Era of Personalized Medicine May Herald End of Soaring Cancer Costs

By Bryan Keogh

Personalized medicine promises to drastically improve quality and longevity in the coming decades by custom-tailoring a patient’s treatment for cancer or other diseases to his or her particular genetic makeup. It may also become the saving grace of developed countries with massive debts and bloated budgets by cutting soaring health care costs by tens of billions of dollars per year.

At least, that’s the hope. Using advances in genomics and proteomics, researchers have developed diagnostics targeting an individual’s unique genetic makeup, potentially eliminating unnecessary treatments, reducing adverse reactions to drugs, and improving health outcomes—while lowering costs, or at least retarding their rapid increase.

“In a sense, it’s the holy grail, being able to treat every person’s disease as their own,” said Richard Sullivan, a professor at King’s College London and lead author of a recent Lancet report on the cost of cancer care. “If you’re going to see real affordability, if you’re going to see real cost savings, and high-quality evidence-based care, you have to do it across the board; you can’t simply say it’s all about medicines.”

The worldwide cost of cancer attributable to premature death and disability reached an estimated $895 billion in 2008, notes the Lancet Oncology Commission report titled “Delivering Affordable Cancer Care in High-Income Countries,” published Sept. 26. U.S. cancer spending grew to $90 billion in 2008 from $27 billion in 1990 and is projected to soar to $157 billion by 2020. In the UK, total spending on breast cancer care has increased 10% annually for the past 4 years. Some form of cancer affected an estimated 12.4 million new patients in 2008, with 7.6 million deaths, figures that may jump to 26.4 million and 17 million, respectively, by 2030, according to the International Agency for Research on Cancer.

Cutting Costs, Preserving Quality

The burden gets exponentially worse, particularly in Europe, as the sovereign debt crisis and austerity measures imposed to reign in excessive deficits leave the region’s economy near recession, putting health care in the crosshairs of political leaders looking for savings. The trick is finding a way to reduce costs without sacrificing quality. France and the UK are on the vanguard in rationalizing their health care systems and cutting costs by creating more integrated networks, Sullivan said.

Sullivan, who prefers the term personalized cancer care, argues that to achieve meaningful cost savings, we have to include hospitalization, radiotherapy, and surgery in the equation, not just drugs. It all depends on where the “real affordability” lies with each particular form of cancer and the rational use of biomarkers, he says. Biomarkers, molecules that indicate disease prevalence, are used in clinical trials to determine whether a particular treatment will benefit a patient. “A biomarker for that expensive drug in, say, brain cancer, where most costs are due to hospitalization, is not going to make a big difference to the overall affordability,” Sullivan said.

The Lancet Oncology Commission cited overuse of health care, its rapid expansion, and shortened life cycles of cancer technologies as a few of the primary drivers behind soaring costs. “In developed countries, cancer treatment is becoming a culture of excess. We overdiagnose, overtreat, and overpromise,” Sullivan and the other 36 experts involved in the report wrote.

The commission noted that personalized medicine is one way to control costs. The efficacy rate of drugs is estimated at 50%, putting the global annual waste from misdiagnosis at about $350 billion, helping to estimate the potential savings of individualized care, according to a white paper published in the March issue of Personalized Medicine.

“Personalized, or individualized, treatment is the future of cancer care,” said Paul Workman, deputy chief executive of the Institute of Cancer Research and head of its cancer therapeutics division. “Cancer is leading all of medicine in applying the fruits of the human genome project to the introduction of personalized medicine.”

Personalized medicine, also known as stratified medicine in the UK or by the scientific term pharmacogenomics, analyzes an individual’s molecular information to determine how likely someone is to develop a disease and how he or she will respond to a particular treatment, something that the mapping of the human genome and proteomics, or the study of the proteins that genes create, makes possible. Leroy Hood, co-founder and president of the Institute for Systems Biology in Seattle and a pioneer in individualized care, developed an approach dubbed P4 medicine: personalized, predictive, preventive, and participatory.

The U.S. personalized medicine market was estimated at $232 billion in 2009 and is expected to grow 11% annually, nearly doubling to more than $450 billion by 2015, according to the consultancy firm Price water house Coopers. The core
diagnostic and targeted therapeutic segment of the market was estimated at $24 billion and expected to grow by 10% annually, reaching $42 billion by 2015.

To achieve real cost savings with new drugs, doctors must use them rationally, Sullivan insists. It won’t work if a biomarker shows a negative reaction in a patient but the doctor prescribes them anyway, nullifying the benefits of the initial screening. The UK National Institute for Health and Clinical Excellence, which determines the treatments its National Health Service will cover, requires a positive reaction before allowing a particular drug to be used, whereas in the U.S. and some European countries such as Germany that isn’t the case, he said. Most biomarkers miss certain people, creating false positives and false negatives, and not enough big studies are being done to validate them, Sullivan says. “We have a problem with the science of biomarkers,” he said. “We still don’t understand how these biomarkers work within the network.”

Personalized medicine also needs “very strong” translational research, a focus on longevity, and a multidisciplinary approach to succeed, said Michael Baumann, president of the European Cancer Organisation in Brussels.

**Multidisciplinary Cancer Medicine**

“None of these personalized approaches would ever make a difference in a clinic if we do not from the beginning appreciate that

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today’s cancer medicine is a multidisciplinary approach,” he said. “Working only on one small component of it in a technological, surgery, or drug arena without having all the other” components won’t work.

New and more effective drugs will explore the molecular basis of each type of cancer, avoiding time wasted on drugs that don’t work for a specific patient, resulting in fewer side effects, improving health outcomes, and causing the cost of clinical trials to fall, because you’ll know from the beginning which participants will respond to the treatment being tested, Workman says. Personalized medicine is “the key” to cutting down on cancer costs, he said.

Workman, who agrees on the need to focus on overall health care and not just drugs, cites trastuzumab and imatinib mesylate as two of the “poster children” for how personalized medicine can lead to better outcomes and reduced costs, demonstrating the “critical importance” of doing clinical trials on stratified cohorts of patients.

The discovery that a certain protein is overexpressed in about 25%–30% of breast cancer patients, causing cells to reproduce uncontrollably, led to the development of trastuzumab as a targeted therapeutic antibody. That wouldn’t have happened without a targeted approach, Workman says.

Imatinib, sold under the trade name Gleevec and the first drug approved to directly turn off the signal of a protein known to cause cancer, helped boost the 5-year survival rate of patients with chronic myeloid leukemia to 89%, Workman said. The National Cancer Institute praised the 2001 approval of imatinib as a bellwether for other molecule-targeting cancer drugs.

The London-based Institute of Cancer Research is focusing on linking molecular pathology to personalized medicine by finding the genes that cause a disease and discovering drugs to treat it, Workman said. The group is also taking part in several government-funded research projects, including acting as one of a few clinical hubs in a pilot program to jumpstart mass genetic testing and analyze tissue samples for molecular abnormalities.

Europe is better positioned to incorporate personalized medicine into its system
than the U.S. European health care is more centrally planned, and the ability to track health outcomes is very powerful, he said. Health care spending is already much lower in Europe than it is in the U.S. France spent about 11% of its gross domestic product on health care in 2007, compared with 10.4% in Germany and 8.4% in the UK, according to the Lancet report. By contrast, the U.S. spent 15.7% of its GDP on health care, a figure expected to reach 20% by 2020.

“The strength of Europe is social medicine,” Workman said. “Once you’ve collected patient specimens, then you got the technology development so you can profile the mutations, it’s much easier to track patients and their outcomes—their survival, basically. So you can link molecular markers to treatments and then to outcomes through the national records that are available.”

Here is what two EU countries are doing to cut cancer costs:

**France**

France has saved hundreds of millions of euros since setting up a network of 28 hospital-linked centers across the country to analyze the molecular diagnostics of cancer patients’ particular tumors, according to its National Cancer Institute. The free testing, operated by the institute and the Ministry of Health, aims to ensure that new targeted therapies are prescribed only to individuals who would actually benefit. For example, France’s health insurance system saved an estimated €69 million after setting up tests with activating mutations of the epidermal growth factor receptor in their tumors, ensuring only those who were likely to benefit from a new treatment known as gefitinib would receive it, according to Fabien Calvo, deputy general director and head of research at the French National Cancer Institute. Targeted therapy represents 57% of the cost of anticancer drugs, according to a May NCI presentation. The total spared costs of molecular testing for lung and colorectal cancers totaled €354 million, versus €4.2 million of public funding allocated for the testing.

**UK**

The UK began a 2-year pilot program in July to show how the National Health Service can offer molecular diagnosis for all cancer types routinely, according to the charity Cancer Research UK, which partnered with two drug companies and the government’s Technology Strategy Board. The Stratified Medicine Program’s aim is to help establish a national service to “ensure standardized, high-quality, cost-effective genetic testing of tumors is available for people with cancer.” When targeted treatments become available, patients will be able to choose to have genetic tests to help doctors decide the most suitable treatment for their individual case, while building a national database of genetic information on tumors. Doctors at seven existing medical centers will recruit as many as 9,000 people with one of six cancer types, including breast and prostate, to have surplus tissue samples tested for specific genetic mutations and variations. The UK’s Technology Strategy Board is also investing as much as £75 million in research and development grants to help develop “stratified” cancer treatment over 5 years.