

Cancer prevention, risk reduction, and control: opportunities for the next decade of health care delivery research

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Abstract

In this commentary, we discuss opportunities to optimize cancer care delivery in the next decade building from evidence and advancements in the conceptualization and implementation of multi-level translational behavioral interventions. We summarize critical issues and discoveries describing new directions for translational behavioral research in the coming decade based on the promise of the accelerated application of this evidence within learning health systems. To illustrate these advances, we discuss cancer prevention, risk reduction (particularly precision prevention and early detection), and cancer treatment and survivorship (particularly risk- and need-stratified comprehensive care) and propose opportunities to equitably improve outcomes while addressing clinician shortages and cross-system coordination. We also discuss the impacts of COVID-19 and potential advances of scientific knowledge in the context of existing evidence, the need for adaptation, and potential areas of innovation to meet the needs of converging crises (e.g., fragmented care, workforce shortages, ongoing pandemic) in cancer health care delivery. Finally, we discuss new areas for exploration by applying key lessons gleaned from implementation efforts guided by advances in behavioral health.

Keywords

cancer care, health care delivery research, COVID-19, learning health systems, precision prevention, cancer survivorship

INTRODUCTION

Cancer care delivery research is “the multi-disciplinary field of scientific investigation that studies how social factors, financing systems, organizational structures and processes, health technologies, and health care provider and patient behaviors affect access to cancer care, the quality and cost of cancer care, and ultimately the health and well-being of patients and survivors” [1]. In 2013, a National Academy of Medicine (formerly Institute of Medicine) report characterized cancer care delivery as a “system in crisis” due to fragmented care and failure to use evidence-based practices (EBP) in clinical decision-making [2]. This report recommended a dramatic course correction to achieve high-quality cancer care [2]. Nearly a decade later, this system “in crisis” collided unprepared into the

Implications

Practice: The interdependency of teams across the care system must develop shared understandings of care pathways to support care delivery transformations.

Policy: Policy makers who want to increase the impact of existing evidence should support policy to development and adopt “oncology learning” systems supported by integrated information technology.

Research: Future research should prioritize hybrid designs that use a parallel process of evidence-based development and implementation strategies that considers the real-life, real-clinic constraints of cancer care delivery.

COVID-19 pandemic. When EBPs are incorporated into delivery, the average time from discovery to translation takes approximately 17 years [3]. The COVID-19 pandemic illustrated that, when faced with a threat, the cancer care delivery system can swiftly adapt to re-align and focus diverse stakeholders' interests to achieve a common goal [4]. A key challenge in the next decade is to align diverse stakeholders, including patients, health care professionals, payors, health care delivery organizations, and non-profit cancer-specific organizations' interests to accelerate behavioral health care innovation into cancer care delivery and cancer control efforts more broadly [5].

Cancer care delivery efforts to improve prevention and target risk behaviors have faced substantial translational challenges. Earlier this year, Khan et al. [6] revisited the translational timeline for five key EBPs (i.e., mammography, smoking cessation, colorectal cancer screening, HPV co-testing, and HPV vaccination) and concluded the average length of time from discovery into routine health care practice (i.e., 50% uptake) was 15 years. Uptake of EBPs is further delayed by countervailing forces (e.g., insufficient social safety-nets, fragmented care

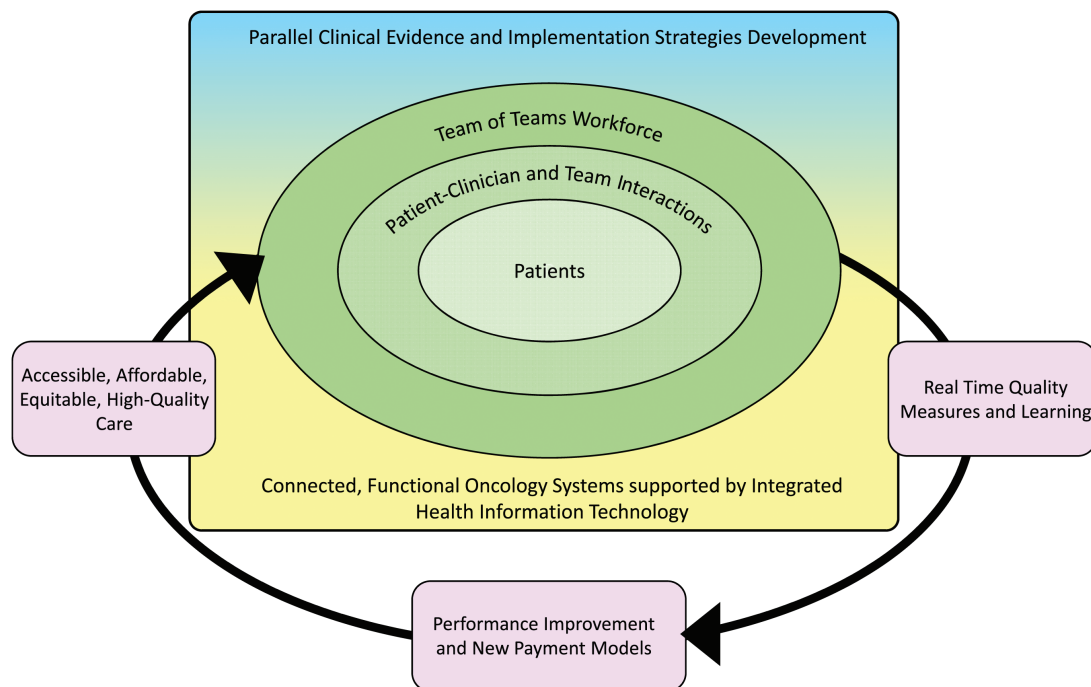


Fig. 1 | Transforming cancer care delivery's "system of systems" to achieve high quality care.

delivery, unconnected health information technology systems, lack of payer incentives, structural racism, the built environment) operating at multiple levels both upstream and downstream of the organizational or provider interaction with an individual patient. Since March 2020, COVID-19 has exposed critical systemic vulnerabilities that impact cancer care quality. For example, information technology tools are vital to cancer care coordination activities (e.g., medication reconciliation, survivorship care plan development) but often create impediments that require medical workforce coordination activities to overcome [7]. The COVID-19 pandemic amplified the impracticality of having multiple, incompatible IT systems that deter real-time, cross-system information sharing and learning as a systematic vulnerability with potentially dire consequences [8].

Pre-pandemic, a series of reports articulated the vision for a nationwide "learning health system" to address the crisis in cancer care delivery, specifically the lack of functional digital infrastructure [9, 10]. A learning health system is a system in which "science, informatics, incentives, and culture align to generate new knowledge as an ongoing, natural by-product of the care experience, and seamlessly refine and deliver best practices for continuous improvement in health and health care" [10]. While there have been pockets of success in achieving regional learning health systems, the pandemic illustrates more behavioral translational evidence and information technology infrastructure are needed to achieve this broader vision. Behavioral medicine

scientists, the multi-disciplinary stakeholders that generate knowledge to integrate social, behavioral, and biomedical knowledge and apply this to achieve best practices in prevention, diagnosis, treatment, rehabilitation, and palliation—are critical partners in realizing the potential of such a system.

In the next decade, translational behavioral scientists are poised to provide the leadership needed to achieve widespread practice change. Implementation of a national learning health system shares commonalities with key attributes of cancer care delivery research studies with the greatest impact on delivery. These commonalities are that learning systems have the potential to: (a) address problems that are important to patients, family, caregivers, and clinicians; (b) engage clinicians as partners in the design and conduct of research; (c) use standardized measures of care quality; (d) examine causal pathways and essential components of practice change; and (e) include diverse populations and contexts [11]. Further, translational behavioral research must investigate the policies and practices identified as "root causes" of structural racism and structurally design these learning health systems to support health equity and dismantle processes that reinforce and sustain racial health disparities [12–14].

This article examines the last decade of progress in cancer care delivery and identifies two key areas requiring attention: (a) optimizing precision prevention and early detection in health care delivery as new interventions and technologies emerge; and (b) implementing cancer risk- and need-stratified

(hereafter “stratified”) comprehensive care. The key areas selected represent salient issues facing cancer care delivery that are cross-cutting (i.e., not limited to cancer site-specific considerations) and impacted by both internal and external multi-level forces across the primary care, community, and oncologic care contexts. In the summary, we reflect on this progress and future vision and propose an expanded conceptualization toward achieving high-quality, equitable cancer care delivery based on understanding the cancer control endeavor broadly as a complex adaptive system [5].

Cancer prevention and risk reduction: optimizing precision prevention and early detection in health care delivery

In the USA, the use of EBPs to prevent and reduce cancer risk has the potential to reduce the overall cancer burden by 42–60% [15, 16]. Two prevailing, complementary cancer prevention strategies have generally been employed in the previous decades—population-based approaches (e.g., colorectal cancer screening, HPV vaccination) and risk-based strategies (e.g., lung cancer screening among smokers, *BRCA1* and *BRCA2* testing). Yet, gaps remain in the translation of EBPs, which are evident in the uncoordinated strategies used for behavioral targets—obesity, alcohol consumption, poor nutrition, and physical inactivity. Addressing behavioral targets in a coordinated manner could reduce the incidence of preventable cancers by 16–18% [17]. Despite overwhelming evidence on effective interventions, translation and transformation of health promotion and health care delivery remain challenging. The Screening, Brief Intervention and Referral to Treatment program (SBIRT), provides insights into various and competing interests across delivery contexts involved in a several decades-long translational research effort [18]. SBIRT roll-out was a major clinical transformation and policy effort that targeted alcohol (a well-established carcinogen) misuse and addiction. Yet, research investments to examine the critical elements necessary for uptake and sustainable implementation have failed to keep pace with the generation of earlier evidence focused on developing efficacious interventions to promote alcohol screening [18].

Delays in translating cancer prevention EBPs into health care delivery maybe indicative of fundamental problems with the process of knowledge development. Investing in cancer prevention interventions without sustained investments to support implementation, contributes to translational lag and wastes resources developing innovations with poor translational potential. SBIRT illustrates a common knowledge development pattern, where efficacious interventions are first developed in isolation from the delivery context. In this regard, the SBIRT program is similar to other cancer prevention and risk reduction programs that optimally would require

multi-level implementation by multi-teams of health providers delivering care to diverse subpopulations, across a variety of performance sites [5, 18]. Thus, to hasten translation and scale-up of cancer prevention and control efforts, future investments should attend to the contextual fit of these strategies during the intervention development process itself [19]. One such model is NCI’s Speeding Research Into Translation (SPRINT) training program that has trained three cohorts of interventionists to incorporate a “design for dissemination” approach into their behavioral science research in cancer prevention and control [20].

An increasing appreciation of the complexity of cancer care delivery has driven the re-conceptualization of delivery problems from those that are narrowly focused and setting specific to those that cut across individual behaviors and systems. Behaviors at the individual level may include patients, caregivers, as well as clinicians, allied health professionals, and trainees who bring their own professional knowledge, skills, and attitudes. Systems may include the organizations in which health care is delivered—solo practices, clinics, medical groups, nursing homes, hospitals, and health systems—and the environment that shapes the organization of health care—health policies, health care market, financial incentives, insurers, and regulations. The use of this “system of systems” lens encourages investigations of understudied cross-system issues in cancer care delivery—for example, care coordination—an area in need of conceptual clarity and reliable cross-team measurements [7, 21, 22]. See Fig. 1. The Population-based Research Optimizing Screening through Personalized Regimens (PROSPR) consortium, for example, has presented a unified trans-organ (breast, cervical, colorectal, and now lung) framework that covers four types of care involved in the screening process (e.g., risk assessment, detection, diagnosis, and referral to treatment) [23]. Similar work could be extended into treatment and survivorship [24].

Conceptually reframing cancer screening through a trans-organ lens provides an opportunity to align diverse stakeholders who may focus on cancer site-specific screening indicators; and it brings these stakeholders into greater alignment with the cross-system changes that are needed for implementation and sustainment [5]. This approach encourages a needed shift away from narrow, disease-specific goals that compete for resources and time in the delivery context, and toward the integration of interventions that promote overall health with cancer and chronic disease-specific prevention behaviors that share clinical pathways [5]. The role of behavioral health research in informing the translation of bundling interventions that target shared clinical pathways into care delivery is key. Broad implementation initiatives often serve similar, complementary

objectives across cancer and chronic disease prevention that could be strategically aligned and coordinated during the planning phases. Therefore, coordination of implementation efforts is a critical step toward the creation of a national cancer control plan to “principally ensure resource integration and operational coordination across various components of the cancer control system” [5].

Population-based cancer screening implementation research has been conducted in the past decade to improve rates of breast, cervical, and colorectal cancer screenings. Screening is a well-established intervention for reducing cancer burden and death [25]; however, the effectiveness of these programs varies widely state by state based on implementation [15]. Translational lag variations in screening are illustrated by high and low performers in state prevalence rates for colon cancer screening (Massachusetts 76.5% vs. Wyoming 56.7%), mammography (Massachusetts 82.1% vs. Idaho 62.5%), and Papanicolaou testing uptake (Massachusetts 88% vs. Idaho 76.2%) [15]. Data provided from the National Health Interview Survey (NHIS) suggest that the national cancer screening rates are a cause for concern [25]. While rates of colorectal cancer screening have risen [25], there are health disparities in CRC screening based on socioeconomic status, for some racial minorities, and by type of primary care organization [26, 27]. Cervical cancer screening rates have declined since 2005, and breast cancer screening rates have leveled—both screening rates remain at suboptimal levels [25]. Lung cancer screening uptake remains unacceptably low. For lung cancer screening, there is an ongoing debate about who should be screened and how screening conversations around risk and benefits should be framed [28]. Racial and socioeconomic health disparities in cancer screening persist for each of these cancer sites and are lower in community health center settings compared to other primary care organizations [29, 30].

Before the COVID-19 pandemic, rates of cancer screening were suboptimal [25]. The pandemic represents a major disruption in cancer screening, due to canceled screening services and delayed elective surgeries [31, 32]. Primary care, already facing demands for services that outstrip the health care system’s capacity as currently configured due to looming physician shortages and inadequate reimbursement, remains the main target of interventions to improve the implementation of cancer screening guidelines [33]. Nearly two decades ago, the implementation of all chronic disease and preventive service guidelines was deemed impossible [34]. At that time, estimates suggested that primary care physicians would need 11 hr per day to meet chronic disease management requirements and 7 hr for preventive services [35, 36]. Since then the pace of scientific progress has accelerated, with more

disease-specific guidelines emerging to inform care delivery, though it has not resulted in improved outcomes [37]. Precision prevention and early detection (PPED) strategies will continue to produce additional and often more complex care delivery guidelines. PPED strategies generally focus on more specific intervention targets (e.g., family history, genetic risk factors); therefore, the need to nimbly identify and track patients based on specific characteristics is critical to their implementation [38, 39]. PPED strategies have the potential to complement population and risk-based strategies as research uncovers more of the mechanistic underpinnings of the carcinogenesis process. Examples of PPED strategies include prophylactic oophorectomies in BRCA1 and BRCA2 mutation carriers and use of aspirin as a chemopreventive agent in obese Lynch syndrome carriers [40]. These examples illustrate that the lessons learned from SBIRT implementation (i.e., the importance of stakeholder engagement and need to consider dissemination contexts) are equally applicable to the translation of evidence of bio-physiological mechanisms into care delivery. Multi-level translational evidence testing the efficacy of interventions for PPED enabled by a learning health system will be needed in the coming decade. Translational behavioral scientists can inform the implementation of these multi-step PPED interventions that require a level of specificity and targeting that poses cross-system, cross-team, informational, and emotional challenges (for patients and health care team members).

Cancer treatment and survivorship: implementing risk- and need-stratified care across oncology and primary care systems

There are an estimated 16.9 million cancer survivors in the United States today and this population is expected to grow to over 26 million by 2040 [41]. Cancer survivors are a heterogeneous population of individuals who have received a cancer diagnosis, those in active treatment, and those living with cancer in remission, recurrent, progressive or metastatic, life-limiting cancer, including patients who recently completed therapy and long-term survivors with no evidence of disease [42–44]. Many cancer patients receive multimodal treatments, including surgery, chemotherapy, radiation, hormonal therapy, immunotherapy, and/or targeted therapy. Although new treatments have extended survival or averted death, these therapies are not without physical, psychosocial, and financial sequelae that often limit function and full participation in life and must be managed beyond active treatment [45, 46]. The patient’s health, social, psychological, and financial needs often have to be managed interdependently among a team-of-teams—or multi-team system (MTS)—of clinicians and allied health care professionals across diverse

health care “system of systems” [47, 48]. For example, survivors receiving multi-modal cancer therapy who also manage a chronic condition may have multiple oncology teams (i.e., medical, surgical, radiation), primary care (for preventive and chronic disease management), and specialty care (e.g., endocrinologist, cardiologist). These teams may or may not practice in an integrated care delivery system/context with the capability of easily sharing information. Hence, care coordination for cancer survivors is complex.

Health care organizations can leverage resources and capital to integrate risk-stratified care pathways and coordination strategies for MTS. Implementation research has called for new models of stratified comprehensive care pathways (also called need-stratified, personalized care pathways) [31–33]. Stratified comprehensive care models carve out care pathways during treatment that extend through survivorship, supported by a connected and thinking health information technology [49–51]. Innovation is needed to shift approaches so that care models are responsive to health care organizational factors, MTS interdependency, and resource constraints.

Stratified comprehensive care pathways match patients with relevant levels of medical and psychosocial support based on their risk of morbidity and mortality, their ongoing needs, and their resources and capacity to self-manage their health. This involves considering their personal and family health history and severity of treatment sequelae, chronic illness burden, functional ability, health literacy, financial well-being, social risk factors, and social needs [52–57]. Building stratified comprehensive care involves modifying care delivery in three ways. First, it entails commencing survivorship at diagnosis, to optimize the individual’s long-term health and well-being by anticipating needs; monitoring the patient in a prospective surveillance model using comprehensive assessments of patient-reported outcomes and other patient-generated data to detect issues promptly; and using these data to facilitate timely referrals for the appropriate level and setting of intervention efforts. Fatigue management is illustrative here: patients with low levels of fatigue might only need links to educational and self-management materials so they know what to look out for and how to connect with their clinical team when needed. Conversely, patients with higher levels of fatigue might need immediate referrals for clinical care and evaluation of issues like sleep disruption, psychological distress (anxiety and depression), and treatment toxicity that may be contributing to fatigue.

For stratified comprehensive care to be truly “comprehensive,” the ongoing evaluation and referral to appropriate levels of care will need to be shared across the oncology, primary care, survivorship care, and subspecialty care contexts. This system also

requires initiation at acute treatment phases with continuation through the post-oncology treatment trajectory. A stratified care delivery system would be useful in guiding initial discussions around: (a) appropriate clinical trials for anti-cancer therapy; (b) management of treatment toxicities and their medical, functional, psychosocial, social, and financial sequelae; and (c) the detection and management of late effects of cancer treatment. A similar model has also been proposed to help triage cancer patients to the appropriate level of a personalized exercise program that is safe, feasible, and effective for them [58].

During post-treatment follow-up care, this system of monitoring patient needs and using those data to personalize care delivery would be helpful in effecting the second significant change to how care is delivered currently. That is, these data need to point to the appropriate follow-up care pathway for a given patient. Patients with low risk and low needs might safely follow with their primary care team for ongoing cancer-related and non-cancer-related care. Conversely, patients with high risk and high needs might need to be followed in separate clinics by clinicians with specialized expertise in the long-term needs of cancer survivors. For example, the United Kingdom has tested pivoting its survivorship care to a three-tier stratification model. In evaluations of those care delivery approaches, stratified survivorship care has been shown to reduce unnecessary testing and oncology visits, improved timeliness of surveillance testing, and lowered health care costs [54,59]. Implementing stratified cancer care in the USA will be more complex due to differences in health care delivery and reimbursement [51]. Yet these implementations demonstrated that stratified survivorship models are feasible, and can reasonably identify and differentiate patients who require more intensive follow-up from those who can self-manage with less support [51, 54, 59].

The third necessary change for the successful implementation of stratified comprehensive care is the adoption of a multi-team system perspective. During cancer care, patients would see a team of teams or multiple clinicians and allied health professionals from medical, radiation, and/or surgical oncology who are “interdependent, highly specialized, and geographically dispersed,” all working toward the same overarching goal of providing high-quality care [21, 60]. Using an multi-team system lens, research has just begun to illuminate how team structure—including team composition, boundary spanning, geographic dispersion—affects teamwork processes and cancer outcomes. Limited research to date suggests that a multidisciplinary cancer care team is associated with better cancer care quality [61–63]. Optimal chronic disease management during breast cancer treatment was also more likely among patients care for by multi-team systems that

included oncology, primary care, and/or medical subspecialty [64].

“Shared care” (i.e., oncology and primary care) are multi-team system cancer care delivery models. Shared care models have been compared to oncology and primary care-led models of post-treatment cancer care and mixed findings have been reported [65–67]. For example, Etim et al. [66] described increased adherence to follow-up mammography among breast survivors receiving shared care compared to primary care led models. Conversely, Halpern et al. [65] found the only difference in patient experiences and care quality of older cancer survivors based on between type of model delivery (e.g., oncology-led, primary-care led and shared care) was greater likelihood for getting needed prescriptions among patients who received shared care. A systematic review [67] evaluating the effectiveness of shared care concluded usual and shared care had similar effectiveness; however, shared care was more acceptable to patients. Across these studies, there remains a need to describe the within and across team processes, with greater specificity, to allow for meaningful comparison of care delivery processes [68]. For example, how these teams develop shared understandings (e.g., shared mental model, role clarity, shared leadership, boundary spanning, trans-active memory) among multi-team system members of different specialties across contexts remains understudied. Future research on MTS should consider drawing from teaming frameworks and teamwork measures in health care delivery [21, 47, 69–78]. For example, Verhoeven’s *Teaming in Cancer Care Delivery Framework* identifies and defines team structure characteristics and teamwork processes that contribute to optimal care coordination relevant to both observational and interventional research [47].

As part of a learning health system, understanding and addressing how organizational structures and organizational processes establish and sustain high-functioning multi-team systems to deliver stratified comprehensive care is clearly needed. Studies are needed that systematically compare care delivery models among different organizational settings or health systems [72]. Several research frameworks highlight the need to better understand how different health care organizational structures—e.g., culture, capacity, leadership, academic affiliation, financial/payment systems, level of integration, and others—influence care delivery and cancer outcomes [72, 79, 80]. For example, it is likely that health information technology could support care coordination mechanisms by creating electronic decision support tools and treatment algorithms, establishing a shared goal and situational awareness of ongoing clinical activities, and improving data collection and analysis of care delivery and health outcomes at the population level [81–83]. New payment models

and health system integration/consolidation could redesign the delivery of care and directly impact team processes, quality of care, cost of care, and cancer outcomes. For example, health systems can leverage resources and capital to integrate stratified comprehensive care pathways and coordination strategies. There is also a growing body of literature demonstrating that patient preferences, local practice norms, and health care organizational factors are associated with much of the variation in care quality and disparities in cancer outcomes [84–89]. Next steps include identifying key metrics for quality stratified comprehensive care that can be assessed at the organizational, team/provider, and patient levels, as well as in different settings while monitoring and addressing cancer care inequities.

CONCLUSIONS

Given that the past decades’ experiences of risk-based and population-based cancer prevention strategies still require scientific attention—how might we approach the challenges of implementing precision prevention and early detection strategies more strategically within a learning health system? First, the field needs to recognize the need for a parallel process of evidence-based development and implementation strategies that considers the real-life, real-clinic constraints of care transformation and address suboptimal screening and screening disparities for cancers and hereditary cancer syndromes, as proposed in several recent scientific contributions [15, 90, 91]. Second, the field should embrace the National Academy of Medicine’s call to re-conceptualize scientific approaches to advancing cancer prevention and all cancer control efforts using a “system-of-systems” and “complex adaptive system” lens. This shift, which was embraced in the scientific literature guiding primary care transformations before the Affordable Care Act’s widespread system redesign, recognizes cancer control as a “system whose elements are interactive and influential at multiple levels of society, starting with the individual. (p. 129)” [5]. This requires a fundamental reconsideration of health system financing and incentive structures. Third, the field should advocate for investments to support the development, adoption of the use of learning oncology systems that reduce the human burden of care coordination across multi-team systems, employing the strategies identified to foster connected care (see Alfano et al. [83]) [81, 82]. In the development of functional learning systems in oncology the measurement of care coordination using a “team of teams” perspective are critical quality indicators. These types of measures appreciate the interdependent nature of the cross-system (e.g., primary care, oncology, and specialty care), and cross-team efforts in the testing and evaluation of functional learning health systems [21, 83].

Focusing on these broader goals have the potential to strengthen the translational infrastructure and pathways to support a wide range of evidence-based cancer care health service improvements.

What will it take to innovate the U.S. health care delivery to be in line with this vision? Examining the key barriers and facilitators to similar changes in other countries is illustrative for the USA. [50]. Some of the needed changes will be enabled through the modernizing of health information technology that assesses patient issues and resources and patient preferences for care and remotely monitors patients outside of clinic walls [50, 83, 92]. But simply having this assessment technology is not enough: these data must feed into algorithms that suggest appropriate intervention strategies, and those algorithms must then be linked to a clinical workflow that delivers the appropriate level of care an individual patient needs at the time when the individual needs it. This system of multi-source data inputs (e.g., from the electronic health record, patient-generated data, genomic tests, and other clinical data), analytics running on those inputs, and the resulting outputs that support clinical decision making and personalized care strategies needs to function as one integrated cancer data ecosystem to work [93]. The same systems must also be used to facilitate clinical teamwork processes that engage all of the team members required to provide comprehensive care for patients (e.g., from oncology, primary care, physical or occupational therapy or physiatry, palliative care, psychosocial care, cardio-oncology, dermatology, dentistry, referrals for nutrition and exercise interventions and many others) and to *coordinate* that care [48, 50]. In that regard, providing the patient with support to self-manage their health, empowering them to communicate and engage actively in their care, as well as redesigning the health care system that provides patient-centered communication [94] that is respectful and responsive to a patient's individual needs, preferences, and values must become the cornerstone of cancer care [95], as is the case for diabetes or asthma management [50, 96].

A critical step to achieve this vision is the engagement and alignment of national stakeholders (e.g. clinicians, patients and their families, patient advocacy groups, organizational and health information technology leaders, community-based organizations, non-profits, and national funders) to increase the capacity of the learning health system [5]. This engagement must begin from the planning phases to ensure the necessary components are developed to be feasible, effective, equitably accessible, and to result in the value that is needed [50]. The National Academy of Medicine committee reflected on the fragmented nature of process improvements and advocated for future transformation efforts to ensure that cancer control decisions: “[take] into account how changes will affect the entire system and not

just one aspect of it” [5]. Innovations in the health care system were catalyzed as a response to the COVID-19 pandemic (e.g., the essential policy and regulatory changes related to reimbursement of telemedicine). What is needed now is to understand what has worked from this “grand experiment,” as well as for whom it has worked, what can be improved, and what has failed.

In response to COVID-19, real-time solutions were implemented to address care delivery disruptions (e.g., preventive care, preservation of the diagnostic pathway) and improve access to care especially among medically disadvantaged populations (e.g., telemedicine visits) [97, 98]. The effectiveness of these improvised solutions in mitigating disruptions in care require deliberate evaluation. Possible solutions have elements of a learning health care system embedded in envisioned systems. For example, Horn and Haas [99] described a mandate for updating preventive care delivery by advocating for “smarter” and inclusive preventive care registries, such as interoperability across delivery contexts despite different electronic medical vendors. This preventive care mandate would require infrastructure to provide language and culturally tailored “prevention kits,” virtual visits with primary care providers to allow for shared decision making, and specific programs to address population-specific barriers known to contribute to disparities [99]. Helsper et al. [100] proposed suggestions to preserve the diagnostic pathway (i.e., enhance telehealth, identify and direct patients at risk, expand access to diagnostic services). Implementing these strategies would be facilitated by a learning health system infrastructure that enables coordination of multiple activities in real-time. The activities include anticipating COVID-19 surges, coordinating between primary and secondary care, expanding telehealth capacity, and targeting outreach to underserved populations impacted by the “digital divide” with suboptimal access to timely diagnosis [100]. Challenges of care disruption and the toll this disruption on psychosocial functioning, clinical outcomes, and the exacerbation of disparities among specific subpopulations impact all phases of the cancer continuum [101–103].

These outcomes should be evaluated against the national cancer screening metrics, cancer stage at diagnosis, mortality, and the cancer survivorship care quality framework of Nekhlyudov and colleagues [104]. That knowledge can point to the elements of care innovation that need to continue in a post-COVID world and to the policies and regulations that are needed to facilitate these changes permanently. It can also lead researchers to understand the most pressing care delivery research questions [49] that are needed to enact equitable cancer screening and stratified comprehensive care of the future.

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Compliance with Ethical Standards

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