2019 Healthcare That Works for All

This paper is one of a series describing what a decade of successful change in healthcare could look like in 2019. Each paper focuses on one aspect of healthcare. To see the other papers for a comprehensive view of systems change, go to http://www.altfutures.com/2019_Healthcare_That_Works_For_All.

Science & Technology Base in 2019

Science & Technology That Works for All

Fostering Science & Technology for a Better Future Requires:

1. Value -based Evaluation of New Technologies To Address Risks and Benefits
2. Strong Support for Science Education and Interdisciplinary Research
3. Moving Upstream Towards Prevention
4. Furthering Personalization of Risk Assessment for Targeted Medicine
5. Leveraging New Methods of Open Source Collaboration

A New Approach to Research & Development

Improving our healthcare system will require a new approach to research and development that is more open and interdisciplinary. This approach to research and development will broaden as it aligns with values, public policies and signals from the free market. Science can contribute more to health by focusing on preventing sickness, controlling costs, improving efficiency, and developing therapies for neglected and high disparity diseases. The resulting breakthroughs from science and technology are going to come from more sources because the global population of educated people will gain greater access to knowledge that can be applied to improve health.

Some basic paradigms will also change as the culture of science expands to integrate social sciences, which will help address community health, prevention and disease management. By combining traditionally separate "soft" and "hard" science researchers will better understand the complex interrelationships between environment, social interactions and biology. Recent research already shows that events in early life, even starting during pregnancy, can alter gene expression by a process called epigenetics. Newly released studies support the idea that these epigenetic changes, which alter gene expression, can be passed on from parents to future generations. This dynamic appears to be an underlying factor in our worsening epidemics of obesity and diabetes, and we may not be able to

reverse the trends without making fundamental changes in our environment and social forces. Mental health disorders, some cancers and other disease also appear to involve epigenetic dynamics. The environment and social determinants of health, which currently receive little research attention, will turn out to be critically important. So new genetic knowledge could point the way for how we must change our environment, personal behavior and society as a whole to maintain a healthy nation. This knowledge will weaken long-standing boundaries between scientific disciplines and other forms of understanding, including various cultural worldviews and religions that are studied in the social sciences.

The new scientific agenda will be propelled by centers emerging in China, India and other areas that will be linked by better tools for online collaboration. These tools will allow researchers to interact in real time in virtual worlds to share ideas and test hypothesis. These new forms of collaboration will change the cultural silos of the global scientific community by including more eastern values and focusing on scientific problems of concern to the developing world. This cultural shift will make prevention, neglected and high disparity diseases paramount concerns for science.

The ethos and methods of open source will propel the free flow of ideas and reverse the propensity to over-patent and restrict basic research, which has been an unintended consequence of the 1980 Bayh-Dole Act. More open, collaborative projects that involve multiple research centers from around the world will define much of the "big" basic science occurring globally. These projects will follow the footsteps of earlier collaborations such as the Human Genome Project and International HapMap Project. Other projects, such as the Biological Innovation for an Open Society (BIOS), and the Public Library of Science (PLoS), will explicitly draw on the ethos, community building methods, and I.P. protections of the open source community in software to create an "intellectual commons" of scientific knowledge that researchers can draw upon.

Scientists and policy makers alike will be operating in a more democratic and transparent world that moves toward interdisciplinary approaches and holistic views. The most effective way to improve health and lower healthcare costs requires biomedical scientists and social scientists to collaborate in finding solid links between lifestyle, environment, society and health. Together biomedical and social scientists can create the tools needed by policy-makers to improve health by using community based interventions. Both scientists and policy-makers will be supported by new biomonitoring technologies and health information systems that provide real time tracking of health information.

Policy-makers will also need to revamp regulation in the healthcare sector to take advantage of new technologies, reduce costs and improve safety. For example, in drug development, much of the costs are caused by lengthy and expensive clinical trials that provide very partial information regarding safety and efficacy. Relatively rare safety problems that are unlikely to be found in clinical trials can be more effectively found in markets given a new infrastructure of electronic medical records, biomonitors and linked scientists who study data in open source networks. Reducing the costs of drug development will also require the use of new methods such as adaptive clinical trials to more quickly identify promising drug candidates, eliminate those with safety problems, and identify sub-populations of patients for whom specific drugs will be the most beneficial. However, these changes will work only with increased

support for regulatory agencies so they have the knowledge needed to use new methods and technology.

Better computer simulations and advances in molecular biology will also make it easier for both regulators and drug companies to identify promising candidates early in clinical trials and eliminate those most likely to fail. They will also make it easier to identify sub-populations most likely to benefit. These same technologies will also be used to further identify and narrow down sub-populations most likely to see benefit from any given treatment.

Forecast for Science & Technology Breakthroughs

Advances in science & technology in 2019 illuminate not only the importance of molecular changes inside the cell, but the complex and interactive systems that affect health. Advances in the –omic sciences (e.g. genomics, epigenomics, proteomics, metabolomics, etc.) provide a basis for understanding the complex interactions inside the human body that predict disease. By 2019, systems biology will contribute to better measures of risk for disease as well as better diagnostic tests for monitoring and managing health.

Genomics in 2019 heralds a form of personalized medicine where diagnostic tests are used to identify treatments most likely to help a patient. This includes personalized lifestyle and nutrition changes focused on preventing disease and supported by biomonitoring technologies. Proteomics, metabolomics and other –omic sciences are a vital part of this move toward personalized medicine as they provide new targets for therapies and diagnostic devices. Epigenomics provides the link between personal genomics and effective prevention by illuminating the relationship between genetics and social, environmental and lifestyle changes. Systems biology, a scientific discipline that studies the complexity in biological systems, combines these disciplines together and allows researchers to understanding how complex systems work inside the cell and the importance of environmental and social influences. Preventing disease by making major changes in the way we live could be the bedrock of future health management.

Nanotechnology supports advances in the –omic sciences and systems biology and is an integral part of new diagnostic tests and therapies in 2019. The ability of nanotechnology to create new molecules and manipulate existing molecules is widely used in developing new diagnostics and therapies. Nanotechnology allows medical device companies to alter the surface of materials enabling, for example, companies to create smaller implants, artificial organs with pores at the nanoscale and implants that bind with tissue faster. Quantum dots and other nano-particles improve imaging technologies by enabling better visualization and image guided therapies. Micro-fluidic nanolabs are developed that are capable of measuring key interactions within individual cells and aggregating those measurements for hundreds of thousands of cells.

In 2019, patients will track their own health using biomonitoring technologies and work with automated programs to improve their lifestyles. Advances in high-throughput screening allow patients to receive a full, personal genome for under a $1,000.00. Other biomarker tests enable patients to monitor the level of a wide range of proteins, metabolites and other molecules in the body. Consumer devices enable the health conscious to accurately track calorie input and energy expenditure as well as exposure to environmental toxins. Inexpensive wireless broadband enables these devices to share information with patient's cell phone or computer. Patients can then store that information in robust personal health records that allow them to track vital statistics over time to monitor their own health. This data will be shared with patients' care teams so they can accurately determine genetic risk for certain types of diseases, how well they are doing in managing their diseases, reacting to therapy or improving their lifestyles.

A Successful Innovation System For Healthcare In 2019

The healthcare innovation system of 2019 balances the tension between generous support for health science research and the growing funding crisis in healthcare. Many of the new technologies and therapies in healthcare that will emerge in 2019 will be extraordinarily expensive. They will also save or improve the lives of millions. To manage that balance, the healthcare payment and delivery systems of 2019 focus on prevention and using safe, effective interventions. These changes send the right market signals to the companies that develop new technologies and therapies. The changes are consistent with the changes identified as needed in our healthcare system as outlined in IAF's payment and delivery system briefs as well as the values for healthcare identified by the 2019 Healthcare that Works for All.

While the costs of maintaining world leadership in research and development in 2019 remains high, the United States receives more health benefit for each dollar spent by focusing on prevention, using new technologies for pre and post-market studies, embracing adaptive clinical trials and targeting therapies to those sub-populations most likely to receive benefit. Many of the cost savings come by restricting access to technologies and therapies that do not help a patient, or lead to expensive complications with therapeutic failures. These changes in incentives for science and technology are achieved by the market focused incentives and pressure by stakeholders as outlined in the health economics brief.

The 2019 healthcare system links science and health through partnerships with local communities on effective public health and disease prevention initiatives. Government agencies work together to address the underlying causes of health inequities such as sub-standard housing, environmental pollutants, inadequate transportation and institutional racism. Large scale studies on community health, using the information gathered by the personal health records of community members, provide policy-makers with concrete evidence to justify expenditures in public health and disease prevention. These new strategies not only reduce morally unjust health inequities, but also reduce healthcare costs by reducing expensive care for preventable chronic diseases and high cost acute care at emergency rooms where technology is put to work at a very high cost.

Pragmatic Steps To Achieve This Vision Of A Better Future

A. Continued support for basic research
B. More support for applied and post market research
C. Strong patent protections combined with innovations from open source
D. Shift to adaptive clinical trials combined with strong post-market studies
E. Improved funding for regulatory agencies to build up capacity in new science and technology
F. New funding and innovation approaches for neglected and high disparity diseases
G. More funding on the socioeconomic links to poor health
H. Better alignment in healthcare payment and delivery systems with prevention to provide the right market forces for innovation

What Would Happen If We Fail To Change?

Failure to change our system of innovation promises to undermine public support for science and technology. If dazzling and expensive science serves the interests of a few while failing to improve the health of many, the ethical base of medical innovation will erode, and the large budgets provided NIH and the patents granted to industry will come under attack. Public outrage over preventable harm from therapeutic failure will lead to a rejection of high-tech medicine and adoption of alternative therapies. America has been spending over $2 trillion a year in the healthcare sector of our economy. One of the benefits of this tremendous expense has been access to the most cutting edge technology and therapies in the world for those with good health coverage. However, to continue to provide access to this cutting edge technology requires the U.S. to focus on developing, and paying for, only the most efficacious therapies. This must be combined with upgrades to our health information systems to ensure patients, physicians and researchers have access to timely and accurate health information. In the coming era of tight federal and state budgets, there will also be the temptation to cut back on the basic research that fuels innovation. And there will always be political pressure to restrict research in ethically grey areas such as stem cells. Both pressures must resisted least the locus of innovation, and high quality jobs, that currently reside in the United States move abroad.