

## **Partners HealthCare Announces the 2016 “Disruptive Dozen” Technologies That Can Revolutionize Cancer Care**

*12 Innovative Fields Selected by Top Harvard Medical School Faculty for Their Ability to Enhance Cancer Care in the Next Decade*

BOSTON--(BUSINESS WIRE)--Partners HealthCare today announced its selections for the second annual “Disruptive Dozen,” the 12 emerging technologies with the potential to revolutionize cancer care over the next decade. The “Disruptive Dozen” was developed as a way to highlight the innovations with the greatest potential to enhance care in a specific area of medicine. The technologies were featured as part of the World Medical Innovation Forum™, an annual collaborative innovation event held in Boston to examine the state of health care and innovation in a chosen medical discipline. The year’s Forum, which took place April 25-27, 2016, was focused on cancer.

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“The culture of innovation across Partners institutions drives a continuous dialogue on what state-of-the-art medical technologies could have the biggest impact on patient care. The ‘Disruptive Dozen’ process was adopted as a way to identify and recognize the technologies that we believe will breakthrough to enhance care in the next decade,” said Monica Bertagnolli, MD, Chief of the Division of Surgical Oncology at Brigham and Women’s Hospital and Professor of Surgery at Harvard Medical School.

“We hope that the selected technologies will provide both encouragement and optimism around the future of cancer care to everyone trying to discover new treatments and to physicians, patients and their families,” said Daniel Haber, MD, PhD, Professor of Medicine at Harvard Medical School and Director of the Cancer Center at Massachusetts General Hospital.

The “Disruptive Dozen” were chosen via a rigorous nomination and selection process during which more than 45 Partners HealthCare oncology experts were interviewed to elicit nearly 34 nominations. A panel of 21 senior faculty members then ranked the finalists through a defined group process. The selected technologies are as follows:

### **1. CELLULAR IMMUNOTHERAPY**

CARs, or chimeric antigen receptors, are proteins that allow certain immune cells, called T-cells, to recognize a specific target on tumor cells. While the field is early in its development, the response rate to many of the new CAR T-therapies has been unprecedented for patients who had stopped responding to all other cancer treatments. The latest research is investigating how best to use CAR T-cells with other immunotherapies. Combining checkpoint inhibitors, such as PD-1 inhibitors and anti-CTLA4 drugs, with CAR T-cells are strong possibilities. Going forward, cancer experts predict that CAR Ts have the potential to become frontline cancer therapies by engineering the patient’s own immune system to fight their cancer and defeat it.

### **2. IMMUNE MODULATORS (CHECKPOINT INHIBITORS) AND VACCINES**

Checkpoint inhibitor drugs that target the PD-1/PD-L1 pathway have made a lasting impression on cancer outcomes during a rapid rise from benchtop to FDA approval. It’s this unique approach of removing the breaks on the immune system to boost the body’s own defenses that is producing significant long-term cancer remissions—cures, in some cases, especially when checkpoint inhibitors are combined with standard anticancer

therapies. Novel vaccines are also being developed that can generate anti-tumor responses by expanding the population of immune cells capable of fighting cancer. Vaccines are now being tested in a variety of malignancies and, once approved, will allow doctors to make significantly more progress against advanced cancer than they had been able to achieve in decades.

### **3. LIQUID BIOPSY FOR ONCOLOGY**

A new type of blood test has the potential to transform cancer diagnosis and treatment while sparing patients the surgical and needle biopsies long needed to guide their care and enabling repeated sampling of patients through the course of their disease. Liquid biopsies rely on the capture of cancer cells in the blood (called circulating tumor cells, or CTCs), and isolation of cell fragments called exosomes or free circulating tumor DNA that tumors shed into the blood. Molecular analysis of these blood-borne, tumor-derived entities is then used for diagnosis and to inform treatment options. Capitalizing on advances in gene sequencing and the falling costs of performing genetic analyses, more than a dozen companies currently have liquid biopsy tests in development. Many doctors think liquid biopsies will be the transformative advance that could make personalized medicine possible for far more people.

### **4. MACHINE LEARNING AND COMPUTATIONAL BIOLOGY TO TRANSFORM CANCER CARE**

To understand the cause of cancer and to develop more effective methods of prevention, detection and treatment, clinicians and researchers need access to rich molecular and clinical data sets. Leading U.S. and European research institutes in machine learning and statistical genetics are now working together to develop techniques for robust biomarker discovery and elucidation of the causal mechanisms governing cancer and its progression. By gathering the latest information from the patient's biology, and combining that with trillions of data points from tens of thousands of other cancer patients, individualized patient-specific cancer treatment options can then be created in days, and sometimes in just a matter of minutes. Ultimately, this treasure trove of information will be added to data banks and help cancer researchers from across the world mine and glean insights from the gigantic amounts of data in order to truly progress in the fight against cancer.

### **5. EPIGENETICS AND CANCER TREATMENT**

The ability to modulate epigenetics is a critical way to reset cellular states and plasticity in cancer. Researchers are now finding that epigenetic changes that lead to some cancers can be reversed with novel treatments that are, in some cases, less toxic than conventional chemotherapy. The epigenetic approach will not only change the way that researchers look at cancer but also the way that they treat it: instead of killing cancer cells, these new epigenetic cancer treatments will transform them from diseased cells to healthy ones or increase their sensitivity to new or existing therapies. Such knowledge of wiring differences in the packaging of DNA within cancer cells could help doctors one day prescribe more potent and precise drugs that home in on specific epigenetic targets within tumors, leading to durable remissions and, quite possibly, cures.

### **6. THE MICROBIOME AND CANCER**

Though still in its infancy, the complex and dynamic field of microbiome research continues to evolve as scientists learn more about how it may play causative roles in cancer formation, disease progression and response to treatment. As the exploration of the human microbiome increases, a better understanding of the role of the gut microbiota in cancer may lead to the development of targeted individualized interventions that prevent or ameliorate microbial imbalance, thereby reducing symptoms. Many companies have recently been launched to develop and commercialize microbiome-based cancer immunotherapies that employ select gut microbes to boost the immune system's attack on cancer cells and improve the efficacy of anti-cancer drugs. The

opportunity to exploit the microbiome for therapeutic benefit offers an exciting new approach with limitless possibilities.

## **7. CRISPR: GENOME EDITING AND CANCER**

CRISPR, or Clustered Regularly Interspaced Short Palindromic Repeats, is sweeping the world with excitement due to the unprecedented ease and speed with which this new technology allows scientists to make precise changes to the genetic code of DNA. Some say CRISPR gene editing may prove to be one of the most important biologic tools invented in the past 100 years. The technology holds great promise for discovering new therapeutic targets in cancer. From replacement gene editing to targeting immune cells against cancer, the technology is enabling an entire new world of possibilities for cancer treatment.

## **8. SINGLE-CELL MOLECULAR PROFILING**

When cancer develops, a single rogue cell can eventually lead to the downfall of an entire organism. It's for these reasons that scientists are studying how to measure, catalog, describe and categorize individual cells. Some techniques are being used to amplify material from one cell at a time, while others allow them to multiplex many cells together. Rapid technological developments at the level of cell capture, phenotyping, molecular biology and bioinformatics promise an exciting future with numerous biological and medical applications. In the coming years, single-cell profiling promises to answer key issues in cancer research, including resolving intratumor heterogeneity, tracing cell lineages, understanding rare tumor cell populations and measuring mutation rates. These tools will also have direct translational applications in the clinic in areas such as early cancer detection, noninvasive monitoring and guiding targeted therapy. Furthermore, a greatly improved understanding of cellular invasion, metastasis and therapy resistance during cancer progression will significantly benefit cancer management.

## **9. mHEALTH AND CANCER CARE**

The ability to use technology-enabled care for patients with cancer allows providers to reach into patients' homes and their daily lives, not only capturing patient-generated health information, but also doing it in real time. The entry of Google, Apple and Microsoft and other major players into the mHealth field and the greater use of smart devices and wearable technologies has allowed for this increased monitoring and intervention, for both care and research. The emerging field of novel cancer-care apps may also offer new, relatively inexpensive routes to supportive cancer care that can improve patient quality of life, patient education, navigation through complex medical systems and personalized social support. Ultimately, this will help lower health care costs and achieve better quality of life for patients.

## **10. PATIENT-SPECIFIC RESEARCH TO ENABLE EFFICIENT DRUG DEVELOPMENT**

Novel research strategies that allow individualized testing to predict treatment efficacy based on a patient's medical history, cancer stage and pathology will play an increasingly critical role in years to come. To address the heterogeneity and complexity of treatment response, clinicians will also use computational modeling of tumor-derived parameters, including molecular genetic and proteomic data, tumor cell functional assays, drug dosing and prior treatment data. Researchers have begun using information from studies such as NCI-MATCH and the Exceptional Responders Initiative, the NCI's phenotype to genotype study, to capitalize on the growing knowledge of patient subpopulations for which a therapy may be effective and not compromise the FDA's rigorous safety standards. Many are optimistic that these novel trial designs could also improve regulatory success rates and ensure the more rapid and cost-effective delivery of innovative medications to those cancer patients who are predisposed to respond favorably.

## **11. REDEFINING VALUE IN CANCER CARE**

Due to technological advances and an aging population, cancer care will continue to be a primary driver of increasing health spending. We will need to pay for and treat cancer differently moving forward and this will become a major disruptor over the next decade. Players across the industry are coming together to share cancer-related data and generate performance metrics to better understand the advances that are being made in the field. The increasing involvement of patients and patient organizations in the decision-making process is another important step in improving value. As the various stakeholders work together, improved value in cancer care will be achieved through managing the complexity of cancer, finding alternative payment models and the assurance of guideline conforming care that can help reduce waste—for example, better designed trials through genotyping (precision medicine)—eliminating therapies that offer little value, and avoiding inappropriate treatment. It's this collaborative approach that will help improve cancer prevention, detection and treatment in ways that will reduce the economic and human burden of cancer, ultimately leading to pricing that reflects value and better outcomes for patients.

## **12. NANOTECHNOLOGY AND CANCER TREATMENT**

Nanotechnology has the potential to target therapeutics directly and selectively to cancerous cells and tumors, guide in surgical resection of tumors, enhance the therapeutic efficacy of radiation-based treatments, and, more broadly, enable complimentary technologies such as gene editing and gene therapy for a myriad of cancers. The pace of nanotechnology development has been brisk, and the entire field has seen a rise in innovation on a sharp slope. The expectation is that as nanoparticles begin to make their way through clinical trials, and as nanotechnology continues its impact on other medical breakthroughs—immunotherapy, gene therapy, RNA interference, and gene editing—we will begin to see the enormous power of cancer nanotechnology, as measured by improvements in patient survival and commercialized products in this field.