1 understanding risk

The early warning signs of colon cancer:

You feel great.

You have a healthy appetite.

You're only 50.

For many people, this is a pretty scary message. It says that you need to worry: if you feel well, you may have colon cancer (cancer of the large intestine or rectum). The purpose of the message, which ran in the *New York Times* as part of an advertisement for the Memorial Sloan-Kettering Cancer Center, is to motivate people to go in for colon cancer screening. But some key information is missing from this message. For starters, it doesn't tell you how likely colon cancer is. If your chance of getting colon cancer is large, there is more reason to worry than if your chance is small. This information might help you decide whether to try to lower your risk.

QUIZ

Do all 50-year-old people who feel great and have healthy appetites really have colon cancer?

a. Yes
b. No

The correct answer is no, of course not. The vast majority do not have colon cancer. Do you know how common colon cancer is? It turns out that most people—including many doctors—don't have a good understanding of how common different diseases really are. Messages like the Sloan-Kettering ad are good at catching people's attention. Unfortunately, they can leave you with either an exaggerated sense of risk or a feeling of confusion. In the next few pages, we'll try to help you understand how big your risk of colon cancer really is.

One word of warning: all the numbers we'll show you are real. Most are U.S. government health statistics. The numbers may seem hard to believe because they will seem to change a lot as you go through the chapter. But that's part of our point: we'll be saying the same thing in different ways. And, as you'll see, how you say things matters. Seeing different ways of expressing numbers will help you understand what the numbers mean.

Consider this message:

> "Colon cancer will strike about 150,000 Americans."

This statement illustrates a common strategy used to highlight—really, to exaggerate—risk. The message uses an attention-grabbing large number, but it lacks any information that would allow you to put the number in context. To understand what the number means, you need to know more.

To make sense of this message, you need to ask, "150,000 out of how many?"—that is, how many people could possibly get colon cancer? (Scientists refer to this group as the *population at risk*.) In the United States, the number of people who could develop colon cancer is the entire American population, about 300 million people. So we can say that colon cancer strikes 150,000 out of these 300 million (300,000,000). The number 150,000 divided by 300,000,000 is 0.0005—or 5 out of 10,000. Some people like to give these numbers as percentages; in this case, the number would be 0.05 percent. (See the Learn More box on page 13.)

Highlighting the number of cancer cases (or occurrences of any disease) without mentioning the number of people at risk is a common way to make

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Calculating Risk

Risk can be expressed as a fraction. The numerator is the number of people who actually experience the outcome, and the denominator is the number of people who could possibly experience it (sometimes called the population at risk). For example, consider the risk of getting colon cancer:

$$\text{Risk} = \frac{\text{number of people diagnosed with colon cancer (numerator)}}{\text{number of people at risk (denominator)}}$$

$$= \frac{\text{150,000 Americans diagnosed}}{\text{300,000,000 Americans}}$$

$$= 0.0005 = \frac{5}{10{,}000}$$

So, here, the risk of getting colon cancer is 0.0005.

Many people find numbers like this—with all those zeros after the decimal point—hard to understand. In this case, the number means that, on average, a person's chance of getting colon cancer is five ten-thousandths (0.0005). There are many ways to describe the 0.0005 risk of colon cancer. For example, all the different expressions shown in this table say exactly the same thing:

Format Goal	Decimal Format	Multiplication Needed		"Out of How Many?" Format
Risk per 1 person	0.0005	× 1	=	0.0005 out of 1 person
Risk per 10 people	0.0005	× 10	=	0.005 out of 10 people
Risk per 100 people	0.0005	× 100	=	0.05 out of 100 people
Risk per 1,000 people	0.0005	× 1,000	=	0.5 out of 1,000 people
Risk per 10,000 people	0.0005	× 10,000	=	5 out of 10,000 people
Risk per 100,000 people	0.0005	× 100,000	=	50 out of 100,000 people

Risk per 100 people is often expressed as a percentage. "Percent" is just a fancy way of saying "out of 100." So you can say "0.05 percent" instead of "0.05 per 100 people"; both expressions mean the same thing.

Scientists tend to favor the expression that lets them use whole numbers rather than decimals—in this case, they would say "5 out of 10,000."

risks sound big. Your attention is focused on the large number (for example, 150,000) instead of the small percentage (0.05 percent). Therefore, when you hear about the number of people with a disease, you should always ask, "Out of how many?"

QUIZ Cervical cancer will strike about 13,000 women in the United States.

What information is missing?

a. Total number of American women
b. Total number of Americans

The correct answer is a, the total number of American women. That answers the question "13,000 out of how many?" This quiz contained a trick question (sorry). It required you to know that only women can get cervical cancer. Why? Because only women have a cervix (it's the opening to the uterus, or womb). But this trick question illustrates an important point. To really understand a risk, you need to know two things: how many people experience the outcome (here, the 13,000 women whom cervical cancer strikes), and how many people could experience the outcome (here, the total number of women, which is about 150 million). So a woman's risk of cervical cancer is 13,000 divided by 150,000,000 women, which is 0.00009, or 0.009 percent.

The cervical cancer example demonstrates an important point: the population at risk (the "out of how many?" part of the risk calculation) refers only to people who could possibly experience the outcome. Since only women can get cervical cancer, it would be wrong (and would make no sense) to include men when calculating the risk. The same would be true of ovarian cancer, since men don't have ovaries. Similarly, because men have a prostate (a gland right below the bladder that helps produce semen) and women do not, only men can get prostate cancer, so women are excluded from the population at risk for prostate cancer.

But even when both sexes can experience the outcome, looking at risk separately for men and for women can be useful. When the chances of the outcome differ substantially by sex, it is of little value to calculate a single risk for the combined group. For example, both men and women can get breast cancer (both have breast tissue), but the disease is at least 100 times more common in women because women's breasts are much more hormonally active. That is why breast cancer risk is calculated separately for men and for women.

Remember, when you hear about a risk, be clear about how many people actually experience the outcome and how many people could *possibly* experience the outcome.

Here's another way you may have heard people talk about colon cancer risk:

"Colon cancer will strike 1 in 19 people."

Whoa! What happened? This statistic certainly sounds very different from 5 out of 10,000. (Don't worry—we'll explain why soon.)

Many people find statistics like 1 in 19 confusing (we call an expression like this the "1 in ___" format). Because we don't usually come across things in groups of 19, it isn't surprising that we have trouble imagining what 1 in 19 means (or 1 in 13, or 1 in 97, or any unusual group, for that matter). The other problem with numbers like 1 in 19 comes up when we try to compare two such statistics: unless the group sizes (the "in 19" parts) are exactly the same, it's really hard to make comparisons. Try the following quiz to see what we mean:

QUIZ

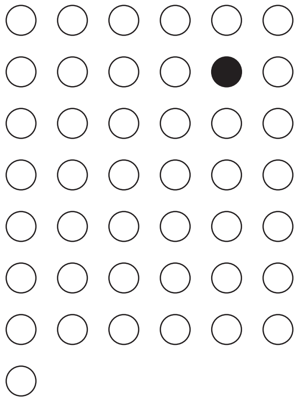
The chance of bladder cancer is 1 in 43.

Which is greater, the chance of bladder cancer (1 in 43) or the chance of colon cancer (1 in 19)?

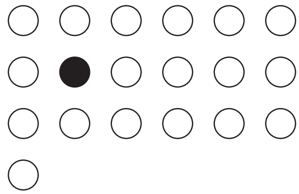
a. Bladder cancer
b. Colon cancer

The correct answer is b, colon cancer. When people compare numbers like 1 in 43 and 1 in 19, it's easy to get confused because the larger chance (in this case, the chance of colon cancer) is "out of" a smaller number. If you got the wrong answer to this quiz or felt unsure, you might find it easier to understand with pictures.

This is 1 in 43



This is 1 in 19



But this can get kind of awkward. Consider breast cancer among men. The chance is about 1 in 909. Who wants to draw that? (Don't you have something better to do?)

To make comparisons easier, it helps to use the same number of people every time. This is usually done by comparing the number of people "out of 100" or "out of 1,000." In this book, we will use "out of 1,000" (because many health risks are smaller than 1 in 100). The easiest way to get the numbers into the "out of 1,000" format is to divide them. (See the Learn More box on page 17.) Here, we have converted the numbers from the quiz:

$$\text{Bladder cancer risk} = \frac{1}{43} = 0.023 = 23 \text{ out of } 1{,}000$$

$$\text{Colon cancer risk} = \frac{1}{19} = 0.053 = 53 \text{ out of } 1{,}000$$

Now it's easy to see that colon cancer is the larger risk. (Don't worry about the changing numbers you're seeing for colon cancer risk; we'll soon explain what's going on.)

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Converting to the "___ out of 1,000" Format

Here's how to convert the "1 in ___" format to the "___ out of 1,000" format.

First divide the numbers. Consider the colon cancer example. The chance of colon cancer is 1 in 19. When you divide 1 by 19, you get 0.053 (we rounded).

$$\frac{1}{19} = 0.053$$

Since most people find numbers like 0.053 awkward, you should change this statistic to a number "out of 1,000." To do this, just multiply 0.053 by 1,000 to get 53.

$$0.053 \times 1{,}000 = 53 \text{ in } 1{,}000$$

Therefore, the chance of colon cancer is 53 in 1,000. (If you prefer, you can say 53 out of 1,000, or 53 per 1,000; the expressions mean the same thing. In fact, we'll use all these phrases.)

Clearly, how you say things matters: some ways are just easier to understand than others. That's why we included the number converter in the Extra Help section of this book (see pages 126–127). Here's an excerpt from the number converter, in which each row shows four different ways of saying the same thing. You can also use the number converter to make estimates: for example, 1 in 19 would be between 1 in 10 and 1 in 20 but much closer to 1 in 20.

1 in ___	Decimal	Percent	___ out of 1,000
1 in 10	0.10	10%	100 out of 1,000
1 in 20	0.05	5%	50 out of 1,000
1 in 25	0.04	4%	40 out of 1,000

Now let's put the two colon cancer risk messages together:

"Colon cancer will strike 53 out of 1,000 people."

"Colon cancer will strike 5 out of 10,000 people."

How can both of these statements be true? The first statistic, 53 out of 1,000, is the chance of colon cancer over a *lifetime.* The statistic means that, on average, colon cancer strikes 53 out of 1,000 people (which is the same as 530 out of 10,000) at some point between birth and death. The number we introduced early in the chapter—5 out of 10,000—is the chance of colon cancer over the course of *1 year.* As you can see, the period of time under consideration matters a lot. Your chance of cancer increases over time. The longer the time, the larger the chance.

You can think of it like the chance of catching a cold. Let's say that you're feeling fine right now. The chance that you'll catch a cold in the next few minutes is extremely small. The chance that you'll catch a cold in the next few days is also very small. But, over time, the chance increases. Most people would agree that the chance that they'll catch a cold in the next 10 years is close to certain. So the longer the time period, the bigger the risk. Unless you know the time frame (such as 1 year, 10 years, or a lifetime), it's very hard to know what a risk statistic means.

Which of these time frames is right? Many organizations, including the American Cancer Society, prefer to present lifetime cancer risks. Such lifetime risks, which are based on long time periods (the average person born nowadays in the United States will live about 78 years), often seem impressive. If a person lives to an old age, it means more time for a cancer (or any other outcome) to occur. So presenting lifetime risks tends to make the risks look big. On the other hand, it often makes risks for a single year seem pretty small.

Many people are more interested in their chance of cancer in the foreseeable future than in the more abstract time frame of an entire lifetime. For that reason, we'll usually talk about the chance over the next 10 years. The 10-year time frame is arbitrary, but it makes sense to us. It's not too long (so it's easy to imagine), and it's not too short (so the risks aren't forced to look too small). And it allows time to do things like change your lifestyle to reduce your risk. (More on that later.)

To summarize how much the time matters, here are risk statistics for all three time frames. On average, colon cancer will strike . . .

5 out of 10,000 people in 1 year
5 out of 1,000 people in 10 years
53 out of 1,000 people in a lifetime

These numbers might seem to imply that the average person lives more than 100 years (because you would have to multiply the 10-year risk by more than 10 to get the lifetime risk). But the lifetime risk is higher than you might expect because the risk of cancer (in general) increases exponentially as you get older. In the case of colon cancer, the risk is extremely low in people younger than 40 and starts going up faster and faster around age 60.

It's clear that the time frame matters—a lot! If someone tells you that colon cancer will strike 53 out of 1,000 people (or any number for that matter), you need to ask, "Over how long a time?"

Here's the revised colon cancer message, which now includes the time frame:

"Over the next 10 years, colon cancer will strike 5 out of 1,000 people."

The message is becoming clearer, but some important information is still missing. What does the word *strike* mean? Does it mean *getting* colon cancer, or does it mean *dying* from colon cancer? Of course, these are not the same. Not all people with colon cancer die from it. To make sense of this message, you need to ask, "Risk of what? The risk of getting a disease or the risk of dying from it?"

For most diseases, getting the disease is much more likely than dying from it. Although many people believe that cancer is a death sentence, fortunately that is far from the case. By comparing your chance of getting cancer to your chance of dying from that cancer, you can get a sense of how deadly the cancer really is.

QUIZ Guess the chance of dying from colon cancer in the next 10 years:

a. 103 out of 1,000
b. 53 out of 1,000
c. 5 out of 1,000
d. 2 out of 1,000

The correct answer is d, 2 out of 1,000. That is, out of 1,000 people, we estimate that 5 will get colon cancer and 2 will die of colon cancer over the next 10 years. (Note that, logically, the chance of dying from colon cancer must be lower than—or equal to—the chance of getting it, so the answer could not have been more than 5.)

QUIZ Compare the following messages about 10-year risks:

Jones's chance of dying of colon cancer is 2 out of 1,000.
Smith's chance of *not* dying of colon cancer is 998 out of 1,000.

Who is more likely to die of colon cancer in the next 10 years?

a. Jones
b. Smith
c. They have the same chance
d. Can't tell from the information given

The correct answer is c—they have the same chance. If the two statements about Jones and Smith don't sound the same to you, don't worry; most people react differently to these two sets of numbers. A 2 out of 1,000 chance of dying from colon cancer sounds scarier than a 998 out of 1,000 chance of not dying from colon cancer, even though these two statements say exactly the same thing. It's a bit like an optical illusion—a small change in perspective makes a big difference in what you see.

2 out of 1,000 die = 998 out of 1,000 live

How you are given information—being told that the glass is half-empty rather than half-full—can really affect how you feel about it (even though the amount of water is the same). Presenting the same information in different ways is called *framing.* There is no reason to think that one way of framing a risk ("2 out of 1,000 die") is more correct than another ("998 out of 1,000 do not die"). The important thing is to be aware of the influence of framing and to try and get past it—in other words, to be sure that it doesn't cloud your objectivity.

One way to do this—to decide how you really feel about a risk—is to give yourself a chance to react to both versions of a risk message. When you hear a risk presented one way (such as the chance of dying), rewrite it the other way (the chance of not dying), so that you can look at it in both frames. Fortunately, you don't need to do this all the time—it could get pretty tedious—but it's a good idea to try recasting risk messages once in a while, especially when you find yourself surprised by a message about a seemingly big risk.

For example, using the colon cancer example, you could say:

> "Over 10 years, the average person's chance of dying from colon cancer is 2 out of 1,000. Another way of saying this is that their chance of *not* dying from colon cancer is 998 out of 1,000."

This statement is pretty complete: it is clear about what outcome is under discussion, how big the risk is, and how long the time frame is. Plus it lets you see that the half-empty glass is also in fact half-full.

But there's still a problem. This complete statement may be quite useful to the average person. But what about you? Let's say you are 65 years old, and the average person is 36 years old. Do you think that your chance of getting colon cancer is the same as the average person's? It's always important to ask, "Whose risk are we talking about?" You are not necessarily the "average person."

Since everyone's risk is different, statistics about risk are most helpful when they are based on people like you. What does it mean, to be "like you"? Well, in health statistics, age and sex are generally the most important predictors of what will happen to you. So the most relevant health numbers for you are ones about people who are of your age and sex. Helping you learn how to put risk into perspective by considering age and sex and by comparing risk across various diseases is what the next chapter is all about.