WebMD

The Future of Precision Medicine

By Barbara Brody

One day, in the not too distant future, your doctor might prescribe you medication based on how quickly your body will process it, rather than relying on rough clues like your height and weight.

In the same era, you might find out you have cancer -- but not just breast cancer or prostate cancer. Instead, your diagnosis and treatment will be directly tied to a genetic mutation the tumor carries, regardless of where it's found in your body.

These kind of nuanced approaches to health care -- often called personalized, individualized, or precision medicine -- aren't as far off as you might think. Some of the necessary technology already exists. It's being refined, tested, and made more cost-effective so doctors and patients can use it on a regular basis.

In many other cases, researchers are still hard at work collecting data and developing brand-new tools designed to tailor health care to people based on their unique genes, environment, and lifestyle. That's the major focus of the "All of Us" research program, a massive effort funded by the National Institutes of Health. Scientists around the country are working to gather as much data as possible and uncover new findings that would improve the ability to treat patients as specifically as possible.

Eric Topol, MD, executive vice president of The Scripps Research Institutes and a principal investigator for All of Us, says the field of precision medicine is exploding. "There's a body of literature coming out at lightning pace. It's hard for a lot of doctors to keep up with it," he says.

While there are no exact timelines, there are a variety of precision medicine advances that should make their way to patients within the next 5-10 years. Here are a few highlights:

Better Antibiotic Choices

When you get a bacterial infection, your doctor makes an educated guess about what kind of antibiotic would best fight it. That’s fine when if you have a routine sinus infection. But with a serious illness like sepsis (a life-threatening response to an infection), it's crucial to identify the bacteria that's to blame. This process can take several days. Doctors send cultures out to a lab and wait for them to grow. In the meantime, you need to start taking medication.

"Today we use a scattershot approach when prescribing antibiotics," Topol says. Choosing the wrong drug might mean you don’t get better. It could also cause serious side effects like kidney damage. But soon doctors will be able to take a sample of blood, sequence the bacteria found in it, and determine which specific pathogen is making you sick. "This

would be a very precise approach, and we'd have results within hours or even minutes," Topol says.

Some health centers around the country are already using this technology, but Topol expects it to become widespread soon. "If we're not doing this routinely in the next 5 years, we've missed a big opportunity," he says.

Fewer Drug Side Effects

Whether you need a medication to control your cholesterol, prevent your blood from clotting too much, or keep you comfortably asleep during a surgical procedure, your doctor should factor in things like your gender, body size, and medical history. But there's a lot your doctor doesn't know, so she might have to adjust your dose or switch you to a different drug due to side effects. Precision medicine is about to take some guesswork out of the equation.

The field of pharmacogenomics -- the study of how your genes affect your response to drugs -- is about to take off, says Keith Stewart, MB, ChB, medical director of the Mayo Clinic Center for Individualized Medicine. By looking at your genes, a doctor will be able to know if the drug will work well for you, how quickly your body will metabolize it (break it down), and whether you're likely to have side effects.

"Currently, there are thousands of patients in pharmacogenomic trials," Stewart says. At least one such trial is looking at the blood thinner clopidogrel (Plavix). If it's successful, doctors will be able to figure out whether this drug is a good fit for a given patient and what the ideal dosing is before they prescribe it.

A More Specific Diagnosis

Some of this is already happening. If you’re diagnosed with breast cancer, for instance, you’ll find out if the cancer has receptors for estrogen or progesterone. You’ll also learn if you’re positive for a protein called HER2. But experts say that's just the tip of the iceberg.

On the horizon: A "pan-cancer" blood test that would identify cancer anywhere in your body. Scientists are excited about these so-called liquid biopsies, which could be used instead of expensive (and radiation-emitting) PET scans to do follow-ups in cancer patients.

"Almost everyone with stage II through IV cancer, except brain cancer, has the tumor DNA show up in their blood," Topol says. "We'd be able to see if someone was responding to treatment or in remission."

Doctors would also be able to diagnose and treat cancer based on the tumor’s genetic makeup. Right now, a doctor “might want to use a drug for breast cancer but they can't because it's only approved for kidney cancer," Stewart says. "As more studies show that it doesn't matter where the tumor is, we're going to see more FDA approvals for drugs based on genetic changes."

Diabetes care is likely to change as well. Topol says there are many different subtypes of type 2 diabetes, but right everyone who has it gets the same diagnosis and treatment.

"There are 30 million people with type 2 diabetes and 14 different drug classes, but no one knows how to best treat them," he says. "The goal is to be able to be rational and smart, rather than just start everyone on the same drug and if it doesn't work, move on."

Fighting Cancer With Your Own Immune Cells

Various types of immunotherapy (harnessing the power of your own immune system to fight a disease) are already in use, for instance, to treat patients with advanced cancer. But CAR T-cell therapy takes it another level. "You're taking patients' own T cells, genetically engineering them, and putting them back into their bodies. You can't get more personalized than that," Stewart says. He expects to see more advances in this arena in the next few years.

Stopping Alzheimer's, Parkinson's, and MS in Their Tracks

Right now there are many treatments for these conditions but no way to substantially slow them down. Personalized medicine may soon change that, as scientists work to identify specific biomarkers (specific signs in your body, rather than symptoms) linked to these conditions. As a result, new treatments may hit the market in the next few years.

A Deeper Dive on Epilepsy

Scientists are also using genetic research to learn more about epilepsy, one of the most common neurological disorders. One NIH-funded trial found three different epilepsy genes. In time, this will translate to new, more specific treatments.

Diagnosing Rare Diseases

Rare diseases can be hard to diagnose, but now that you can get your entire genome (or part of it, the exome) sequenced, it's becoming far easier. Since 2011, this technology has led doctors to pinpoint the correct diagnoses and save lives. "This method is going to become a more accepted practice in medicine," Stewart says.