BY DENISE MYSHKO

THE KNOWLEDGE REVOLUTION

Large-scale changes are taking place in biomedical research and information technology that will lead to entirely new ways to develop medicines and shift how healthcare is delivered.

A better digital strategy is needed to understand where the customers are, and the information needs to be there when they are searching. By mapping the journey of the patient, interesting communications could be developed to drive better health outcomes.

LYNN O'CONNOR VOS
Grey Healthcare Group

Companies need a culture that embraces change. New technologies constantly challenge the paradigms of the past. It's easy to rely on what's worked in the past, but it is important not to let this become an impediment to evolving science.

DR. GLENN GORMLEY
Daiichi Sankyo

In 20 to 25 years, pharmaceutical research and development will be multidimensional. Scientists will use artificial intelligence and robotics and interact through a global networked Web. Modeling and simulations that work at different levels, including digital models of "virtual patients," will be common. These simulations will speed experimentation and help predict safety and efficacy of new medicines for each patient. Researchers and patients will gain access to greater computing power, new user interfaces, and miniature biomonitors that continuously collect data.

Sound like science fiction?

Not to Jonathan Peck. His organization, the Institute for Alternative Futures, predicts there will be a knowledge revolution in the decades ahead that transcends the information revolution of the past two decades. The accelerating spread of knowledge combined with advanced technology will create widespread changes to healthcare and how new medicines are developed.

Mr. Peck, president of the Institute, and other industry experts predict there will be a digital convergence of many of the technologies that are just beginning to take hold in the pharmaceutical industry, including genomics, artificial intelligence, virtual reality, nanotechnology, and supercomputers.

Experts say this transformation is coming about because the rate of change of technology is accelerating, doubling every year the capability of specific information technologies.

"The key is to envision how computers and artificial intelligence work with humans and human intelligence," Mr. Peck

The availability of genome screening will enable preventive healthcare in a more comprehensive way. Treatments will move from being reactive to diseases to being proactive and preventing diseases.

DR. DEBORAH DUNSIRE
Millennium

Innovation in the pharmaceutical industry is slowly dying. Companies have to understand what they are good at and focus on lead indicators that are going to help them down the road. It's all about effective planning.

ARUN RAVI
Frost & Sullivan

says. "The importance of artificial intelligence and computer support tools is that they can accelerate the learning process of human scientists. But the most subtle context and connections are still made through networks of human scientists who understand the nuances and who conduct hypothesis-led learning."

For the pharmaceutical industry, he says, this means the value of the knowledge will grow in relation to the value of the compounds.

"What will determine the success of companies is how effective they are at using knowledge that is learned by their scientists, particularly if it is understood that what is known about biology is dwarfed by the unknown," Mr. Peck says.

Lee Babiss, Ph.D., global head of pharma research at Roche, says the amount of information being generated can't be managed by the brain's current capabilities.

"For example, 10 years ago there might have been 100 papers written in the course of a year on Alzheimer's disease, which was a manageable amount," he says. "Today, this number has risen to more than 12,000; this is neither suitable nor manageable. We have to consider using technology that enables us to get to the salient points of this information. I don't know what the business model will look like yet, but I certainly believe that informatics will become a business opportunity for everybody, including physicians, patients, and healthcare companies such as Roche."

An important part of the transition will be the ability to translate knowledge into wisdom, says Glenn Gormley, M.D., Ph.D., president of Daiichi Sankyo Pharma Development.

"Wisdom is knowing when and how to use the knowledge and when not to," he says. "Scientific discoveries integrated into knowledge can help researchers understand how those data can be used. But usually there is a time lag between discovery and application when questions start to be asked, such as when can the information be used, when is the appropriate time to intervene, and when does the social component of medicine integrate with the technical component and lead to the right societal decisions?"

NEW AND ADVANCING TECHNOLOGIES

Bioinformatics and predictive technologies are already having an impact on early discovery efforts. There are ongoing efforts to use in-silico modeling for drug target identification or in drug-discovery processes.

The Institute for Alternative Futures predicts computer modeling and artificial intelligence will enable significant and personalized intervention in the future. This will be brought about by several technology advances: there will be natural language processing that helps computers "understand" human languages at the same time it democratizes scientific knowledge; intelligent agents with increasingly friendly, intuitive interfaces that help both scientists and citizens engage in research; diagnostics capable of distinguishing between subclasses of diseases and identifying predisease states to create new categories of health; and molecular imaging that peers into cellular processes and uses probes that can be armed with therapeutic agents to address diseases such as cancer.

"There could come a time when a virtual patient is developed that would be specific to each individual and contain all of the medical knowledge generated from biomonitors to predict each person's health," Mr. Peck says. "By putting together all of the knowledge to come from this revolution, it would be possible to create the physiology of a human."

These ideas were echoed by PricewaterhouseCoopers' Pharma 2020 report issued last year. This report predicts that by 2020 virtual cells, organs, and animals will be widely employed in pharmaceutical research. Using advanced computers, researchers will be able to screen drug candidates in a digital representation of the human body, which can be adjusted to reflect common genetic variations and disease traits.

This will show whether a molecule interacts with any unwanted targets and produces

SEVEN RECOMMENDATIONS FOR PLANNING FOR THE FUTURE

The Institute for the Future proposes seven steps to promote the most ethical advances for conducting biomedical R&D, expanding knowledge of health and disease, and improving health for everyone.

1. Set a goal for U.N. adoption of a minimum health standard for all.
2. Create personalized risk profiles.
3. Initiate a global discussion of ethical positions for intellectual property.
4. Move from healthcare focused on treating disease to promoting health.
5. Change healthcare regulations to promote information sharing and new methods beyond clinical trials.
6. Foster an open-source system for health research, including drug discovery.
7. Create a collaboration of stakeholders to design and develop the Health Advocate Avatar.

Source: The Institute for Alternative Futures, Pharma 2029. For more information, visit altfutures.com/2029.asp.

Simulations are meant to translate animal studies so that we can predict drug effects in humans; we can use that information to improve the design of studies to reduce risk in the trial process.

ALEX BANGS
Entelos

There is an opportunity in the longer term for monitoring to occur inside the body. Implantable devices will allow for monitoring basic functions.

DR. ALICE JACOBS
IntelligentMDx

any side effects. Predictive analysis will then enable researchers to assess how the molecule is likely to be absorbed, distributed, metabolized, and excreted.

"With the computing power and the processing power that will become available, certainly the industry could reach this point," says Neil Patel, Pharm.D., director of pharmaceutical research and development operations at PricewaterhouseCoopers. "The next step is getting a handle on all of the attributes and pieces of information that would have to go into the model."

Dr. Patel says this is going to require a more collaborative exchange of noncompetitive information between researchers within the industry, as well as the government, academic research institutions, and any other stakeholders that are working in the research space.

Dr. Gormley says both modeling and simulation technology have gone through a transformation in the last five years.

"I've seen the impressive contributions that modeling and simulation activities can make to the drug-development process, specifically

2029: WHAT'S TO COME

1. IMAGING AND BIOMARKERS

In 2029, molecular and energy-based imaging will let scientists visualize functions so that pathology and normal biology are visible. In 2029, the understanding of health, disease, treatment, and the relationship between body and mind are greatly illuminated by imaging and a huge public library of biomarkers.

2. OPEN-SOURCE RESEARCH

By 2029, open-source research will prove to be faster and better than organizationally based research at discovery. A significant percentage of university and independent research, and some corporate research, is immediately available without copyright or patent restrictions on its use or application. Companies commercializing open-source discoveries must compete on speed to market, quality, cost of manufacturing, transportation, and sale of resulting products and services.

3. HUMAN-MACHINE INTERCONNECTIONS

In 2029, science is conducted jointly with humans, artificial intelligences (AIs), and robotics interacting via a global Web. AIs bring calculating capabilities far beyond the capacity of the human species along with computer memory that can assemble trillions of facts instantly and use visualization, interactive models, and other techniques. Robotics works at various scales and gives scientists and AIs an ever-growing array of tools, therapeutics, and delivery systems. In 2029, experiments that previously took months to set up can be assembled in minutes and scaled-up within hours.

4. BROWN-CHEMICAL CRISIS

By 2029, widespread use of ultra-sensitive testing tools such as Microelectro Mechanical Systems (MEMS) and DNA arrays create a common awareness that a broad spectrum of industrial chemicals and pollutants are present in everyone's bodies at levels that have significant impact on gene expression. There is widespread public fear that this burden of chemicals increasingly threatens health. The high public demand for "green chemistry" that eliminates the use or generation of hazardous substances affects every area of biomedical science and biotechnology.

5. THE ROLE OF ANIMALS

Animals continue to play a key role in research in 2029, though few animals are sacrificed for the knowledge they yield. Genetic profiles from most species contribute to evolutionary simulations and theory. Chemical compounds and biologics are tested in bioengineered tissues harvested from animals and through in silico simulations

before in vivo tests. Animal neural networks are also transferred to in silico media where they serve as control systems for many lower-order AI applications.

6. MINIATURIZED RESEARCH INFRASTRUCTURE

Biochips and nanolabs proliferate, allowing research to operate at various scales from molecular to global. Interconnected sensors communicate through a network that links trillions of information sources. A large human population contributes data directly through biomonitors in the form of implants and wearables. Massive computational models continue to account for changing environments and genetics and to calculate effects.

7. MERGER OF DISCIPLINES

In 2029, more than 50% of scientists with Ph.D.s combine social science and a spiritual discipline with what were formerly called "hard sciences" in their education and professional work. Education in 2029 integrates brain research into the traditional curriculum, typically offering a lifelong trajectory of cross-disciplinary expeditions undertaken with teams of people who work in various venues — in person, in virtual reality, and in isolation for different periods. Cross-cultural team learning is universally recognized as the most effective process when facilitated by mentors and teachers trained in effective interpersonal performance techniques.

8. EVOLUTION OF SYSTEMS BIOLOGY

In 2029, systems biology incorporates laws of biology derived from evolutionary theory. A new theory of evolution helps scientists propose laws that govern molecular, cellular, and physiological processes. Predictive models are highly reliable for most molecular processes, many key cellular pathways, and a number of key organ systems. The use of systems biology has also broadened the policy perspective on most environmental and biohazard issues, leading to more effective risk management.

9. BIOCHEMICAL DESIGN AND FASTER, LOWER-COST MEDICATIONS

By 2029, scientists will have exquisite design tools to customize molecular compounds that meet criteria set by knowledge of pharmacokinetics and pharmacodynamics as well as cell biology. Willful creation of biological designs arising out of biology, infotech, and nanotech is the order of the day in 2029. Regulators focus on how these designs are likely to affect evolution and the ecology as well as individual patients.

10. ETHICAL DIMENSIONS OF SCIENCE

In 2029, all scientific projects engage participants in public debates that explore the ethical dimensions of the endeavor. Ethical concerns have widened to encompass multiple worldviews and cultural perspectives.

11. AGING AND LONGEVITY

By 2029, a single theory of aging organizes efforts to make greater longevity available to those who seek it. Regenerative medicine provides many alternatives for those who want to delay death for extended periods.

12. HEALTHY SOCIETIES

In 2029, research has shown that health can be created at the level of countries, and large-scale experiments are under way to show pathways to health. The interplay between societal (communal, tribal, and national) dynamics and family or individual health have become a focal point for a great deal of biomedical research. Ecological failures, including overmedicated societies that polluted their water with metabolites early in the century, helped teach that a global surveillance system is crucial for creating healthy societies.

13. RACE TO AFRICA

In 2029, the business models for commercializing innovation all address equity. Years of speeding new health products and services to the poorest continent on the globe have yielded significant health results. Success against SARS, the AIDS pandemic, and a series of cross-species infections created large-scale understanding of global interdependence. The great majority of multinational businesses have shifted from the old "triple bottom line" that balanced profits with ecological and social responsibility to a quadruple bottom line that adds ethical teachings as a key business success factor.

14. EARTH SYSTEMS ENGINEERING AND MANAGEMENT (ESEM)

In 2029, ecology and climate science have advanced through the contributions of global monitoring instrumentation, large networks of citizen-scientist observers, and advanced models and simulations. Biomarkers for river health, soil conditions, and a wide variety of other signals of ecological stress are continuously studied. Comprehensive monitoring and sophisticated modeling allow scientists to predict changes in ecosystems, and the consequences of these changes, just as networks of meteorological stations allow forecasters to predict changes in weather.

Source: The Institute for Alternative Futures, Pharma 2029. For more information, visit altfutures.com/2029/2029_Forecasts.pdf.

the derivation of more data from a single experiment than ever before," he says. "It's possible to fill in the blanks where data are missing for higher predictability. There are also virtual reality technologies that enable the creation of 3-D images; a 3-D hologram of a patient can be created by a computer, which allows a surgeon to practice surgery on the hologram using robotics."

Modeling has tremendous potential in clinical trials; it will allow researchers to use simulations to determine the appropriate dosing schedule, the expectation for modulation of disease, and what potential safety issues could emerge, all in advance of a compound going into patients, Dr. Babiss says.

"This is a huge advancement, because then smaller, more effective clinical trials can be designed, which ultimately means safer and more effective drugs can potentially get to patients faster," he says.

Dr. Gormley says modeling could allow for a decrease in the sample size necessary to answer safety questions.

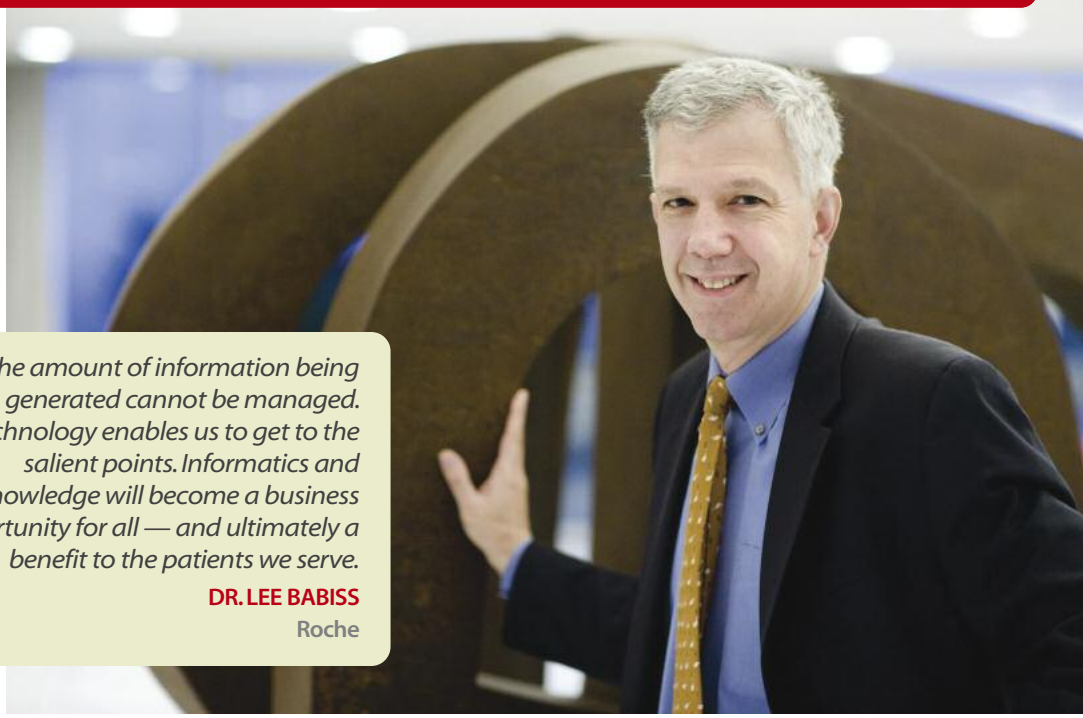
"Being able to predict the binding characteristics at a molecular level means that clinical trials can be designed in ways that decrease variability and provide clearer answers with smaller sample sizes," he says. "I suspect this will lead to higher effectiveness in early testing."

Another big advantage of simulations is that they would allow researchers to move away from a reliance on animal models, Mr. Peck says.

"There is both an ethical and an economical drive to move away from animal models," he says. "Through simulations it would be possible to use high-throughput cellular systems that work faster, enabling greater control and reliability at lower cost and higher speed."

A 2007 paper from Health Industry Insights concludes that there is a significant return on investment (ROI) to be realized from the use of modeling and simulation software tools. Analysis suggests there is a cumulative ROI of between $3 and $10 for every $1 invested in these tools.

Entelos has developed a modeling approach and technology platform to construct large-scale physiological models of human disease. These platforms, called PhysioLab systems, facilitate pharmaceutical R&D in a number of immune/inflammatory diseases, including asthma and rheumatoid arthritis, and in diseases related to cardiovascular and metabolism, including obesity, diabetes, and atherosclerois.



These models have been applied to a wide variety of R&D problems.

The company started by modeling human health, allowing researchers to draw from a large volume of data about normal physiology, in addition to disease data, and ensuring that PhysioLab systems are of a high enough quality to maintain the stability and dynamics of a homeostatic system. The model is validated by running simulations and comparing virtual experimental results with known experimental results on the cellular, tissue, and whole-patient levels.

The amount of information being generated cannot be managed. Technology enables us to get to the salient points. Informatics and knowledge will become a business opportunity for all — and ultimately a benefit to the patients we serve.

DR. LEE BABISS
Roche

"The platform is designed to translate animal studies and, given the early information, predict the diversity of human response and, from there, design better trials and reduce risk in the trial process," says Alex Bangs, cofounder and chief technology officer at Entelos. "The goal is to simulate a patient over time. This could be for a short period of time, but usually longer. For example, for cardiovascular conditions the simulation could be for a period of 10 years to track the risk a patient has for having a heart attack. We can then introduce changes, such as putting a patient on a statin."

He says simulation technologies are shifting from early adopters to broader usage, and some clients have used data from PhysioLab to support their submissions.

"The FDA has begun to embrace modeling," Mr. Bangs says. "The agency is becoming accustomed to using pharmacokinetics/pharmacodynamics (PK/PD) modeling. Physiology modeling is the next step to better understand novel therapeutics and the diversity of patients. As part of the FDA's Critical Path Initiative, the FDA has indicated that modeling and simulation are important to help reduce risk and improve how the drug development process works."

PK characterizes the absorption, distribution, metabolism, and elimination properties of a drug, while PD defines the patient's response to the administered drug. Thus, PK/PD modeling enables drug exposure and drug response to be predicted in the target patient population.

Mr. Bangs says pharma companies can look to other industries that lead the way in this area.

"The communications, electronics, automotive, and aerospace industries spend a lot of money to get a product to market — they wouldn't consider going into production or building their manufacturing plant to produce something without a great deal of modeling and simulation to know that the product was going to work when it came off the assembly line," Mr. Bangs says. "Yet pharma companies do this every day. Biology is hard to predict, and while the problems are not exactly the same, there is still a huge amount that can be mapped. Those other industries are pointing the way and showing that it is possible to spend less on R&D and greatly reduce risk by using simulation."

We believe there will be a convergence of capital, assets, and attributes from many different industries through complex collaborations.

CAROLYN BUCK LUCE
Ernst & Young

TRULY PERSONALIZED HEALTHCARE

These advances will lead to tremendous changes for diagnosing disease and healthcare delivery. Experts predict that by 2029, healthcare will be fully personalized.

Looking 20 years into the future, Mr. Bangs says modeling and simulation technologies will have a significant impact on personalized medicine.

"This technology can help patients determine their potential health risks and how those risks can be mitigated by changes in lifestyle and medication," he says.

Physicians, he says, will play a central role in using technology to provide a more personalized approach to medicine.

"Using all of the data that are available with virtual representation of a patient, physicians can come up with a solution in collaboration with the patient," he says. "The application of modeling and simulation will likely result in more sophisticated healthcare practices and a wider range of pharmaceuticals available for the physician."

The Institute for Alternative Futures believes that medical science will be able predict changes in health status and prevent illness

KEY TRENDS NOW EMERGING AND THEIR IMPLICATION FOR PHARMA

TRENDS

MARKET TRENDS

- Patients are becoming better informed
- Patients are picking up a bigger share of the bill
- Demand for personalized medicine is increasing
- Patients want cures, not treatments
- The emerging markets are becoming more important

HEALTH AND HEALTHCARE TRENDS

- The burden of — and bill for — chronic diseases is soaring
- Healthcare payers are establishing treatment protocols
- Pay-for-perfomance models are on the rise
- The boundaries between different forms of care are blurring
- Financial constraints on payers are increasing

SCIENTIFIC AND TECHNOLOGICAL TRENDS

- R&D is becoming more virtualized
- The research base is shifting to Asia
- Remote monitoring is improving rapidly

IMPLICATIONS

PHARMA WILL NEED TO GO BEYOND THE MEDICINE

- Pharma will be paid for outcomes, not products
- Outcomes data will drive healthcare policy
- Prevention will gain a higher healthcare profile
- Pharma will need to offer "medicine-plus" packages of care
- Pharma will have to adopt more flexible pricing strategies

R&D WILL NEED TO GO BEYOND THE LAB

- Pharma will need access to outcomes data
- Pharma will have to work with technology vendors to virtualize R&D
- Pharma will need a wider, more multidisciplinary skills base
- Pharma will need to expand its presence in Asia
- Pharma will need to demonstrate "real" value-for-money

THE PHARMA AND HEALTHCARE VALUE CHAINS WILL BECOME MUCH MORE INTERTWINED

- Pharma will have to work more closely with regulators
- Pharma will have to collaborate with payers and providers to perform continuous trials
- Pharma will have to collaborate with numerous service providers to deliver packages of care

BUSINESS MODELS BASED ON COLLABORATION

Source: PricewaterhouseCoopers, Pharma2020, Business Models. For more information, visit pwc.com.

through many developments. This includes systems biology that understands the dynamic within cells based on cross-disciplinary research — building up knowledge from the cell to organisms, to tissues, and to organs.

The ability to continually monitor individuals and create personal risk assessments will lead to individualized therapy, the Institute notes. The platforms for assessing risk will define therapeutic selection, meaning the platforms will prove more valuable than the medicines.

"Medicine will become much more individualized around all aspects of healthcare," Dr. Babiss says. "This will be done with continuous monitoring through implanted chips, for example, where the patient and the physician, through some type of computer program, are constantly monitoring the patient's health status, response to medicines, and so forth."

Mr. Peck says biomarkers and biomonitors will provide more information than ever about each patient.

"There is going to be a great deal of information available; we are going to need knowledge technology to put it into context," he says.

Dr. Gormley predicts that over the next 25 years, technologies will become available that will enable genome sequencing of everyone.

"Questions related to how genomes contribute to diseases will be answered," he says. "But for a long time, we will be in a world where there is a trade off between benefits and risks. Physicians, however, will be able to integrate this information in the office setting and will be able to provide the right drug to the right patient at the right time."

Deborah Dunsire, M.D., president and CEO of Millennium: The Takeda Oncology Company, says these changes are coming about because of the intersection of short-cycle businesses, such as IT, with the longer cycle of health delivery.

"Down the path, the melding of information technologies and diagnostics with prevention and therapeutics will be able to be accomplished in a much more reasoned way," she says. "The availability of genome screening will enable the practice of preventive health in a better way. There are clearly unmet medical needs, and we continue to need new medicines, but we're going to be able to manage health much more ably on the prevention side."

Dr. Dunsire says better diagnostic tools will provide physicians with the ability to make better choices for individual patients.

"Physicians will be able to look at predictors for long-term patient health," she says.

"Right now, doctors ask about family history to determine risk. Longer term, the genome will provide the answers."

Alice Jacobs, M.D., founder, chairman, and CEO of IntelligentMDx, says human genetic and pathogen markers will allow for a better understanding of causative agents that contribute to disease and better patient care.

"In the current environment of healthcare reform and to deliver more effective care, we're going to have to incorporate technologies sooner," she says. "A futurist healthcare may come sooner than we think, but in 25 years I am fairly confident that detection and treatment will occur through miniaturized in vivo monitoring stations. Whether it is nanotechnology or microtechnology remains to be seen."

Because of the cost, the world's governments, politicians, and consumers are going to change healthcare faster than the industry can exude influence.

DR. NEIL PATEL
PricewaterhouseCoopers

Dr. Jacobs says on the 10-year horizon, healthcare will move toward a symptom-based, more holistic approach to detection and treatment where doctors will have a better understanding of how a person will respond to a certain drug.

"Longer term, there is an opportunity for monitoring to occur inside the body," she says. "Small advances are already starting, such as cameras that can be swallowed as an alternative to a colonoscopy. Implantable devices will allow us to monitor and keep track of basic functions."

IMPACT ON LIFE-SCIENCES INDUSTRY

Dr. Dunsire says the ability to assess long-term risk coupled with better ways to select medicines will allow the economics of healthcare to be better controlled.

"The other force that's going to come to bear in a big way over the next two decades is an aging population and the declining workforce," she says. "All of the healthcare programs in the developed world are funded by people who are working and making contributions, which take care of the elderly and people who are not working. Controlling the investment of healthcare dollars over the next 25 years is going to be the essential issue. Whenever there is pressure on a system, innovation happens. This will drive a push forward in areas such as prevention."

What this means, she says, is that the pharmaceutical industry is going to have to find new business models that prioritize mechanisms for driving prevention.

"Companies will not be able to survive under the same model," Dr. Dunsire says. "The next step is going to be an important one. We have to do things differently. We'll see new business models, new research models, and new partnering models begin to emerge."

A changing business model will require pharmaceutical companies to think about their own innovation in connection with that of other industry innovations, says Carolyn Buck Luce, global life science sector leader at Ernst & Young

"Pharmaceutical companies haven't fully grasped that they need to understand the business model of other companies and industries that are going to be players in healthcare," she says. "Other companies that will likely become involved in the healthcare equation are diagnostic, information, and consumer products companies — these companies have a much more extensive distribution pathway to potential customers and patients globally. They are also embedding into their products a promise of healthy outcomes."

Ms. Buck Luce says the pharmaceutical industry in the future is going to have to embrace more complex collaborations with companies from many different industries, with the goal of delivering healthy outcomes.

"We believe there will be a convergence of capital, assets, and attributes from many different industries through complex collaborations," she says. "Companies will need to be able to bring together the science of medicines and devices, information technology, infrastructure distribution, and knowledge about customer-centric businesses."

She says on their own any of these players is unlikely to be successful.

Another report from PricewaterhouseCoopers' 2020 series finds that disruptive innovations in various industries have dismantled the prevailing business model, and the pharma industry is currently undergoing a similar disruption. PWC experts say by 2020, most medicines will be paid for on the basis of the results they deliver, and since many factors influence outcomes, this means that the industry will have to move into the health management space. Analysts say no pharmaceutical company will be able to "profit alone." Rather, they will have to "profit together" by joining forces with a wide range of organizations, from academic institutions, hospitals, and technology providers to companies offering compliance programs, nutritional advice, stress management, physiotherapy, exercise facilities, health screening, and other such services.

Arun Ravi, a healthcare consultant at Frost & Sullivan, agrees that integration and cooperation with other companies are critical factors for future success.

"Companies have to understand what they are good at and focus on lead indicators that

Computers and artificial intelligence are not detached from humans and human intelligence; the key is how they work together.

JONATHAN PECK
Institute for Alternative Futures

are going to help them down the road," he says. "It's all about effective planning."

On the consumer information side, the Institute for Alternative Futures predicts there will be a knowledge interface — which it calls a Health Advocate Avatar — that can mediate interactions between individuals and the world of medical knowledge. The Health Advocate Avatar is envisioned as a coach, educator, and health manager that draws on the experience of large populations. The avatar can provide people with personalized advice while serving the general healthcare industry worldwide.

Right now the state of digital health information is in the early stages, says Lynn O'Connor Vos, CEO of Grey Healthcare Group.

"People are taking control of their own health, but they need more information," she says. "And they need expert guidance on that information."

The challenge, Ms. Vos says, is integrating good content with medical expertise to help patients synthesize the information to make better decisions for their health.

"We need a better digital strategy to understand where customers are and ensure that the information is there when they are searching," she says. "There isn't a perfect model yet, but there is certainly some very good thinking and plenty of investment around developing a solution." ✦

PharmaVOICE welcomes comments about this article. E-mail us at feedback@pharmavoice.com.

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