This book adopts an integrated and workflow-based treatment of the field of personalized and precision medicine (PPM). Outlined within are established, proven and mature workflows as well as emerging and highly-promising opportunities for development. Each workflow is reviewed in terms of its operation and how they are enabled by a multitude of informatics methods and infrastructures. The book goes on to describe which parts are crucial to discovery and which are essential to delivery and how each of these interface and feed into one-another. Personalized and Precision Medicine Informatics provides a comprehensive review of the integrative as well as interpretive nature of the topic and brings together a large body of literature to define the topic and ensure that this is the key reference for the topic. It is an unique contribution that is positioned to be an essential guide for both PPM experts and non-experts, and for both informatics and non-informatics professionals.

Those involved in the drug development process face challenges of efficiency and overall sustainability due in part to high research costs, lengthy development timelines, and late-stage drug failures. Novel clinical trial designs that enroll participants based on their genetics represent a potentially disruptive change that could improve patient outcomes, reduce costs associated with drug development, and further realize the goals of precision medicine. On
March 8, 2017, the Forum on Drug Discovery, Development, and Translation and the Roundtable on Genomics and Precision Health of the National Academies of Sciences, Engineering, and Medicine hosted the workshop Enabling Precision Medicine: The Role of Genetics in Clinical Drug Development. Participants examined successes, challenges, and possible best practices for effectively using genetic information in the design and implementation of clinical trials to support the development of precision medicines, including exploring the potential advantages and disadvantages of such trials across a variety of disease areas. This publication summarizes the presentations and discussions from the workshop.

Precision medicine is focused on the individual and will require the rapid and accurate identification and prioritization of causative factors of disease. To move forward and accelerate the delivery of the anticipated benefits of precision medicine, developing predictable, reproducible, and reliable animal models will be essential. In order to explore the topic of animal-based research and its relevance to precision medicine, the National Academies of Sciences, Engineering, and Medicine convened a 2-day workshop on October 5 and 6, 2017. The workshop was designed to focus on the development, implementation, and interpretation of model organisms to advance and accelerate the field of precision medicine. Participants examined the extent to which next-generation animal models, designed using patient data and phenotyping platforms targeted to reveal and inform disease mechanisms, will be essential to the successful implementation of precision medicine. This publication summarizes the presentations and discussions from the workshop.

Personalized and precision medicine (PPM)—the targeting of therapies according to an individual's genetic, environmental, or lifestyle characteristics—is becoming an increasingly important approach in health care treatment and prevention. The advancement of PPM is a challenge in traditional clinical, reimbursement, and regulatory landscapes because it is costly to develop and introduces a wide range of scientific, clinical, ethical, and socioeconomic issues. PPM raises a multitude of economic issues, including how information on accurate diagnosis and treatment success will be disseminated and who will bear the cost; changes to physician training to incorporate genetics, probability and statistics, and economic considerations; questions about whether the benefits of PPM will be confined to developed countries or will diffuse to emerging economies with less developed health care systems; the effects of patient heterogeneity on cost-effectiveness analysis; and opportunities for PPM’s growth beyond treatment of acute illness, such as prevention and reversal of chronic conditions. This volume explores the intersection of the scientific, clinical, and economic factors affecting the development of PPM, including its effects on the drug pipeline, on reimbursement of PPM diagnostics and treatments, and on funding of the requisite underlying research; and it examines recent empirical applications of PPM.

Those involved in the drug development process face challenges of efficiency and overall sustainability due in part to high research costs, lengthy development timelines, and late-stage drug failures. Novel clinical trial designs that enroll participants based on their genetics represent a potentially disruptive change that could improve patient outcomes, reduce costs associated with drug development, and further realize the goals of precision medicine. On March 8, 2017, the Forum on Drug Discovery, Development, and Translation and the Roundtable on Genomics and Precision Health of the National Academies of Sciences, Engineering, and Medicine hosted the workshop Enabling Precision Medicine: The Role of Genetics in Clinical Drug Development. Participants examined successes, challenges, and possible best practices for effectively using genetic information in the design and
implementation of clinical trials to support the development of precision medicines, including exploring the potential advantages and disadvantages of such trials across a variety of disease areas. This publication summarizes the presentations and discussions from the workshop.

This book provides a review of precision agriculture technology development, followed by a presentation of the state-of-the-art and future requirements of precision agriculture technology. It presents different styles of precision agriculture technologies suitable for large scale mechanized farming; highly automated community-based mechanized production; and fully mechanized farming practices commonly seen in emerging economic regions. The book emphasizes the introduction of core technical features of sensing, data processing and interpretation technologies, crop modeling and production control theory, intelligent machinery and field robots for precision agriculture production.

These are the proceedings of the Workshop on Precision Measurements of $\alpha_s$ held at the Max-Planck-Institute for Physics, Munich, February 9-11, 2011. The workshop explored in depth the determination of $\alpha_s(m_{\text{Z}})$ in the $\text{MS}$ scheme from the key categories where high precision measurements are currently being made, including DIS and global PDF fits, $\tau$-decays, electro-weak precision observables and $Z$-decays, event-shapes, and lattice QCD. These proceedings contain a short summary contribution from the speakers, as well as the lists of authors, conveners, participants, and talks.

This book highlights the latest advances in the application of artificial intelligence to healthcare and medicine. It gathers selected papers presented at the 2019 Health Intelligence workshop, which was jointly held with the Association for the Advancement of Artificial Intelligence (AAAI) annual conference, and presents an overview of the central issues, challenges, and potential opportunities in the field, along with new research results. By addressing a wide range of practical applications, the book makes the emerging topics of digital health and precision medicine accessible to a broad readership. Further, it offers an essential source of information for scientists, researchers, students, industry professionals, national and international public health agencies, and NGOs interested in the theory and practice of digital and precision medicine and health, with an emphasis on risk factors in connection with disease prevention, diagnosis, and intervention.

This book describes the analysis and design of precision temperature sensors in CMOS IC technology, focusing on so-called smart temperature sensors, which provide a digital output signal that can be readily interpreted by a computer. The text shows how temperature characteristics can be used to obtain an accurate digital temperature reading. The book ends with a detailed description of three prototypes, one of which achieves the best performance reported to date.

On January 20, 2015, President Obama announced the Precision Medicine Initiative (PMI) in his State of the Union address. The PMI, by developing new approaches for detecting, measuring, and analyzing a wide range of biomedical information including molecular, genomic, cellular, clinical, behavioral, physiological, and environmental parameters, is intended to enable a new era of medicine in which researchers, providers, and patients work together to develop individualized care. Part of this effort included the creation of a national, large-scale research participant group, or cohort. The PMI Cohort Program is aimed at extending precision
medicine to many diseases, including both rare and common diseases such as diabetes, heart disease, Alzheimer's disease, obesity, and mental illnesses such as depression, bipolar disorder, and schizophrenia, by building a national research cohort of 1 million or more U.S. participants. An important challenge to assembling the PMI Cohort will be to reach individuals who are socioeconomically disadvantaged. Individuals who are socioeconomically disadvantaged have lower health literacy; often belong to racial, ethnic, and minority communities; and are often less likely to participate in research studies and biorepositories. To explore possible strategies and messaging designs, the Roundtable on Health Literacy formed an ad hoc committee charged with planning and conducting a 1-day public workshop on the intersection of health literacy and precision medicine. The workshop participants discussed a variety of topics including an overview of precision medicine and its potential, the relevance of health literacy to the success of precision medicine efforts, and perspectives and understanding of different groups, such as health care providers, consumers, and insurers. This publication summarizes the presentations and discussions from the workshop.

Genomic and Precision Medicine: Primary Care, Third Edition is an invaluable resource on the state-of-the-art tools, technologies and policy issues that are required to fully realize personalized health care in the area of primary care. One of the major areas where genomic and personalized medicine is most active is the realm of the primary care practitioner. Risk, family history, personal genomics and pharmacogenomics are becoming increasingly important to the PCP and their patients, and this book discusses the implications as they relate to primary care practitioners. Presents a comprehensive volume for primary care providers Provides succinct commentary and key learning points that will assist providers with their local needs for the implementation of genomic and personalized medicine Includes a current overview on major opportunities for genomic and personalized medicine in practice Highlights case studies that illustrate the practical use of genomics in the management in patients

The National Clinical Trials Network (NCTN) supported by the National Cancer Institute (NCI) has played an integral role in cancer research and in establishing the standard of care for cancer patients for more than 50 years. Formerly known as the NCI Clinical Trials Cooperative Group Program, the NCTN is comprised of more than 2,100 institutions and 14,000 investigators, who enroll more than 20,000 cancer patients in clinical trials each year across the United States and internationally. Recognizing the recent transformative advances in cancer research that necessitate modernization in how cancer clinical trials are run, as well as inefficiencies and other challenges impeding the national cancer clinical trials program, the NCI asked the IOM to develop a set of recommendations to improve the federally funded cancer clinical trials system. These recommendations were published in the 2010 report, A National Cancer Clinical Trials System for the 21st Century: Reinvigorating the NCI Cooperative Group Program. In early 2011, the NCPF and the American Society of Clinical Oncology (ASCO) held a workshop in which stakeholders discussed the changes they planned to implement in response to the IOM goals and recommendations. Two years later, on February 11-12, 2013, in Washington, DC, the NCPF and ASCO reconvened stakeholders to report on the changes they have made thus far to address the IOM recommendations. At this workshop, representatives from the NCI, the NCTN, comprehensive cancer centers, patient advocacy groups, the Food and Drug Administration (FDA), industry, and other stakeholders highlighted the progress that has been made in achieving the goals for a reinvigorated national cancer clinical trials system. Implementing a National Cancer Clinical Trials System for the 21st Century is a summary of that workshop.
On January 20, 2015, President Obama announced the Precision Medicine Initiative (PMI) in his State of the Union address. The PMI, by developing new approaches for detecting, measuring, and analyzing a wide range of biomedical information including molecular, genomic, cellular, clinical, behavioral, physiological, and environmental parameters, is intended to enable a new era of medicine in which researchers, providers, and patients work together to develop individualized care. Part of this effort included the creation of a national, large-scale research participant group, or cohort. The PMI Cohort Program is aimed at extending precision medicine to many diseases, including both rare and common diseases such as diabetes, heart disease, Alzheimer's disease, obesity, and mental illnesses such as depression, bipolar disorder, and schizophrenia, by building a national research cohort of 1 million or more U.S. participants. An important challenge to assembling the PMI Cohort will be to reach individuals who are socioeconomically disadvantaged. Individuals who are socioeconomically disadvantaged have lower health literacy; often belong to racial, ethnic, and minority communities; and are often less likely to participate in research studies and biorepositories. To explore possible strategies and messaging designs, the Roundtable on Health Literacy formed an ad hoc committee charged with planning and conducting a 1-day public workshop on the intersection of health literacy and precision medicine. The workshop participants discussed a variety of topics including an overview of precision medicine and its potential, the relevance of health literacy to the success of precision medicine efforts, and perspectives and understanding of different groups, such as health care providers, consumers, and insurers. This publication summarizes the presentations and discussions from the workshop.

Papers presented at the conference.

Consumer genomics, encompassing both direct-to-consumer applications (i.e., genetic testing that is accessed by a consumer directly from a commercial company apart from a health care provider) and consumer-driven genetic testing (i.e., genetic testing ordered by a health care provider in response to an informed patient request), has evolved considerably over the past decade, moving from more personal utility-focused applications outside of traditional health care to interfacing with clinical care in nontraditional ways. As consumer genomics has increasingly intersected with clinical applications, discussions have arisen around the need to demonstrate clinical and analytical validity and clinical utility due to the potential for misinterpretation by consumers. Clinical readiness and interest for this information have presented educational and training challenges for providers. At the same time, consumer genomics has emerged as a potentially innovative mechanism for thinking about health literacy and engaging participants in their health and health care. To explore the current landscape of consumer genomics and the implications for how genetic test information is used or may be used in research and clinical care, the Roundtable on Genomics and Precision Health of the National Academies of Sciences, Engineering, and Medicine hosted a public workshop on October 29, 2019, in Washington, DC. Discussions included such topics as the diversity of participant populations, the impact of consumer genomics on health literacy and engagement, knowledge gaps related to the use of consumer genomics in clinical care, and regulatory and health policy issues such as data privacy and security. A broad array of stakeholders took part in the workshop, including genomics and consumer genomics experts, epidemiologists, health disparities researchers, clinicians, users of consumer genomics research applications, representatives from patient advocacy groups, payers, bioethicists, regulators, and policy makers. This publication summarizes the presentations and discussion of the workshop.

"The field of Biomarkers and Precision Medicine in drug development is rapidly evolving and this book presents a snapshot of exciting new approaches. By presenting a wide range of
biomarker applications, discussed by knowledgeable and experienced scientists, readers will develop an appreciation of the scope and breadth of biomarker knowledge and find examples that will help them in their own work." - Maria Freire, Foundation for the National Institutes of Health Handbook of Biomarkers and Precision Medicine provides comprehensive insights into biomarker discovery and development which has driven the new era of Precision Medicine. A wide variety of renowned experts from government, academia, teaching hospitals, biotechnology and pharmaceutical companies share best practices, examples and exciting new developments. The handbook aims to provide in-depth knowledge to research scientists, students and decision makers engaged in Biomarker and Precision Medicine-centric drug development. Features: Detailed insights into biomarker discovery, validation and diagnostic development with implementation strategies Lessons-learned from successful Precision Medicine case studies A variety of exciting and emerging biomarker technologies The next frontiers and future challenges of biomarkers in Precision Medicine Claudio Carini, Mark Fidock and Alain van Gool are internationally recognized as scientific leaders in Biomarkers and Precision Medicine. They have worked for decades in academia and pharmaceutical industry in EU, USA and Asia. Currently, Dr. Carini is Honorary Faculty at King's College School of Medicine, London, UK. Dr. Fidock is Vice President of Precision Medicine Laboratories at AstraZeneca, Cambridge, UK. Prof. dr. van Gool is Head Translational Metabolic Laboratory at Radboud university medical school, Nijmegen, NL.

Motivated by the explosion of molecular data on humans-particularly data associated with individual patients-and the sense that there are large, as-yet-untapped opportunities to use this data to improve health outcomes, Toward Precision Medicine explores the feasibility and need for "a new taxonomy of human disease based on molecular biology" and develops a potential framework for creating one. The book says that a new data network that integrates emerging research on the molecular makeup of diseases with clinical data on individual patients could drive the development of a more accurate classification of diseases and ultimately enhance diagnosis and treatment. The "new taxonomy" that emerges would define diseases by their underlying molecular causes and other factors in addition to their traditional physical signs and symptoms. The book adds that the new data network could also improve biomedical research by enabling scientists to access patients' information during treatment while still protecting their rights. This would allow the marriage of molecular research and clinical data at the point of care, as opposed to research information continuing to reside primarily in academia. Toward Precision Medicine notes that moving toward individualized medicine requires that researchers and health care providers have access to very large sets of health- and disease-related data linked to individual patients. These data are also critical for developing the information commons, the knowledge network of disease, and ultimately the new taxonomy.

At a time when libraries are no longer the leading proprietors of information, many library professionals find themselves rethinking their purpose. In this collection of new essays, contributors share their experiences and ideas for keeping libraries integral to changing communities. Innovative approaches and best practices are discussed for strategic planning, packaging, branding and marketing, funding issues, physical spaces, collection needs and trends, partnerships, programming and services, professional education, and staffing.

On March 2, 2016, the Roundtable on Health Literacy of the National Academies of Sciences, Engineering, and Medicine convened a workshop to examine the relevance of health literacy to
precision medicine, a growing field that takes into account individuals' differences in genes, environments, and lifestyles. The workshop explored the intersection of health literacy and precision medicine through a number of topics, but its impetus was the Precision Medicine Initiative (PMI). The PMI is a multiyear effort announced in 2015 and launched in 2016, led by the White House and including agencies across the federal government, to advance the practice of precision medicine. The information and viewpoints summarized in this Workshop in Brief reflect the knowledge and opinions of the workshop participants.

Genomic medicine is defined as the routine use of genomic information about an individual as part of his or her clinical care as well as the health outcomes and policy implications of that clinical use. It is one approach that has the potential to improve the quality of health care by allowing practitioners to tailor prevention, diagnostic, and treatment strategies to individual patients. In recent years, research breakthroughs, technological advances, and the decreasing cost of DNA sequencing have led to the wider adoption of genomic medicine. However, as with the introduction of new technologies into health care, there are concerns that genetic and genomic testing and services will not reach all segments of the population both now and in the near future, and there remains a gap in knowledge regarding potential health care disparities in genomic medicine and precision health approaches. On June 27, 2018, the National Academies of Sciences, Engineering, and Medicine hosted a public workshop to examine the gaps in knowledge related to access to genomic medicine and to discuss health care disparities and possible approaches to overcoming the disparate use of genomic medicine among populations. Workshop participants discussed research on access to genetics and genomics services in medically underserved areas, model programs of care for diverse patient populations, and current challenges and possible best practices for alleviating health care disparities as they relate to genomics-based approaches. This publication summarizes the presentations and discussions from the workshop.

Precision Medicine for Investigators, Practitioners and Providers addresses the needs of investigators by covering the topic as an umbrella concept, from new drug trials to wearable diagnostic devices, and from pediatrics to psychiatry in a manner that is up-to-date and authoritative. Sections include broad coverage of concerning disease groups and ancillary information about techniques, resources and consequences. Moreover, each chapter follows a structured blueprint, so that multiple, essential items are not overlooked. Instead of simply concentrating on a limited number of extensive and pedantic coverages, scholarly diagrams are also included. Provides a three-pronged approach to precision medicine that is focused on investigators, practitioners and healthcare providers Covers disease groups and ancillary information about techniques, resources and consequences Follows a structured blueprint, ensuring essential chapters items are not overlooked.

On March 24, 2020, a 1-day public workshop titled The Role of Digital Health Technologies in Drug Development was convened by the National Academies of Sciences, Engineering, and Medicine. This workshop builds on prior efforts to explore how virtual clinical trials facilitated by digital health technologies (DHTs) might change the landscape of drug development. To explore the challenges and opportunities in using DHTs for improving the probability of
success in drug R&D, enabling better patient care, and improving precision medicine, the workshop featured presentations and panel discussions on the integration of DHTs across all phases of drug development. Throughout the workshop, participants considered how DHTs could be applied to achieve the greatest impact and perhaps even change the face of how clinical trials are conducted in ways that are also ethical, equitable, safe, and effective. This publication summarizes the presentations and discussions from the workshop.

A FRESH EXAMINATION OF PRECISION MEDICINE’S INCREASINGLY PROMINENT ROLE IN THE FIELD OF ONCOLOGY Precision medicine takes into account each patient’s specific characteristics and requirements to arrive at treatment plans that are optimized towards the best possible outcome. As the field of oncology continues to advance, this tailored approach is becoming more and more prevalent, channelling data on genomics, proteomics, metabolomics and other areas into new and innovative methods of practice. Precision Medicine in Oncology draws together the essential research driving the field forward, providing oncology clinicians and trainees alike with an illuminating overview of the technology and thinking behind the breakthroughs currently being made. Topics covered include: Biologically-guided radiation therapy Informatics for precision medicine Molecular imaging Biomarkers for treatment assessment Big data Nanoplatforms Casting a spotlight on this emerging knowledge base and its impact upon the management of tumors, Precision Medicine in Oncology opens up new possibilities and ways of working – not only for oncologists, but also for molecular biologists, radiologists, medical geneticists, and others.

A hallmark of high-quality cancer care is the delivery of the right treatment to the right patient at the right time. Precision oncology therapies, which target specific genetic changes in a patient’s cancer, are changing the nature of cancer treatment by allowing clinicians to select therapies that are most likely to benefit individual patients. In current clinical practice, oncologists are increasingly formulating cancer treatment plans using results from complex laboratory and imaging tests that characterize the molecular underpinnings of an individual patient's cancer. These molecular fingerprints can be quite complex and heterogeneous, even within a single patient. To enable these molecular tumor characterizations to effectively and safely inform cancer care, the cancer community is working to develop and validate multiparameter omics tests and imaging tests as well as software and computational methods for interpretation of the resulting datasets. To examine opportunities to improve cancer diagnosis and care in the new precision oncology era, the National Cancer Policy Forum developed a two-workshop series. The first workshop focused on patient access to expertise and technologies in oncologic imaging and pathology and was held in February 2018. The second workshop, conducted in collaboration with the Board on Mathematical Sciences and Analytics, was held in October 2018 to examine the use of multidimensional data derived from patients with cancer, and the computational methods that analyze these data to inform cancer treatment decisions. This publication summarizes the presentations and discussions from the second workshop.

Copyright code: 0c12e41d3ede25f6a9adc9315a759f14