The future of cancer care: Moving from promise to reality

A thought leadership paper on “High-value cancer care”
Preface

The Insights Series

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We believe that increasing value in healthcare—delivering better outcomes at lower cost—rests on four strategies. These four principles serve as the cornerstones of the Insights Series.

Our Insights portfolio is an integrated collection of events, speaking engagements, roundtable discussions, and an expanding array of print and digital platforms and products all carefully curated to share ideas, encourage discussion, disseminate original research and reinforce our position as a healthcare thought leader.

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Executive summary

Imagine a world where a cancer diagnosis isn’t a tragedy. A world where a cancer patient can be confident that no matter how complex the case, it will be carefully and quickly addressed. A world where cancer is viewed as another manageable chronic disease. A world without fear of cancer.

Experts predict that by 2047—just 25 years down the road—that world might not be too far off. In fact for some types of cancer, even today in 2022, that world is drawing close.

As a first step to achieving this ambitious goal, we need to reflect on where we are and what’s required to advance the fight against cancer. This paper outlines some of the most pressing challenges healthcare providers and cancer care teams currently face, including:

- Fragmented care with a lack of integration between clinical specialties
- Increasing demands on medical professionals, including the vast and accelerating amount of new information clinicians must absorb
- The high cost of care
- Non-standardized and fragmented medical technology infrastructures that create barriers to coordinated, comprehensive cancer care
- Variability in access to care and gaps in the adoption of modern technologies that can lead to compromises in treatment quality and/or patient outcomes

Several exciting near-term solutions are beginning to have a positive impact, and will form the foundation of a future with more comprehensive, multimodal, integrated cancer care. These include:

- Earlier detection and diagnosis, as well as localized, less-invasive treatment approaches
- The ability to harness the power of panomics
- Transformation of data into decision support tools
- Expansion of the potential of immunotherapy, as well as new methodologies in diagnostics, genomics, precision medicine, robotic surgery, interventional oncology, and radiotherapy
- Development of intelligent cancer care tools that harness the power of artificial intelligence and machine learning to enable greater personalization and standardization of care

If scientists, researchers, and health systems around the world collaborate to address the challenges and implement the solutions, we are confident that we will achieve a world without fear of cancer.
Cancer is currently one of the biggest global health challenges we face. Cancer accounts for nearly 10 million deaths in 2020, or nearly one in six deaths.\(^1\) It is the leading cause of death in developed countries and the number two cause of death globally. There were more than 18 million new cancer cases around the world in 2020.\(^2\)

Scientists, researchers, and healthcare providers have been locked in a battle with cancer for generations. For a very long time, it was believed that this might be a battle where only small victories would be achieved. Today, there are many reasons to be more optimistic about the future of cancer care than ever before.

Over the next 25 years, some experts predict it is entirely possible the perception of cancer can shift, so that it is considered a manageable, chronic disease, similar to how some now think of diabetes and hypertension. In other words, a cancer diagnosis will no longer cause the fear that it does today. Advances in global networking, cloud computing, and digital communications are enabling greater connectivity between centers of excellence in cancer care and populations in need throughout the world. New discoveries and methodologies in diagnostics, genomics, precision medicine, immunotherapy, artificial intelligence, robotic surgery, radiotherapy, and data analytics are being introduced every year.
These new technologies and treatment approaches will be used to create a world where surviving cancer is much more common. By harnessing these and other emerging technologies, we can usher in an era where a number of tumor types can effectively be managed or even eradicated.\textsuperscript{3,4}

In many ways, health systems around the world already possess much of the knowledge, skill, and technology that will be required. The next step will be leveraging these capabilities and working together to drive change in how medical care is organized and managed, and how knowledge derived from data is brought to bear at every step of the cancer patient’s journey. It is now just a question of summoning the will and collective effort required to make it happen.
The challenge

The challenges, and tremendous potential, of cancer care

Moving from fragmented care to integrated care

Moving beyond today’s fragmented cancer care landscape towards a more integrated approach to cancer care is critical. The cancer care continuum today is siloed. This not only prevents cancer specialists, primary care physicians, and affiliated healthcare providers from properly working together, but it also remains a barrier to optimal patient outcomes.

Healthcare systems everywhere now understand the need for better integration, and one solution that is emerging is integrated multidisciplinary cancer care teams, where cancer patients can become active participants in sharing information and making treatment decisions. In addition, ensuring connectivity between academic institutions, cancer treatment centers, community oncology practices, and primary care providers is absolutely necessary to drive continued progress in cancer care. Empowering physicians to spend more of their time treating patients and less time wrestling with technology is an important shared goal for physicians and technology solutions providers alike. In addition, equipping patients with resources that allow them to become more active and engaged members of the cancer care team is critical to improving outcomes.

Increasing demands on medical professionals

Rapid, exponential progress in available technology, data analytics, and cancer treatment approaches over the next 25 years will require the role of physicians to evolve to keep pace.

Workforce demand-supply gap grows every year
While rapid progress in cancer care is inherently positive, we must also account for the new challenges and demands that may arise. For example, in recent years, new medical articles have been appearing at a rate of at least one every 26 seconds. This means that to stay current, a doctor would need to read thousands of articles per day.\textsuperscript{6}

This highlights a clear need for changes in medical education, training, and certifications for physicians and other healthcare professionals specializing in cancer care. It also reinforces the importance of intelligent technology. A more integrated, data-based technology ecosystem could address many of these challenges by enabling data aggregation—including published outcomes research—and making it possible to mine the data for actionable insights that can inform patient care.

Detection, diagnosis, and localized treatment approaches

Diagnosing cancer earlier significantly improves the chances of successful treatment. With earlier diagnosis, more cancers can be targeted and treated locally (at the tumor site) rather than systemically. In these cases, patients diagnosed with early-stage disease may not need systemic treatments such as chemotherapy. Less reliance on systemic chemotherapy provides an opportunity to significantly reduce treatment side effects.

The potential impact that earlier diagnosis will have on treatment outcomes and survival will be transformative. Artificial intelligence and machine learning have both been shown to enable and expand early detection of cancer by more accurately identifying at-risk patients, improving diagnostic test sensitivity and specificity, accelerating our ability to screen and risk-stratify patient populations, improving treatment planning, and predicting treatment outcomes.\textsuperscript{7,8} Blood tests used as “liquid biopsies” to identify circulating tumor DNA will also enable earlier detection, diagnosis, and treatment of cancer. These technologies are currently in development.

The earlier cancer is caught, the more localized the treatment can be. Advances in treatment that target tumors very narrowly include intensity-modulated radiation therapy (IMRT), proton therapy, stereotactic radiosurgery (SRS), microwave, cryotherapy, and robotic surgery are all local therapies that are becoming increasingly precise. The more cancer can be diagnosed while the disease itself is still localized, the more these technologies can be used to treat specific types of cancer. This approach has the potential to deliver better treatment outcomes and improve both convenience and quality of life for millions of cancer patients.

In addition to early diagnosis, timely treatment is a key predictor of patient outcomes. A four-week delay in starting treatment is associated with increased mortality across surgical, systemic treatment, and radiotherapy indications for seven types of cancer.\textsuperscript{9} By connecting the steps between screening, diagnosis, and treatment, we can shorten the time a patient waits while a treatment path is determined.
Transforming data into decision support tools

Over the past decade, we have witnessed an explosion in big data, particularly in our ability to collect and analyze vast numbers of data points. There is great focus within governments, industry experts, and academics on improving our ability to synthesize all of this data and leverage it into actionable intelligence. Our success in doing this will determine the degree to which we can transform cancer care over the next 25 years.

The four “Vs” of big data are volume, velocity, variety, and veracity. Volume refers to the incredible amounts of data now being generated. Velocity is the rapid speed at which data is accumulating. Variety is the proliferation of different data sets and the wide range of formats, practice settings, specialties, and disease states for which these data sets are being created. Standardizing these many different data sets so that together they provide meaningful, actionable information that drives treatment is key. With so much data being generated at an increasingly rapid rate and for so many different treatment settings and disease states, the veracity of this data—whether it accurate and error free—is extremely important as healthcare practitioners and patients come to rely on it more and more.

Harnessing the four “Vs” is one thing. Turning that data into useful decision support tools for physicians and patients is a major challenge where a significant amount of work remains to be done. This will require greater standardization of data sets and electronic health records (EHRs) between governments, large institutions, and private practices. It will require better integration between databases, including ASCO’s CancerLinQ®, the Surveillance, Epidemiology and End Results (SEER) database in the United States, the World Health Organization’s Global Cancer Observatory (GCO) and the EU European Cancer Information System. And it will require the improved utilization of treatment guidelines. Finally, it will require significant improvements in our ability to track, analyze, and use patient-reported outcomes to change research and treatment protocols in real time. All of this will need to be done in ways that adhere to national and international data privacy laws and regulations, and respect the privacy of individual cancer patients around the world.
The four “Vs” of Big Data

Volume

Velocity

Variety

Veracity
Harnessing the power of panomics

An accelerated understanding of the complex molecular basis of cancer is giving rise to panomics, which is the integration of increasingly complex datasets from subfields such as genomics, proteomics, metabolomics and more. Panomics offers an expanded framework for learning about the complex networks of molecular pathways and characteristics of the tumor microenvironment. A more sophisticated understanding of the factors that drive cancer is significantly increasing the number of available targets and allowing for far greater precision in attacking those targets.³

Tapping into the potential of immunotherapy

We have known for more than a decade that targeted immunotherapy—treatment that triggers the body’s immune system to fight cancer—has the potential to control or even eradicate certain types of cancer. Though it is still in the early phases of development, immunotherapy in general holds enormous promise. In the past five years, the increased availability of approved immunotherapy drugs has led to greater interest in the potential of combining immunotherapy therapy treatments with other treatment modalities (e.g., radiotherapy) for certain types of cancer.

The results of these combination studies have been encouraging so far, and many researchers believe that we are just starting to scratch the surface.¹¹

There are still a number of challenges to immunotherapy delivering on its early promise. These include patient selection for a particular treatment based on tumor biomarkers, effectively managing toxicities, identifying ideal combinations of immunotherapy and other therapies for specific tumor types, and managing treatment costs. However, given the pace of recent progress, there is good reason to believe that these challenges can be addressed within the next 25 years.

Tackling clinical research and treatment costs

In 2016, the Tufts Center for the Study of Drug Development estimated the total cost of bringing a new drug to market to be $2.8 billion and rising.¹² With cancer incidence and mortality continuing to rise in developing countries, cost effectiveness must become the guiding principle in cancer treatment and clinical research.

This is an area where data analytics, AI, and machine learning can have an enormous impact by reducing the time required to complete clinical trials and improving the quality and utility of the data generated from those trials. In addition to promising new drugs and biologics to treat specific tumor types, new cancer treatment technologies in imaging, radiotherapy, robotic surgery, and stereotactic surgery are adding to the range of treatment options available to cancer specialists. To successfully address the challenges of managing cost effectiveness and improving access to promising new treatments over the next 25 years, partnerships between industry, governments, academic institutions, and patient advocacy groups will be critical.
Conclusion

The future promise

The mission is to create a world without the fear of cancer. What follows is a snapshot from the future we imagine—a future where that vision has been realized.

On June 11th, 2047, a few months after her 45th birthday, Victoria Anderson is meeting with her multidisciplinary cancer care team (MCCT) at the local cancer center.

During her annual physical, Vicki’s primary care doctor ordered a routine liquid biopsy, and found tumor cell DNA, which is indicative of early-stage breast cancer, circulating in Vicki’s blood. Vicki’s doctor, who is linked with the MCCT, has referred her to the cancer care center.

Five year cancer survival rate

Forecasted survival rate based on increases in treatment efficacy (Phase 2/3 data) and liquid biopsy availability.
The MCCT leader, a cancer specialist, explains to Vicki that she has Stage I breast cancer. While this news is serious and should not be taken lightly, the good news as the doctor explains is that in 2047, the prognosis for early-stage breast cancer is very positive. With current treatment options, standardized protocols and integrated care management, disease-free survival for early-stage breast cancer patients averages 96% at five years, 92% at 10 years and 91% after 20 years. In other words, with proper care provided by an integrated multidisciplinary team, it is very likely that Vicki will not only survive, but will be cancer free over the long term.

During her visit with the MCCT, thanks to the benefit of AI and access to enormous volumes of data on treatment outcomes in early-stage breast cancer, Vicki is provided with a personalized treatment plan. Her plan includes an algorithm showing all of the possible treatment options her care team will consider. Among these options are radiation therapy, combination immunotherapy, robotic surgery, microwave ablation, cryotherapy, and emerging treatments such as nanoparticle therapy. Vicki’s treatment plan will be adjusted in real time based on companion diagnostics and treatment response assessments through imaging during treatment. The MCCT will also connect Vicki with the cancer care center’s survivorship and healthy lifestyle teams so she can learn about lifestyle factors that may affect breast cancer survivors and make any necessary lifestyle adjustments. Wearable technologies will constantly monitor and inform Vicki of how she is doing and if anything new is developing that will require more urgent medical attention. Finally, Vicky schedules follow-up visits with her care team and is provided with the appropriate contact information for team members in case she has any questions or concerns.

With all available treatment options clearly understood, a personalized treatment plan in place and follow-up visits scheduled, as well as a clear understanding of what she can expect from her care team, Vicki leaves her visit feeling like an active member of the MCCT for her cancer treatment. She feels involved in all aspects of her care, and very confident that she will be able to overcome her cancer and move forward to live a happy and healthy life. In other words, while Vicki is concerned, she is confident that with the help of her team, she will get through this and enjoy the rest of her life. She is not afraid.

Creating a world without fear of cancer may sound like science fiction to some. Certainly, the picture presented above is partly imaginary, but many of the elements described above are already here today in different shapes and forms.
Suggested follow-up on

siemens-healthineers.com/insights/
transforming-care-delivery


- Insights Series, issue 7: Do one thing, and do it better than anyone else. Available at: siemens-healthineers.com/insights/news/martini-klinik-specialization-optimization.html


Information:

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Deepak “Dee” Khuntia, M.D., FASTRO, joined Varian in 2013 and leads the office of Medical Affairs, which is responsible for providing medical-clinical expertise to all Varian operations, including clinical research, medical evidence generation, medical science education, product development, product support, regulatory affairs, government affairs, mergers and acquisitions. Dr. Khuntia has played a leading role in innovating and bringing new cancer treatment and cardiac radiosurgery technologies to hospitals worldwide.

In addition to his responsibilities at Varian, Dr. Khuntia continues to hold a part-time clinical practice in Radiation Oncology in the San Francisco Bay Area, where he has a special interest in advanced radiation treatment technologies, central nervous system tumors, head and neck cancer, and lung cancer. Dr. Khuntia is a board-certified radiation oncologist and Fellow of the American Society for Radiation Oncology.

Dr. Khuntia holds both undergraduate and medical school degrees from the University of Illinois, and completed his residency in Radiation Oncology at the Cleveland Clinic. Prior to moving to the Bay Area, he was an Associate Professor at the University of Wisconsin, where he served multiple leadership roles including Residency Director, Director of Radiation Oncology Outreach, and Course Director of Oncology for the Medical School. Dr. Khuntia is considered an expert in brain tumors, head and neck cancer, and lung cancer and has published more than 100 articles, book chapters, and abstracts.
References


At Siemens Healthineers, we pioneer breakthroughs in healthcare. For everyone. Everywhere. By constantly bringing breakthrough innovations to market, we enable healthcare professionals to deliver high-quality care, leading to the best possible outcomes for patients. Our portfolio, spanning from in-vitro and in-vivo diagnostics to image-guided therapy and innovative cancer care, is crucial for clinical decision-making and treatment pathways.

Built on a history of innovation going back more than 125 years and with unique strengths in patient twinning, precision therapy, as well as digital, data, and artificial intelligence (AI), we are well positioned to take on the biggest challenges in healthcare. We will continue to build on these strengths to help fight the world’s most threatening diseases, improving the quality of outcomes, and enabling access to care.

As a leader in the industry, we aspire to create better outcomes and experiences for patients no matter where they live or what health issues they are facing. We innovate sustainably to develop scalable solutions that can be tailored to the needs of healthcare providers, and the local health infrastructures.

Motivated by our purpose and guided by our values, we are building an inclusive culture, where we embrace diversity in all its forms. We are a team of 66,000 highly dedicated employees across more than 70 countries passionately pushing the boundaries of what’s possible in healthcare to help improve lives of people around the world.

For regulatory reasons, the solutions described in this paper may not be commercially available in all countries and their future availability cannot be guaranteed.