Medicine's

Thanks to research being conducted today, doctors 30 years from now will be able to treat and prevent a host of diseases, including cancer and heart disease. Here's a look at the brave new future of medicine.

Futuristic medicine—hmmm. What would it entail? Zooming to the doctor's office in a Jetsons space car—the one you expected in the year 2000 and didn't get? Being patched up with Star Trek lasers as kind little R2-D2 robots bring you Jell-O?

OK, forget the Jetsons cars and the Jell-O. But local experts say medicine of the future will be different—excitingly so—in terms of prevention, diagnosis, treatment, even the way health care is delivered.

For example, you may not actually have to *go* to the doctor—you'll be able to monitor or measure body functions from home and send the results to the doctor's office via computer. Robots and lasers will make surgery easier and less invasive. And breakthroughs in treating and curing some of our most frightening diseases are on the way.

Consider this: Cancer likely will become a chronic disease managed with medication—medication that will have few or no side effects. Organs such as your liver, heart and pancreas will be easily repaired, either by transplants or through new cell growth. Genetic analysis will be so precise, your susceptibility to disease will be able to be measured and the disease itself likely prevented. Medicines and other therapies one day will be specifically designed for your individual system. Screening exams may involve nothing more than a small blood sample and a CT scan—one that will be able to accurately measure cellular changes. Your life span—and certainly your kids'—is expected to grow and grow.

But while researchers and physicians are united in their enthusiasm about these coming advances, they have concerns as well: How as a society will we pay for them? Who will have access to them: everyone, or just a few? Lastly, long life is great—but what about its quality? Join us as we take a look at medicine of the future.

BY THEA MARIE ROOD

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Cutting Edge

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The Biggies

Currently, the biggest killers are heart disease and cancer, but many experts believe these conditions will become less life-threatening in the future. "There are a couple of things that will impact how heart disease and cancer will change," says Paul Wallace, M.D., executive director for Kaiser Permanente's Care Management Institute in Oakland. "One of those is the increased recognition of risk factors."

Already, a decline in the number of people who smoke—combined with better control of diet and weight, blood pressure and cholesterol—has drastically reduced the mortality rate for those with heart disease. (According to the National Heart, Lung and Blood Institute, if death rates from cardiovascular disease were unchanged from 30 years ago, 815,000 more Americans would die annually of heart disease and 250,000 more would die of stroke.) Thirty more years of "engaging people in managing their own health," according to Wallace, may yield similar improvements.

The second major impact is a better understanding of each individual's unique genetic structure, so that disease can be prevented, caught extremely early or treated with medications tailored to a person's specific body chemistry.

"We're making huge breakthroughs in genetic risk factors," says Ralph deVere White, M.D., director of the UC Davis Cancer Center. "We'll be able to determine risk factors and apply specific preventive measures." Based on a risk profile, for example, you'll be able to have simple screening exams that can determine if you're getting a disease long before you experience symptoms. "We'll have blood tests [for cancer]," says deVere White, "and we'll also have CT scans for the whole body that will be accurate to the cellular level. They will literally be able to tell you if there are cellular changes."

And if cellular changes are found, researchers believe they will be better understood. "There is a revolution in molecular biology," says Tim Grennan, M.D., clinical professor of internal medicine at UC Davis and staff physician at Kaiser Permanente. Grennan says what we now consider a disease—breast cancer, for example—is in fact a molecular defect that is unique to the individual. "Different molecular defects can present in a very similar way, such as a lump in the breast," he says. "But breast cancer in women in their 70s and 80s is much different than breast cancer in women who are in their 20s or 30s."

In terms of cancer treatment, researchers say big breakthroughs already are here and will be commonly used within the next couple of decades. "We'll be able to obliterate small tumors using some version of light and laser," says deVere White, "and we'll be able to deliver drugs to a specific tumor in ways that won't affect healthy cells. We'll also have ways to alter an individual's metabolism, basically eliminating side effects."

What all this means is the very concept of cancer will change. "Although we are learning more about how to regulate cell growth and cell death—and on a molecular level, that's what cancer is—it may not necessarily be cured," says Fitz-Roy Curry, Ph.D., associate dean of research for UC Davis, "but it will be managed medically. What we will see, in the immediate future, is tailoring drugs [to an individual]—no more one-size-fits-all. It's really here now, just not widely applied."

This tailored treatment will make cancer management less debilitating for patients. "The treatments we have now—radiation, chemotherapy, surgery—will still have a role, but [our current methods of delivering them] will look like the mainframe computer at IBM 20 years ago," says deVere White.

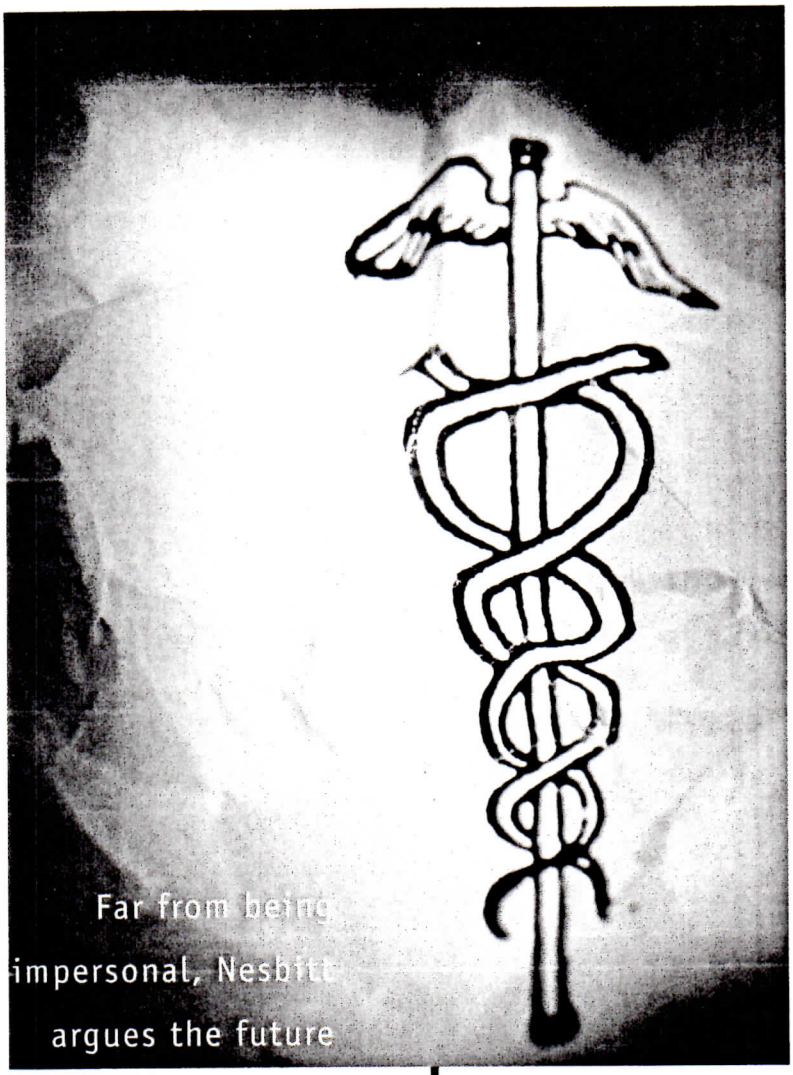
Spare Parts

Another challenge to current medicine is what Wallace calls "things just plain wearing out, like joints or hearts. But I think the ability to replace worn-out parts using spare parts is already in view." Wallace gives the example of a left-ventricular assist device, a pump that was designed to keep a heart from failing while the patient waited for a transplant. Surprisingly, patients do OK with the pump alone and no longer need the transplant. "Now the idea of a partial artificial heart is here," he says.

Similarly, Lawrence Livermore National Laboratory, which now works in conjunction with UC Davis on a number of research projects, is developing an artificial pancreas, according to Mark A. Zern, M.D., director of the transplant research program at the university. "There is a sensor under the skin that can measure glucose levels, and then feed the information to an indwelling insulin pump," he says. Insulin then can be released in the body on a "real-time basis," making for a much better-controlled diabetes patient with fewer secondary health risks. Zern says "there is so much room for error" with the current system, in which patients check blood sugar levels and administer insulin themselves only three times a day. This artificial pancreas also would eliminate the need for blood sticks and insulin injections, greatly improving patients' quality of life.

Zern, a liver specialist, is involved in research that would help the 10 million Americans who have serious liver disease. "We're able to do about 5,000 liver transplants a year now, and there are more than 20,000 on the transplant list," he says. Currently, work is focused on inhibiting liver disease. "Maybe we can do liver-cell transplant, not the whole liver," he says, a technique that would be less invasive and less expensive and would require fewer—if any—immunosuppressant drugs. Such a procedure also could be done in much larger numbers: "Instead of 5,000 [liver transplants] a year, we could theoretically do 100,000 [cell transplants]—whatever was needed," he says. Bioengineers at Livermore also are working on a bioartificial liver, and research is being done on liver dialysis.

In other areas, Zern says bioengineering research is focused on portable kidney dialysis machines—so that "patients can go ahead with life"—and other indwelling sensors, such as one that could monitor transplant patients and send an immediate alert if there is a problem. "That's something that's happening more and more," says Zern.



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Telemedicine

Much as you may like your physician, it's safe to assume seeing him isn't high on your list of things to do. But by 2033, you may not have to—or at least not very often. "Everyone in the future will have a personal computer," says deVere White, and when you combine that with technology the Army currently is using, "such as sensors under a patient's skin that can monitor things like blood count," it's clear much of what we currently see a physician for can be done in our own homes.

"You used to have to check blood sugar in the lab," says Thomas S. Nesbitt, M.D., director of UC Davis' telemedicine department. "And now it's a finger stick the patient does themselves. And there are home pregnancy tests now." Nesbitt believes we'll be able to measure and monitor an increasing number of body functions and conditions ourselves and simply send the data to health care providers. "This would enable physicians to see only those patients who have to be seen," says deVere White.

Far from being impersonal, Nesbitt argues the future of telemedicine "really does bring back the house call." He cites the example of a home health care nurse, who may drive 45 minutes each way to see a patient, a process that is time-consuming and expensive. But with good telemedicine technology, that same nurse could check blood pressure, listen to heart and lungs or look at a patient's wound from her office. "It really enables you to see patients more frequently," he says. "You could check on someone twice a day as opposed to driving out there every other day." Lastly, Nesbitt sees it as a way to keep older people in their own homes instead of a nursing home—even if they live in remote areas.

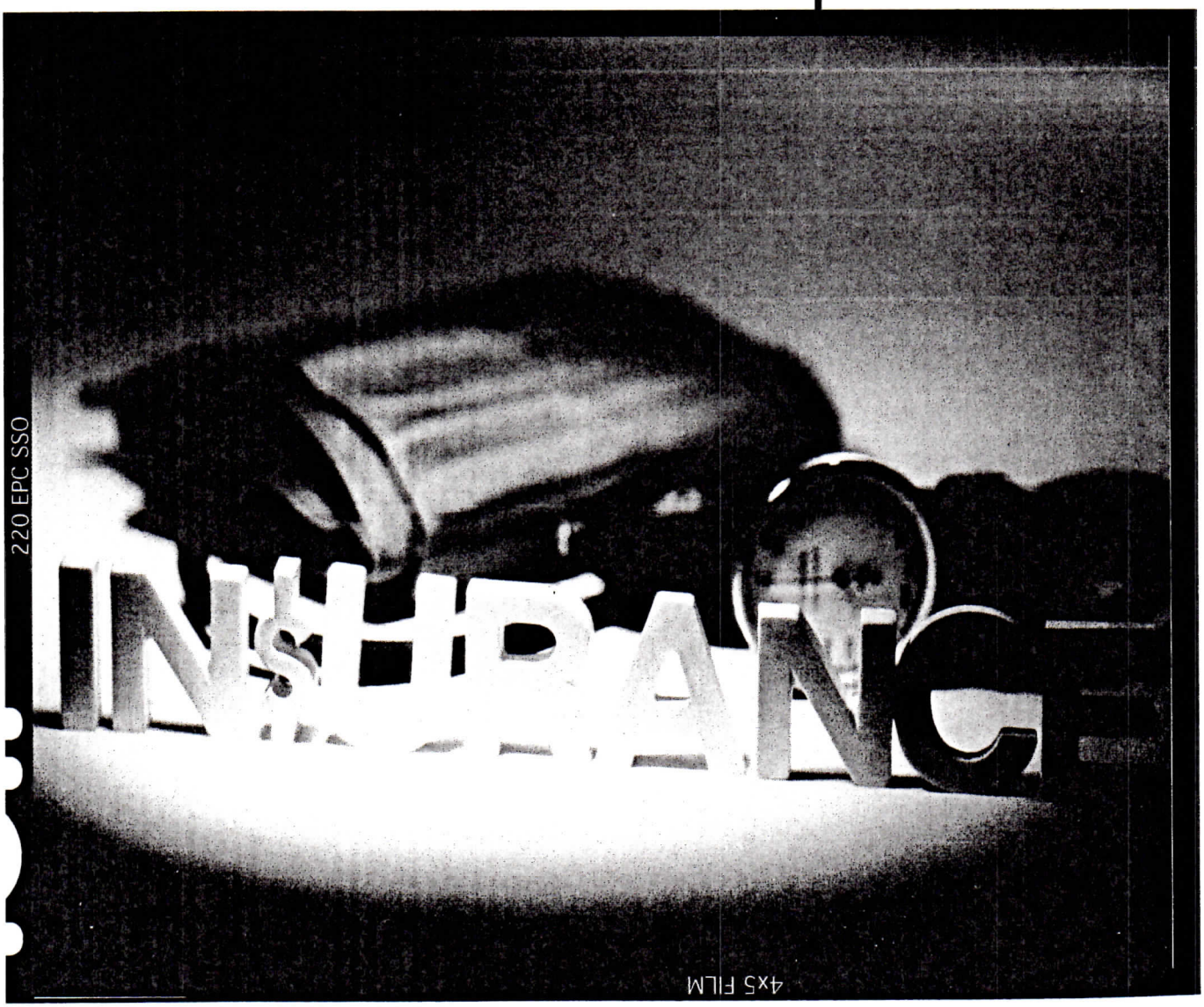
Nesbitt also is excited by the next stage of telemedicine. "Up until now, we've had videoconferencing equipment," he says, "but now we're moving into equipment more tailored to patient interaction—specifically, touch. So we'd be able to do a physical remotely." He says the "hottest idea" in this field is the idea of remote surgery, which involves a robot in an operating room, responding to commands from a surgical specialist in another location. "Patients have already been operated on by robots," he says, "and they leave the hospital sooner. Robots can do things we can't—their little tiny arms can spin around, they can sew behind blood vessels where we can't reach." Remote robotic surgery takes this a step further and basically gives patients the benefit of a top specialist without either of them leaving home. "A surgeon in the community—not a specialist—could be there, but the specialist from a distance could do critical parts of the surgery [using the robot]," says Nesbitt.

Nesbitt says telemedicine means quality health care can be provided to anyone, anywhere. "It's making sure that science gets to people who need it, wherever they are," he says. "If we have a cure for cancer, but only half the people have access to it, does that mean we have half a cure?"

Matters of Concern

In fact, this idea of access—particularly as medicine makes great leaps in the future—worries many experts. "Frankly, I'd love to live in a society where one out of every four dollars is spent on health care," says Wallace. "But we currently spend one out of every six or seven—and people are already saying that's too much." He, like many of his colleagues, believes an overhaul of the health insurance system is a necessary component for the future of medicine. "The overriding issue that needs to be addressed is universal health care," says deVere White. He suggests a referendum for the California ballot that says the current health care system doesn't work, and gives the state legislature five years to fix the problem. And for those who worry any health care plan eventually would evolve into a two-tiered system, deVere White says, "Having 46 million uninsured people is already a two-tiered system—it's not how high the tier can go that's at issue, but how to offer basic health care to the lowest tier." As for money, deVere suggests we are already paying the price for those uninsured—through our taxes, insurance premiums and increased health care costs.

Another area of concern for health care providers is, frankly, our frustrating human nature. "Is there an individual in the U.S. who doesn't know smoking is bad for you?"



asks deVere White. "But now something like 60 percent of us are overweight. We do respond—we do keep changing behavior, but something else always comes along."

On the other hand, some physicians are hopeful the, uh, food issue eventually may go the way of cigarettes. "Positive messages can be impactful," says Wallace. "When you think about it, one of the biggest public health successes in the last 50 years has been smoking cessation. It took a long time and it moved forward on a lot of different fronts, from the surgeon general to public policy to smoke-free environments to taxes. And the legal system has also helped the overall public perception. Maybe we can learn from that." Wallace, like many experts, is particularly concerned about the issue of children's health. "Obesity is clearly a public health issue we need to deal with—whether it's a question of building sidewalks in neighborhoods so kids can walk to school, or school boards that derive money from soft-drink companies," he says.

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A third concern voiced by some experts is the issue of infectious diseases, which are unpredictable except in the sense that they *will* come. "There are things as common as the influenza virus that can come in very infectious and dangerous forms, as well as new infectious diseases—SARS being a good example," says Curry. "We must be prepared for that."

Lastly, with some of our biggest killers turned into chronic, manageable diseases in the future, will we be playing golf at 100? "The ideal is to be healthy and active up to whatever life span there is," says Curry, "and not to have a prolonged, degenerative aging process." Like others in the field, Curry believes the impact of managing chronic diseases could "easily yield an extra 10 years" in overall life span. Similarly, Wallace says in the absence of major cancers, average life expectancy could go well into the 90s, but warns "the brain can be problematic." His hope is that in the next two decades, breakthroughs in treatment and prevention of dementia and Alzheimer's could help people live long and "live well."

Even this, however, seems to have a personal component: "What happens [now] is people who control disease, keep their blood pressure low, exercise, eat at a sensible level—not a saintly one—tend to have good quality lives," says deVere White. ●