Six Reasons to Eat Less Red Meat
The latest links to heart disease, cancer, & diabetes

Researchers believe they have found a new link between the consumption of red meat and heart disease,” explained the NBC News report in April. “That’s something called carnitine.”

Heart disease. Cancer. Diabetes. Stroke. All have been tied to red meat in recent years. Yet Americans still eat more red meat (beef, pork, lamb, and veal) than poultry and seafood combined.

Here’s why you might want to think twice before you toss that burger or steak on the grill.

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Six Reasons to Eat Less Red Meat

1. Live longer

In 2012, scientists at the Harvard School of Public Health published data on more than 120,000 participants in the Health Professionals Follow-Up Study and the Nurses’ Health Study. After 28 years, those who ate the most red meat (roughly two servings a day) had a 30 percent higher risk of dying than those who ate the least (about half a serving a day).1

“Eating red meat increases the risk of dying early,” says co-author Adam Bernstein, now research director at the Cleveland Clinic’s Wellness Institute. “We estimated that 8 percent of deaths in women and almost 10 percent in men could be prevented if people consumed less than half a serving per day of red meat,” adds Bernstein. “That’s remarkable.”

(In this study, a serving was three ounces of cooked steak, hamburger, pork chop, or other unprocessed meat, but only one ounce of sausage, ham, or other processed meat and half an ounce of bacon.)

It wasn’t the first time a major study had linked red meat to shorter lives. In 2009, the NIH-AARP Diet and Health Study reported results on half a million people.2 After 10 years, those who ate the most red meat (about five ounces a day) were 30 percent more likely to die than those who ate the least (about two-thirds of an ounce a day). That’s not much compared to what you get in a typical restaurant steak, sandwich, or burger (see “One Serving?”).

“You don’t have to stop eating meat entirely,” says Walter Willett, chair of the department of nutrition at the Harvard School of Public Health, who co-authored the Harvard study with Bernstein. “Eating meat only once a week can eliminate most of the risk.”

2. Protect your heart

“Many recommendations for limiting red meat intake are based on its saturated fat and cholesterol content,” says Bernstein. That’s because red meat is one of the largest sources of saturated fat in the average American’s diet.3

“We know that saturated fat can raise LDL, or bad, cholesterol levels,” adds Bernstein. “But what do we know about the whole food?”

So the researchers set out to find whether some sources of protein are linked to a higher risk of heart disease. “Lo and behold, we saw that people who eat the most red meat have a higher risk,” says Bernstein.

Bernstein, Willett, and their colleagues tracked more than 84,000 women in the Nurses’ Health Study for 26 years.4 Those who ate the most red meat (at least two servings a day) had a 29 percent higher risk of heart disease than those who ate the least (half a serving a day).

And sticking with lean meat may not eliminate that risk. “Probably a combination of half a dozen different compounds and nutrients lead to the ill-health effects of meat,” suggests Bernstein.

Among them: heme iron, nitrite, salt, and compounds that are created when meats are cooked at high temperatures. “If

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One Serving?

Panera Smoked Ham & Swiss sandwich
4 servings

Outback 14 oz. Ribeye Steak
(11 oz. cooked)
3½ servings

Five Guys Bacon Burger
2½ servings

What some studies call a “serving” of meat isn’t much (3 oz. cooked steak or burger; 1 oz. ham or sausage; ½ oz. bacon). Here’s how many of those servings you get in some restaurant foods.

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How strong is the evidence that we should eat less meat?

“We’ve seen that a high-red-meat intake is associated with coronary heart disease, stroke, diabetes, and premature death,” says Adam Bernstein of the Cleveland Clinic. “Other investigators have looked at colorectal cancer. So when you look at the whole picture, I’d say the evidence is very strong at this point.”

And that doesn’t even consider meat’s impact on the health of the planet. Here’s half a dozen reasons to eat less red meat.

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people just zero in on the fat and buy, say, lower-fat deli meats or other processed meats, that’s not the healthiest choice,” says Bernstein.

In April, Stanley Hazen and colleagues at the Cleveland Clinic published a study pointing a finger at a potential new culprit in meat: carnitine. “We believe that carnitine ingestion leads to accelerated atherosclerosis, or hardening of the arteries,” says Hazen, chair of cellular and molecular medicine at the Cleveland Clinic’s Lerner Research Institute.

But carnitine, a nutrient that ferries fuel into our cells’ furnaces—the mitochondria—may not cause damage on its own.

“Both in animals and in humans, when you ingest carnitine, microbes that live in your intestines digest the carnitine,” explains Hazen. “And as a byproduct, the microbes make something that gets converted into a compound called TMAO.”

And TMAO, which stands for trimethylamine-N-oxide, may be the true troublemaker, says Hazen. (See “TMA Uh-Oh.”)

Your everyday diet can affect how much TMAO your microbes make. Hazen and his team fed a large dose of carnitine to omnivores (who reported eating beef, pork, lamb, or other meat almost every day) and to six long-term vegans (who for at least one year had eaten no meat, fish, dairy, or eggs).

The omnivores had a rise in blood levels of TMAO, but the vegans had virtually none. When Hazen put the omnivores on a cocktail of oral antibiotics (which wipe out gut bacteria) for a week, they made no TMAO either. Three weeks after stopping the antibiotics, they once again did, confirming that gut microbes have a role in forming TMAO.

“In omnivores, who are constantly eating meat, the microbes that like to eat carnitine are more abundant, and they’re more likely to make more TMAO from carnitine,” notes Hazen.

Then there’s the mice. Those fed chow with carnitine from the time they were weaned had twice as much plaque in their aortas as mice that got no carnitine. “They had accelerated heart disease,” says Hazen.

How did researchers zero in on TMAO as a new culprit in heart disease? “We’ve long recognized that two individuals could have the same LDL—or bad—cholesterol, yet one goes on to develop heart disease and one doesn’t,” says the Cleveland Clinic’s Stanley Hazen.

That started the hunt. “First we said, ‘Let’s look at all the compounds in the blood that differ between people who have heart disease and people who don’t,’” recalls Hazen. “And we discovered that TMAO was one of the top things that tracked with risk.” But where did the TMAO come from?

When bacteria in our intestines “eat” carnitine or choline, they make TMA (trimethylamine), which gets converted to TMAO (trimethylamine-N-oxide) in the liver (see illustration). Carnitine is found largely in red meat. Egg yolks and liver have the highest levels of choline, but it’s also in meat, poultry, fish, grains, vegetables, and other foods.

“You can’t get away from choline,” says Hazen. “It’s in everything, and you don’t want to completely eliminate it from your diet. If you got absolutely none, you’d get a deficiency, just like you’d get scurvy if you didn’t get any vitamin C. So you can’t eat your way out of that problem.”

Until we know more, you can hedge your bets by cutting back on red meat and ditching supplements of carnitine, choline, or choline’s most common form, phosphatidylcholine (lecithin).

“No one’s been instructed by your physician to take carnitine, which can happen with mitochondrial disorders or with long-term dialysis, you probably don’t need it,” says Hazen. “Your body can make all the carnitine it needs even if you’re a vegan or never eat any meat.”

You don’t need choline supplements either. “Deficiencies are exceedingly rare,” says Hazen. “We just don’t see it in the United States. You have to be very malnourished.”

“There’s a potential for long-term risk from both carnitine and choline,” he adds. “And I know of no clear, hard benefit for an otherwise healthy person. Supplement companies may argue that they’re helpful because they’re nutrients. But cholesterol is a nutrient too, and we don’t take cholesterol tablets.”

And don’t bother asking your doctor to test your TMAO. “Unfortunately, the test isn’t currently available for clinical use,” says Hazen. “It should be before the end of the year.”

1 www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/Choline/Chln02.pdf.
What’s more, he could see how the animals’ arteries got clogged. The cells that deposit cholesterol in the artery walls were more active, and the animals’ livers made fewer bile acids, which shuttle cholesterol into the gut and out of the body.

“The net effect was increased depositing of cholesterol in the artery wall and decreased removal of cholesterol from the artery wall,” explains Hazen.

That’s mice. Researchers can’t feed carnitine to people for years to see if it clogs their arteries. Instead, they look at whether people with high carnitine or TMAO levels have a higher risk of heart disease.

First, Hazen and his team studied roughly 2,600 people who had gone to the Cleveland Clinic for a cardiac catheterization—a procedure that enables doctors to see if the arteries feeding the heart muscle are clogged.

“We found that increased blood carnitine levels in patients strongly predicted increased risks for cardiovascular disease and major adverse events like heart attack, stroke, and death,” says Hazen. “But that was only true in subjects who also had high TMAO levels.”

In a second study, the researchers reported on roughly 4,000 stable patients who were undergoing a heart evaluation.

Those who had higher blood levels of TMAO were about 50 percent more likely to have a heart attack, stroke, or other cardiovascular event over the next three years (once the researchers took into account risk factors like high blood pressure, smoking, and high LDL cholesterol).

“TMAO was a strong and independent predictor of future heart attack, stroke, and death,” says Hazen.

His second study showed that gut bacteria can also make TMAO out of choline, a nutrient that’s especially high in egg yolks and liver (see “TMA Uh-Oh”).

That’s not to say that TMAO’s role in heart disease is a done deal. “Our results have to be replicated by others,” says Hazen. “We need to look at other populations.”

For example, does TMAO predict heart disease in people who have no symptoms or known risk factors for heart disease? Even more important, does lowering TMAO reduce the risk of heart disease?

“There’s more that needs to be done,” says Hazen. But “these studies identify a new target involved in heart disease.”

### 3. Cut your cancer risk

“Limit consumption of processed meat and red meat,” the American Cancer Society has been advising Americans since 2002.

“To reduce your cancer risk, eat no more than 18 oz. (cooked weight) per week of red meats, like beef, pork, and lamb, and avoid processed meat such as ham, bacon, salami, hot dogs, and sausages,” said a joint 2011 report by the American Institute for Cancer Research and the World Cancer Research Fund.

N-nitroso compounds. N-nitroso compounds cause cancer in laboratory animals. They’re created by the nitrite that’s used to color and preserve processed meats like bacon, sausage, and lunch meats.

N-nitroso compounds don’t show up in the meat itself (now that companies must add sodium ascorbate or sodium erythorbate to keep N-nitroso compounds from forming in meats that have added nitrite). Instead, the N-nitroso compounds form in the gut in a reaction that’s “probably catalyzed by bacteria,” says Cross.

That might explain why processed-meat eaters have a higher risk of colorectal cancer. But what about people who eat unprocessed red meat?

“When we fed people increasing doses of unprocessed red meat, we saw levels of the N-nitroso compounds that are formed in the gut increase,” says Cross.

In contrast, “when we fed the same amount of white meat, we saw absolutely nothing,” she adds. “So the obvious question is: What’s the difference between red and white meat?”

One possibility: the iron attached to hemoglobin in blood.

“We fed people a low-red-meat diet and then supplemented that diet with blood sausage,” explains Cross. “And we saw the same increase in N-nitroso compounds as we did with a high-red-meat diet.”

In the NIH-AARP study, the risk of colorectal cancer was higher in people who ate more heme iron, which is found in all meats but predominantly in red meat.

“But we haven’t got enough studies that have looked at heme, so we don’t have enough data to say how much it or other potential mechanisms matter,” says Cross.

Meat mutagens. “Starting many years ago, scientists found that heterocyclic amines and polycyclic aromatic hydrocarbons are formed when meats are cooked to well done at high temperatures,” explains Cross. “Animal studies showed that they are both carcinogenic.”

When Cross and co-workers looked at roughly 300,000 men and women in the NIH-AARP Diet and Health Study, they found about a 20 percent higher risk of...

“AARP was a large study, but until you’ve seen the association with HCAs in multiple studies, it’s hard to make too much of it,” says Cross.

The good news is that it’s fairly easy to avoid these meat mutagens.

“Studies have shown that the levels of HCAs and PAHs are much lower in meats that are cooked at lower temperatures and are not well done,” says Cross. Marinating the meat before you cook it—and pouring off the marinade—also cuts the mutagens. (See “Good Grilling.”) That advice also applies to poultry and fish.

“The levels of HCAs are quite high in barbecued chicken,” says Cross. But studies find a lower risk of colorectal cancer in chicken eaters. “So the HCAs aren’t the be all and end all of this story.”

4. Skip a stroke

“If you want to reduce your risk of stroke, there are healthier choices than meat,” says the Cleveland Clinic’s Adam Bernstein.

That may come as no surprise, given that most strokes that strike Americans are caused by a clogged artery—rather than a ruptured artery, or hemorrhage—in the brain.

When Bernstein and Willett followed more than 125,000 people for more than 22 years, the risk of a non-hemorrhagic stroke rose by 30 percent for every one to two ounces of processed meat—and by 21 percent for every four to six ounces of unprocessed meat—eaten per day.15

And in a meta-analysis of six studies on more than 300,000 people, Swedish scientists reported that the risk of a non-hemorrhagic stroke was 12 percent higher for every serving of red meat eaten per day.15

Bernstein and Willett’s study estimated that swapping one serving a day of red meat for poultry would cut the risk of stroke by 27 percent, that trading a serving a day for fish or nuts would cut the risk by 17 percent, and that trading a serving a day for dairy would cut the risk by about 10 percent.

“Switching to poultry stood out as a way to reduce stroke risk,” says Bernstein.

What’s more, high blood pressure is the biggest risk factor for stroke. And the diet that lowered blood pressure in the DASH (Dietary Approaches to Stop Hypertension) study has only about two servings of meat a week.16 Instead, it’s loaded with nutrient-rich vegetables and fruits, with two daily servings of low-fat dairy foods.

“At the same time you’re eating the red meat, you’re not eating the healthier protein sources,” says Bernstein. So it’s not just the bad stuff in red meat—but what you’re missing when you eat red meat—that causes problems.

5. Dodge diabetes

Processed red meats have been linked to a higher risk of type 2 diabetes in several studies.17 Now some studies are also picking up a link with unprocessed red meats.

One example: Harvard researchers tracked more than 200,000 men and women for up to 28 years. The risk of type 2 diabetes increased by 32 percent for every two ounces of processed meat—and by 12 percent for every three ounces of unprocessed meat—eaten per day.18

“We’re not yet sure just how red meat raises the risk of diabetes,” says Willett. “We have some evidence that the high amounts of heme iron found in red meat may play a role.”

People with iron overload (hemochromatosis) were the first clue. “We know that the accumulation of iron due to hemochromatosis can cause diabetes by damaging the cells that secrete insulin,” says Willett.

The fats in red meat may also play a role. “Polyunsaturated fatty acids are
related to lower risk, and red meat has very low amounts,” notes Willett.

In the Harvard study, people who ate about a quarter cup of nuts a day—nuts are rich in polyunsaturated fat—had a 21 percent lower risk of diabetes than those who ate one serving of red meat.

“At a minimum, red meat will displace healthier fatty acids found in other sources of protein,” says Willett. Another possibility: the N-nitroso compounds generated by red meats may be toxic to insulin-making cells in the pancreas.

“Carnitine metabolites could also damage cells that secrete insulin,” says Willett, referring to the new findings on TMAO. “I suspect that more than one factor is involved,” he adds. “This is usually the case for the most damaging risk factors like smoking or obesity.”

### 6. Protect the Earth

How does red meat harm the environment? The core problem is that growing meat is so inefficient.

“It takes 7 to 8 pounds of feed to produce a pound of beef and 5½ to 6 pounds of feed to produce a pound of pork,” says Robert Lawrence, professor of environmental health sciences, health policy, and international health at the Johns Hopkins Bloomberg School of Public Health in Baltimore.

In fact, most of U.S. farming is devoted to growing animal feed.

“About 60 to 70 percent of soybeans and a slightly higher percentage of corn goes for animal feed rather than as feed for humans or other uses,” Lawrence notes.

The water and fossil fuels needed to grow all that grain and the sheer number of animals consumed in the United States cause considerable damage:

- **Water.** “It requires about 1,000 tons of water to produce a ton of grain,” explains Lawrence. “Worldwide, it’s estimated that 80 percent of groundwater from shallow and deep aquifers is used for agricultural purposes, and, increasingly, that purpose is irrigating crops for animal feed.” And it takes fuel to get that water.

“As we rely more and more on groundwater for irrigation in areas that aren’t getting enough natural rainfall, we need more and more energy to pump and distribute water to produce the feed.”

- **Methane.** “As ruminants, cattle digest the cellulose in feed in their rumens,” explains Lawrence. That produces methane gas that the cattle get rid of either by belching or passing wind.

And methane is a potent greenhouse gas. “It has 23 times the heat-trapping capacity of carbon dioxide,” says Lawrence.

- **Nitrous oxide.** “Molecule for molecule, nitrous oxide has about 200 times the heat-trapping capacity of carbon dioxide,” says Lawrence. “Nitrous oxide comes from the intense application of nitrous fertilizers for the soy and corn being grown for animal feed.”

- **Deforestation.** When forests are cut down to make pasture or farmland to feed animals, we lose a “carbon sink”—that is, we lose the trees that soak up and store methane gas. “But worse than that, the soil is exposed and often tilled to prepare it for seeding for pasture,” says Lawrence. “As soon as you begin to turn over soil to create pastureland, the organic material that’s trapped in the topsoil is exposed to the oxygen in the air and carbon dioxide is released.” And then comes fertilizer. “Particularly in tropical areas, the soil is lacking in nutrients, and when you start fertilizing that land, nitrous oxide is released.”

- **Solid waste.** “Big open cesspits can contain as much as three million gallons of urine and feces in a typical hog CAFO,” says Lawrence. (“CAFO” stands for concentrated animal feeding operation.)

“A lot of anaerobic digestion goes on in the waste, which leads to methane production,” he adds. And using tarps to trap the methane “has been a big disappointment.” It’s not just pigs. “The waste in big cattle feedlots can be properly composted, but it almost never is,” says Lawrence. “In a typical operation, the manure is just bulldozed into big mounds, so there’s a release of methane.”

- **Transportation.** “When animals in smaller numbers were grown on smaller farms, the feed was in the pasture or in the hay that was laid up for the winter,” says Lawrence. “Now we’ve moved animals into confinement, so we have to transport feed to them.” And that takes more fossil fuels.

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**The Bottom Line**

- **Eat as little red and processed meat as possible.**
- **Replace red meat with beans, nuts, soy-based veggie meats, poultry, or fish.**
- **Don’t take carnitine, lecithin, or choline supplements.**