come up with a decision on your own. Anyone can follow an algorithm. There is a tendency to say, "Well, certainly I can do better. It can't be this simple and efficient; otherwise, why are they paying me so much money?" The algorithm doesn't feel right.

Many years ago a researcher named Stuart Oskamp conducted a famous study in which he gathered together a group of psychologists and asked each of them to consider the case of a twenty-nine-year-old war veteran named Joseph Kidd. In the first stage of the experiment, he gave them just basic information about Kidd. Then he gave them one and a half single-spaced pages about his childhood. In the third stage, he gave each person two more pages of background on Kidd's high school and college years. Finally, he gave them a detailed account of Kidd's time in the army and his later activities. After each stage, the psychologists were asked to answer a twenty-five-item multiple-choice test about Kidd. Oskamp found that as he gave the psychologists more and more information about Kidd, their confidence in the accuracy of their diagnoses increased dramatically. But were they really getting more accurate? As it turns out, they weren't. With each new round of data, they would go back over the test and change their answers to eight or nine or ten of the questions, but their overall accuracy remained pretty constant at about 30 percent.

"As they received more information," Oskamp concluded, "their certainty about their own decisions became entirely out of proportion to the actual correctness of those decisions." This is the same thing that happens with doctors in the ER. They gather and consider far more information than is truly necessary because it makes them feel more confident — and with someone's life in the balance, they need to feel more confident. The irony, though, is that that very desire for confidence is precisely what ends up undermining the accuracy of their decision. They feed the extra information into the already overcrowded equation they are building in their heads, and they get even more muddled.

What Reilly and his team at Cook County were trying to do, in short, was provide some structure for the spontaneity of the ER. The algorithm is a rule that protects the doctors from being swamped with too much information —the same way that the rule of agreement protects improv actors when they get up onstage. The algorithm frees doctors to attend to all of the other decisions that need to be made in the heat of the moment: If the patient isn't having a heart attack, what is wrong with him? Do I need to spend more time with this patient or turn my attention to someone with a more serious problem? How should I talk to and relate to him? What does this person need from me to get better?

"One of the things Brendan tries to convey to the house staff is to be meticulous in talking to patients and listening to them and giving a very careful and thorough physical examination — skills that have been neglected by many training programs," Evans says. "He feels strongly that those activities have intrinsic value in terms of connecting you to another person. He thinks it's impossible to care for someone unless you know about their circumstances — their home, their neighborhood, their life. He thinks that there are a lot of social and psychological aspects to medicine that physicians don't pay enough attention to." Reilly believes that a doctor has to understand the patient as a person, and if you believe in the importance of empathy and respect in the doctor-patient relationship, you have to create a place for that. To do so, you have to relieve the pressure of decision making in other areas.

There are, I think, two important lessons here. The first is that truly successful decision making relies on a balance between deliberate and instinctive thinking. Cook County's doctors, function as well as they do in the day-to-day rush of the ER because Lee Goldman sat down at his computer and over the course of many months painstakingly evaluated every possible piece of information that he could. Deliberate thinking is a wonderful tool when we have the luxury of time, the help of a computer, and a clearly defined task, and the fruits of that type of analysis can set the stage for rapid cognition.

The second lesson is that in good decision making, frugality matters. John Gottman took a complex problem and reduced it to its simplest elements: even the most complicated of relationships and problems, he showed, have an identifiable underlying pattern. Lee Goldman's research proves that in picking up these sorts of patterns, less is more.

Assignment

1. Create a mind map illustrating all the challenges originally facing Cook County Hospital (not just the medical challenges).
2. Create a mind map illustrating all the factors related to the symptom "chest pains". Visually highlight what Goldman considered the essential risk factors.
3. Try to draw a decision tree or flow chart that outlines the recommended treatment options.
4. Create a glossary of definitions and acronyms used in this article and define them in terms you can easily understand.