AN INDEPENDENT SUPPLEMENT BY MEDIAPLANET TO USA TODAY

Transformation nation
The U.S. ushers in a new age of health care

On the cusp
Oncology advancements

Cracking the code
What DNA reveals about your health

MEDIA PLANET

September 2012

PERSONALIZED HEALTH

4 STATISTICS ABOUT HEALTH CARE IN THE U.S.

UP CLOSE AND PERSONAL

Lung cancer survivor Richard Heimler **finds a reason to breathe easier with tailored therapy**

PHOTO: RICHARD HEIMLER

CHALLENGES

By decoding DNA, the very fiber of our being, we will be able to **transform our approach to health care from one that is reactive to one that is proactive.**

A paradigm shift

"Our generation has been given an unprecedented opportunity to transform health care."

Ed Abrahams, Ph.D., President, Personalized Medicine Coalition

"Personalized medicine," according to the President's Council of Advisors on Science and Technology, "refers to the tailoring of medical treatment to the individual characteristics of each patient [in order] to classify individuals into subpopulations that differ in their susceptibility to a particular disease or their response to a specific treatment. Preventive or therapeutic interventions can then be concentrated on those who will benefit, sparing expense and side effects for those will not."

Personalized medicine offers a vision of health care in the 21st century that incorporates new discoveries in biology and the development of new molecular diagnostic tools that can guide therapeutic decisions and move us away from a one-size-fits all, trial and error model into one that is more precise and targeted to patients most likely to benefit. By increasing efficacy, decreasing adverse events, and lowering systemic costs, personalized medicine tailors new medical treatments to patients based on their personal profiles—representing a paradigm shift in the way we think about medicine.

The case for personalized medicine

At this time of unprecedented scientific breakthroughs and technological advancements, personalized health care has the capacity to:

- Diagnose a large number of devastating human diseases more accurately.
- Predict individual susceptibility to disease, based on genetic and other factors.
- Detect the onset of disease at the earliest stages.
- Preempt the progression of disease.
- Target medicines and dosages more precisely and safely to each patient.
- Increase the efficiency of the health care system by improving quality, accessibility, and affordability.

Now that a number of diseases can be sub-classified into categories that presage the course of disease and its likely response to treatment, there is an obligation to act on that information. Our generation has been given an unprecedented opportunity to transform health care. To make this a reality is going to require an approach with combined resources of multiple stakeholders, all willing to invest in a paradigm change that can preserve innovation, improve outcomes, and reduce the overall costs of health care.

The Personalized Medicine Coalition (PMC) is an international educational and advocacy organization representing scientists, patients, providers and payers, dedicated to the advancement of personalized medicine.

President's Council of Advisors on Science and Technology, Priorities for Personalized Medicine (Washington, DC: Executive Office of the President of the United States, 2008), 1.

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75%
INCREASE IN PERSONALIZED MEDICINE INVESTMENT OVER THE LAST 5 YEARS

WE RECOMMEND

Big genes to fill: The shift from one-size-fits-all medicine.

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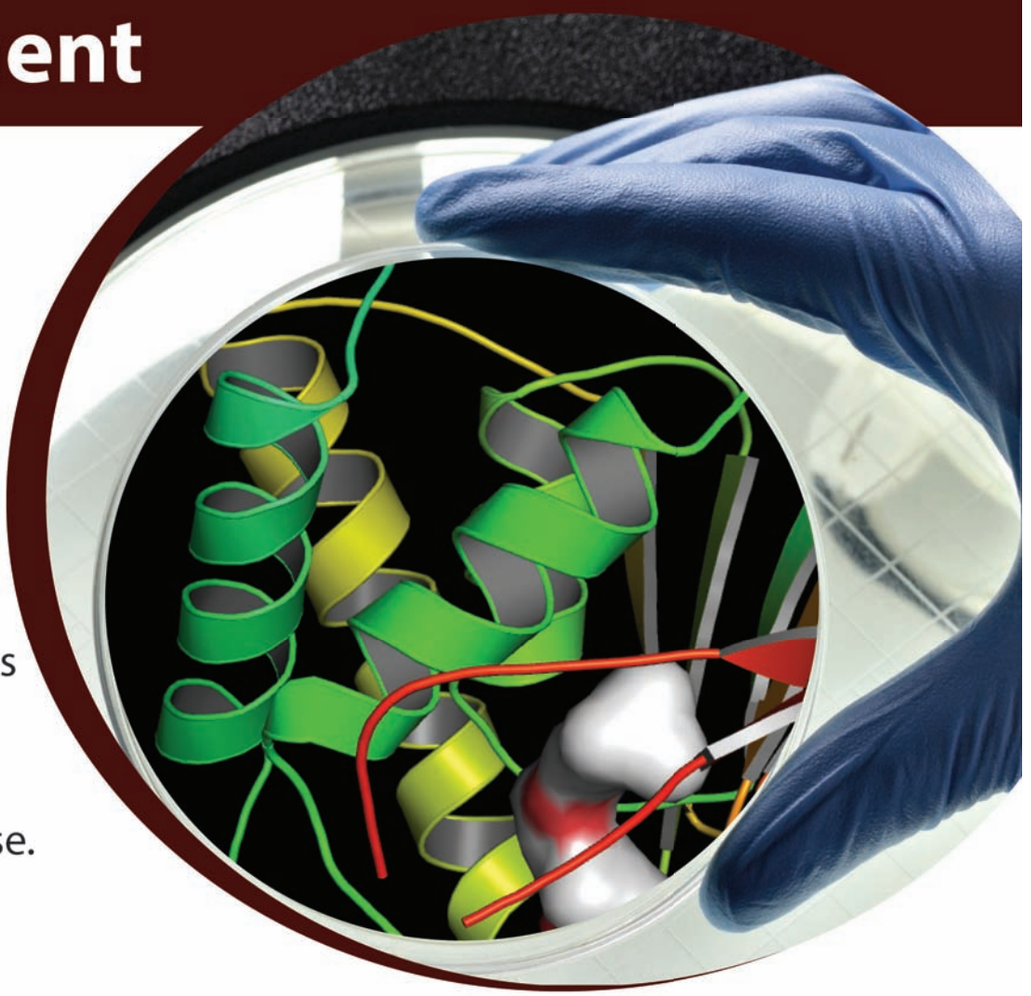
WE RECOMMEND PHOTO: ISTOCK.COM

Epizyme

Personalized Therapeutics • The Power of Epigenetics

New Approaches to *Personalized* Cancer Treatment



Each day we learn more about the biology of cancer and how genetic mutations in cancer cells cause them to grow and spread. This is the age of personalized therapeutics – medicines that hone in on patient-specific drivers of disease.

The next frontier of personalized therapeutics – epigenetics

Epizyme is at the forefront of drug discovery and development, leveraging discoveries to create new treatments for genetically defined cancers.

www.epizyme.com

INSIGHT

A SEQUENCE OF EVENTS

1900 Gregor Mendel's work, conducted in 1865 and largely ignored, is rediscovered, launching the genetic era.

1967 The genetic code is cracked, revealing how DNA sequences code for protein.

1990 The Human Genome Project is launched.

2001 $300,000,000 is the cost of sequencing the human genome.

2003 April: The sequencing of the human genome is declared complete after 13 years and a $3 billion investment.

2006 August: Senator Barack Obama introduces the Genomics and Personalized Medicine Act.

2009 April: Senate brings personalized medicine into national budget discussions.

2012 $5,000 cost to sequence the human genome.

The broader picture

P4: Predictive, preventative, personalized, participatory

A healthier nation is realized by understanding disease on a molecular level.

The United States spends more than $2.5 trillion per year on health care, 50 percent more than other countries. Despite this investment, the U.S. ranks 37 out of 191 countries in health care effectiveness.

Moreover, the Institute of Medicine finds at least 98,000 deaths annually are preventable, and nearly 40 percent of the medicines we prescribe are ineffective. These data present a strong case for change. P4 Medicine's approach to healthcare delivery focuses on more precise, cost-effective and higher quality health care for patients.

P4 Medicine refers to creating interdependent ecosystems to deliver health care focused on bringing the right intervention or treatment to the right person at the right time to reduce cost and improve outcomes. It focuses on identifying key elements that define a person's health and seeks to leverage the interface between an individual's unique DNA, environment and behavior to promote health and wellness. P4 Medicine combines genomics and molecular testing diagnostics with a person's emotional, social, behavioral and physical status to provide *predictive* information necessary to tailor, or *personalize,* individual disease-management and prevention approaches. Therapeutics and health management tools are being developed to help prevent disease rather than merely treating symptoms. Medicine of the future is also *participatory.* Our patients have access to a single portal that electronically stores their medical records and genetic profiles and analytical tools that help provide precise strategies to promote wellness.

P4 Medicine's success hinges on being able to detect a person's likelihood of developing disease early enough so that *preventive* measures can be taken to improve quality of life and reduce costs. In situations where disease is unavoidable, P4 Medicine will provide tailored treatments that lead to successful outcomes.

However, we believe the ultimate success of P4 Medicine is providing a true longitudinal partnership with each person to enrich their life purpose and allows them to live the life they choose. While technical considerations are important to provide precision to medicine, as we learn from the blue zone areas of the world, foundational elements like exercise, diet, connection to family and purpose, and living a life that matters intimately influences longevity and happiness.

A NEW AGE
The success of personalized health depends on the proactive patient.
PHOTO: ISTOCK.COM

CLAY B. MARSH
EXECUTIVE DIRECTOR OF THE CENTER FOR PERSONALIZED HEALTH CARE AT THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER
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PANEL OF EXPERTS

	Michael Nova, M.D. Chief Medical Officer, Pathway Genomics		**David D. Halbert** Chairman and CEO, Caris Life Sciences		**Neil de Crescenzo** Senior Vice President and General Manager, Oracle Health Sciences Global Business Unit	
Question 1: What does personalized health care/medicine mean for the future of health care?	**Using genetics to** tailor treatments and lifestyle management techniques will allow health care professionals to more precisely deliver optimal therapies for each individual patient at the lowest cost. Genetic testing provides actionable information, such as how to improve diet and exercise, which will encourage patients to be proactive about their own health in collaboration with their health care providers.		**Personalized medicine is** the future of healthcare. To date, most physicians have practiced 'intuitive' medicine—they use their clinical judgment to select treatment based on a patient's symptoms, which can only provide clues. In the future, doctors will transition to 'precision' medicine, which will produce accurate and precise information. The biological and genetic elements unique to each person and their disease will dictate the most accurate diagnosis. The right diagnosis leads to the right treatment.		**It means that** more people receive the right kind of care, at the right time, and in the right setting. These improvements will help improve health care while moderating cost increases.	
Question 2: How does personalized health care/medicine promise to transform the patient-doctor relationship?	**Doctors have always** practiced personalized medicine, but genetics will allow them to do it with greater precision. By understanding genetic predisposition to disease, drug response, as well as metabolic and behavioral health factors, doctors and patients can proactively address risk for diseases, such as diabetes and cancer, and prescribe more effective therapies.		**Personalized medicine can** only strengthen the doctor-patient relationship. Individualized care means the doctor can more quickly and accurately diagnose and treat sick patients, which means better health outcomes more often. Patients will have increased peace-of-mind because they will know their doctor is using information unique to them and their disease.		**Personalized health care** should provide doctors more precise information to tailor their diagnoses and treatments to patients. It should also allow patients to have more detailed information and improved control over how they maintain and improve their health.	
Question 3: What is the role that technology plays on propelling personalized health care/medicine forward?	**New technologies will** advance personalized health care by making it affordable, accessible and understandable. Because of technological advancements, Pathway Genomics has transformed billions of dollars' worth of leading-edge scientific research and made it available at the point of care for a few hundred dollars.		**Technology is the** single most important driver to make personalized medicine an everyday reality. Take for example our Carisome platform, where through a few drops of blood, we are now able to rapidly and precisely detect a patient's cancer in its earliest stages. It's my belief that early diagnosis is the most powerful weapon we have in the fight against cancer. This fight will be won through technological innovation.		**Given the volume,** velocity and variety of data necessary for more personalized health care, sophisticated information technology is needed to gather and store the data, maintain appropriate security and privacy controls, and effectively communicate and utilize the data to help both caregivers and patients.	

INSPIRATION

Q & A

W. Jeff Edenfield, M.D.
Associate Medical Director, Institute for Translational Oncology Research, Greenville Hospital System Cancer Center

As an oncologist, how are you practicing personalized medicine with your patients?

Personalized medicine has been integral to oncology for decades. For example, we routinely tailor cancer therapeutics for women with estrogen receptor positive breast cancer by prescribing anti-estrogens. Through research, we've individualized care for lung, colorectal, gastric, basal cell and melanoma cancer patients, as well as those with most hematologic malignancies. As our understanding of cancer grows, elements of personalized medicine are becoming more readily available, through technologies like molecular profiling. Personalized medicine is available now, and it is redefining the way we treat cancer.

How does personalized healthcare promise to transform the patient doctor relationship?

Not surprisingly, patients would prefer to know about their cancer rather than generalities about a specific cancer type. Doctors who can speak to the individual rather than the disease will be increasingly in demand. The human dimension of the patient-physician relationship is only enhanced by access to the most relevant and timely information. Communication about prognosis, treatment and outcome is refined by such knowledge to the betterment of physicians, insurers and most importantly patients and their families.

W. JEFF EDENFIELD, M.D.
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Twist of fate

Deciphering DNA yields life-saving advancements

BRIGHT FUTURE
Personalized medicine is here now and giving patients a second chance at life.
PHOTOS: RICHARD HEIMLER

By zeroing in on the individual person, the individual cell, the individual gene, we are better able to understand the intricacies of a disease like lung cancer, deliver more effective treatments, and allow patients to breathe a sigh of relief.

At 44, Richard Heimler went to a physician with chest pains, fearing a heart attack. What the active, non-smoking, father of two without a family history of cancer didn't expect was a 3-millimeter spot on his lung diagnosed as non-small cell lung cancer.

"That's the problem with lung cancer," Heimler said. "Everyone wants to associate it with smoking, but mine was just random. I've always accepted the fact that there may not be an answer of why this tumor showed up in my body."

Although he caught the small tumor early, it required removal of his entire right lung. This reduced his breathing capacity to 29 percent.

Uncertain yet undeterred

The following years brought multiple rounds of chemotherapy, two brain malignancies, a rib-cage tumor, and, in 2008, tumors on his remaining lung. Heimler started the only treatment available—another two years of chemotherapy.

"If it's a baseball game, my life was in the bottom of the seventh or top of the eighth," he said.

Heimler left work and went on of full-time disability due to chemotherapy side effects. The treatment he hoped would save his life, gradually stole his normal lifestyle. "Your body is so different when you go on chemo," he said. "You forget what it feels like to feel good."

A breath of fresh air

In 2010, Heimler's doctors learned of a clinical trial for a drug targeting lung cancer patients carrying the ALK gene. While only 4 percent of the population carries the gene, it held Heimler's best hope of treating his specific cancer.

After testing positive, he immediately entered the trial. Tumors began shrinking. A year later, they were gone. After eight years of available one-size-fits-all treatments and 800 days on the targeted medication, only two centimeter-sized tumors of little concern remain today.

Reduced side effects and exercise dedication also helped Heimler increase his lung capacity to 37 percent. He can again take his son to Jets games and accompany his daughter to the gym.

Heimler realizes his personal triumph also contributes to a better understanding of individual cancer behaviors.

"Eventually, lung cancer will not be a death sentence like it is today," Heimler said. "It may not be curable, but it will be treatable."

WENDY TAYLOR
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QUALITY TIME
Companion diagnostics and tailored treatments are restoring quality of life. Richard Heimler (pictured with his children) is able to take his son to Jets games and go to the gym with his daughter.

Non-Small Cell Lung Cancer Treatment Just Got More Personal… It's YOUR Move

The people depicted in this ad are not actual patients or physicians.

Only Testing Can Tell…
Know Your Vysis ALK Status

- ☑ Talk with your doctor.
- ☑ Ask for the Vysis ALK test – the only FDA-approved test.
- ☑ To find a lab near you, visit www.AbbottALK.com or call 1-855-TEST-ALK.

Work with your doctor to identify a personalized treatment plan

Whether you or a loved one has been diagnosed with Non-Small Cell Lung Cancer (NSCLC), you should know there is a personalized treatment option available. Testing positive for ALK gene rearrangements is the key to a targeted treatment path for approximately 3-5% of patients with NSCLC.

The Vysis ALK test is the only FDA-approved test validated in the XALKORI® (crizotinib) clinical trials and uses the test method recommended by the National Comprehensive Cancer Network (NCCN) guidelines for determining ALK gene rearrangements status.

Only testing can determine your status…it's your move.

INTENDED USE

The Vysis ALK Break Apart FISH Probe Kit is a test to detect rearrangements involving the ALK gene in tissue samples from non-small cell lung cancer (NSCLC) patients to aid in identifying those patients eligible for treatment with XALKORI® (crizotinib).

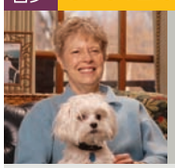
The clinical interpretation of any test results should be evaluated within the context of the patient's medical history and other diagnostic laboratory test results. Rx only.

For In Vitro Diagnostic Use

Abbott Molecular

NEWS

SPOTLIGHT



Sandra Fehrman
Stage IV Breast Cancer Survivor

■ "Personalized medicine isn't 10 years down the road—it's changing the lives of cancer patients today. After exhausting all standard treatments, tumor profiling provided information unique to my cancer that identified other unconsidered treatment options. Because of this, I saw my children married and witnessed the births of my grandchildren—I now have a new lease on life."

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Cancer care: A personal touch

Breaking away from the one-size-fits all mentality, doctors and researchers are thinking outside of the box.

For years, common chemotherapy drugs targeted not only tumors, but also healthy cells, causing patients nausea, fatigue, weight and hair loss, without a guarantee of success. Today, doctors can identify a growing number of specific cancers, resulting in targeted treatments that expose patients to fewer systemic side effects.

"Chemotherapy works, but it isn't effective enough and it has side effects," Dr. Charles Shapiro, professor of Internal Medicine and Breast Program leader at Ohio State University Comprehensive Cancer Center and Division of Oncology at Wexner Medical Center said. "The trick is finding what drives the immune of these cancers and then developing drugs that are targeted at specific pathways that drive the engine of that cancer."

Connecting the dots

The groundwork for attacking a specific mutation came in the development of the medication Gleevec that attacks a protein triggering the over-production of white blood cells in chronic myeloid leukemia patients. Research on breast, lung cancers and melanomas currently show the greatest progress in utilizing such personalized treatments.

"In the next decade, I think we're talking about a complete shift to taking each and every patient tumor and analyzing it at the DNA level and several other levels to identify all possible targets and crafting a complete treatment plan using multiple drugs to really nail a tumor and hopefully put it into complete remission," Dr. Chris Coreless medical director of the Knight Diagnostic Laboratories at Oregon Health and Science University said.

Researchers are also looking into cells' environmental factors. According to Dr. Robert Nagourney, medical and laboratory director at Rational Therapeutics, a cell under stressful conditions such as decreased oxygen, sugar, glutamine or blood supply may adapt by utilizing existing or mutated genes that drive it toward cancer.

"There was once one breast cancer and one way to treat it. Now, there are at least five different breast cancers and five different ways to treat them ... that's in 25 years," Shapiro said. "The next 25 years will continue along these same lines of personalizing therapy, so I think the future is very bright in this realm."

WENDY TAYLOR

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NEWS

The role of big data and analytics in transforming healthcare

Healthcare is changing, requiring medical providers to manage and understand new and varied information in real time so they optimally diagnose and treat patients.

We are increasingly moving towards personalized, precision medicine, instead of being less certain which therapies may work. Patients benefit today from targeted therapies geared to work for their genetic profile and clinical histories. In the US and globally, health systems have been investing in Electronic Medical Records (EMRs), which document and capture clinical histories for the first time in a meaningfully complete digital format.

New data management and analytics platforms are now required to integrate genomics, family history, patient-reported data, and outcomes with EMR data to understand what works. EMRs were not designed to support these new models of personalized medicine involving enormous volumes and variety of data.

"These new integrated data management platforms are really changing the face of medicine," says Neil de Crescenzo, Senior Vice President and General Manager for Health Sciences at Oracle, an enterprise software and systems vendor.

Dealing with data

At the heart of these new platforms is the ability to integrate and analyze data about patients and populations from a vast array of sources, ranging from the clinical notes to genomic information.

de Crescenzo says this information will become increasingly incorporated into diagnosis and treatment, since the technology will make it possible to make more informed medical decisions even at the point of care. As the cost of genome sequencing decreases to only $1,000 per analysis, this type of "precision medicine" will spread beyond the top academic medical centers currently leading in this emerging area today.

Benefits

The healthcare industry is benefiting from the emerging ability to collect, integrate and analyze patient health data from EMRs, patients, genomic data, even payer data such as claims and reimbursement. Researchers, doctors and other healthcare professionals are able to provide better and safer care for patients.

In addition to providing this new and complex information to physicians, the IT industry is also creating solutions to engage patients and their families in using new data such as genomics. "It's important that researchers, doctors and other health care providers can communicate their insights from this new data to patients," says de Crescenzo.

Many leading healthcare providers are now implementing these new analytics platforms to maximize their use of data to personalize care.

Information technology in practice

"We started a project over six years ago called "Total Cancer Care®," where we partner with patients by inviting them to participate in a study to follow them throughout their lifetime so we can learn from every patient experience," says Dr. William Dalton, Director of the Personalized Medicine Institute at Moffitt Cancer Center and CEO of a Moffitt subsidiary called M2Gen®.

Patients donate their healthcare information to the study, which allows researchers to personalize cancer treatments based on an individual patient's unique disease at the molecular level.

"Patients want to do this, they want to help each other and they want us to learn," explains Dr. Dalton.

Over 90,000 patients have enrolled in the program so far, which has 18 sites in 10 states.

"The goal is to identify need, develop an approach to meet need, and then by learning from patients, be able to predict need before it actually manifests. You're really helping people when you can do that," Dr. Dalton says.

UPMC, a nonprofit health system in Pennsylvania, is also using new enterprise analytics platforms to support science driven, accountable care.

Lisa Khorey, the vice president for enterprise systems and data management for UPMC, says the data drive efficiency in the healthcare industry is allowing clinicians to focus on quality and better patient outcomes.

"We take better care of patients when we consider the individual and their clinical indicators and combine that with the latest scientific evidence," she says.

Khorey also credits the technology as helping to get new scientific findings and information into medical practice faster than ever before.

Data are "most valuable when you put them all together to drive action; when people not only view information, but can act on it," explains Khorey.

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Q & A

Lawrence J. Lesko, Ph.D., F.C.P.
Director of the Center for Pharmacometrics and Systems Pharmacology at the University of Florida College of Pharmacy

■ What is the role of pharmacogenomics?

It investigates how a person's genes affect his response to drugs. Family history, age, and weight are all factors in prescribing drugs. Knowing genetics adds one more piece to the pie.

■ What are adverse drug reactions (ADRs)? How will pharmacogenomics help reduce ADRs?

Prescription drugs are like the two sides of a coin; one side is the benefit, and the other is possible side effects. One example is an anticlotting medication where if the drug dose is too low, it won't work; too high means risk of bleeding. One patient's slower drug metabolism can make the average patient's dose very toxic. Pharmacogenomics will help reveal if a patient might suffer a serious reaction on a certain dosage.

■ With this new age of personalized health, will we see more adherent patients?

When people do not take their medications as prescribed, it has serious and costly consequences. Among other reasons, patients stop their drug regimens because the medicine isn't working, or there is an adverse effect. A genetic test can help doctors get the prescription right, minimizing these two possibilities.

DR. LAWRENCE LESKO
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NEWS

Q & A

Patrick J. Balthrop Sr.
President and Chief Executive Officer, Luminex Corporation

■ Why did you have your personal genome sequenced?

My wife and I participated in Dr. Topol's genome scan study after attending a scientific conference. The data confirmed that I have mutations for restless legs syndrome and hyperthyroidism—part of my family history. Surprisingly, I also have genetic mutations that increase my risk for developing chronic gastrointestinal diseases, which my children have inherited.

■ How has understanding your personal genome affected you?

After receiving this information, my healthy adult son contracted a bacterial GI infection. The infection resolved but his inflammatory symptoms remained. He now has chronic ulcerative colitis. While at less risk than me, the environmental cause of his infection triggered a GI disease that will affect him throughout his lifetime. DNA is important, but not the entire story.

■ So genes, proteins and environmental events are important in understanding disease?

That seems very clear. How genes instruct cells to produce and express proteins, thereby determining health, is the next frontier. Mapping the human genome was a seminal event. Next will be completion of the library of human proteins. Understanding the combination of the genome, environmental factors, and proteins will elevate our understanding of disease and treatment.

PATRICK J. BALTHROP SR.
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Unraveling the mystery: Decoding DNA to deliver improved patient outcomes

A patient's emerging and unprecedented access to his or her important health information is reshaping medicine.

The new era of precision, individualized medicine includes smart phone apps for tracking conditions like blood pressure; wireless connectivity for sending vital data anywhere in the world; and the ability to sequence your entire genome within hours.

Precision medicine for heart patients

Precision medicine in cardiology includes using DNA data to make sure drugs are working and to prevent serious complications.

If you're about to have a stent placement and are prescribed clopidogrel, which goes by the brand name Plavix, you'll want to know about a test that could tell you whether or not the drug will work for you.

The test, which can be run from a blood or saliva sample, determines if the version of a person's gene called 2C19, will enable Plavix to work.

Patients with coronary artery disease, who have a stent for blood flow to the heart, may take Plavix, but about 30 percent of these patients can't activate the inert drug normally, rendering the drug potentially useless.

"In those one-third of people who don't metabolize the drug, they're at a three-fold risk of clotting in their stents," says Dr. Eric Topol, cardiologist, Chief Academic Officer of Scripps Health and Professor of Genomics at The Scripps Research Institute. "While that doesn't happen frequently, when it does happen, and the stent clots, the person either dies suddenly or has a heart attack."

> "I've been a student of medicine for almost three decades and I've never seen any time as exciting, as extraordinary as this one."
>
> **Eric Topol, M.D.**
> Cardiologist, Chief Academic Officer of Scripps Health and Professor of Genomics at The Scripps Research Institute

Getting tested

Dr. Topol and his team at Scripps Health in San Diego, which emphasizes genomic medicine, were the first in the country to start using the 2C19 gene test in 2009. Several other centers, such as Vanderbilt and the University of Florida are now on board, but Dr. Topol wishes other medical providers would use it too.

"In a survey of 10,000 doctors, 90 percent felt they were not at all up to speed and [do not] have the proper knowledge to use genomics in their daily practice," he says.

The patient perspective is quite different.

"We studied and published on thousands of people who got their genome-wide scans," says Dr. Topol. "We showed that people were perfectly comfortable when they got that information—there was no increased anxiety or depression."

He says one-forth of those studied shared the genome-wide testing with their doctors, which led to "better alignment" of which tests to do and medicines to use.

"There's a knowledge base we have to remedy," Dr. Topol says, "because pretty soon the patients are going to know more about their own genomics than many doctors know about genomics overall."

DNA democratization

Dr. Topol believes patients will play a large role in helping to drive precision medicine by asking their doctors for DNA testing.

"I've been a student of medicine for almost three decades and I've never seen any time as exciting, as extraordinary as this one," he says.

Dr. Topol's new book, "The Creative Destruction of Medicine," delves deeply into this new form of individualized medicine. Follow him on Twitter @EricTopol.

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Pioneers in the next generation of medicine.

Genomics. Personalized medicine. Individualized medicine. Call it what you like, but it's the future of medicine. At Inova, we're pushing the frontiers of genomics every day.

See how far our Inova Translational Medicine Institute has gone at: Inova.org/ITMI

INOVA™

Join the future of health.

INSPIRATION

Q&A

What is "nutrigenetics"?

■ In general, this refers to matching dietary recommendations to one's genetic profile. While the fundamentals of healthful eating pertain to us all, we differ from one another in many ways. To the extent differences in metabolism can be predicted based on genetic variations that we are now able to measure, dietary 'prescriptions' can be better customized.

What does DNA reveal to us about a person's metabolism? How can it be used to create a personalized diet plan?

■ In the context of diet, genes determine whether you have more or less of a given enzyme, metabolize a certain nutrient fast or slow, or produce more or less insulin. A genetic pattern can help determine whether a lower fat, or higher fat/lower carbohydrate, or higher protein dietary pattern is apt to work best. As long as these variations adhere to the fundamentals of healthful eating, the capacity to customize is important, and empowering.

DAVID L. KATZ, MD, MPH FACPM, FACP
Founding (1998) director of Yale University's Prevention Research Center and a clinical instructor in medicine at the Yale School of Medicine

The proactive patient

Become an advocate for your own health—it can save your life.

Rita Hardy of Charlestown, Indiana didn't feel sick at all. So when she went for a health screening, which revealed two blocked arteries that required surgery, she was shocked.

"I had no symptoms whatsoever. None," she says. "I was dumbfounded. The technician told me, 'We would like you to consult your doctor within 48 hours.'"

The thin 62-year-old retiree later had vascular surgery, both on her right and left carotid arteries which were blocked by plaque.

"If I hadn't gone to the screening, I could have had a stroke," she says. "It's something you don't know until you do a screening."

Health problems revealed

Hardy learned about the screening from a pamphlet she received in the mail. She'd received the mailer before, but this time, something was different.

"I thought, 'It was only $149,'" she says. "I'm going to have this done."

> "I had no symptoms whatsoever. None. I was dumbfounded."

The painless screening, which lasted about an hour, included an ultrasound of Hardy's neck. The screening saved her life.

"Thank God I did it because they found major problems," she says, reporting even her doctor was surprised with the results.

"I was just a walking time bomb for a stroke," says Hardy, who is doing well and spends time doing work around her yard. "I feel blessed."

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{personalized} DEFINED

Medicine has always been personal, but by using the latest technology, Penn State Hershey Institute for Personalized Medicine scientists are making it even more so. By studying individual genetic and environmental factors, doctors will be able to tailor your health care for a better fit.

Medicine doesn't have to be one size fits all. We're committed to customizing it for you. ***It's what we do.***

TO LEARN MORE VISIT MED.PSU.EDU/IPM

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1855 Milton S. Hershey Medical Center

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INSIGHT

On the record:

ePathology propels personalized medicine

Jared N. Schwartz, MD, Ph.D
Chief Medical Officer, Aperio

"As goes pathology so goes medicine." – William Osler (The Father of Modern Medicine – 1849-1919)

If we are to improve the quality of patient care and enable personalized medicine, it is essential that a patient's complete medical record be available. This is particularly true in laboratory medicine as it is estimated that 70 percent of patient care decisions are tied to laboratory results that include pathology and radiology images. Radiology is well on its way to having images available; however, pathology is just getting started in its move to ePathology, the process by which a patient's pathology results, including images, are available in their medical record. Today the technologies exist to enable ePathology, and a growing number of hospitals are adopting it into use.

When a biopsy of a tumor is taken, the specimen is prepared into microscope slides, stained for a variety of markers, and examined by a pathologist. With ePathology, the glass slide is converted into an eSlide enabling a pathologist to view the whole slide image on a computer screen, and easily share the images with others. The ease with which images can be shared can aid in the interpretation of results.

The goal of personalized medicine is to be precise so that patients will be subjected to less trial and error. The whole slide image enables the use of computer-assisted analytic tools that can precisely assess the image. An example is Immunohistochemistry (IHC), which is the standard procedure used at hospitals to provide prognostic information to help stage cancers. With a whole slide image, these quantitative analyses are automated to enable precise, patient-targeted therapies. ePathology also plays a role in research, aiding the identification of the diagnostic pathways for companion diagnostics so that pharmaceutical companies can develop precision medicines that improve patient care and outcomes.

ePathology extends the reach of physicians and researchers in collaboration, consultation, and peer review to a global team and for this reason, is essential to achieve the promise of personalized medicine.

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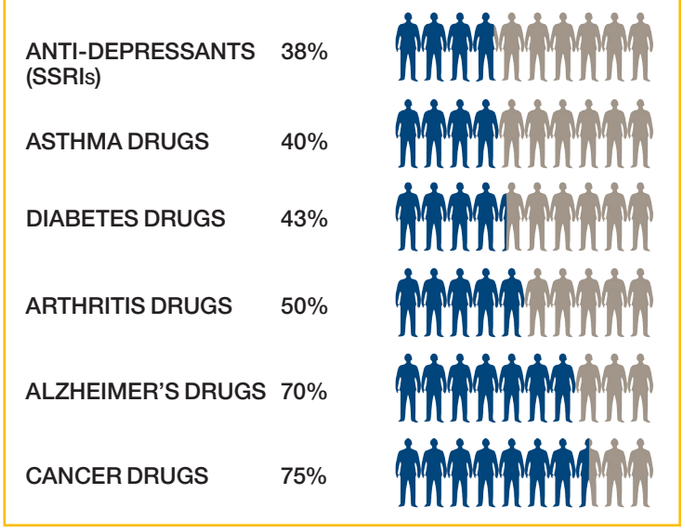
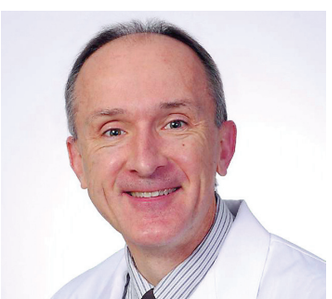
PERCENTAGE OF THE PATIENT POPULATION FOR WHICH A PARTICULAR DRUG IS INEFFECTIVE, ON AVERAGE



Bio-banking on the future

Progress towards personalized medicine relies on a partnership among patients, physicians and scientists.



Glenn S. Gerhard, M.D.
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Administrative Director, Penn State Hershey Institute for Personalized Medicine Biorepository

For doctors to tailor care specifically to each individual patient, scientists need to find convenient markers that precisely define the nature of a patient's illness, that predict a patient's susceptibility to disease, and that point to the potential success of specific treatments.

To find these markers, scientists need to study blood, saliva and biopsy samples or tissues from surgery. This need has led to the creation of bio-banks.

A bio-bank is a secure collection of blood samples, tissues and other biological materials donated by patients, coupled with information about their health, environment, lifestyle, medical care and responses to treatment.

Samples are often collected during the normal course of care and matched with information from the patient's medical record. For most bio-bank research studies, a patient's only responsibility is to follow normal health care treatment.

A healthy investment

By donating samples, patients provide physicians and scientists the means to answer important questions about disease risk and treatment. The tools to analyze blood and tissue samples produce very detailed profiles of a patient and his condition, which may be linked to important aspects of a patient's care. For example, while sequencing the entire three billion "letters" of DNA in a person's genome now approaches $10,000, it will likely be less than $1,000 in the next few years, making it affordable for scientists and clinicians to sequence the DNA samples stored in bio-banks.

This approach has already allowed investigators to identify the cause of a number of genetic diseases and currently directs tailored treatments for a variety of conditions, including cancer.

Bio-banks have recently become the engine for personalized medicine research. Decades ago, scientists recruited volunteers for specific studies, a process that was costly and time-consuming. For example, Elliot S. Vesell, M.D, Sc.D., at Penn State College of Medicine, conducted studies on human twins to assess the role of genetic factors in the large variations among individuals in the response to several drugs. These studies inaugurated the scientific field of pharmacogenomics.

Recent studies using bio-banks have identified the specific genetic factors influencing the response to these drugs and now allow doctors to prescribe the right dosage of the best drug to the individual patient.

These are just some of the many breakthroughs establishing that the future of personalized medicine is something to bank on.

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