

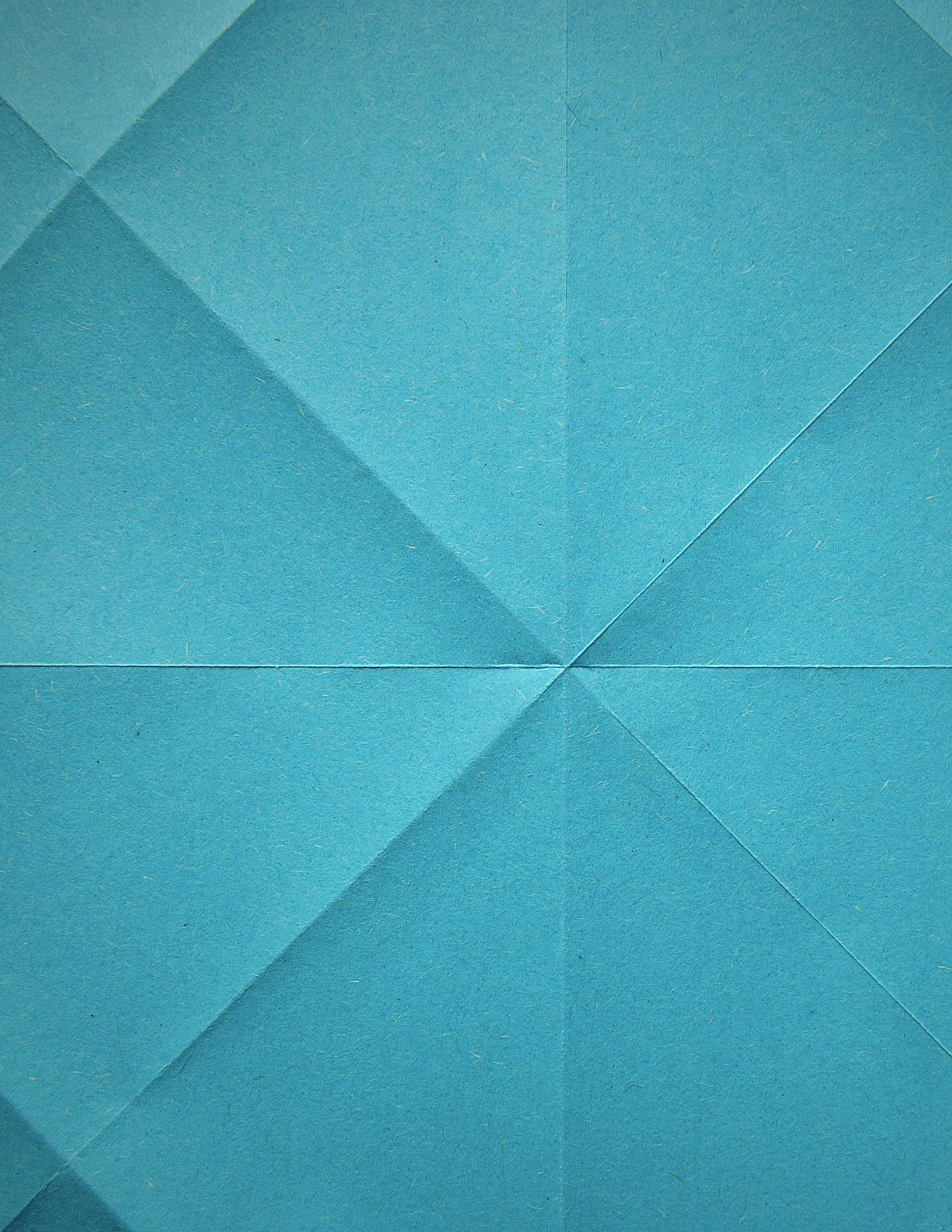
2021 OVERVIEW AND HIGHLIGHTS

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# GUIDING THE FUTURE OF CANCER CONTROL









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## MESSAGE FROM THE DIRECTOR

I'm pleased to introduce this year's special edition of Overview and Highlights, which presents a broad summary of our division's initiatives and accomplishments. In recent years, our annual Overview and Highlights report has featured specific, cross-cutting areas of programmatic emphasis in the division, such as Implementation Science and Behavioral Science. This year, however, a year marked by transition in the division's leadership, it seemed appropriate to reflect on the division's evolution and provide a wider view of current initiatives and opportunities.

The remarkable breadth and depth of the work conducted by DCCPS reflects its unique role within the NCI, NIH, and HHS. As an extramural division, we support the many subfields of cancer control and population sciences, from etiological epidemiology to studies of long-term cancer survivors. As described in this report, the diversity of disciplines supported in our portfolio and represented by our staff is especially impressive. But our program staff are also remarkably productive in their own scientific scholarship because of the opportunities afforded through our management of unique research resources, such as the SEER Program.

The origami graphical theme of this year's report provides a metaphor for both science and science management. Science begins with an idea, a simple blank sheet of paper. Research then proceeds through the careful design of a study, which in turn yields data that, when compiled and interpreted, can provide an elegant, holistic picture of a complex problem. Similarly, the Division of Cancer Control and Population Sciences began, under the visionary leadership of Barbara Rimer and Bob Hiatt, our founding leaders, with a blank sheet of paper. Their initial organizational chart grew in complexity and scale over time as the division evolved to respond to new scientific opportunities and public health challenges. The integrated entity we call DCCPS is the culmination of creativity, effort, and a passion for public service that continues to underlie scientific leadership and effective stewardship of our nation's cancer control research enterprise.

A handwritten signature in black ink, reading "R. T. Croyle". The signature is fluid and cursive.

**ROBERT T. CROYLE, PHD**

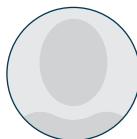
Director, Division of Cancer Control and Population Sciences  
National Cancer Institute



# LEADERSHIP AT A GLANCE



**OFFICE OF THE DIRECTOR**  
**Dr. Robert Croyle**  
 DIRECTOR OF DIVISION  
 OF CANCER CONTROL AND  
 POPULATION SCIENCES



**OFFICE OF THE DIRECTOR**  
**VACANT**  
 DEPUTY DIRECTOR  
*Recruiting in 2022 under new DCCPS Director*



**OFFICE OF THE DIRECTOR**  
**Dr. David Chambers**  
 DEPUTY DIRECTOR FOR  
 IMPLEMENTATION SCIENCE

## 4 RESEARCH PROGRAMS



**EPIDEMIOLOGY AND GENOMICS  
 RESEARCH PROGRAM**  
**Dr. Kathy Helzlsouer**  
 ASSOCIATE DIRECTOR



**EPIDEMIOLOGY AND  
 GENOMICS  
 RESEARCH PROGRAM**  
**Dr. Pothur Srinivas**  
 DEPUTY ASSOCIATE  
 DIRECTOR



**METHODS AND TECHNOLOGIES**  
**Dr. Mukesh Verma**  
 BRANCH CHIEF



**ENVIRONMENTAL EPIDEMIOLOGY**  
**Dr. Gary Ellison**  
 BRANCH CHIEF



**GENOMIC EPIDEMIOLOGY**  
**Dr. Elizabeth Gillanders**  
 BRANCH CHIEF



**CLINICAL AND TRANSLATIONAL  
 EPIDEMIOLOGY**  
**Dr. Andrew Freedman**  
 BRANCH CHIEF



**RISK FACTOR ASSESSMENT**  
**Dr. Jill Reedy**  
 BRANCH CHIEF



**SURVEILLANCE RESEARCH  
 PROGRAM**  
**Dr. Lynne Penberthy**  
 ASSOCIATE DIRECTOR



**SURVEILLANCE  
 RESEARCH PROGRAM**  
**Dr. Kathleen Cronin**  
 DEPUTY ASSOCIATE  
 DIRECTOR



**DATA QUALITY, ANALYSIS,  
 AND INTERPRETATION**  
**Dr. Serban Negoita**  
 BRANCH CHIEF



**SURVEILLANCE INFORMATICS**  
**Dr. Elizabeth (Betsy) Hsu**  
 BRANCH CHIEF



**DATA ANALYTICS**  
**Dr. Angela Mariotto**  
 BRANCH CHIEF



**STATISTICAL RESEARCH AND  
 APPLICATIONS**  
**Dr. Eric Feuer**  
 BRANCH CHIEF





**OFFICE OF THE DIRECTOR**  
**Dr. Shobha Srinivasan**  
 SENIOR ADVISOR  
 FOR HEALTH DISPARITIES



**OFFICE OF CANCER SURVIVORSHIP**  
**Dr. Emily Tonorezos**  
 DIRECTOR



**BEHAVIORAL RESEARCH PROGRAM**  
**Dr. William Klein**  
 ASSOCIATE DIRECTOR



**BEHAVIORAL RESEARCH PROGRAM**  
**Dr. Linda Nebeling**  
 DEPUTY ASSOCIATE DIRECTOR



**BASIC BIOBEHAVIORAL AND PSYCHOLOGICAL SCIENCES**  
**Dr. Paige Green**  
 BRANCH CHIEF



**HEALTH BEHAVIORS RESEARCH**  
**Dr. Susan Czajkowski**  
 BRANCH CHIEF



**HEALTH COMMUNICATION AND INFORMATICS RESEARCH**  
**Dr. Robin Vanderpool**  
 BRANCH CHIEF



**TOBACCO CONTROL RESEARCH**  
**Dr. Michele Bloch**  
 BRANCH CHIEF



**HEALTHCARE DELIVERY RESEARCH PROGRAM**  
**Dr. Paul Jacobsen**  
 ASSOCIATE DIRECTOR



**HEALTHCARE DELIVERY RESEARCH PROGRAM**  
**Dr. Janet de Moor**  
 DEPUTY ASSOCIATE DIRECTOR



**HEALTHCARE ASSESSMENT RESEARCH**  
**Dr. Paul Doria-Rose**  
 BRANCH CHIEF

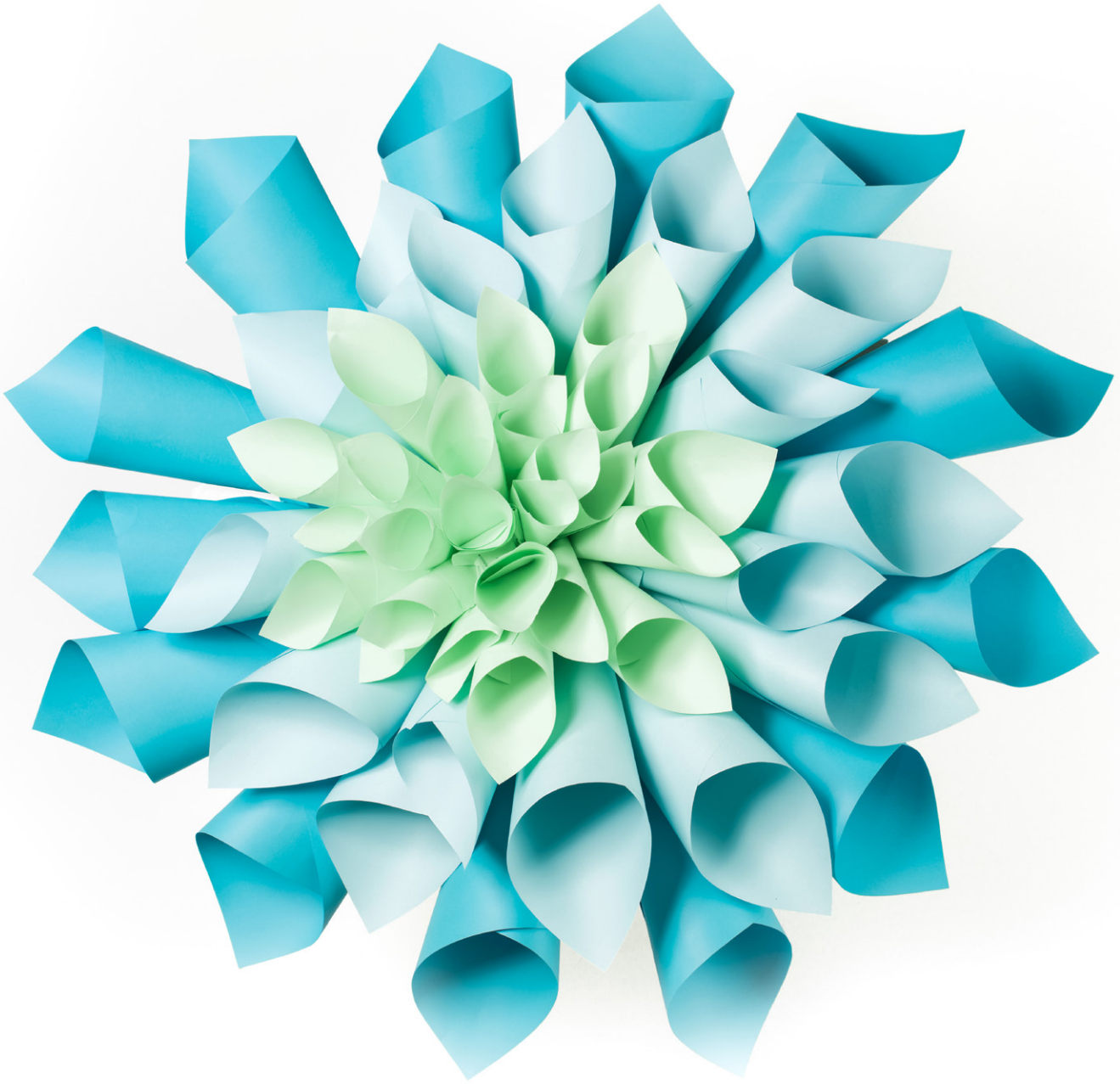


**HEALTH SYSTEMS AND INTERVENTIONS RESEARCH**  
**Dr. Sarah Kobrin**  
 BRANCH CHIEF



**OUTCOMES RESEARCH**  
**Dr. Ashley Wilder Smith**  
 BRANCH CHIEF







# THE DIVISION OF CANCER CONTROL AND POPULATION SCIENCES: STUDYING IT ALL, FROM A SINGLE GENE TO THE PUBLIC'S HEALTH

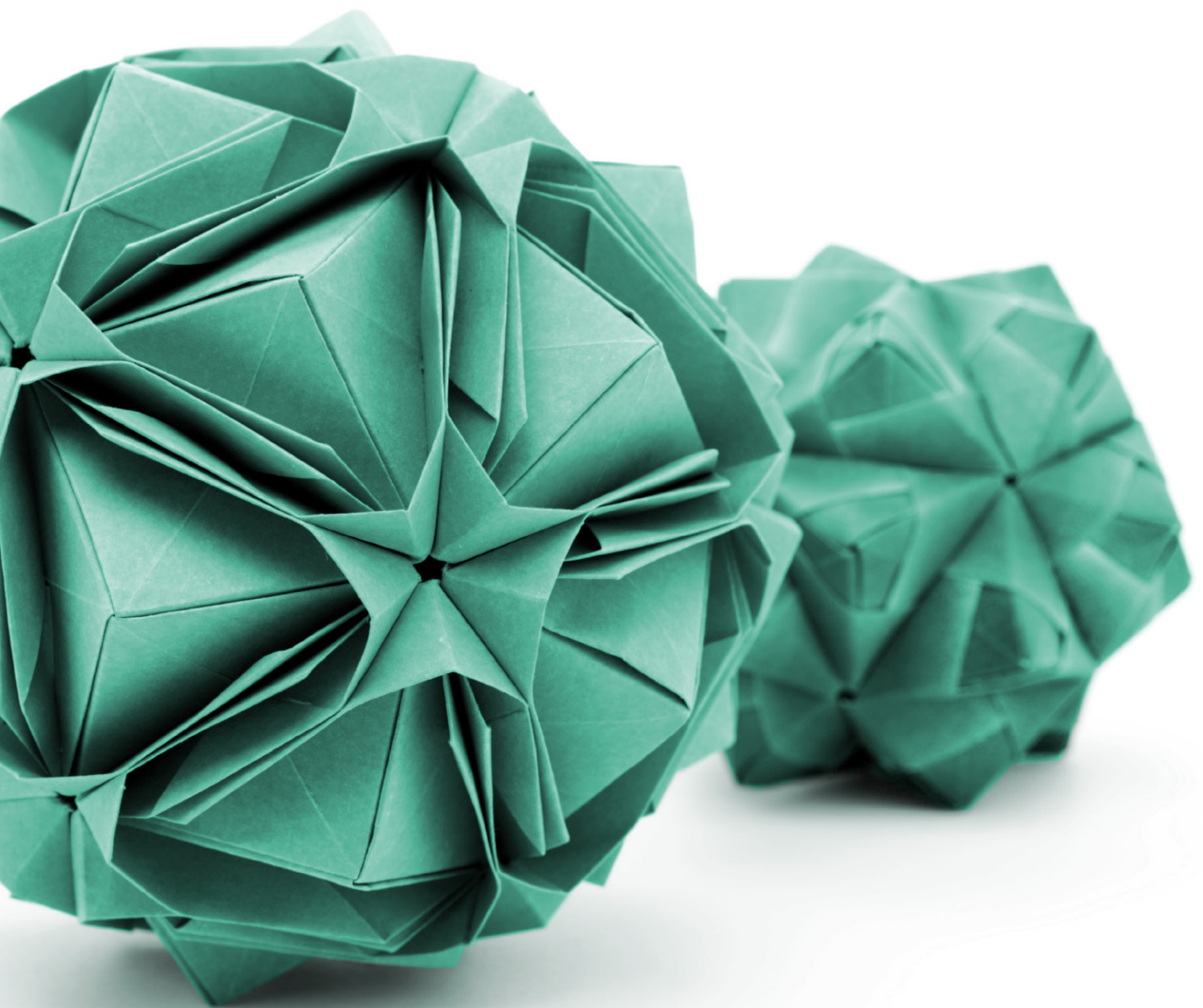
The Division of Cancer Control and Population Sciences (DCCPS) has played a unique role in reducing the burden of cancer since the division's creation in 1997. In that year, DCCPS was established to enhance the National Cancer Institute's (NCI's) ability to alleviate the burden of cancer through research in epidemiology, behavioral sciences, health services, surveillance, and cancer survivorship. The division has grown and evolved since that time, and it now also serves a central role within the federal government as a source of expertise and evidence on issues such as the quality of cancer care, the economic burden of cancer, geographic information systems, statistical methods, communication science, comparative effectiveness research, obesity and tobacco control, and the translation of research into practice. The diverse science funded and conducted by DCCPS reflects the division's overarching philosophy: Scientific progress in the 21st century will depend on the transdisciplinary integration of research methods, models, and levels of analysis.

Past [DCCPS Overview & Highlights](#) have been largely snapshots of the division's work over that past year, with recent editions focusing on behavioral research and on implementation science. This report takes a step back, allowing the reader to delve further into areas of DCCPS research, to better understand the history, some of the milestones, and the promise for the future. In addition to spotlights on each DCCPS office, program, and the branches within each program, the report highlights cross-cutting work across the division. The breadth and depth of the science contained in these pages—and the impact they have had on public health—are, simply put, remarkable. They clearly demonstrate why DCCPS has evolved into the nation's model for cancer control research and beyond.

# BUILDING THE SCIENCE







# STRATEGIC METHODS FOR BUILDING THE SCIENCE

DCCPS uses a variety of tools and methods to facilitate expansion of a scientific area. The steps along any given pathway may differ depending on which strategy will have the most impact or allow for greatest flexibility or efficiency.

Regardless of which method is used, input from the research community and collaboration with our numerous partners are inevitably key components of that strategy.

## SOLICITING INPUT FROM THE RESEARCH COMMUNITY

DCCPS has always greatly valued and relied upon the expertise, insight, and contributions of our research community, both within and outside NIH. Soliciting and gathering the ideas and input of that community is of critical importance and an integral part of the division's scientific planning efforts.

In addition to supporting a large portfolio of investigator-initiated research, the division gathers information from the community on the most important needs and promising opportunities in cancer research through such methods as Requests for Information (RFI) and resulting reports, focus groups, and presentations at largely attended global conferences, NCI board meetings (Board of Scientific Advisors and National Cancer Advisory Board), and our annual New Grantee Workshop. DCCPS also participates in NCI initiatives, such as Provocative Questions, which included town halls around the United States to gather ideas. In addition, DCCPS has sponsored numerous special journal issues and a monograph series in tobacco control, supported relevant National Academy of Medicine (formerly Institute of Medicine [IOM]) reports, and conducted conferences focused on key priority areas (e.g., cancer survivorship and implementation science, in collaboration with key partners).

Numerous mechanisms are used to ensure we hear from the research community formally. Less formally, DCCPS program officers reach out to and listen to our researchers on a daily basis. The DCCPS **C**ommittee **O**N NCI-**E**xtramural **C**ommunication **T**ools and **S**upport (CONNECTS) has developed a suite of activities aimed at promoting exceptional levels of staff and investigator engagement and satisfaction with DCCPS's grant-related communication and outreach policies, practices, and tools. Examples of these activities include a survey about the extramural community's experience and information needs, a fact sheet for investigators on communicating with DCCPS staff along the grants process, and a motion graphic video highlighting key information about the grants process, with additional activities planned as we monitor the success of our outreach and bilateral communication.





## PARTNERSHIPS

Partnerships, both those across government agencies and those with nongovernmental agencies, are a critical element of the cancer control research enterprise and another key component of the division's strategy for building the science of cancer control. Since the creation of the division in 1997, DCCPS has sought out, nurtured, and leveraged these partnerships to capitalize on shared goals, transdisciplinary expertise, infrastructure, and resources.

The listing of interagency agreements below portrays the division's collaborative work with numerous NIH institutes, centers, and offices on research areas of shared interest, to ensure taxpayer investments are maximized and to quicken the pace of research progress. Later in this report, we also list the nearly 70 Requests for Applications (RFAs) from other NIH institutes and centers on which we have collaborated (page 102). All such efforts, whether led by DCCPS or another institute, center, or agency, involve vetting and input from multiple sectors, including NCI leadership and advisory boards.

Recognizing that nongovernmental organizations (NGOs), including professional organizations and community partners, are hugely influential and impactful in research funding and implementation, DCCPS has also entered into dozens of partnerships with NGOs. In addition to unique agreements and specific partnerships focused on specific strategic goals in particular research priority areas, DCCPS also plays a leadership role on behalf of NCI in the [Comprehensive Cancer Control National Partnership](#) (CCCNP), an influential group of 19 leading cancer organizations that utilize their combined strengths and resources to change the trajectory of the cancer burden in the United States.

### DCCPS Partnerships with Federal Agencies\*

- Agency for Healthcare Research and Quality (AHRQ)
- Centers for Disease Control and Prevention (CDC)
- CDC National Center for Health Statistics (CDC NCHS)
- Census Bureau
- Centers for Medicare & Medicaid Services (CMS)
- Department of Energy (DOE)
- Department of Interior/National Business Center (DOI NBC)
- Department of Veterans Affairs (VA)
- Federal Communications Commission (FCC)
- Food and Drug Administration (FDA)
- Health Resources and Services Administration (HRSA)
- Indian Health Service (IHS)
- National Institute of Standards and Technology (NIST)
- National Science Foundation (NSF)
- Office of the National Coordinator for Health Information Technology (ONC)
- Program Support Center (PSC)
- Substance Abuse and Mental Health Services Administration (SAMHSA)
- Social Security Administration (SSA)
- United States Agency for International Development (USAID)
- United States Department of Agriculture (USDA)

\*DCCPS has multiple agreements with most of these agencies, including more than 50 with CDC alone.

# SCALING UP AREAS OF RESEARCH: CENTERS OF EXCELLENCE INITIATIVES

*Growing an area of research requires intentional, guided efforts and significant investment. Over the decades, DCCPS has utilized centers initiatives to develop transdisciplinary research models that can more rapidly advance the science beyond earlier paradigms. By seizing on new opportunities such as Cancer Moonshot<sup>SM</sup> funding and leveraging key partnerships, we are able to elevate areas of emerging cancer control research even more effectively and quickly through these centers.*

- **Transdisciplinary Tobacco Use Research Centers**

The Transdisciplinary Tobacco Use Research Centers (TTURCs) were created by NCI, the National Institute on Drug Abuse (NIDA), and the Robert Wood Johnson Foundation through a funding announcement, released in 1998, inviting grant applications (P50) for a Specialized Program of Research Excellence (SPORE) in tobacco use research. The intent of this initiative was to support tobacco control and addiction research by scientists with expertise in diverse areas such as molecular biology, genetics, neuroscience, epidemiology, imaging, primary care, behavioral science, communication, health policy, economics, and marketing. Each TTURC was also required to provide career development opportunities for new and established investigators who wished to pursue active research careers in transdisciplinary tobacco use research. The ultimate goal was to generate evidence that would inform public health efforts to reduce the disease burden of tobacco use.

- **Breast Cancer and the Environment Research Program**

The [Breast Cancer and the Environment Research Program](#) (BCERP), a joint effort co-funded by the National Institute of Environmental Health Sciences (NIEHS) and NCI, was renewed for a third phase in 2015. BCERP began with the Breast Cancer and the Environment Research Centers (BCERC) in 2003. The BCERP supports a multidisciplinary network of scientists, clinicians, and community partners to examine the effects of environmental exposures throughout a woman's life that may predispose her to breast cancer. Each BCERP project comprises a biology study, a human study, and a community engagement component. The research focuses on adding to the growing knowledge of environmental and genetic factors that may influence breast cancer risk across the lifespan and reflects recommendations made by the [Interagency Breast Cancer and Environmental Research Coordinating Committee](#) in 2013.

- **Centers of Excellence in Cancer Communication Research**

The Centers of Excellence in Cancer Communication Research (CECCRs) initiative was the centerpiece of NCI's "Extraordinary Opportunity in Cancer Communication"—a scientific and programmatic priority first outlined in NCI's fiscal year (FY) 2001 budget proposal. The novelty and scope of the initiative reflected NCI's recognition that effective communication can and should be used to reduce health disparities and



narrow the gap between discovery and application. The RFA, released in 2001, used the P50 centers award mechanism to invite interdisciplinary research applications that addressed the increasing complexity of cancer communication, from the understanding of cancer itself, to the rapid evolution of new media, to the recognition of the manifold literacy and technology needs of diverse audiences. The goal of the CECCR initiative was to significantly increase the size of the cancer communication research enterprise and to better understand the mechanisms by which communication influences behavior across the cancer control continuum. The result would be both knowledge and practical strategies to enhance cancer communication and improve the control of cancer. Four P50 centers were awarded in the first round (2003–2008), and a fifth center was added after the reissuance of the RFA (2008–2013). The CECCRs initiative resulted in more than 550 peer-reviewed publications, including a journal supplement in *Patient Education and Counseling* in 2010. Importantly, the initiative trained 34 postdoctoral trainees and 97 pre-doctoral trainees, and produced numerous data-driven, evidence-based cancer communication programs and products spanning the domains of cancer prevention behaviors, cancer screening behaviors, tobacco prevention and cessation, cancer treatment and survivorship, and clinical communication in oncology.

- **Centers for Population Health and Health Disparities**

The Centers for Population Health and Health Disparities (CPHHD) Program—sponsored jointly by NCI, the National Heart, Lung and Blood Institute (NHLBI), and NIH Office of Behavioral and Social Sciences Research (OBSSR)—solicited grant applications designed to promote transdisciplinary research in the area of health inequities, with the purpose of contributing directly to improved health outcomes and quality of life for populations with a higher disease burden. The focus was on both understanding the pathways that result in disparate health outcomes and developing comprehensive models of how various social, economic, cultural, environmental, biologic, behavioral, physiological, and genetic factors affect individual health outcomes and their distribution in populations. Under the 2008 funding announcement, DCCPS supported centers focused on the differences in incidence, prevalence, mortality, and burden of cancer and related adverse health conditions that exist among specific population groups in the United States. These multilevel interventions, across 10 centers in the United States, focused on only a few social determinants of health but had a ripple effect on the implementation of interventions to improve health outcomes and quality of life. One of the studies showed that the level of neighborhood disadvantage was strongly associated with diagnosis of late-stage breast cancer (Cho et al). The researchers state, “Breast cancer patients residing in neighborhoods that became relatively more disadvantaged over the 1990–2000 decade experienced an additional risk of late-stage diagnosis.” Furthermore, they noted that the benefits of immigrant enclaves are counterbalanced by the lack of structural capacity and, specifically, quality healthcare resources to improve access to healthcare for breast cancer patients. The program was developed with the recognition that achieving health equity requires multidisciplinary, multilevel, and multi-factorial research efforts that identify and account for the roles of multiple, complex, and interacting factors simultaneously. The program was able to illustrate how these disparities in health span from cells to society and delineate how the complex interactions among various determinants, including genetic, biological, behavioral, socioeconomic, and environmental factors, get “under our skin.”

*Cho YI, et al. Neighborhood changes in concentrated immigration and late stage breast cancer diagnosis. J Immigr Minor Health. 2011;13:9–14.*

- **Transdisciplinary Research on Energetics and Cancer Centers**

The [Transdisciplinary Research on Energetics and Cancer Centers](#) (TREC) initiative fosters collaboration across multiple disciplines and encompasses projects that range from the biology, genomics, and genetics of energy balance to behavioral, sociocultural, and environmental influences upon nutrition, physical activity, weight, energetics, and cancer risk. It also provides training opportunities for new and established scientists who can carry out integrative research on energetics and energy balance. Established in 2005, the TREC initiative and the Training Workshops complement NCI's energy balance research endeavors including the [Trans-NCI Obesity and Cancer Working Group](#) and the efforts of the [NIH Obesity Research Task Force](#). TREC has trained 188 early-career researchers through annual transdisciplinary workshops on energy balance and cancer. To date, more than 1,200 peer-reviewed publications have resulted from TREC. The outcome from TREC training activities was an enhanced research network with a common focus on using transdisciplinary science to address problems related to energetics, obesity, and cancer. The TREC Training Workshop continues to promote transdisciplinary information exchange and problem solving and ensures that cross-discipline relationships are built on trust and mutual respect.

- **Tobacco Centers of Regulatory Science**

The [Tobacco Centers of Regulatory Science](#) (TCORS) generate critical research to inform FDA's regulation of the manufacture, marketing, and distribution of tobacco products. The TCORS are multidisciplinary; principal investigators (PIs) and their research teams have a broad range of expertise—including epidemiology, economics, toxicology, addiction, communication, and marketing—and they conduct research projects around an integrative theme. TCORS grantees conduct research pertaining to the landscape of different tobacco products, including e-cigarettes. In addition to primary research projects, these center grants include components for rapid response and pilot research and cores that offer mentored research in tobacco regulatory science. In 2013, 14 centers (TCORS 1.0) were funded, and in 2018, nine centers (TCORS 2.0) received funding. NCI programmatically manages four of the nine TCORS 2.0 centers. These TCORS are funded through NCI, as a participating institute in the Tobacco Regulatory Science Program (TRSP), an interagency partnership to foster research that informs FDA's tobacco regulatory activities. This significant investment by the FDA and NIH has been highly effective in fostering the development of a new discipline of tobacco control research—tobacco regulatory science—and a new cadre of tobacco regulatory scientists. The TCORS's substantial scientific contributions have informed FDA's tobacco regulatory activities, state and local tobacco control policy efforts, and advanced tobacco control more broadly. An analysis conducted in 2019 found that the TCORS program had produced over 1,000 published journal articles and eight themed journal issues. Approximately 150 of the publications involved multiple centers, reflecting the high level of collaborative work among the TCORS.



- **Implementation Science Centers in Cancer Control**

The [Implementation Science Centers in Cancer Control](#) (ISC<sup>3</sup>) Program supports the rapid development, testing, and refinement of innovative approaches to implement a range of evidence-based cancer control interventions. Centers all feature “implementation laboratories” with clinical and community sites. These laboratories will engage in implementation research across the cancer control continuum to advance methods of studying implementation and to develop and validate reliable measures of key implementation science constructs. The ISC<sup>3</sup> Program comprises seven centers funded by [RFA-CA-19-005](#) and [RFA-CA-19-006](#), released in 2018. Over the course of this 5-year initiative, over 70 pilot studies in implementation science and cancer control will be conducted. Researchers are developing capacity-building tools for practitioners and a set of implementation science pilot studies that integrate social determinants of health or social needs to advance health equity.



# SCALING UP AREAS OF RESEARCH: LEVERAGING NCI-DESIGNATED CANCER CENTERS

DCCPS supports NCI-Designated P30 Cancer Centers in developing new ways to prevent, diagnose, and treat cancer. Through several recent initiatives focused on cancer control, the cancer centers have expanded their capacity to conduct research, plan strategy, facilitate professional collaborations, and implement efforts to improve healthcare. These initiatives exemplify how DCCPS is able to leverage the cancer centers to scale up an area of science through targeted administrative supplements and incentivize implementation into the cancer patient community.

- **Population Health Assessment in Cancer Center Catchment Areas**

To create programs that best prevent, diagnose, treat, and provide care for survivors, cancer centers must thoroughly understand the populations they serve. DCCPS supported supplemental funding to conduct research to better characterize the populations and communities within the NCI-Designated Cancer Center catchment areas. The [initiative](#) sought to enhance cancer centers' capacity to acquire, aggregate, and integrate data from multiple sources, as well as plan, coordinate, and enhance catchment area outreach activities. Surveys conducted at each of the 29 funded cancer centers included common demographic and behavioral measures to facilitate cross-site and local-versus-national comparisons on constructs relevant to cancer control. The short-term goal of the supplemental funding was to support local research to better define and describe the cancer center catchment area using a multilevel population health framework. The long-term goal was to facilitate collaborations in which local area providers, public health practitioners, policymakers, and nonprofit organizations utilize data to develop or expand applied cancer control research, planning, intervention, and implementation efforts, with particular attention to local-level health disparities and communication inequalities. The 29 centers funded in FYs 2016 and 2018 have published 33 peer-reviewed publications to date, with two special journal issues published in 2019: A Focus Issue of *Cancer Epidemiology, Biomarkers & Prevention* and Special Section in the *Journal of Rural Health*. Pooled analyses and subsequent publications are under review to examine cancer screening uptake and cancer beliefs in rural catchment populations, and social determinants of health in catchment populations. Four grantee meetings were held from 2016–2020, with the culminating grantee meeting held virtually in March 2020. This initiative has led to catchment area data collection efforts now incorporated into the P30 Cancer Center Support Grants (CCSGs) funding opportunity announcement (FOA).

- **Human Papillomavirus (HPV) Vaccine Uptake**

In September 2020, DCCPS awarded a third round of supplements to 11 NCI-Designated Cancer Centers to support [investigation of vaccine hesitancy related to uptake of the HPV vaccine](#) in regions with low adolescent HPV vaccination rates. The short-term goals for this one-year supplement are to understand characteristics of vaccine-hesitant communities within the cancer center catchment areas, identify promising and innovative approaches to reducing hesitancy and other barriers to HPV vaccination, and gather pilot data to guide future interventions to reduce vaccine hesitancy and increase HPV vaccination. This supplement is part of a larger effort to bring together NCI-Designated Cancer Centers, CDC programs, and state/local health departments and their immunization programs. These administrative supplements are being offered in response to the Cancer Moonshot Blue Ribbon Panel Report's recommendation "to expand the use of proven prevention and early detection strategies" and the World Health Organization's (WHO) report, which cited vaccine hesitancy as one of the "ten threats to global health in 2019." Two previous rounds of supplements were issued to cancer centers that focused on increasing HPV vaccination rates in regions with low HPV vaccination uptake: NCI funded 18 supplements in 2014 and 12 supplements in 2017.

- **Tobacco Cessation in Cancer Patients**

Continued smoking after a cancer diagnosis can interfere with treatment and worsen a patient's prognosis. Fortunately, quitting can help improve a patient's prognosis and reduce cancer treatment toxicity. The [Cancer Center Cessation Initiative \(C3I\)](#) was launched by NCI using Cancer Moonshot funds to help cancer centers build and implement sustainable tobacco cessation treatment programs to routinely address tobacco use among their patients. The C3I provided resources from FY 2017 through FY 2020 to 52 NCI-Designated Cancer Centers to create sustainable systems to identify and treat tobacco use among patients who smoke. Centers are working to modify electronic health records (EHRs) and clinical workflows, identify and surmount patient, clinician, clinic, and health system barriers, and achieve institutional buy-in for providing tobacco treatment as part of routine oncology care. Ultimately, the goal is to improve cancer patient outcomes by ensuring that treating tobacco use is a standard of care for cancer patients. Many C3I sites have made considerable progress. Examples include 50% patient engagement (May et al) and an increase in tobacco treatment referrals from 10 to 24 per month (Meyer et al). With assistance from the C3I Coordinating Center, a number of centers have successfully modified EHRs to allow for automatic identification and referral. In just the first year of funding, EHR referrals increased from 32% to 68% of centers (D'Angelo et al).

*May JR, et al. Leveraging patient reported outcomes measurement via the electronic health record to connect patients with cancer to smoking cessation treatment. Int J Environ Res Public Health. 2020 Jul 13;17(14):5034.*

*Meyer C, et al. A lean quality improvement initiative to enhance tobacco use treatment in a cancer hospital. Int J Environ Res Public Health. 2020 Mar 24;17(6):2165.*

*D'Angelo H, et al. Tobacco Treatment Program Implementation at NCI Cancer Centers: progress of the NCI Cancer Moonshot-funded Cancer Center Cessation Initiative. Cancer Prev Res. 2019 Nov; 12 (11):735-740.*



- **Rural Cancer Control**

Rural communities face numerous challenges compared to urban areas along the entire cancer control continuum, reflected in higher average death rates from cancer for all cancer sites combined. This long-standing public health challenge calls for sustained support for research, with interdisciplinary cross-sectional collaborations. In FYs 2018 and 2019, DCCPS awarded 21 and 20 administrative supplements, respectively, to [P30 CCSGs to develop rural cancer control research capacity](#). These supplements provided resources to support the time and effort of teams at NCI-Designated Cancer Centers, in collaboration with rural communities and clinics, to develop comprehensive rural cancer control research programs that serve low-income and underserved populations. Over one-third of these awarded supplements focused on improving cancer control efforts among American Indian (AI) populations. Awardees of the rural supplements established working groups that continue to meet regularly to discuss issues pertaining to rural cancer control. Over the past year, a consortium of cancer centers, many being former rural supplement recipients, formed IC-4 (Impact of COVID-19 on the Cancer Continuum Consortium), a consortium of centers working to understand the impact of the pandemic on the continuum of cancer care, from prevention to survivorship. This supplement opportunity was the first of numerous rural cancer control-focused funding efforts, including two RFAs that followed ([RFA-CA-19-064](#), [RFA-CA-20-051](#)), and investigators have been able to utilize their work and the connections established with the rural supplement to be successful in subsequent applications.

- **Cancer and Aging**

The [NCI Annual Plan & Budget Proposal](#) for FY 2020 highlighted the need to increase understanding of the role of aging in cancer. DCCPS is making [strategic investments in aging research](#) that will contribute to population health by preserving or promoting health span and ensuring equitable access to and benefit from advances in cancer prevention, control, and population science. A lifespan approach to the elimination or reduction of cancer risk associated with obesity, tobacco use, and physical inactivity is critical for the primary prevention of cancers and other chronic conditions that contribute a substantial public health burden during midlife and older adulthood. Surveillance methods are needed to track aging-relevant factors associated with cancer burden (e.g., multiple chronic conditions, polypharmacy, short- and long-term adverse effects, financial toxicity, residential stability and institutional care transitions [nursing homes, hospice], and behavioral and social exposures). As pediatric and adolescent and young adult (AYA) cancer survivors age chronologically and biologically and experience adverse physical, psychosocial, and behavioral outcomes, interventions to prevent, ameliorate, or rehabilitate aging-related consequences of cancer and its treatments are a priority. In FY 2020, DCCPS funded eight cancer centers, with the goal of addressing these critical research questions.

- **Community Outreach and Engagement**

[Community outreach and engagement](#) (COE) has been a fundamental activity of the NCI-Designated Cancer Centers since the initiation of the cancer centers program in 1971. Historically, COE has been commonly considered an extension of centers' population science/cancer prevention and control research programs. However, since the 2016 and 2019 reissuances of the P30 CCSG guidelines, COE is expected to now span all aspects of centers' programs, including basic, clinical, translational, and population research. Cancer centers—working with community stakeholders—should identify community needs, communicate those needs across the center's leadership and research programs (i.e., “in-reach”), and catalyze activities of special relevance to the cancer center's self-defined geographic catchment area population. In 2020, DCCPS provided supplemental funding to 23 cancer centers to generate examples of research projects where outreach to and engagement of communities resulted in high-impact science. In addition, centers are expected to work with communities to disseminate and implement evidence-based interventions and guidelines, public education, and public health policy recommendations. This bidirectional relationship between communities and cancer centers promotes an understanding of cancer that is more holistic (bench-to-bedside-to-community), transdisciplinary, encompassing of different views and experiences, culturally sensitive, and reflective of mutual goals. In 2021, additional supplements may be issued to encourage greater engagement of NCI-Designated Cancer Centers in comprehensive cancer control planning efforts in their catchment areas.

- **Financial Hardship During Cancer Treatment**

DCCPS is supporting research at NCI-Designated Cancer Centers via a supplement initiative to find new ways to address the difficult [financial challenges that cancer survivors often face](#) throughout treatment and follow-up care. The causes of cancer-related financial hardship are multifaceted, stemming from high out-of-pocket costs, inadequate insurance coverage, missed days from work or job loss, and other related challenges. Thus, a program of services is needed to address this complex problem. A 2019 survey sponsored by DCCPS suggested that most NCI-Designated Cancer Centers offer a range of financial navigation services. However, 40% of centers reported a lack of staff awareness about available financial navigation services, and 46% reported that the pathways or workflows to connect cancer patients with existing financial services were unclear. Additionally, over 50% of centers reported that patients were reluctant to ask for financial help when they needed it, and 37% of centers could not estimate the percentage of their patients who experience cancer-related financial hardship. Collectively, these findings suggest a need to both enhance the systematic identification of patients experiencing financial hardship and improve the coordination and delivery of financial navigation services. This supplement initiative is intended to help cancer centers develop or expand their capacity and infrastructure to deliver financial navigation services and to collect the preliminary data necessary to more broadly implement and evaluate financial navigation programs. To date, DCCPS has funded 11 centers under this initiative. Each project is in the first year of funding, and data collection is underway. DCCPS leads a quarterly investigator meeting to share information and updates among the funded teams. At the end of the funding period, findings from each project will be shared with other NCI-Designated Cancer Centers, as well as with other institutions that provide cancer care, to inform future research and service delivery in these settings.

- **National Childhood Cancer Registry**

[To enable better understanding of the needs of childhood cancer patients](#), DCCPS provides administrative supplement support to a subset of NCI-Designated Cancer Centers to encourage the centers to submit critical existing data that is available at the cancer centers but not routinely reported to cancer registries. The Childhood Cancer Data Initiative (CCDI) symposium hosted by NCI in July 2019 identified a critical need to collect, analyze, and share data to address the burden of cancer in children and AYAs. Currently, cancer registries in the United States hold structured information on every cancer case, including childhood cancers, within their respective catchment area. Using registry data as a base, an infrastructure is being constructed that brings together key information on every childhood cancer patient and will be maintained to support research on childhood cancer survivors throughout treatment and follow-up care. The National Childhood Cancer Registry (NCCR) is envisioned as a connected data infrastructure to enable sharing of childhood cancer data from multiple and heterogeneous data sources. Incorporating available data on genomic and tumor characterization, residential history, social determinants of health, measures of financial toxicity, longitudinal treatments including oral agents, and longitudinal outcomes data including recurrence and subsequent cancers can enhance the core infrastructure of registry data on pediatric patients. To date, DCCPS has provided supplement funding for this effort to 10 cancer center sites.

- **Patterns of Cannabis Use Among Cancer Patients**

In FY 2020, DCCPS funded 12 NCI-Designated Cancer Centers to study [patterns of cannabis use among cancer patients](#). Common conditions for which cannabis has been used among cancer patients include anorexia, nausea, and pain; however, the extent of use, modes of use, perceived risks and benefits of use, and provider interactions about use are uncertain, as well as the degree of accessibility by patients given the variation in state laws concerning legalization of marijuana. As a first step, NCI is supporting research at these centers to survey patients about their use of cannabis during cancer treatment across regions with varying state regulations. All centers will administer a core set of questions in addition to their center-specific research questions. Approximately 12,000 cancer patients will be surveyed across the sites in 2021, with some sites including provider surveys. The survey results will inform future research activities as well as clinical care. The [NCI Cannabis, Cannabinoids, and Cancer Research Symposium](#), in December 2020, highlighted many additional research gaps concerning cannabis use, including potential drug-drug interactions, side effects, impact on comorbid conditions, beneficial effects, modes of use, and dosages.



- **Persistent Poverty**

Advances in cancer prevention, diagnosis, treatment, and survival have unfortunately not benefited everyone equally, and disparities in cancer outcomes persist, as discussed regarding the CPHHD program. Populations living in persistent poverty, in particular, face higher rates of cancer morbidity and mortality. DCCPS announced an administrative supplement opportunity in FY 2021 for NCI-Designated Cancer Centers to enhance research capacity in persistent poverty areas. The purpose of this opportunity is to provide resources to support multidisciplinary research teams at these centers, in collaboration with clinics that serve underserved populations living in persistent poverty areas, to plan, implement, and sustain a cancer control research program that focuses on low-income and/or underserved populations. As such, awardees will be expected to address challenges and opportunities related to working in partnership with these clinics, and enhance delivery of cancer control and prevention strategies to improve overall health and lessen the burden of cancer in these areas. The long-term goal of this supplement is to build the capacity for healthcare clinics and/or safety net providers to implement evidence-based cancer prevention and control programs and practices focused on underserved populations in persistent poverty areas. These supplements align with the White House's [Executive Order On Advancing Racial Equity and Support for Underserved Communities Through the Federal Government](#) and are part of a larger NCI research initiative to inform, test, and strengthen cancer control programs that are sustainable in these communities of persistent poverty across the United States. NCI envisions this effort will lead to new partnerships within communities and among local and state agencies and organizations, and increase the centers catchment area to focus on previously excluded underserved populations.

- **Cancer Survivorship in Children**

In FY 2021, DCCPS released a [funding announcement for administrative supplements](#) to NCI-Designated Cancer Centers to support research aimed at better understanding and addressing organizational factors that contribute to disparities in outcomes among childhood cancer survivors. Over the past several decades, advances in cancer treatment and supportive care have resulted in a growing US population of childhood cancer survivors. At the same time, research in childhood cancer survivorship is also expanding, due in part to the [Childhood Cancer Survivorship, Treatment, Access, and Research \(STAR\) Act](#). Yet, these achievements have not benefited all children equally. Community, health system, organizational, process-of-care, or policy-related barriers may contribute to disparities in survivorship outcomes for childhood cancer survivors. Studies of disparities in treatment and survivorship outcomes among children with cancer are sparse, and even fewer interventions targeting disparities have been tested. Evaluating the root causes of inequities in survivorship outcomes will require understanding barriers that exist in the cancer center care environment. This supplement initiative is a part of a larger NCI research initiative to engage cancer centers and communities in collaborative, translational research focused on decreasing the cancer burden for children diagnosed with cancer across the United States, including among minority and underrepresented populations. The long-term goal of this administrative supplement opportunity is to generate research that will work to eliminate organizational or structural inequalities for children diagnosed with cancer.

# ENABLING LARGE-SCALE DATA COLLABORATIONS: NCI COHORT CONSORTIUM

DCCPS also drives research across the cancer control spectrum by assembling cancer epidemiology cohorts into the NCI Cohort Consortium. This extramural-intramural partnership facilitates large-scale collaborations to pool data and biospecimens necessary to conduct a wide range of prospective cancer studies.

Through its collaborative network of investigators, the consortium provides a coordinated, interdisciplinary approach to tackle important scientific questions with economies of scale (Swerdlow et al). To date, NCI Cohort Consortium members have launched more than 50 scientific initiatives, and more than 260 publications have resulted from [Cohort Consortium projects](#). At the consortium's inception, foundational work led to the development of risk assessment algorithms and polygenic risk scores, holding promise for precision medicine and prevention (Hunter et al). The consortium is most advantageous for prospective studies of rarer cancer sites, where collaboration among multiple cohorts provides the needed large sample size. Examples include the studies of the association between vitamin D and rarer cancers such as ovarian and pancreatic cancer (Helzlsouer et al), the liver cancer pooling project (Petrick et al), and a new project focused on appendiceal cancer.

In addition to coordinating the NCI Cohort Consortium's activities, the division's Epidemiology and Genomics Research Program (EGRP) supports additional cohort-related resources for researchers, such as the [Cancer Epidemiology Descriptive Cohort Database](#) (CEDCD). The CEDCD is a searchable database containing general study information about the cohorts that are active in the consortium (e.g., eligibility criteria and enrollment), types of data and biospecimens collected, number of participants diagnosed with cancer, and key contacts for each cohort. The goal of the CEDCD is to facilitate collaboration and highlight the opportunities for research within existing cohort studies.

The [Cohort Metadata Repository](#) (CMR) is a tool developed by EGRP that documents data harmonization across cohorts. Variables from each cohort can be searched and compared to determine if harmonization is possible. Once harmonization has occurred, the harmonized variables and the specifications used to create the variables are also documented in the CMR. The CMR contains only metadata (variable names, formats, codes, descriptions) and no individual-level data.

The collaborative research activities facilitated by the NCI Cohort Consortium, and resources such as the CEDCD and CMR, advance the goal of DCCPS and NCI to improve the health of the public through cancer control.

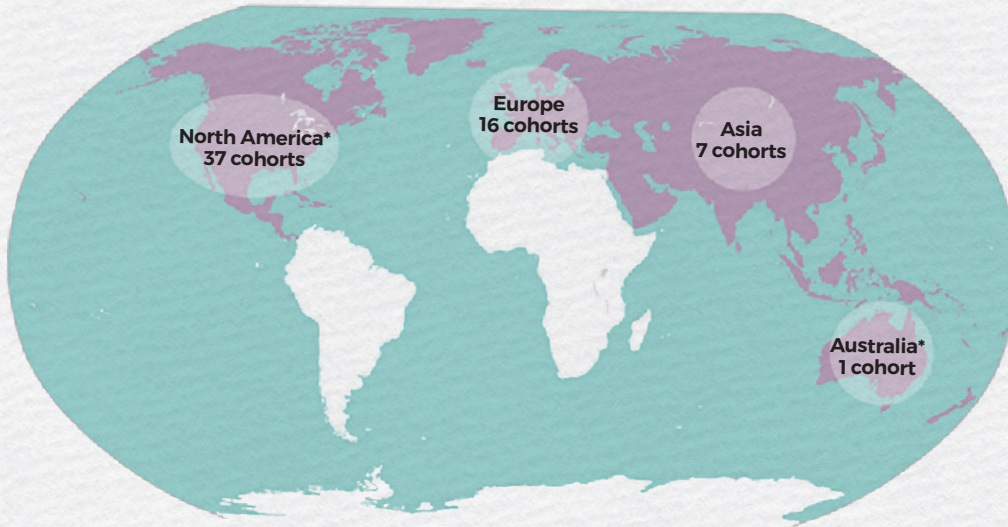
*Swerdlow AJ, et al. The National Cancer Institute Cohort Consortium: an international pooling collaboration of 58 cohorts from 20 countries. Cancer Epidemiol Biomarkers Prev. 2018 Nov;27(11):1307-1319.*

*Hunter DJ, et al. A candidate gene approach to searching for low-penetrance breast and prostate cancer genes. Nat Rev Cancer. 2005 Dec;5(12):977-85.*

*Helzlsouer KJ, et al. Overview of the Cohort Consortium Vitamin D Pooling Project of Rarer Cancers. Am J Epidemiol. 2010 Jul 1;172(1):4-9.*

*Petrick JL, et al. Tobacco, alcohol use and risk of hepatocellular carcinoma and intrahepatic cholangiocarcinoma: the Liver Cancer Pooling Project. Br J Cancer. 2018 Apr;118(7):1005-1012.*

**Map of NCI Cohort Consortium Membership  
by Continent, 2021**



*\*The Breast Cancer Family Registry (BCFR) Cohort and the Colon Cancer Family Registry Cohort (CCFRC) include study participants from both North America and Australia.*



# RESPONDING TO EMERGENT SOCIETAL ISSUES: COVID SEROLOGY RESEARCH

DCCPS has much to offer in responding to emerging public health issues, including those issues that extend beyond our key mission of reducing the burden of cancer. The COVID-19 pandemic has provided a powerful example of how the division is able to rapidly scale up research by leveraging funding opportunities, partnerships, data infrastructure and linkages, and analytical expertise. While cancer control research is the division's priority and focus, DCCPS is contributing critical expertise in serological sciences, data gathering, and analysis to help address key research questions related to the global pandemic.

## STUDYING SARS-COV-2 ANTIBODIES AND VIRUS REINFECTION

In 2020, DCCPS launched a study to better understand whether, and to what degree, detectable antibodies against SARS-CoV-2 protect people from reinfection with the virus. Working with HealthVerity and Aetion, a research team led by DCCPS staff aggregated and analyzed patient information collected from multiple sources, including five commercial labs, EHRs, and private insurers.

The study, published on February 24, 2021, in *JAMA Internal Medicine*, found that people who have had evidence of a prior infection with SARS-CoV-2 appear to be well protected against reinfection, at least for a few months. This finding has important public health implications, including decisions about returning to physical workplaces, school attendance, the prioritization of vaccine distribution, and other activities.

To continue to comprehensively address this important research question, NCI is supporting clinical "seroprotection" studies that monitor infection rates in large populations of people whose antibody status is known. NCI is also sponsoring ongoing studies using real-world data to assess the longer-term association between antibody positivity and subsequent infection rates.

## NCI SEROLOGICAL SCIENCES NETWORK (SERONET)

DCCPS has played a key role as part of the [NCI-led Serological Sciences Network \(SeroNet\)](#), a coordinated effort to study the immune response to COVID-19. The network aims to combat the pandemic by improving the ability to test for infection, especially among diverse populations, and speed the development of treatments and vaccines.

Serologic testing for SARS-CoV-2 antibodies can identify persons who have been exposed and infected with SARS-CoV-2 at any time and might be a correlate of protective immunity. Serological studies at the population level will improve our understanding of the severity of the pandemic, the strength and duration of immunity, how infection varies across demographic groups, and the robustness of the immune response after infection or vaccination.

Serologic testing for the presence of SARS-CoV-2 antibodies is also a critical tool for understanding the epidemiology of COVID-19 and designing control strategies for the pandemic. NCI-supported studies in DCCPS's grant portfolio related to these issues include the following:

- A series of linked studies embedded in a large, integrated health system (Kaiser Permanente Northern California) with a significant number of COVID-19 patients, high SARS-CoV-2 testing capacity, and linked rich demographic, behavioral, and clinical data will assess SARS-CoV-2 seroprevalence, sero-incidence, risk of seroconversion, and longevity of antibody response.
- Investigators at The Ohio State University will use serological and molecular tests to study first responders and their household contacts to understand transmission in both asymptomatic and symptomatic individuals; immune, host, and viral determinants of disease outcomes; factors associated with immune protection; and best practices for communication of test results and COVID-19 information.
- The Harvard SeroSciences Center will develop new methods for serological data analysis, design studies to test and refine these methods, and create novel modeling tools to monitor population immunity to COVID-19 and other infections.

Racial/ethnic minorities bear a disproportionate burden of the incidence, morbidity, and mortality from SARS-CoV-2 infection. In addition to multiple factors that lead to disproportionate rates of infection—such as structural racism and discrimination, higher rates of preexisting health conditions, and delayed or limited access to healthcare—differences in immune response to SARS-CoV-2 may also play a part in this disparity. NCI-supported studies in DCCPS's grant portfolio related to COVID-19 health disparities include the following:

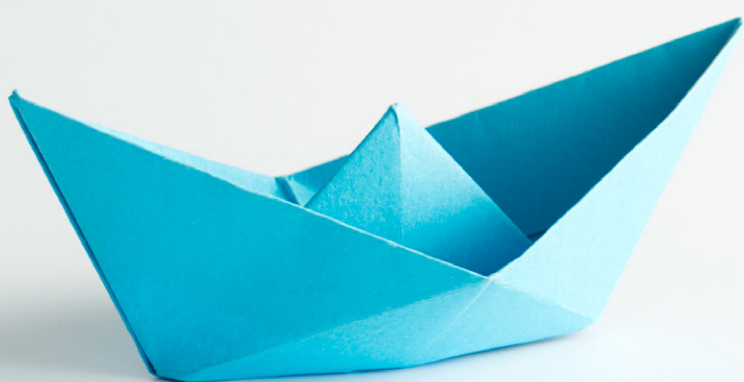
- Investigators at the University of Arkansas for Medical Sciences established a population-based, observational prospective cohort study with a racially, ethnically, and geographically diverse, representative sample of all noninstitutionalized adults residing in Arkansas tested by real-time, reverse transcriptase polymerase chain reaction (RT-PCR) for COVID-19 between November 2020 and April 2021. The cohort will be followed up to 48 months post-testing to determine serological responses to SARS-CoV-2 infection, the durability of response, and multiple factors associated with immune response by race and ethnicity.
- A study led by Michigan State University will develop and compare effects of a general-versus-culturally targeted video about antibody testing on African American and White Flint residents' antibody testing attitudes and uptake. Additionally, the investigators will measure and identify multi-analyte inflammatory biomarker profiles among Flint Registry enrollees who complete salivary antibody testing and compare inflammatory biomarker profiles by race and antibody status.

Lessons learned from SeroNet research have had immediate public health implications and may prove valuable to public health beyond the current pandemic.

PROGRESS  
ACROSS THE  
CANCER CONTROL  
CONTINUUM







# BEHAVIORAL RESEARCH PROGRAM

## A COMPREHENSIVE PROGRAM FOR BEHAVIORAL RESEARCH IN CANCER PREVENTION AND CONTROL

Up to 50% of cancer deaths are attributable to behaviors such as tobacco use, unhealthy diet, lack of physical activity, ultraviolet (UV) exposure, and alcohol consumption. Undeniably, behavior—including communication—is an important factor across the cancer control continuum. Social media users post information—sometimes inaccurate information—about cancer causes and treatments, read by thousands. Oncologists communicate with patients and families and make treatment and palliative care decisions, and radiologists make judgments based on training and prior experience when evaluating mammograms. Lawmakers design policies that influence behavior, such as laws that prohibit indoor tanning among youths and smoking in public places and workplaces. Patients decide whether to engage in genetic testing to better understand their cancer risk. Indeed, the human experience can play a part in many cancer outcomes. Stress can accelerate tumorigenesis; cancer treatment can diminish cognitive abilities; cancer can accelerate the aging process; and anticipated emotions can drive big decisions, such as enrolling in a clinical trial.

Recognizing the impact of human behavior on cancer morbidity, mortality, and survivorship, NCI established the Behavioral Research Program (BRP) in 1998. Since then, BRP has built a large and diverse grants portfolio in behavioral research related to cancer (nearly 300 grants awarded totaling almost \$200 million in FY 2020). The portfolio features grants on a wide range of topics, including interventions to address tobacco initiation and cessation in high-risk groups, such as youths, cancer patients, and people living with HIV; innovative applications of mobile health technology to manage cancer symptoms; and state-of-the-art programs to promote physical activity in cancer survivors. Many grants focus on health disparities by addressing cancer prevalence and control in traditionally underrepresented subpopulations.



BRP has prioritized the support of data and research tools to advance the integration of behavioral science and cancer control and to facilitate the research pursuits of our extramural community. These tools include the Health Information National Trends Survey ([HINTS](#)), a nationally representative survey of engagement with health information; the Family Life, Activity, Sleep, Health, and Eating ([FLASHE](#)) survey, which assesses health behaviors and predictors in parent-adolescent dyads; the Grid-Enabled Measures ([GEM](#)) portal, a collaborative tool to help groups reach consensus about best measures in disparate areas of cancer control; the Classification of Laws Associated with School Students ([CLASS](#)) data set, which collects policy data related to obesogenic factors affecting youth, such as physical activity requirements; and the Tobacco Use Supplement to the Current Population Survey ([TUS-CPS](#)), which tracks tobacco use behaviors, attitudes, and policies across the United States.

BRP uses insights from basic communications science and basic behavioral science to inform cancer prevention and control, including the application of (1) communication “best practices” in the design of anti-tobacco messaging; (2) basic research on decision-making to understand and improve palliative care decisions; (3) research on stigma to understand and narrow disparities in pain management; (4) cognitive science research to determine how best to assess the effects of chemotherapy on cognitive functioning; and (5) research on nutrition, physical activity or sedentary behaviors, sleep behavior, and the built environment, to elucidate the links among obesity, energy balance, and cancer prevention. The program also takes a full lifespan approach—ranging from research on predictors of obesity and the use of electronic nicotine delivery systems (ENDS) in children to predictors of frailty and cognitive decline in older cancer survivors. A key priority is to take a systemic, multilevel approach, because behaviors are influenced by factors at many levels—from individual factors, like emotions, to sociocultural factors, such as structural racism and the built environment. In collaboration with other institutes and centers (ICs) and offices within the National Institutes of Health (NIH), BRP has advanced innovative research methods, such as integrative data analysis, intensive longitudinal assessments, and natural experiments, and has employed innovative methods, such as [NCI - Cancer Research U.K. \(CRUK\) “Sandpit” idea labs and summer workshops](#), to build new areas of research and to facilitate the career development of early-stage investigators.

BRP research needs to be particularly nimble and responsive to national and international developments. When the FDA was provided the authority to regulate tobacco products in 2009, BRP supported critical research efforts to help inform the development of new policies, and when menu labeling was mandated in 2008, BRP supported research to assess the effects of labels on dietary choices. The COVID-19 pandemic, the nation’s reckoning with structural racism, public skepticism about the value of science (combined with the spread of health misinformation), and even the increasing threat of climate change on human health will all influence behavioral factors along the cancer control continuum. The rapid increase in cancer survivors due in part to promising developments in cancer therapeutics necessitates a focus on helping survivors engage in behaviors that enhance longevity and that minimize the risk of recurrence and secondary cancers. With a concerted effort, it should be possible to reduce the number of preventable cancers and to make a lasting contribution to population health.

## **BASIC BIOBEHAVIORAL AND PSYCHOLOGICAL SCIENCES BRANCH: BRAIN, BEHAVIOR, AND CANCER CONTROL**

Use-inspired basic research is fundamental to understanding human behaviors, social context, decision-making, and clinical practices. The [Basic Biobehavioral and Psychological Sciences Branch](#) (BBPSB) supports experimental studies involving humans or animals and observational and clinical studies that broaden our knowledge of cognitive, affective, perceptual, and sensory processes related to cancer etiology, prevention, screening, detection, diagnosis, treatment, and survivorship.

### **Decision Science, Affect, and Emotion**

BBPSB has endeavored to understand how individuals make health-related decisions about cancer. Over the last 20 years, BBPSB has supported research to develop decision support tools (e.g., electronic decision aids) and research to understand how individuals apply heuristics and biases to health-related decisions (e.g., understanding numeric risk estimates). Recently, BBPSB developed a Cancer Moonshot initiative to improve risk communications and decision-making for individuals and families with an inherited susceptibility to cancer.

In 2011, BBPSB articulated the need to support basic research on the phenomenological nature of affect to advance understanding of how emotion influences cancer control. Three workshops led to a [white paper](#), NCI and trans-NIH [funding opportunities](#), and the Society for Affective Science inaugural meeting. In 2015, BBPSB convened four meetings of affective/decision scientists and palliative care researchers/practitioners and developed [a conceptual model of affective prediction in palliative care](#) (published in 2019).

### **Interoception and Perception**

Interoception is the perception and integration of autonomic, hormonal, visceral, and immunological homeostatic signals that collectively describe the body's physiological state. Fundamental knowledge of interoception can be leveraged to understand aspects of cancer control, such as the role of hunger and satiation perception in obesity, the perception of pain and other symptoms, individual differences in patient-reported outcomes, and treatment adherence. BBPSB established the Interoception Research Network in 2019 to promote discussion and collaboration among interoception experts.

Detecting and diagnosing cancer often relies on humans interpreting complex medical images, such as mammograms or pathology slides. In an era of rapidly advancing imaging technologies, the role of the human observer remains critical. To improve diagnostic accuracy, we must understand the perceptual and cognitive mechanisms underlying medical image perception. BBPSB convened an agenda-setting workshop (2014) and a [think tank](#) (2019), which led to funding opportunities in collaboration with the National Institute for Biomedical Imaging and Bioengineering (NIBIB) and the NSF. Further, BBPSB sponsored [mobile perception laboratories](#) at radiological meetings and launched a [platform for online medical image perception experiments](#) to connect researchers and clinical diagnosticians.



## Multimorbidity, Aging, Cognitive Impairment, and Pain

BBPSB continues to expand its research portfolio in the areas of multimorbidity, accelerated aging, cancer-related cognitive impairment, and [cancer pain inequities](#) to improve survivorship and extend health span. Cancer survivors are more likely than those without cancer to experience multimorbidities and premature mortality, and more than 50% of cancer survivors experience overweight or obesity. BBPSB established the [Perspectives on Cancer and Aging: The Arti Hurria Memorial Webinar Series](#), in partnership with EGRP, to honor the late Arti Hurria, MD, a pioneer in the fields of geriatrics and oncology, a BBPSB grantee, and servant-based leader, collaborator, and mentor. In addition, the Cancer and Accelerated Aging initiative, started in 2017 with EGRP, convened think tank meetings to understand how best to [measure aging in cancer populations](#) and identify [strategies to prevent, ameliorate, or rehabilitate the aging-related consequences of cancer](#).

A significant proportion of non-central nervous system cancer survivors report mild cognitive impairment at diagnosis, during treatment, and for some, for years after treatment completion. Recognizing the opportunity to leverage cognitive neuroscience to improve the assessment of cancer-related cognitive impairment (CRCI), BBPSB published a [commentary](#) in *Trends In Neurosciences* to encourage research through grant and contract mechanisms and created the CRCI-Cognitive Science Network to encourage transdisciplinary collaboration.

## Biobehavioral Mechanisms of Cancer Progression

BBPSB has led NCI's investment in discovering cancer-relevant molecular pathways and networks regulated by social, behavioral, or psychological factors. Over the last 20 years, the branch convened subject-matter experts to inform scientific agenda-setting, sponsored roundtables, symposia, and workshops, published seminal field-shaping perspectives, and cultivated a preclinical and clinical portfolio of research project grants. BBPSB founded the [NCI Network on Biobehavioral Pathways in Cancer](#), a collaborative research consortium comprising scientists with expertise in molecular biology, biobehavioral sciences, preclinical and translational medicine, and clinical oncology. Between 2010 and 2018, requests for proposals released by Leidos Biomedical, Inc. resulted in 14 subcontract awards that fulfilled the network's mission and contributed to a [feature](#) in *Science* magazine.



If you want to go fast, go alone. If you want to go far, go together.”

– Proverb shared by Dr. Arti Hurria, Founding Chair, Cancer and Accelerated Aging: Advancing Research for Healthier Survivors

## HEALTH BEHAVIORS RESEARCH BRANCH: THE PROMISE OF CANCER PREVENTION AND CONTROL THROUGH BEHAVIOR CHANGE

Imagine a regimen that could *prevent up to one-half of all cancer deaths*; such a discovery would galvanize the world of cancer prevention and treatment.

We have at hand such a “magic formula,” though not in pill form. As stated before, up to 50% of cancer deaths are believed to be attributable to unhealthy behaviors and could be prevented. While tobacco use is the most important modifiable risk factor, other behavioral risk factors such as obesity, lack of physical activity, unhealthy diets, alcohol use, and UV radiation exposure, account for a large proportion of preventable cancer deaths (Lippman et al).

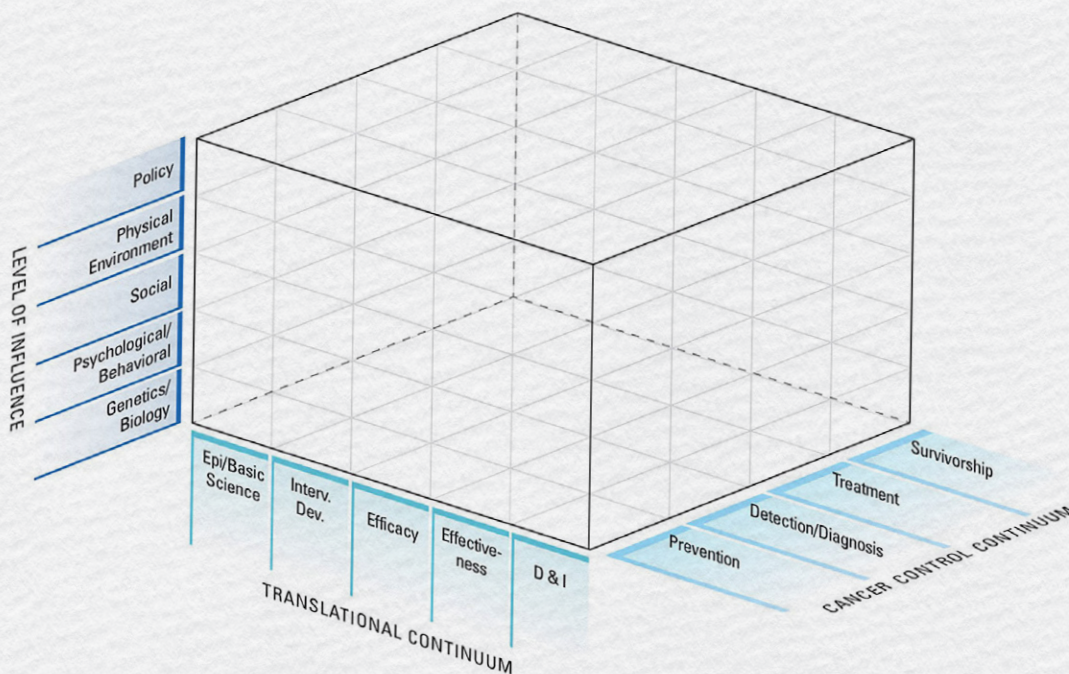
The Health Behaviors Research Branch (HBRB) has made significant progress over the past 20 years in supporting and catalyzing research to develop, test, and implement effective strategies to improve cancer risk behaviors and to evaluate programs, policies, and environments that influence such behaviors. Through this research, the branch has discovered that adopting and maintaining healthy behaviors requires a deep understanding of the complex, multilevel array of influences on human behavior. HBRB-supported research spans multiple levels of influence, all phases of the translational spectrum, and all aspects of the cancer control continuum, as illustrated by the HBRB [strategic plan](#) and accompanying multilevel framework [see figure on next page].



Effective cancer prevention  
requires evidence-based personal  
and population actions.”

– Lippman et al, 2018

### A multi-level, translational framework for understanding and improving cancer-related health behaviors



### Advancing the Science of Energy Balance, Obesity, Diet, Physical Activity, and Cancer

Since the early 2000s, HBRB has worked to advance our understanding of obesity, poor diets, and low levels of physical activity; identify the relationship of these risk factors to cancer incidence, progression, and outcomes; and devise more effective strategies to mitigate their adverse effects. The branch created the [FLASHE](#) survey to assess health behaviors and predictors in parent-adolescent dyads. It established the [TREC](#) consortium, which focused on elucidating the relationships between energy balance, body weight, and cancer, and laid the groundwork for characterizing how energy balance, obesity, diet, and physical activity influence cancer incidence and treatment outcomes through biological and behavioral pathways. DCCPS was a foundational member and continues to be a major supporter of the National Collaborative on Childhood Obesity Research ([NCCOR](#)), a public-private collaboration among three federal agencies (NIH, CDC, and the USDA) and the Robert Wood Johnson Foundation, aimed at reversing the epidemic of overweight and obesity among US youths. These and other projects formed the foundation for the branch’s current work and demonstrate the benefits of transdisciplinary partnerships in advancing the science of energy balance, obesity, and cancer.

This work has evolved to incorporate new concepts, such as precision prevention in the areas of nutrition and weight loss, while also promoting broader environmental and policy approaches to cancer prevention and control. Current projects in the area of precision prevention include the [Accumulating Data to Optimally Predict Obesity Treatment \(ADOPT\) Core Measures](#) and [Trans-NIH Consortium of Lifestyle Weight Loss Interventions](#), both of which aim to identify predictors of successful weight loss and to incorporate information on genetic, psychosocial, behavioral, biological, and environmental factors into predictive profiles to enable more precise and, ultimately, more effective weight loss interventions.

HBRB's support for environmental, geospatial, and policy research represents a broader direction for our work. The branch is investigating the impact of policy and social determinants of health in such projects as the [trans-NIH FOA on time-sensitive obesity policies](#) and the CLASS project. HBRB has promoted the use of translational frameworks for intervention development and testing (e.g., [Obesity-Related Behavioral Intervention Trials \[ORBIT\]](#) model), stimulated advances in geospatial and environmental measurement and methods, and led efforts in methodological innovation in natural experiments (e.g., Pathways to Prevention [P2P] Methods workshop program).

HBRB is tackling problems in cancer prevention and control at the intersection of climate change, health inequities, and advances in research that allow for targeting multilevel interventions with both individual- and policy-level strategies. Future directions will include the integration of guideline-based health behavior recommendations into care for cancer survivors and the development of research networks that support the testing of multilevel interventions by embedding studies on individual-level, obesity-related behavior change within natural experiments of communities adopting obesity prevention and control policies.



## Investigating Emerging Cancer Risk Factors

HBRB aims to better understand and develop behavioral and policy-focused interventions in emerging areas, such as alcohol and sleep, by leveraging lessons learned in other areas, like tobacco control. The branch has led and participated in symposia and panels at major meetings; organized an [NCI-sponsored workshop on alcohol and cancer](#); and developed and participated in an [NCI-National Institute on Alcohol Abuse and Alcoholism \(NIAAA\) FOA](#). The workshop led to a white paper authored by leading researchers on alcohol as a target for cancer prevention and control. The branch is actively engaged in efforts to address prevention of alcohol-related cancers and to understand the synergistic interactions of alcohol and tobacco across the cancer control continuum.

Recognizing the transdisciplinary nature of sleep and circadian dysfunction research, HBRB is collaborating with staff in other DCCPS branches (e.g., BBPSB), programs (e.g., EGRP), NCI divisions, and NIH institutes and centers to develop a scientific interest group, participate in several trans-NIH FOAs, and create a “sleep team” of NCI and extramural experts to define future research needs.

Over the past two decades, HBRB has made significant strides in addressing the challenging task of improving cancer-related risk behaviors and in creating a strong foundation for realizing HBRB’s vision of a world in which individuals, families, and communities engage in healthy lifestyles to prevent cancer, improve treatment outcomes, and optimize health and well-being.

*Lippman SM, et al. AACR white paper: shaping the future of cancer prevention – a roadmap for advancing science and public health. Cancer Prev Res (Phila). 2018 Dec;11(12):735–778.*

## HEALTH COMMUNICATION AND INFORMATICS RESEARCH BRANCH: KEEPING PACE WITH AN EVOLVING COMMUNICATION LANDSCAPE

Health communication science has been a priority for NCI for over two decades, since its identification as an “extraordinary opportunity for investment” in the NCI Budget Proposal for FY 2001. The budget proposal stated, “... there is a need for a public institution such as NCI to provide leadership in the cancer communications arena; the broad and reasoned perspective that NCI brings to patients and healthcare providers alike is essential to successfully implement communications strategies to reduce the cancer burden.” The Health Communication and Informatics Research Branch (HCIRB)—the only research branch at NIH focused on communication research—continues to lead efforts to realize the promise of this investment in a rapidly changing communication landscape.

### Health Communication Surveillance: HINTS

NCI’s [HINTS](#), the only nationally representative health communication surveillance vehicle, has been collecting data on trends in cancer communication and information technology (IT) since 2003. Across 14 administrations, HINTS has surveyed more than 55,000 American adults, tracking profound shifts in the communication landscape. HINTS has a robust community of over 10,000 data users, who have published more than 600 peer-reviewed papers using publicly accessible HINTS data. To date, the HINTS program has also published 46 [HINTS Briefs](#), which provide a snapshot of published HINTS research on such topics as trust in health information resources, tobacco risk perceptions, cancer knowledge and awareness, and the information support needs of cancer survivors.

### Social Media and Health

The communication landscape has been transformed by the rise of social media over the past two decades, posing new research questions for cancer communication. HCIRB has been at the forefront of research at the intersection of social media and health. The branch collaborated with NIDA and NIAAA on an RFA in 2013 titled “Using Social Media to Understand and Address Substance Use and Addiction,” which resulted in 11 research projects that leveraged social media to advance understanding of tobacco, alcohol, and illicit drug use and test-related interventions. HCIRB continues to support social media research through the “Innovative Approaches to Studying Cancer Communication in the New Information Ecosystem” program announcements (PAs), which have funded 13 grants since 2016. Funded grants have assessed the impact of health-related Facebook advertisements and monitored tobacco-related communication on Twitter, for example.

As the amount of misinformation circulating on social media became more apparent, HCIRB convened a multidisciplinary working group in 2018 to develop a research agenda for cancer-related misinformation on social media. The meeting led to the publication of high-profile editorials in the *Journal of the American Medical Association* (Chou et al.) and the *American Journal of Preventive Medicine* (Southwell et al.), outlining priorities and key considerations for research and practice. These efforts were followed by an [NCI-sponsored special issue of the American Journal of Public Health](#) in October 2020, which addressed critical issues related to online misinformation, including antivaccine messaging, bots, and the impact of content-moderation policies.

## Patient-Centered Communication

In response to the evolving communication landscape in healthcare, HCIRB also focuses on promoting patient-centered communication, including research on health literacy. In 2007, NCI commissioned a monograph [Patient-Centered Communication in Cancer Care: Promoting Healing and Reducing Suffering](#), which focused on optimizing the communications process between patients and families and healthcare delivery teams. For more than a decade, the monograph's conceptual framework has served as a cornerstone for research on patient-centered cancer communication.

HCIRB participated in the trans-NIH "Understanding and Promoting Health Literacy" PA from 2004 to 2016, which resulted in 25 funded grants. More recently, HCIRB partnered with the National Institute of Nursing Research to support health literacy research in specific domains, including advanced illness and end-of-life communication, through the "End-of-Life and Palliative Care Health Literacy" funding opportunity.

HCIRB has also been involved with efforts to leverage technology in support of patient-centered cancer care. HCIRB contributed to the [2016 President's Cancer Panel report](#) "Improving Cancer-Related Outcomes With Connected Health," and collaborates with the NSF on the Smart and Connected Health interagency funding opportunity, which supports interdisciplinary high-risk, high-reward technology-based solutions coupled with biobehavioral health research. HCIRB's recent contributions to NCI's Telehealth in Cancer Care initiatives and NIH's COVID-19 response demonstrate continued commitment to ensuring that communication research remains current as major shifts in the health, social, and technological landscape unfold.

*Chou W-YS, et al. Addressing health-related misinformation on social media. JAMA. 2018 Dec 18;320(23):2417-2418.*

*Southwell BG, et al. Misinformation as a misunderstood challenge to public health. Am J Prev Med. 2019 Aug;57(2):282-285.*



At this pivotal juncture, there is a need for a public institution such as NCI to provide leadership in the cancer communications arena; the broad and reasoned perspective that NCI brings to patients and healthcare providers alike is essential to successfully implement communications strategies to reduce the cancer burden.”

– From the [NCI 2001 Annual Plan](#)

## TOBACCO CONTROL RESEARCH BRANCH: TOWARD A TOBACCO-FREE WORLD

Tobacco research has been integral to NCI research efforts for many years. In the 1950s, NCI scientists conducted studies and developed research methods that documented cigarette smoking as the primary causal agent underlying the dramatic rise in lung cancer seen in the 20th century. In the decades that followed, NCI funded and conducted research to prevent and control tobacco use. These efforts have contributed to the nation's tremendous progress in [reducing tobacco use and tobacco-related disease](#).

The Tobacco Control Research Branch (TCRB) continues to build on this storied history. TCRB leads and collaborates on research and disseminates evidence-based findings to prevent, treat, and control tobacco use to create a world free of tobacco use and related cancer and suffering. A key research area involves tobacco-related disparities, because not all groups have experienced the same degree of benefit. TCRB has supported research demonstrating that a powerful lever of behavior change involves the conversion of social, economic, and policy environments that support tobacco use into those that support tobacco-free norms. TCRB also plays a crucial role in the surveillance of tobacco use, provision of evidence-based cessation services to the public, and the synthesis and dissemination of research findings.

### Tobacco Use Surveillance

NCI has sponsored the [TUS-CPS](#), administered by the US Census Bureau, since 1992–1993. The survey is a key data source of national, state, and sub-state data on tobacco use behaviors, attitudes, and policies. TCRB scientists have created harmonized data files to enhance the survey's usability across multiple time points and have linked the TUS-CPS to the National Death Index to create the Tobacco Longitudinal Mortality Study—the largest dataset linking tobacco use to mortality and to other morbidity outcomes.

### Evidence-Based Cessation Services

TCRB staff members created and maintain the [Smokefree.gov](#) Initiative, a multimodal suite of digital interventions (e.g., websites, text message programs, mobile apps) that provides free, evidence-based cessation support to smokers interested in quitting. Through partnerships with FDA, CDC, VA, and other federal agency partners, the initiative provides assistance to a wide variety of populations.

### Synthesizing Research Findings

NCI established its [Tobacco Control Monograph series](#) in 1991 and has since published 22 volumes, many of which have made seminal contributions to the literature. [Monograph 13](#) (2001) established the deception inherent in the marketing of low-yield, low-tar cigarettes; [Monograph 19](#) (2008) demonstrated the causal relationship between tobacco advertising and promotion and increased tobacco use; and [Monograph 21](#) (2016), produced with the WHO, summarized the evidence that tobacco control interventions make sense from an economic and a public health perspective across the globe.



## Addressing Key Challenges Now and in the Future

As TCRB looks to the future, new challenges lie ahead, such as the growth in ENDS use and changes in state and local laws regulating cannabis use that may be altering patterns of tobacco use among both youths and adults. Although developing technologies provide new opportunities to deliver tobacco cessation and prevention interventions, they have also enhanced the tobacco industry's ability to promote tobacco use. The 2009 Family Smoking Prevention and Tobacco Control Act (Public Law 111-31) provided regulatory authority to FDA; this law has dramatically reshaped the US regulatory landscape and has generated a need for NCI-supported regulatory science to inform FDA. In addition, the entry into force of the WHO Framework Convention on Tobacco Control has unleashed a wave of new policy implementation across the globe. Today, many of the most informative research studies are those that compare the implementation of policies and programs across countries.

TCRB is addressing these and other challenges through its large and diverse grant portfolio, which includes targeted funding initiatives, such as those that are aimed at (1) stimulating scientific inquiry focused on innovative state- and local-level tobacco prevention and control policies to promote health equity ([PAR 20-302/303](#)) and (2) improving smoking cessation interventions to reduce tobacco use among people living with HIV, whose smoking rate far exceeds the population average. TCRB also participates in several funding initiatives to understand the patterns of ENDS use, their short- and long-term harms, and their potential benefits, such as [NIH's Tobacco Regulatory Science Program](#), a partnership between NIH and FDA to fund research to inform FDA's regulatory authority.

Former NCI Director Dr. Samuel Broder wrote in NCI Monograph 1 (1991), "I call upon the entire medical and public health community to become involved in the fight against this Nation's number one public health menace—cigarette smoking." This call to action still resonates. TCRB remains committed to funding cutting-edge research to inform efforts to *eradicate tobacco use* in the United States and around the world.



I call upon the entire medical and public health community to become involved in the fight against this Nation's number one public health menace—cigarette smoking.”

– Dr. Samuel Broder,  
Former NCI Director

# EPIDEMIOLOGY AND GENOMICS RESEARCH PROGRAM

## ADVANCING CANCER CONTROL THROUGH THE SCIENCE OF EPIDEMIOLOGY

Foundational epidemiologic research, the scientific bedrock of public health and evidence-based medicine, has contributed to the strides made in reducing cancer incidence and mortality and improving the quality of life after cancer diagnosis and during and after treatment. EGRP, including the Office of the Associate Director and the program's five branches, supports and advances the science across the cancer control continuum through developing and validating tools to assess exposures, developing research initiatives, managing grants, and facilitating democratization of data access through broad data sharing, collaborative research, and generation and leveraging of existing resources. Members collaborate across the program, division, institute, NIH, and other agencies, in carrying out these activities.

### From Etiology to Action

EGRP has been at the forefront of etiologic research, facilitating studies that have identified genetic, constitutional, and environmental factors associated with cancer risk, creating a pathway to prevention, early detection, and improving cancer outcomes. Supported research covers an array of study designs, such as familial and linkage studies, case-control, and prospective cohort studies, that have shed light on understanding the genetic and environmental landscape of risk and how exposures that occur across the lifespan interact to increase the risk for, or protect against, cancer, and provide a road map for cancer prevention and control.

A significant investment in long-term prospective cohort studies for over 40 years has contributed to discovering the determinants of cancer risk. One of the first population-based US cohort studies with a biobank was the CLUE study, established in Washington County, Maryland, in 1974 (Comstock et al), followed in short order by the [Nurses' Health Study](#), which was initiated



in 1976 as a questionnaire-based study with later additions of biospecimen collections. Subsequently, numerous prospective etiologic-focused and survivor-focused cohort studies have been established with NCI funding and serve as valuable resources for cancer-focused research. EGRP has harnessed and leveraged these resources through the [NCI Cohort Consortium](#), described earlier. The consortium provides strength in numbers and fosters pooling projects of particular value in the study of rarer forms of cancer.

### **Rigor, Reproducibility, and Sharing**

The ultimate value of research results depends on the quality of the data captured as well as a rigorous study design. EGRP includes two branches that have a primary focus on developing accurate and reproducible assessment methods and translating those tools to large-scale research endeavors. From single-cell technology, to multiple “omics” assays, to dietary and physical activity assessment measures, advances in technologies and high-quality assessment are supported and made available to researchers. A variety of tools and resources have been developed, maintained, and continue to evolve, with special emphasis in dietary and physical activity assessment.

Data sharing with the democratization of data access enables the totality of research investment to be greater than the sum of its parts. Broad sharing enables students to develop research skills, early-stage investigators to explore research directions and obtain preliminary data, and any investigator to analyze the data in innovative ways and to reproduce findings in similar or different populations. Program members lead efforts across the division and the institute to foster data sharing of NCI-supported research, enabling the leveraging of existing resources to expand knowledge. The program has developed resources to assist the extramural research community in complying with NIH data-sharing policies and enabling broad data sharing.

### **From Research to Action**

Epidemiologic research has identified multiple major causes of cancer incidence, which has led to advances in cancer prevention (such as chemoprevention for breast cancer risk reduction and HPV and hepatitis vaccines to prevent infection-associated cancers), guided additional risk reduction by avoidance of carcinogenic exposures, and provided the evidence for public health and clinical prevention guidelines. While significant progress has been made, more causes remain to be discovered and addressed using the armamentarium of epidemiologic approaches of observational studies and intervention trials.

### **Looking to the Future**

With constant forward motion to accelerate cancer control research, EGRP has launched new initiatives to fund the next generation of cohort studies to investigate environmental risk factors for developing cancer and the cancer survivorship experience, with a particular emphasis on understudied and underserved populations. Simultaneously, EGRP is opportunistic in leveraging emerging, novel, high-throughput, and at-scale approaches including omics to study the cancer continuum in populations. These initiatives, along with leveraging and democratization of existing resources, ensure continued progress in identifying new approaches to cancer control.

*Comstock GW, et al. The Washington County Training Center: an exemplar of public health research in the field. Am J Epidemiol. 1991 Nov 15;134(10):1023–9.*

## CLINICAL AND TRANSLATIONAL EPIDEMIOLOGY BRANCH: IDENTIFYING FACTORS TO IMPROVE OUTCOMES FOR CANCER SURVIVORS

The Clinical and Translational Epidemiology Branch (CTEB) funds and promotes epidemiologic research to investigate how clinical, genomic, lifestyle, and other factors affect cancer outcomes among cancer survivors, a steadily growing population due to advances in screening and treatment. CTEB also supports the development, evaluation, and implementation of individualized risk prediction models that identify individuals at the greatest risk of treatment-related adverse health outcomes. These efforts advance CTEB's goal to generate evidence to inform the development of interventional strategies and clinical guidelines and improve the health of cancer survivors.

Epidemiologic research supported by the branch includes both observational and interventional study designs that focus on health effects after a cancer diagnosis. Over the past decade, CTEB has led a major initiative to support the development and growth of more than 10 prospective cohort studies of cancer survivors, investigating multiple factors and their association with short- and long-term health outcomes. Together, these studies include more than 50,000 cancer survivors across more than 12 cancer sites. Most recently, in FY 2021, new cohorts have been funded to fill in evidence gaps related to postdiagnosis cancer outcomes, such as the longer-term health outcomes in cancer patients exposed to newer treatments (e.g., immunotherapy and molecularly targeted therapy); cancer outcome disparities based on race/ethnicity, socioeconomic status, geography, and other factors; and survivors diagnosed with less common cancers.

Long-term side effects of some cancer treatments can impair the length and quality of life of cancer survivors. For example, cancer treatment-related cardiovascular complications, such as heart failure, hypertension, and arrhythmias, remain a leading cause of treatment-associated morbidity and mortality among cancer survivors. Since 2011, CTEB has led a multi-institute initiative across NCI and NHLBI that supports collaborative research on cancer treatment-related cardiotoxicity to address knowledge gaps and identify promising opportunities—including early detection, management, risk prediction, and prevention—stemming from workshops held in 2013 ([2013 Workshop](#)) and 2018 ([2018 Workshop](#)). CTEB has also led a trans-NCI initiative on the clinical characterization of cancer therapy-induced adverse sequelae and, in 2019, developed a funding announcement to support collaborative research in this area ([PAR-19-325](#)).

Another area of focus has been understanding how cancer, cancer treatment, and other factors influence the aging trajectories of cancer survivors. The treatments that spare cancer survivors from mortality may put the cancer survivor at risk for a spectrum of aging-related health conditions at a younger age than would normally occur. In 2018 and 2019, with our partners in BRP, CTEB led two workshops to identify gaps in the area of accelerated aging in cancer survivors. Subsequently, an administrative supplement opportunity was made available, and in partnership with the National Institute on Aging, a Notice of Special Interest (NOSI) was published to encourage research in the following areas: longitudinal studies to examine aging trajectories; studies to elucidate the pathways that lead to aging phenotypes in cancer survivors; and long-term clinical surveillance to monitor survivors for late-emerging effects. Addressing these needs will help inform strategies to optimize healthy aging of cancer survivors.



## **Lifestyle and Nutrition-related Factors**

CTEB supports research to understand how diet, physical activity, and obesity may influence health after cancer treatment. Research results suggest dietary factors and exercise are associated with better outcomes among cancer survivors. A relatively new area of emphasis for CTEB is how body composition (i.e., the proportions of fat and lean mass) affects cancer outcomes, including common adverse events of systemic cancer therapies and survival. Varying levels of muscle and fat may affect the pharmacokinetics of systemic cancer therapies, resulting in life-threatening toxicities from overdosing or poor disease outcomes from underdosing. CTEB supports a webinar series highlighting methodologic challenges and the latest research results, and a range of initiatives that help build the evidence to inform patient management guidelines.

## **Clinical, Genomic, and Pharmacogenomic Factors**

Variation in germline and somatic genomes and clinical and lifestyle factors can influence the development of adverse events, increase risk for certain types of cancers and syndromes, guide treatment decisions, and affect response to therapy. Supported research investigates the association between genomic factors, chemotherapy dosages, lifestyle factors, and severe toxicities, such as neurotoxicity and cardiotoxicity.

## **Risk Prediction**

CTEB also supports the development of individualized risk prediction models that identify individuals at the greatest risk of treatment-related adverse health outcomes. For example, funded studies investigate the genomic and clinical features allowing for the stratification of tumors into those with a good prognosis and those with poor prognosis at the time of diagnosis and thus guiding treatment interventions.

Looking toward the future, CTEB plans to continue to expand its support of studies that identify factors affecting adverse outcomes in cancer survivors, including leveraging existing and completed clinical treatment trials to capture long-term outcomes.

## ENVIRONMENTAL EPIDEMIOLOGY BRANCH: LIFE EXPOSED —HOW OUR SURROUNDINGS CAN IMPACT CANCER RISK

The Environmental Epidemiology Branch (EEB) promotes and supports epidemiologic research on modifiable risk factors and cancer risk in diverse populations to inform and advance the prevention and control of cancer. In accordance with this mission, EEB advances research opportunities to increase understanding of environmental exposures across the life-course on cancer risk in humans. This is illustrated by funding opportunities initiated and led by EEB, such as the [Early-life Factors and Cancer Development Later in Life](#), and by collaborations with other NIH Institutes, such the BCERP and the [Global Environmental and Occupational Health \(GEOHealth\)](#) initiatives.

### Initiatives Focused on Understanding of Environmental Exposures and Cancer Risk

The initiative on early-life factors provides key DCCPS-led funding of epidemiologic research to understand how exposures early in life, an understudied area of research, affect cancer risk. BCERP exemplifies a long-standing collaboration with NIEHS to address community-driven efforts to understand whether exposure to environmental factors, in adulthood as well as in early life and developmental periods, are associated with the development of breast cancer. EEB's collaboration with the Fogarty International Center's GEOHealth initiative supports research and training for institutions in low- or middle-income countries (LMICs) to tackle environmental and occupational health threats.

To address knowledge gaps in environmental exposures and cancer, EEB has initiated and led a recent funding initiative, [New Cohorts for Environmental Exposures and Cancer Risk](#). This initiative will fund the next generation of prospective cancer cohorts anticipated to have substantial public health impact in assessing environmental exposures, especially environmental chemical and physical exposures, and the risk of cancer, especially in underserved and understudied populations. These new cancer epidemiology cohorts are expected to become national resources, leveraged by the research community to reduce risk, incidence, and deaths from cancer as well as enhance the quality of life for cancer survivors, the division's overarching mission.

EEB is actively collaborating with the NIEHS-led [Human Health Exposure Analysis Resource](#) initiative that enables cost-effective laboratory measurements of novel environmental exposures. This is another example of EEB's efforts to fund grants that apply novel approaches and techniques to advance research on the exposome and cancer risk either through directly leading or joining with other NIH initiatives. The staff of EEB also actively collaborate with NIH's [Environmental Influences on Child Health Outcomes \(ECHO\)](#) program, which addresses research at the intersection of pediatric and environmental health.

## **Broadening Research in Diverse, Understudied, and Underrepresented Populations**

EEB continues efforts to broaden research in diverse human populations. Members of the branch are involved in a plethora of funding opportunities focusing on [risk factors](#) or cancers that disproportionately affect understudied and underrepresented populations, including those living in certain geographic locations or the important factors contributing to the increase in [AIDS-defining and non-AIDS defining cancers](#). The branch continues to apply novel approaches and techniques to advance research on the environment and cancer risk, for example, in areas related to geospatial methods, exposomics, metabolomics, and [microbiomics](#). EEB also actively engages community partners to identify relevant scientific focus and recruitment of hard-to-reach populations to scientific studies. The areas highlighted in this overview represent a research snapshot of activities that EEB is involved with as a branch to realize its vision of eliminating environmentally induced cancers for the well-being of all populations.

## **Looking Forward**

As EEB looks to the near future, the branch will advance current efforts to expand its focus to other novel exposures/factors (e.g., cannabis, novel pathogens, e-cigarettes, climate change, chemical toxicants, co-morbid conditions, social constructs), to evaluate the notably complex interactions among exposures and the subsequent risk of cancer, and to broaden research across diverse populations. These ongoing efforts capitalize on the branch's scientific and programmatic expertise and knowledge base to timely and collaboratively address contemporaneous issues. For example, the legal landscape of medical and recreational cannabis use is rapidly evolving. Several efforts across NCI are underway to understand the scientific landscape regarding the risks and benefits of cannabis use. EEB led the [2020 symposium](#) on cannabis and cannabinoids and cancer, which highlighted the state of the science and research gaps. Likewise, as the obesity epidemic continues and the evidence of its etiologic association with multiple cancers is solidifying, EEB is leading a cross-NCI initiative to establish a transdisciplinary consortium of funded research projects to understand the underlying mechanisms of obesity-associated cancer risk. EEB members are also engaged in collaborations with partners across NIH to address the challenge of climate change and cancer. These examples serve to highlight a multitude of planned and ongoing activities that will chart EEB's scientific engagement in the near-term and beyond.

## GENOMIC EPIDEMIOLOGY BRANCH: UNDERSTANDING THE INHERENT RISK FACTORS OF CANCER

The overarching goal of the Genomic Epidemiology Branch (GEB) is to elucidate the genetic architecture of cancer, improve our understanding of the genetics of cancer, and enhance its potential to enable effective disease prevention, treatment, and survivorship. Since the completion of the Human Genome Project in 2003, technological advances have revolutionized our ability to catalogue both common and rare genomic variation. This has led to a greater appreciation of cancer as a complex disease caused by many genetic and environmental factors working together, with few, if any, being absolutely required for disease to occur. This means that jointly modeling genetic, environmental, and lifestyle-related exposures promoting cancer is critical to understanding the role of genetics in cancer risk, and cancer health disparities.

GEB's scientific priorities include novel genetic discovery, understanding the role of inherited genetic variants in cancer biology, and enabling advances that benefit all. Further, leveraging existing resources, ensuring rigor and reproducibility, and promoting innovative study designs and analytic approaches drive the branch's activities.

### **Driving Discovery of New Genetic Risk Loci by Leveraging Existing Resources, Sharing Data, and Collaborating Across Disciplines**

Each of these priorities is evident in the foundational branch-led [Genetic Associations and Mechanisms in Oncology \(GAME-ON\)](#) initiative ([RFA-CA-09-002](#)). Specifically, the GAME-ON initiative, including the OncoArray consortium, built on NCI's previous investment in cancer epidemiology studies as well as existing genome-wide genotyping data, have given rise to some of the largest collections of cancer genomic risk data. Notably, pooling data on this large scale (33 studies; 500,000 samples; and 128 investigators) empowered both the replication of previous findings as well as the discovery of new risk loci. The GAME-ON initiative led to many new partnerships and investigators from more than 350 institutions, 60 countries, and multiple research areas collaborating to discover hundreds of novel variants associated with cancer predisposition. To date, the GAME-ON initiative has led to more than 400 publications.



All of the data generated by the GAME-ON initiative is currently available for secondary analyses via NIH's database of Genotypes and Phenotypes ([dbGaP](#)). Notably, many investigators have leveraged these data to formulate new hypotheses that are being investigated using additional NIH funding. This work has often been supported by branch-developed funding opportunity announcements ([PA-17-239](#), [PA-17-243](#), [PAR-20-277](#), [PAR-20-276](#)) focused on secondary analysis and integration of existing data to elucidate the genetic architecture of cancer risk and related outcomes.

### **Investments in Functional Genomics Methodologies**

A critical step in understanding the genetic architecture of cancer is narrowing an implicated locus to a set of genetic variants that directly cause an increased cancer risk by disrupting the expression or function of a protein. Functional genomics highlights the need to foster collaboration between basic cancer biologists and genetic epidemiologists, as well as the integration of many data types, including genomics, metabolomics, transcriptomics, and epigenomics, to gain insight into disease mechanisms. GEB has invested heavily in metabolomics as a functional genomics methodology. The primary metabolomics initiative managed by the branch is the [COnsortium of METabolomics Studies \(COMETS\)](#). Many COMETS activities, such as [COMETS Analytics](#), focus on ensuring rigor and reproducibility in the application of this new technology to cancer epidemiologic studies.

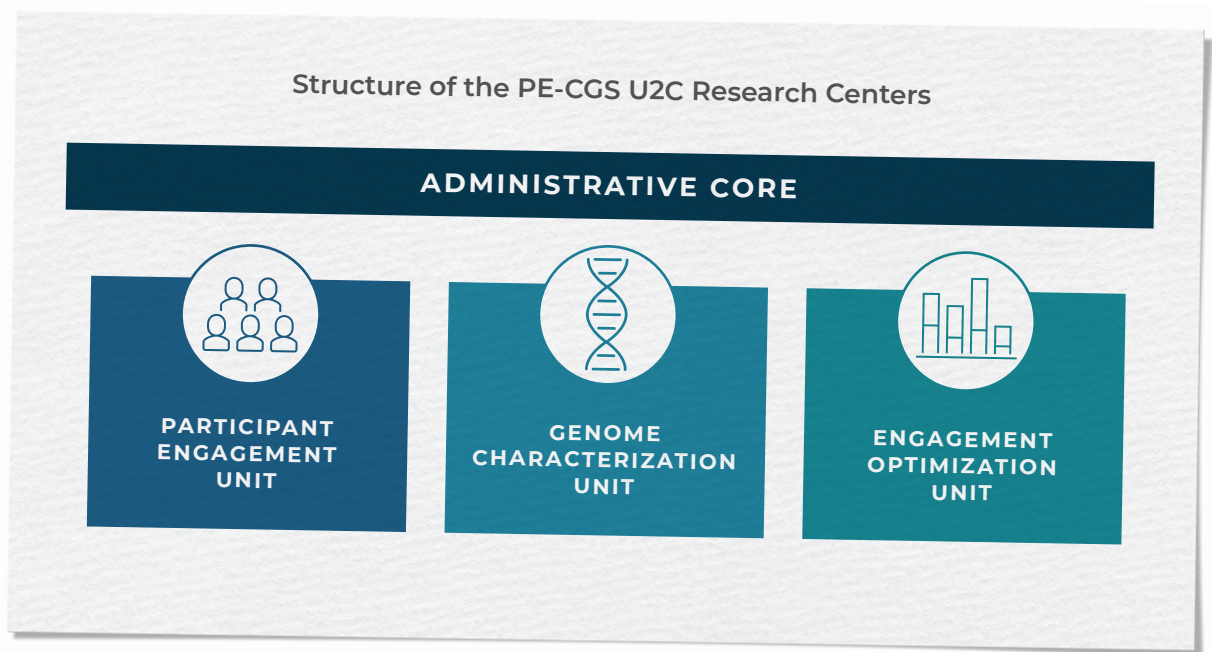
### **Improving Inclusion of Diverse Populations in Research Studies**

While progress has been made towards improving the inclusion of diverse populations, racial and ethnic minorities remain underrepresented in cancer genomic epidemiologic studies. This inadequate representation limits the translational impact of findings on these populations. The GAME-ON initiative included ~200,000 samples from previously understudied populations and helped identify cancer risk variants across and unique to different populations. GEB continues to build rich genomic resources and promote the inclusion of diverse populations in genetic epidemiologic research. Current efforts include "Genome-wide Genotyping of Existing Samples from Minority Racial/Ethnic Populations and Sharing of Associated Epidemiologic Data" ([NOT-CA-21-049](#)), which will leverage existing biospecimens to diversify germline genome-wide genotyping data repositories and further enhance them with accompanying exposure, phenotype, and outcome data. These data resources will allow the study of genetic cancer susceptibility in diverse populations, to better understand its role in cancer health disparities.

## Integrating Innovative Study Designs and Analytical Approaches

Innovative study designs and analytic approaches are essential to drive genomic discoveries and examine inherited genetic variation within a broader context considering gene-gene or [gene-environment interactions](#), as well as interactions between the germline and somatic genomes (as explored through [PO3 in RFA-CA-17-017](#)). Many branch activities are driven by innovation, and this is exemplified most recently by the Cancer Moonshot-supported Participant Engagement and Cancer Genome Sequencing (PE-CGS) Network ([RFA-CA-19-045](#) and [RFA-CA-19-046](#)). The PE-CGS Network employs innovative ways to directly engage cancer patients and post-treatment cancer survivors as participants in rigorous cancer genome sequencing programs, addressing important knowledge gaps in the genomic characterizations of understudied tumors.

Through these initiatives and the support of our extramural researchers, GEB is shaping the research landscape on the genetic, epigenetic, immunological, and biological factors that influence cancer risk and maximizing its scientific potential.



## METHODS AND TECHNOLOGY BRANCH: FOSTERING RIGOR AND REPRODUCIBILITY

The transition of assays from small-scale applications to large-scale population studies requires high-throughput procedures that maintain high standards of reproducibility and validity and low cost. The Methods and Technologies Branch (MTB) supports the adaptation of laboratory and technical approaches to large-scale human population studies, ensuring the validity of tests used in population studies. During the last decade, efforts were successfully made in incorporating epigenomics, metabolomics, transcriptomics, proteomics, and microbiome in large-scale population-based studies relevant to multiple stages across the cancer control continuum.

### Applying Omics Approaches to Large-Scale Studies

A prototypic example of MTB's role in facilitating technological applications in large-scale studies is the use of epigenomics in research studies. Epigenetic changes are essential for normal development, and their abnormal expression may result in the initiation or progression of different cancer types. Both DNA sequence-based genetic changes (mutations, polymorphism, deletions, additions, translocations) and epigenetic changes may alter gene expression. Through MTB-initiated and collaborative funding announcements across NCI and NIH, the branch has supported research to help determine the role of epigenetic changes in developing cancer risk and identification of genetic, environmental, and host susceptibility factors that modify the risk in different populations by capitalizing on approaches for profiling of methylation patterns, histone modifications, and microRNAs. Further, through participation in the Common Fund Epigenomics program, the branch is leveraging opportunities to identify cancer-associated epigenetic marks. In association with the National Institute on Minority Health and Disparities, MTB participated in initiatives on social epigenomics focused on minority health and health disparities. These initiatives are especially significant because individuals living in disadvantaged neighborhoods are often exposed to social (food desert, violence or threat of violence, discrimination, residential segregation, and psychosocial stress), chemical, and physical (noise pollution, lack of green space) stressors. Ultimately, this line of research may contribute to new approaches to reduce health disparities.

MTB staff represent NCI in many trans-NIH initiatives, such as the congressionally mandated [ECHO](#) program focused on supporting existing cohorts to address how pre, peri, and postnatal environmental exposures impact childhood development and health outcomes. This initiative leverages existing populations and emerging technological resources to study environmental factors and associations with outcomes that have a high public health impact. In addition to ECHO, MTB staff represent NCI in many NIH Common Fund initiatives in epigenomics, metabolomics, and molecular transducers of physical activities and contribute to developing molecular approaches in these emerging areas of research.

### **Developing and Improving Technologies for Cancer Control and Population-Based Research**

In parallel to the trans-NIH initiatives, MTB participates in multiple collaborative trans-NCI initiatives focused on technological advances to study mechanisms of carcinogenesis, as well as validation of assay technologies for high-quality markers in clinical studies to assess their utility in cancer detection, diagnosis, and treatment. Through collaboration with the Center for Global Health, MTB has promoted initiatives to develop cost-effective technologies that can be implemented in low-resource settings. Further, MTB staff have collaborated for many years with NCI's Small Business Innovation Research (SBIR) program, developing topics for SBIR solicitations aimed at supporting research and development of new or improved technologies and methodologies that pertain to cancer control and population sciences and have the potential to succeed as commercial products. Examples of SBIR topics include high-throughput technologies for simultaneous isolation and analysis of exosomes, the development of single-cell "unbiased discovery" proteomic technologies, multiplex technologies for screening and monitoring cancer-associated co-infections at the point of sample collection, next-generation 3D tissue culture systems with tertiary lymphoid organoids, and direct sequencing of nucleic acids without clonal amplification or synthesis.

Through its initiatives and extensive collaborative activities across NCI and NIH, MTB serves the research community at large to ensure the validity and reproducibility of emerging technologies in large-scale studies. Notable recent achievements that accelerated research activities included techniques to leverage the value of archival tissue, multi-omic technologies (genomics, epigenomics, metabolomics, microbiome, transcriptomics, and proteomics), and the development of software and tools for next-generation heat maps for fluent, interactive exploration of data. Looking toward the future, MTB sees the expansion of emerging techniques, such as single-cell technologies, and will continue to support the necessary research to ensure their validity as they expand to application in large-scale population-based studies.

## RISK FACTOR ASSESSMENT BRANCH: INNOVATING ASSESSMENT OF DIET, PHYSICAL ACTIVITY, AND SLEEP ACROSS THE CANCER CONTINUUM

The Risk Factor Assessment Branch's (RFAB) innovation in diet and physical activity assessment provides a critical link between research and translation into guidance and interventions for cancer prevention and control. RFAB develops, supports, and stimulates assessment of modifiable risk factors among individuals and diverse populations across the cancer continuum to inform and advance health promotion.

### Providing Tools and Developing Metrics

RFAB has revolutionized the field of diet assessment and helped change the way we think about diet, pioneering a holistic view that considers and analyzes dietary patterns, not only individual nutrients, and incorporates multilayered contextual factors that vary throughout a person's life. RFAB and collaborators developed a freely available tool, the [Automated Self-Administered 24-Hour \(ASA24®\) Dietary Assessment Tool](#), which enables research participants to report what they have consumed within the last 24 hours or in real time as a food record (Subar et al). ASA24 provides information that previous tools do not, such as when food was eaten, where, with whom the food was eaten, and with what other foods and beverages. RFAB has advanced the discourse on dietary patterns and partnered with USDA to develop and evaluate the [Healthy Eating Index \(HEI\)](#) (Krebs-Smith et al), a measure of alignment with the *Dietary Guidelines for Americans* (DGAs). By supporting researchers to apply the HEI as a measure of the totality of the diet and standardizing analyses in large cohorts through the [Dietary Patterns Methods Project](#), research on dietary patterns has been transformed.

### Supporting Data and Infrastructure

RFAB has facilitated advances in the assessment of physical activity research by promoting and supporting the inclusion of physical activity assessment with devices in the National Health and Nutrition Examination Survey ([NHANES](#)). Publicly available data from the waist-worn accelerometers deployed in NHANES 2003–2006 have been the basis of more than 80 research publications, and the initial 2008 paper describing these data (Troiano et al) has been noted as one of five most influential papers in physical activity research (Varela et al). Building on technology advances, RFAB led an effort to include wrist-worn accelerometer devices in NHANES 2011–2014 and the NHANES National Youth Fitness Survey. These data, based upon 24-hour wear, will provide a rich resource to study physical activity as well as sleep among children, adolescents, and adults. RFAB staff have also developed population reference curves for the daily accelerometer metrics for use by researchers. Ongoing efforts focus on harmonizing behavioral labelling to support data pooling and to develop algorithms to classify movement behaviors from wrist-worn accelerometer device signal data.



## Promoting Synergistic Thinking

RFAB has nurtured partnerships with multidisciplinary teams to advance new analytical methods and directions in assessment. This includes novel insights into the types and extent of measurement error in self-reported diet and physical activity data, and efforts to reduce them, and usual intake modeling of foods across the lifespan to inform guidance. Additionally, RFAB has partnered in collaborations resulting in NCI funding for obesity policy research and development of time-sensitive initiatives to evaluate natural experiments ([PAR-18-854](#), [NOT-DK-20-035](#)), and, with NCCOR, to prioritize next steps for measurement needs to spur progress in reducing childhood obesity by creating the [Measures Registry Resource Suite](#) and [Catalogue of Surveillance Systems](#).

RFAB's leadership has been essential to NCI's contributions to the [2020-2030 Strategic Plan for NIH Nutrition Research](#), the first NIH-wide strategic plan for nutrition research that presents a vision for the next decade of NIH-supported nutrition research. Aligning with this plan, RFAB will support the Dietary Assessment Center ([RFA-RM-21-004](#)) to examine ASA24 and other innovative approaches in the [Nutrition for Precision Health powered by All of Us Research Program](#) and accelerate improvements in diet assessment.

International partnerships allowed RFAB staff to support the development of the [WHO 2020 Guidelines on Physical Activity and Sedentary Behaviour](#) (2020) and lead the development and standardization of a new score based on cancer prevention recommendations with the World Cancer Research Fund International/American Institute for Cancer Research. RFAB staff served as Executive Secretary for the 2008 and 2018 *Physical Activity Guidelines for Americans* and on the Policy Writing Group for the 2015 and 2020 DGAs.

Future efforts are focused on innovative strategies to integrate assessment of 24-hour behavior patterns, to help answer questions that single approaches cannot answer. Supporting research that combines self-report diet, physical activity, and/or sleep questionnaires with device-based images, movement sensors, geospatial, and time-stamped data can create a more complete picture for new developments in predictive models with enhanced validity and opportunities for guidance and interventions for cancer prevention. To continue to

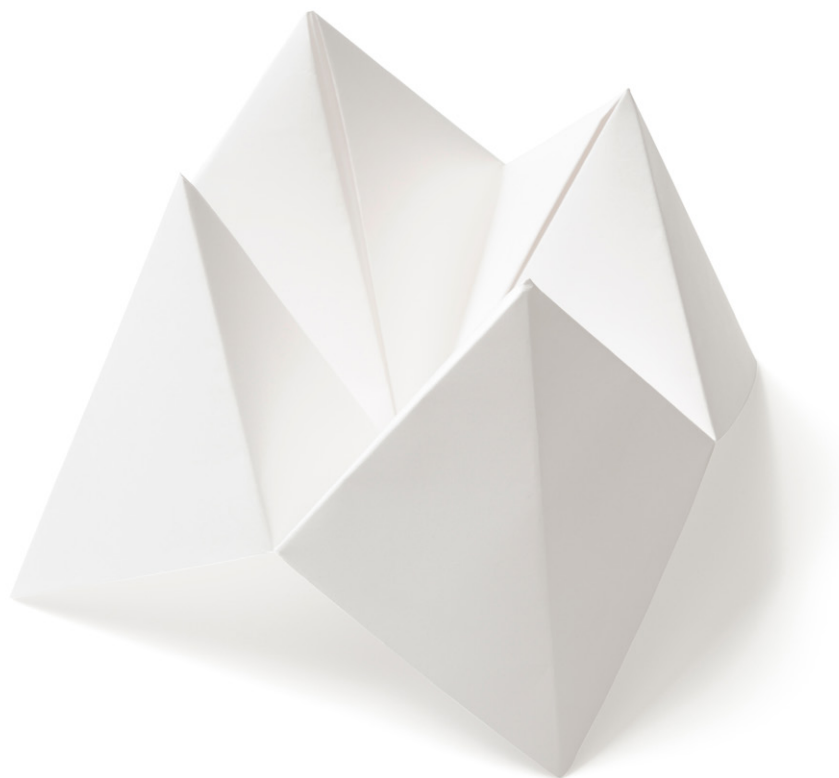
move these efforts forward, RFAB will further enhance its collaborations within NCI and with other NIH institutes and centers, government agencies, and public-private partnerships. Going forward, further systems-focused efforts will integrate multidimensionality and dynamism not only within these risk factors, but across risk factors, including sedentary behavior and sleep, and yield insights into differences among population subgroups, environmental and other external influences, and interventions designed to change or improve these behaviors.

*Subar AF, et al. Performance and feasibility of recalls completed using the Automated Self-Administered 24-Hour Dietary Assessment tool in relation to other self-report tools and biomarkers in the Interactive Diet and Activity Tracking in AARP (IDATA) Study. J Acad Nutr Diet. 2020 Nov;120(11):1805–1820.*

*Krebs-Smith SM, et al. Update of the Healthy Eating Index-2015. J Acad Nutr Diet. 2018 Sep;118(9):1591–1602.*

*Troiano RP, et al. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008 Jan; 40(1):181–188.*

*Varela AR, et al. Mapping the historical development of physical activity and health research: a structured literature review and citation network analysis. Prev Med. 2018 Jun;111:466–472.*



# HEALTHCARE DELIVERY RESEARCH PROGRAM

## RESEARCH TO IMPROVE CANCER CARE OUTCOMES AND ENHANCE THE PATIENT EXPERIENCE

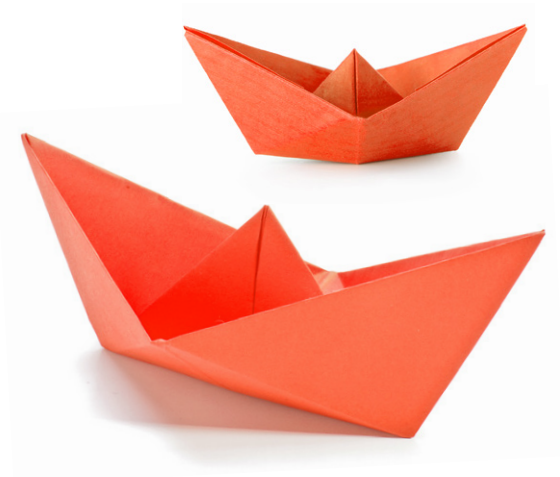
In 2015, NCI created the Healthcare Delivery Research Program (HDRP) within DCCPS to advance innovative research to improve the delivery of cancer-related care and achieve optimal health outcomes for individuals, families, and communities affected by cancer. HDRP is organized into three branches, which spearhead scientific initiatives at the patient, healthcare system, and community levels.

### Approaches to Advancing the Science of Healthcare Delivery

HDRP advances healthcare delivery research by developing funding opportunities to stimulate research in the extramural community on key issues and priorities for the field and by providing programmatic oversight of grants and contracts. Collectively, HDRP fosters research across the cancer control continuum. Recent major scientific initiatives include research aimed at improving cancer screening (i.e., [Population-based Research to Optimize the Screening PROcess \[PROSPR\]](#), [Accelerating Colorectal Cancer Screening and follow-up through Implementation Science \[ACCSIS\]](#)), delivery of cancer treatment ([Centers on Telehealth Research for Cancer-Related Care \[RFA-CA-21-029\]](#)), and survivorship care ([Improving the Management of symPtoms during And following Cancer Treatment \[IMPACT\]](#)).

Major initiatives in HDRP also center around the development and support of research infrastructure, data resources, and measurement tools. For example, the [NCI Community Oncology Research Program Cancer Care Delivery Research](#), a nation-wide network of over 1,000 community-based hospitals and practices, provides unique infrastructure to support research to improve care delivery in community hospitals and practices.

Data resources, such as linkages between Surveillance, Epidemiology, and End Results (SEER) Program data and CMS data, provide population-based information about



the utilization and cost of care ([SEER-Medicare](#)), experience with care ([SEER-Consumer Assessment of Healthcare Providers and Systems \[CAHPS\]](#)), and health-related quality of life ([SEER-Medical Health Outcomes Survey \[MHOS\]](#)) among older adults with cancer as well as how enrollment in Medicaid impacts cancer outcomes ([SEER-Medicaid](#)). Supplements to nationally representative surveys—for example, the [Cancer Control Supplement](#) to the National Health Interview Survey (NHIS) and the [Experiences with Cancer Survivorship Supplement](#) to the [Medical Expenditure Panel Survey \(MEPS\)](#)—leverage existing data to support research on healthcare access, utilization, cost, and cancer control more broadly.

Measurement tools, such as the [Patient Reported Outcomes version of the Common Terminology Criteria for Adverse Events \(PRO-CTCAE™\)](#) Measurement System, were developed to evaluate symptomatic toxicities by self-report in adults, adolescents, and children participating in cancer clinical trials, thereby complementing data captured through the CTCAE. Additionally, the [HealthMeasures](#) resource provides state-of-the-science assessment of physical, mental, and social health, as well as performance measures of cognition, motor, and sensory function, for use across a range of chronic diseases and the general population.

The future of healthcare delivery research depends on a pipeline of well-trained multidisciplinary investigators. Building the workforce of investigators who conduct healthcare delivery research is central to the mission of HDRP. To foster the development of mid-career investigators, HDRP partners with the NCI/AcademyHealth Healthcare Delivery Research Program to host the Visiting Scholars Program, whereby investigators are recruited to collaborate with HDRP staff and lead research to advance healthcare delivery. To support continuing education, HDRP also periodically develops and sponsors training opportunities to address emerging methodological topics. A recent example is the [Multilevel Intervention Training Institute \(MLTI\)](#), first offered in 2020.

### **Future Directions**

As cancer treatment continues to evolve, so does the social, political, and economic landscape in which that treatment is delivered. Over the next two years, programmatic activities will be guided by a set of cross-cutting research priorities. The first priority is to develop and support efforts to improve the use of digital health data both as a source of information for care delivery research and as a tool for improving cancer-related care. Recognizing the rapid expansion in use of telehealth during the COVID-19 pandemic, HDRP also seeks to support research demonstrating how telehealth can be used to improve patient and care delivery outcomes. The second priority is to expand research evaluating the impact of legislation, regulation, and reimbursement on cancer-related care delivery and outcomes. Given the negative impact of rising costs at the individual level, HDRP also seeks to expand research to understand and address the impact of the ability to afford care on receipt of recommended care and patient and caregiver outcomes. Although HDRP has long advocated for research that addresses disparities in cancer care and the needs of vulnerable and underserved communities, events in 2020 emphasized the persistence of systemic racism and social disparities in American society. HDRP's third cross-cutting priority is to promote research aimed at increasing knowledge of the role of systemic racism in cancer care delivery and promoting research that effectively addresses the impact of social disparities on delivery of high-quality cancer care.

## HEALTHCARE ASSESSMENT RESEARCH BRANCH: DATA RESOURCES FOR HEALTHCARE DELIVERY AND HEALTH ECONOMICS RESEARCH

The Healthcare Assessment Research Branch (HARB) promotes population-based research on demographic, social, economic, provider, and health system factors as they relate to providing screening, treatment, and survivorship services for cancer. Key focuses of the branch are to understand patterns of cancer-related healthcare in community settings and to develop, improve, and disseminate data resources to support economic and health services research across the cancer continuum. Below are examples of resources that are currently or have been funded by DCCPS.

### SEER-CMS Linkages

SEER cancer registry data and Medicare enrollment and claims data from CMS were first linked in 1991. In the ensuing three decades, [SEER-Medicare](#) has probably been the most influential resource available for cancer-related healthcare delivery research. Recent enhancements to this suite of databases include CAHPS, which measures Medicare patients' care experiences, and MHOS, which provides health-related quality-of-life information about Medicare Advantage enrollees; [SEER-CAHPS](#) and [SEER-MHOS](#) are led by HDRP's Outcomes Research Branch (ORB). Most recently, [SEER-Medicaid](#) has expanded our ability to study non-Medicare populations via a SEER linkage with national Medicaid enrollment data. Other enhancements to SEER-CMS linkages are highlighted in a May 2020 [JNCI Monograph](#). In the future, we intend to expand available information regarding provider- and system-level characteristics, and to incorporate new sources of data regarding social determinants of health, economic position, and financial distress.

### Data Collected as Part of Routine Clinical Care

While SEER-Medicare and other claims-based databases have been a mainstay of cancer-related healthcare delivery research, they cannot capture certain features of care including, for example, results of screening or laboratory tests or patient-reported symptoms. DCCPS has also supported consortia that capture more detailed data from healthcare as delivered in community settings. These include registries such as the [Breast Cancer Surveillance Consortium](#), first developed in response to the 1992 Mammography Quality Standards Act, which mandated the development of a surveillance system to monitor breast cancer screening. Additionally, in 1998 NCI partnered with the HMO Research Network (now the [Health Care Systems Research Network](#)) to create the [Cancer Research Network \(CRN\)](#), a consortium of healthcare systems with defined patient populations that extract data from patient health records for research purposes. CRN research includes not only descriptive studies of patterns of cancer-related care, but also design and testing of interventions to improve care delivery. The CRN pioneered development and use of the Virtual Data Warehouse (VDW), a set of common data standards that has served as a model for numerous other distributed research networks, including [PROSPR](#), an HDRP-funded network studying cervical, colorectal, and lung cancer screening in 10 different healthcare systems across the United States.



## Patterns of Care

The [Patterns of Care \(POC\)](#) study was created in 1987 in response to a congressional mandate to evaluate the dissemination of state-of-the-art cancer therapy into community oncology practice, as well as to assess patient-, provider-, and system-level factors associated with receipt of specific therapies. For a subset of cancer cases in the SEER registries, more detailed treatment data are collected and verified. The study includes two to three different cancer sites annually; the current cycle focuses on kidney and urinary bladder cancers. More recently, we have broadened the types of data collected, including symptom assessment, patient-provider cost discussions, receipt of multidisciplinary care, and impacts of drug shortages on cancer treatment patterns, and have oversampled cases testing positive for specific tumor mutations. While POC data are not routinely available to researchers outside of NCI and SEER investigators, the recently developed POC\*Explorer website allows for simple data queries to generate tabular and graphical summaries of POC data.

## National Surveys

DCCPS has supported multiple surveys to obtain nationally representative estimates of the utilization of cancer-related healthcare services and prevention behaviors. In partnership with CDC, the [Cancer Control Supplement to the NHIS](#) has assessed cancer screening, diet and nutrition, physical activity, and tobacco use and control since 2000. Additionally, the [Cancer Survivorship Supplement to MEPS](#), conducted in collaboration with AHRQ and other non-federal partners, addresses issues related to financial burden, access to care, and employment among cancer survivors.

For over 30 years, HARB and its predecessors have pursued the development of multiple types of new data sources. As availability of data to evaluate cancer-related healthcare delivery continues to expand rapidly, our goal is to enhance and improve resources for the extramural community.

## HEALTH SYSTEMS AND INTERVENTIONS RESEARCH BRANCH: UNDERSTANDING MULTILEVEL CONTEXTUAL FACTORS RELATED TO PROCESSES AND OUTCOMES OF CARE

The Health Systems and Interventions Research Branch (HSIRB) studies the context of healthcare delivery and its effect on people, from healthy people being vaccinated and screened, to clinicians, administrators, policymakers, cancer patients, family members, and cancer survivors. Our focus on these multiple levels is a deliberate departure from behavioral interventions focused on individuals and occasionally their clinicians (Meissner et al). Our shift to a multilevel focus can be traced to 2010, when a group of NCI scientists, led by Stephen Taplin, began planning to conceptualize, measure, and intervene on a range of new targets, including healthcare organizations and care teams (Edwards et al, Taplin et al).

From 2012–2014, this DCCPS-based group published funding opportunities calling for multilevel interventions, but few projects were funded. Challenges included inadequate investigator training, reviewer expectations, and lack of validated analytic methods and measures. Nevertheless, NCI and other funders, such as the Patient-Centered Outcomes Research Institute (PCORI), continued to see a need for intervening on more than an individual level.

HSIRB continued this focus on healthcare organizations and systems, interplay across levels, and multilevel interventions from its inception in early 2015. The branch began with expertise in behavioral interventions and epidemiology, and quickly added staff who study IT, team performance, and organizational measurement. At present, our expertise includes clinical practice, industrial/organizational psychology, public health behavioral and administrative sciences, social psychology, health services, and health disparities. Additional expertise may come from anthropology, sociology, and system science.

This deliberate combination of training and experience allows us to advance innovations across a range of healthcare processes. These processes include IT, where HSIRB has used IT both to extract data describing patterns in treatments (Chen et al) and as a tool to support delivery of care for cancer patients with depression ([PA-18-492](#), [PA-18-493](#)), and follow-up to abnormal cancer screening tests ([PA-17-495](#)). The performance of clinical care teams is another area where HSIRB is innovating. Our staff have developed models to describe processes used by teams in cancer care (Verhoeven et al); identified essential features of training cancer care teams (Chollette et al); and brought together academic team scientists with clinicians and cancer care researchers to create unique research teams to promote better care teams (NCI-ASCO Teams). Each of these processes is studied in the context of a multilevel healthcare organization.

Directly addressing the challenges of funding multilevel interventions, HSIRB developed and has twice offered training in multilevel methods and intervention through its MLTI; to our knowledge, this was the first training of its kind. Nearly all the funding opportunities offered by HSIRB now require a multilevel perspective. These include announcements for research on the HPV vaccine ([PAR-19-358](#), [PAR-19-359](#), [PAR-19-360](#)), on multi-team clinician systems ([NOT-CA-19-059](#)), on follow-up to abnormal cancer screening tests ([PA-17-495](#)), on de-implementation of low-value care ([NOT-CA-20-021](#), [PA-18-005](#), [PA-18-015](#)) on implementing colorectal cancer screening and follow-up (ACCSIS), and on care coordination to improve care of cancer patients with depression ([PA-18-493](#)).

Focus on organizational characteristics and their effect on cancer prevention and control outcomes has been increasing in HSIRB. These characteristics go beyond aggregations of individuals, such as numbers of patients or specialists, and beyond administrative features, such as proportion of patients supported by Medicaid. Instead, in collaborations across NCI and with external investigators, HSIRB is leading work to identify influential, modifiable characteristics of healthcare organizations, such as clinical policies, physician autonomy, and staff turnover. Completed and ongoing work in this area includes the [Organizational Research in Healthcare Workshop](#), development and implementation of organizational surveys (PROSPR II), and a Delphi survey, in development, to identify available, underused data in healthcare and organizational business for future cancer care delivery research.

### **Moving Forward: Flexibility to Address Rising Public Health Challenges**

Our focus on context creates flexibility to study issues and outcomes across the cancer continuum and to address rising public health challenges. In 2021, we began to consider how every ongoing HSIRB project could consider systemic racism; the Delphi project underway will be the first to change midstream to increase that focus. Our systems lens allows us to move quickly toward measurement and intervention. Rural health issues and multi-morbidities are two other rising health problems that are best considered from a multilevel, system perspective, as care is inevitably distributed across providers and delivered simultaneously. In response, HSIRB supports funding opportunities in both areas ([RFA-CA-18-026](#), [RFA-CA-19-064](#), [RFA-CA-20-004](#), [RFA-CA-20-005](#)).

HSIRB is committed to understanding the healthcare system in ways that promote innovative cancer prevention and control interventions. We approach this work with multidisciplinary expertise and the understanding that cancer care is delivered by interacting systems of policies, organizations, clinicians, and individuals that influence care quality, health outcomes, and our nation's public health.

Meissner HI, et al. *The future of research that promotes cancer screening. Cancer.* 2004;101(5 SUPPL.):1251–1259.

Edwards HM, et al. *Summary of the multilevel interventions in health care conference. J Natl Cancer Inst Monogr.* 2012;2012(44):123–126.

Taplin SH, et al. *Introduction: Understanding and influencing multilevel factors across the cancer care continuum. J Natl Cancer Inst Monogr.* 2012;2012(44):2–10.

Chen R, et al. *Treatment patterns for chronic comorbid conditions in patients with cancer using a large-scale observational data network. JCO Clin Cancer Informatics.* 2020;4(4):171–183.

Verhoeven DC, et al. *The anatomy and physiology of teaming in cancer care delivery: a conceptual framework. J Natl Cancer Inst.* 2021;113(4):360–370.

Chollette V, et al. *Identifying cancer care team competencies to improve care coordination in multiteam systems: a Modified Delphi Study. JCO Oncol Pract.* 2020;16(11):e1324–e1331.

NCI-ASCO Teams. *Special Series: NCI-ASCO Teams in Cancer Care. Journal of Oncology Practice.* October 18, 2016.

## OUTCOMES RESEARCH BRANCH: RESEARCH TO FACILITATE PATIENT ENGAGEMENT AND OPTIMIZE HEALTH AND WELL-BEING

Outcomes research is a field of inquiry that studies the quality and effectiveness of healthcare and its impact on health outcomes. This research uses quantitative and qualitative methodology to examine specific components, including the organization, management, and financing of health services resultant outcomes such as the health status, functioning, and well-being of patients and populations.

In its inception, ORB focused on the development of methods and measurement to establish the best ways to capture multidimensional health outcomes that are meaningful to, and often reported by, patients. These included quality of life, functional status, and symptoms, as well as preference-based utility measures and economic costs of cancer care. ORB's goal was to embed robust and feasible measures in clinical research. As the field of outcomes research evolved, ORB efforts became more applied and focused on care quality and outcomes as part of a larger cancer survivorship research umbrella, supporting research on patients and families from diagnosis onward. Though we continue our stewardship of methods and measurement, we also generate national and population-based outcome data, support the conduct of novel interventional research, and support the generation of an evidence base of best practices for incorporating patient-centered health outcomes in healthcare delivery.

ORB, along with many internal and external partners, has supported groundbreaking research on patient-reported care quality and health outcomes, symptom management and palliative care, and novel methodological patient-centered data capture. Examples of our efforts include data resources ([SEER-MHOS](#), [SEER-CAHPS](#)) (Ambs et al; Mollica et al), measurement tools ([PRO-CTCAE](#), [HealthMeasures](#), [Patient-Reported Outcomes Measurement Information System \[PROMIS\]](#)) (Kluetz et al; Smith AW, Mitchell SA et al; Smith AW, Jensen RE), and initiatives focused on augmenting research on specific populations. These include pediatric and AYA survivors ([RFA-CA-20-027](#); [RFA-CA-20-028](#)) ([Adolescent & Young Adult Health Outcomes & Patient Experience Study \[AYA HOPE\]](#)) (Smith AW, Keegan T et al) (Smith AW, Seibel NL et al); cancer survivors with multiple chronic conditions (Smith AW, Reeve BB et al) [PAR-20-179](#); [PAR-20-180](#); as well as informal cancer caregivers (Kent EE et al; [PAR-19-352](#); [PAR-19-355](#)). We also invest in intervention research to improve healthcare delivery and outcomes across the life course, including interventions to improve outcomes in young survivors ([RFA-CA-19-033](#)) and in interventions that generate real-world data collection to expeditiously drive evidence into practice ([IMPACT](#)).

## Our Future

Our evolving and planned future efforts recognize the importance of the changing healthcare environment, important shifts in use of telehealth, new healthcare payment models, health policy, and technological advancements that have made patient-centered outcomes more widely available and usable in clinical care by patients and care teams. We have continued our efforts related to novel methodological approaches, broadening this area to also consider areas of data science, such as natural language processing and machine learning. We are paying close attention to the growing use of clinical informatics and EHR-based research. We are broadening our reach to understudied populations, such as those with [advanced and metastatic cancers](#) (Mollica MA, Tesaro G et al); the aging cancer population; and historically marginalized individuals with cancer such as black, indigenous, and people of color, and LGBTQI communities; and those managing complex care due to multiple health conditions. We also continue to develop scientific goals to better understand social health and social determinants of health and their influence on patient care and health outcomes, including addressing health inequities and inadequate access to care.





## Celebration of Team Science

We could not do what we do without tremendous collaboration, both within and across DCCPS and NCI, and with external partnerships. Our science, at its heart, is team-based because outcomes research is cross-cutting and interdisciplinary by design. In ORB, we have many collaborations with federal partners, national and international organizations, and professional societies. We work with scientists across disciplines, such as psychology, epidemiology, psychometrics, nursing science, medicine, and health services research. We co-facilitate research funding and activities with colleagues across NIH institutes, centers, and offices. We are grateful for the many scientists, administrators, and fellows both within and outside of our branch, along with the survivors themselves, who have contributed their time and energy to the progress made in cancer outcomes research.

*Ambas A, et al. Overview of the SEER—Medicare Health Outcomes Survey linked dataset. Health Care Financ Rev. Summer 2008;29(4):5–21.*

*Mollica MA, et al. Patient experiences of cancer care: scoping review, future directions, and introduction of a new data resource: Surveillance Epidemiology and End Results—Consumer Assessment of Healthcare Providers and Systems (SEER-CAHPS). Patient Experience Journal. 2017;Vol. 4: Iss. 1, Article 12.*

*Kluetz PG, et al. Patient-reported outcomes in cancer clinical trials: measuring symptomatic adverse events with the National Cancer Institute's Patient-Reported Outcomes Version of the Common Terminology Criteria for Adverse Events (PRO-CTCAE). American Society of Clinical Oncology Educational Book. American Society of Clinical Oncology. Annual Meeting vol. 35 (2016): 67–73.*

*Smith AW, et al. News from the NIH: person-centered outcomes measurement: NIH-supported measurement systems to evaluate self-assessed health, functional performance, and symptomatic toxicity. Transl Behav Med. 2016 Sep;6(3):470–4.*

*Smith AW, et al. Beyond methods to applied research: realizing the vision of PROMIS®. Health Psychology. 2019;38(5):347–350.*

*Smith AW, et al. Understanding care and outcomes in adolescents and young adult with cancer: a review of the AYA HOPE study. Pediatr Blood Cancer. 2019 Jan;66(1):e27486.*

*Smith AW, et al. Next steps for adolescent and young adult oncology workshop: an update on progress and recommendations for the future. Cancer. 2016;122(7):988–999.*

*Smith AW, et al. Cancer, comorbidities, and health-related quality of life of older adults. Health Care Financ Rev. Summer 2008;29(4):41–56.*

*Kent EE, et al. Caring for caregivers and patients: research and clinical priorities for informal cancer caregiving. Cancer. 2016;122:1987-1995.*

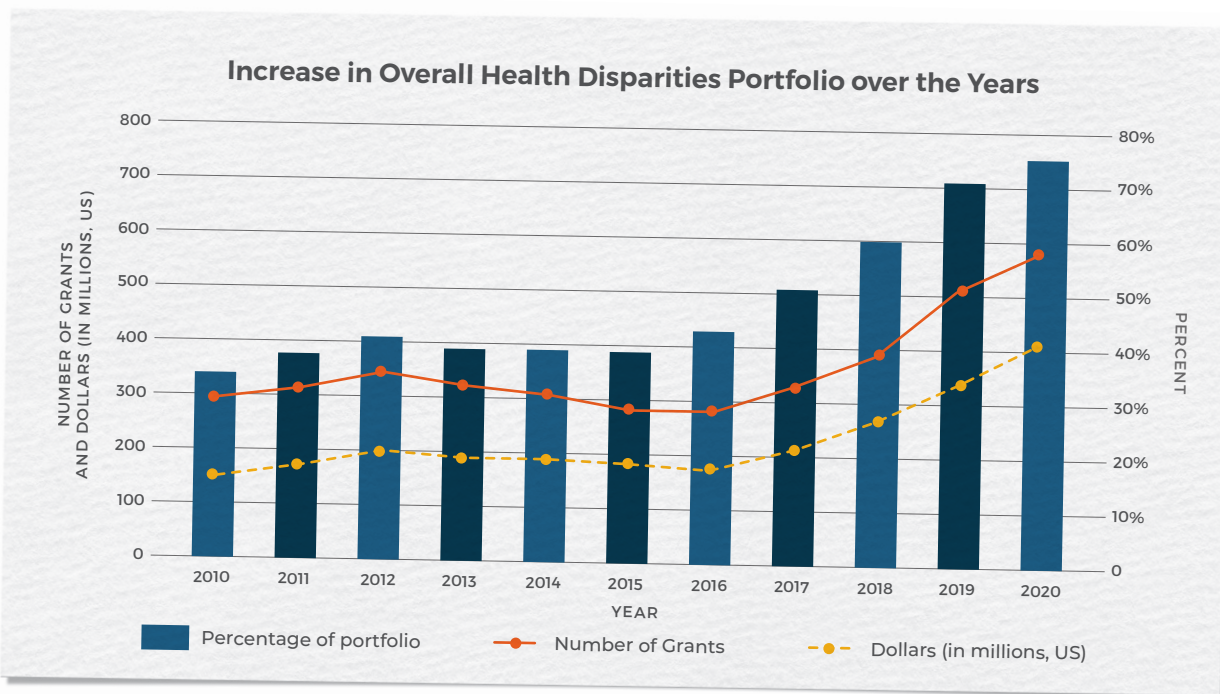
*Mollica MA, et al. Current state of funded National Institutes of Health grants focused on individuals living with advanced and metastatic cancers: a portfolio analysis. J Cancer Surviv. 2021 Jun;15(3):370–374.*

# HEALTH DISPARITIES RESEARCH

## INCREASING HEALTH DISPARITIES CANCER CONTROL RESEARCH TO ACHIEVE HEALTH EQUITY

The elimination of cancer-related disparities is an important goal for DCCPS. Health disparities (HD) are the adverse effects on populations who have systematically experienced greater obstacles to health based on factors such as race and ethnicity, gender, age, religion, socioeconomic status, education, disability, geographic location, sexual identity, gender identity, or other characteristics historically linked to discrimination or exclusion. While health disparity research focuses on the challenges different groups face in achieving the highest level of health possible, health equity (HE) is the attainment of the highest level of health for all people. Achieving health equity requires valuing everyone equally, with focused and ongoing societal efforts to address avoidable inequalities, historical and contemporary injustices, and the elimination of health and healthcare disparities.

DCCPS's commitment to addressing health disparities in cancer control has resulted in an extensive portfolio of grants spanning from longitudinal cohort studies to epidemiological studies, healthcare delivery research, social and behavioral intervention research, omics research, and surveillance studies. The division has dedicated efforts to increasing the cancer control health disparities and health equities funded research portfolio and, in recent years, has seen a tremendous increase in the number of health disparities and health equity grants within the total division grant portfolio. In FY 2020, approximately 76% of the division's funded awards included a health disparities component.

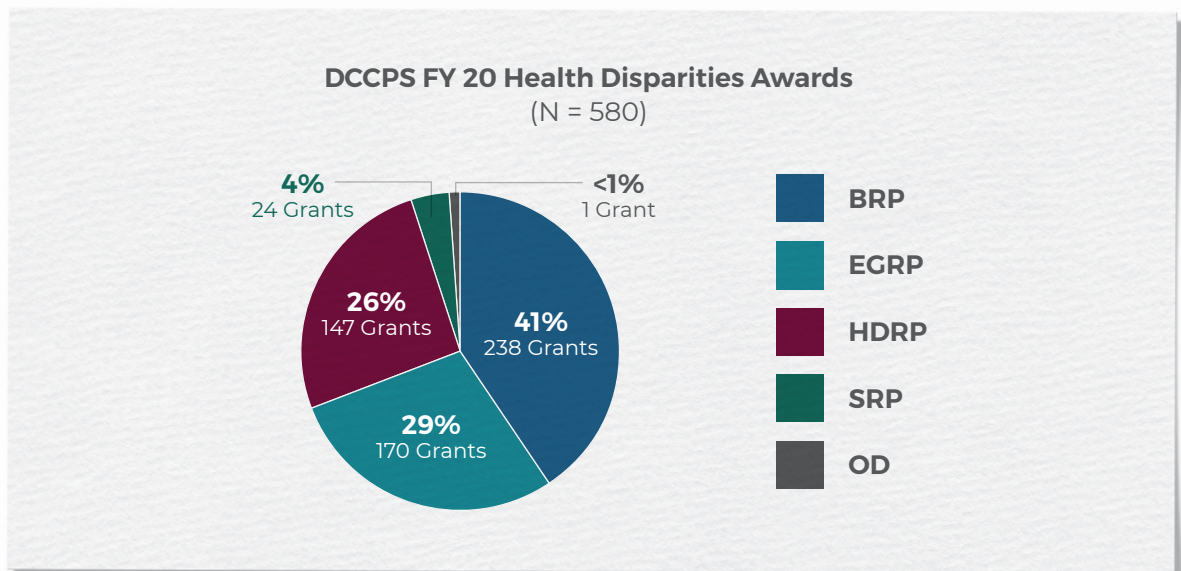


Source: National Cancer Institute. Health Disparities Research Grants Funded in the US  
 Available at: <https://maps.cancer.gov/overview/map/index.jsp?grantType=5&raid=2&fy=1998&programId=undefined>

## Expanding the Portfolio

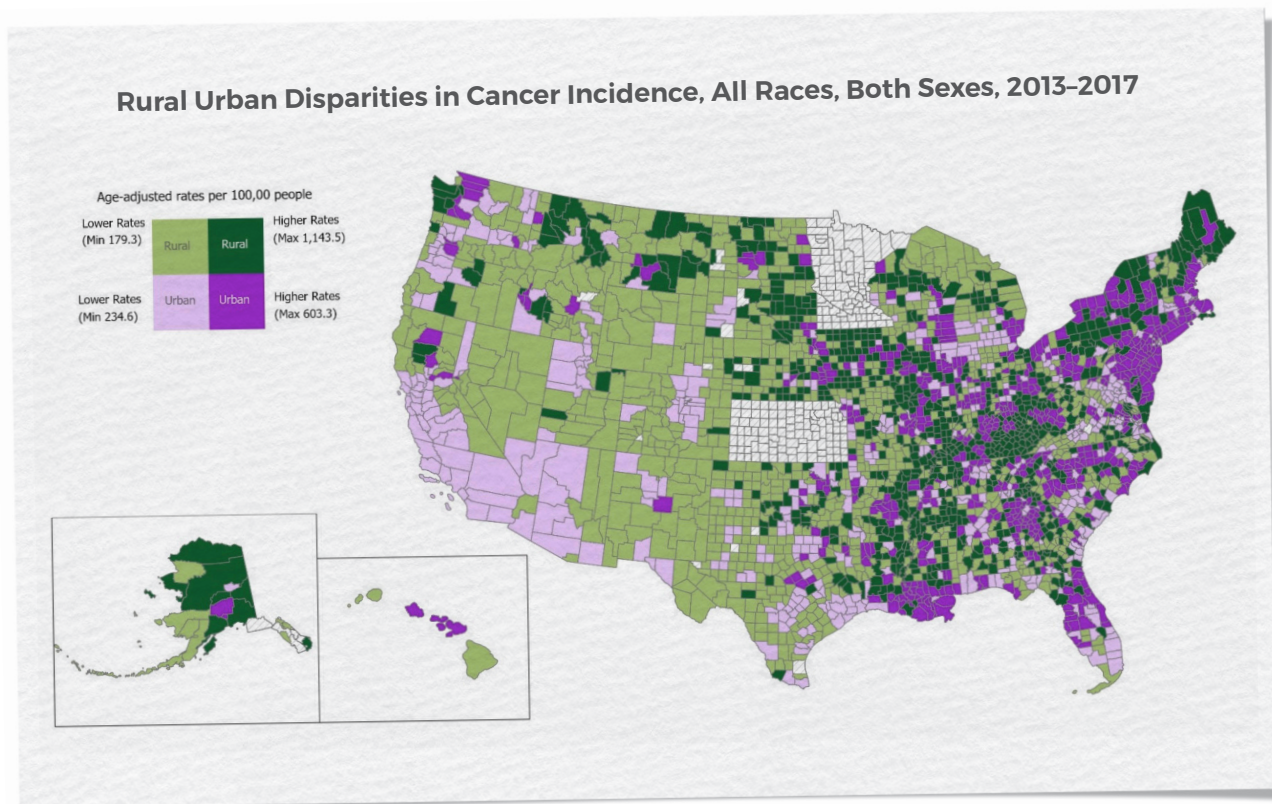
The growth in the number of HD/HE grants is primarily due to the expansion of programs focusing on various medically underserved populations. The [RESPOND Study](#), Research on Prostate Cancer in African American Men: Defining the Roles of Genetics, Tumor Markers, and Social Stress, is the largest coordinated research effort to study biological and non-biological factors associated with aggressive prostate cancer in African American men. This [research](#) is vital to address the prostate cancer disparities that currently exist: African American men are over 75% more likely to be diagnosed with prostate cancer and more than twice as likely to die of prostate cancer compared to other racial/ethnic groups. Similar disparities are shown with cancer incidence and mortality rates for other cancers such as breast, colorectal, and lung cancers, with African Americans more likely to be diagnosed with more-advanced-stage disease and experience higher cancer mortality rates than other groups. The [Detroit Research on Cancer Survivors study](#) focuses on the major factors affecting cancer progression, recurrence, mortality, and quality of life among African American cancer survivors in the [largest study to date](#) of African American cancer survivors in the United States.

Concerted efforts to enhance research capacity in rural and remote areas through multiple funding opportunities and networks have led to the creation of many new partnerships between researchers and NCI-Designated Cancer Centers, with community stakeholders, and with rural healthcare delivery partners. Populations living in rural areas have higher average death rates for all cancer sites combined, compared to populations in urban counties, and have higher incidence and death rates for cancers caused by smoking (e.g., lung and laryngeal cancers) and higher rates of incidence of cancers that can be prevented by screening (i.e., colorectal and cervical cancers). To reduce and ultimately eliminate rural cancer-related health disparities, DCCPS has collaborated with HRSA, USDA, the National Center for Health Statistics, CDC, and the US Census Bureau—agencies who have spent many years working with rural communities—and who have provided the division with valuable information and insights on how to address rural health disparities.





Funding opportunities have invited investigators to conduct research in these rural communities of greatest need. The [Rural Supplements to NCI-Designated Cancer Centers](#) were funded in FYs 2018 and 2019, with the goal of developing research capacity and feasibility on rural cancer control through collaboration with rural clinics, data collection and integration, and studying the implementation of research programs. Many awardees of this supplement went on to receive funding for more extensive work in rural communities, including those awarded grants from the “[Improving the Reach and Quality of Cancer Care in Rural Populations](#)” RFA, and the recent NOSI for administrative supplements focused on [Research in Geographically Underserved Areas](#). In addition, the current “[Social and Behavioral Intervention Research to Address Modifiable Risk Factors for Cancer in Rural Populations](#)” RFA seeks research applications that develop, adapt, and test interventions to address social and behavioral modifiable risk factors for cancer in rural populations. The recent release of the [Rural-Urban Disparities in Cancer map story](#) provides a geographic portrayal of cancer burden among populations that reside in rural versus urban areas, drawing upon the recent research findings related to rural disadvantage and summarizing the division’s efforts to improve the outcomes of cancer in rural areas.



Source: National Vital Statistics System  
[https://www.cdc.gov/nchs/nvss/index.htm?CDC\\_AA\\_refVal=https%3A%2F%2Fwww.cdc.gov%2Fnchs%2Fnvss.htm](https://www.cdc.gov/nchs/nvss/index.htm?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fnchs%2Fnvss.htm)  
 at the National Center for Health Statistics, Centers for Disease Control and Prevention.  
 Rural-urban county classification is based on 2013 USDA Rural-Urban Continuum Codes.

American Indian and Alaska Native (AI/AN) populations are among the underserved minority groups in the United States disproportionately affected by certain cancers, with the lowest survival rates for nearly all types of cancer of any subpopulation and cancers often detected at later stages. The [Intervention Research to Improve Native American Health \(IRINAH\) program](#) was created in 2011 to develop, adapt, and test the effectiveness of health-promotion and disease-prevention interventions in Native populations, and over the years has funded 35 projects from across multiple NIH institutes, with four projects focusing on cancer research. A [Native American Cancer Control Literature Database](#) was developed in conjunction with the IRINAH program and has now expanded to include over 1,700 scientific publications on cancer-related topics with Native American communities, including AI, AN, Native Hawaiian, and First Nations populations. Another intervention project is the “Dissemination of a Colorectal Cancer Screening Program Across American Indian Communities in the Southern Plains and Southwest United States Consortia,” which consists of three NCI-Designated Cancer Centers that are [funded through the Cancer Moonshot](#). The goal of this research effort is to enhance health equity through the reduction of colorectal cancer disparities in morbidity, mortality, stage at diagnosis, and increased survival among AIs through the implementation of multilevel interventions.

We have made substantial progress in our understanding of cancer disparities and inequity over the past few decades. Future advances require expansion into more tailored research focused on medically underserved populations. DCCPS will continue to support HD/HE research to address barriers faced by medically underserved populations and to improve cancer care prevention and delivery conditions research, ultimately working toward eliminating all cancer-related disparities.



# IMPLEMENTATION SCIENCE

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## FOSTERING THE RAPID INTEGRATION OF RESEARCH, PRACTICE, AND POLICY

Implementation science (IS) bridges the gap between research and practice to ultimately improve individual and population health outcomes through the integration of effective health interventions in clinical and community settings. Implementation science activities at NCI were initiated from a recognition that biomedical research findings and health interventions were not being taken up within health systems and communities, limiting the benefit for population health. Significant strides have been made in recent years to move beyond identifying barriers, toward the adoption of interventions, and increasingly focused on intervention adaptation, sustainment, implementation strategies, and de-implementation of ineffective practices.

Implementation science has long been supported across the entire NIH. At NCI, implementation science is largely led by DCCPS and the IS team, working to advance the field through a variety of activities, including funded studies and training programs. Notably, NCI, along with many other participating institutes and centers across NIH, issued the trans-NIH PAs with special receipt, referral and/or review (PAR) Dissemination and Implementation Research in Health ([R01/R03/R21](#)). Investigators are encouraged to submit research applications that utilize innovative approaches to identifying, understanding, and developing strategies for overcoming barriers to the adoption, adaptation, integration, scale-up, and sustainability of evidence-based interventions, tools, policies, and guidelines. Conversely, there is a benefit to understanding circumstances that create a need to stop, or reduce, or de-implement the use of interventions that are ineffective, unproven, low-value, or harmful. The goals of these PARs are to (1) encourage transdisciplinary teams of scientists and practice stakeholders to work together to develop and test conceptual models of dissemination and implementation (D&I) that are potentially applicable across diverse community and practice settings and (2) design studies that will accurately assess the outcomes of D&I efforts. In further support of advancing the science, the IS team co-chairs the Annual Conference on the Science of Dissemination and Implementation, organizes [monthly webinars](#) and [blogs](#) on new areas of research, and published an [edited volume on cancer IS](#).

As a discipline, implementation science is characterized by a variety of research designs and methodological approaches, partnerships with key stakeholder groups (e.g., patients, providers, organizations, systems, and/or communities), and the development and testing of ways to effectively and efficiently integrate evidence-based practices, interventions, and policies into routine health settings. To build capacity in the field and support the study of these methods, the [Training Institute for Dissemination and Implementation Research in Cancer](#) (TIDIRC) was developed to provide participants a thorough grounding in conducting D&I research—with a specific focus on cancer—across the cancer control continuum. In its fourth year, TIDIRC has welcomed faculty and guest lecturers that include leading experts in D&I theories, models, and frameworks; intervention fidelity

and adaptation; stakeholder engagement and partnership for D&I; research methods and study designs for D&I; and measures and outcomes for D&I. The 2018 and 2019 institutes utilized a combination of online coursework and in-person training, and the 2020 and 2021 institutes have been conducted virtually. Since 2018, a total of 185 trainees have matriculated through the course. While attendees must be accepted to participate in TIDIRC, all training materials are publicly [available online](#), and in 2021, the entire curriculum was refreshed and expanded with a focus on study designs, qualitative research approaches, and emerging topics in implementation science, including equity, policy, and costs.

NCI's implementation science approach involves strategic partnerships and multilevel perspectives, along with strong stakeholder engagement. Along with CDC and HRSA, the IS team is a member of the CCCNP, a collaborative group of 19 diverse national organizations working together to build and strengthen comprehensive cancer control efforts across the nation. Through coordination and collaboration, the CCCNP assists comprehensive cancer control coalitions to develop and sustain implementation of comprehensive cancer control plans at the state, tribe, territory, US Pacific Island Jurisdiction, and local levels. NCI staff enhance this research-practice partnership through active participation as subject matter experts and by serving in past and current leadership roles.

To better collaborate with and incorporate feedback from stakeholders, the [Consortium for Cancer Implementation Science](#), launched in 2019 (formerly the Implementation Science Consortium in Cancer), seeks to (1) create “public goods” for IS, (2) foster collaborations across the implementation science and cancer control field, (3) improve networking and dissemination of implementation science information and resources to the field at-large, (4) target and work with underrepresented topics and areas, and (5) maintain ongoing engagement with underrepresented communities. Significantly, this consortium has brought together a total of 658 cancer control and implementation researchers, practitioners, and funders representing more than 111 institutions around the world and most recently focused on short-term and long-term cancer control priorities, challenges, and opportunities during the COVID-19 pandemic, synergies and gaps in the implementation science space across NCI and other federally funded initiatives, as well as discussions on infrastructure for cross-collaboration.

NCI has been and continues to be an important leader in and funder of implementation science. Current and future efforts should build upon this important foundation and infrastructure to improve the impact of cancer control and population science on the health and healthcare of the population, and foster rapid integration of research, practice, and policy.

# OFFICE OF CANCER SURVIVORSHIP

## “CURE IS NOT ENOUGH”

In 1974, Giulio “Dan” D’Angio, a pioneering radiation oncologist, wrote a seminal paper on the need for cancer survivorship research and clinical care, called “Pediatric Cancer in Perspective: Cure Is Not Enough.” Advances in treatment had led to remarkable improvement in prognosis, particularly in his field of pediatric oncology. But Dr. D’Angio recognized the harmful effects of therapy, and he advocated for care that would minimize complications, also bearing in mind the heavy psychosocial and economic burdens of cancer and its treatment.

Other early leaders joined Dr. D’Angio in calling attention to the importance of understanding and addressing life after cancer, and, as the number of cancer survivors continued to grow, so too did the field of cancer survivorship. When the NCI Office of Cancer Survivorship (OCS) was created in 1996, 25 years ago—thanks largely to the efforts of the survivorship advocacy community—there were an estimated 8.4 million cancer survivors. Today, there are more than 17 million cancer survivors; by 2040, that number is expected to climb to over 26 million.

OCS celebrates the success of cancer diagnosis and treatment, while at the same time acknowledging the struggles and challenges of long-term and late effects. The office was influential in the publication of the 2006 landmark IOM report [From Cancer Patient to Cancer Survivor: Lost in Transition](#), which outlined 10 recommendations to enhance the care of the growing survivor population as they transitioned into life post-treatment. The report included key contributions by Dr. Julia Rowland, the OCS director at the time, regarding NCI-funded survivorship research. In 2016, Dr. Rowland again joined other cancer survivorship champions in [Going Beyond Being Lost in Transition: A Decade of Progress in Cancer Survivorship](#), which reflected on the successes in the field but noted the continued efforts needed “to ensure all survivors receive quality, comprehensive, and coordinated care.”

Per PubMed, the number of publications with the words *cancer survivor*:

1947\* to 1995 =

2,340

**PUBLICATIONS**

*\*first year that citations are included in PubMed*

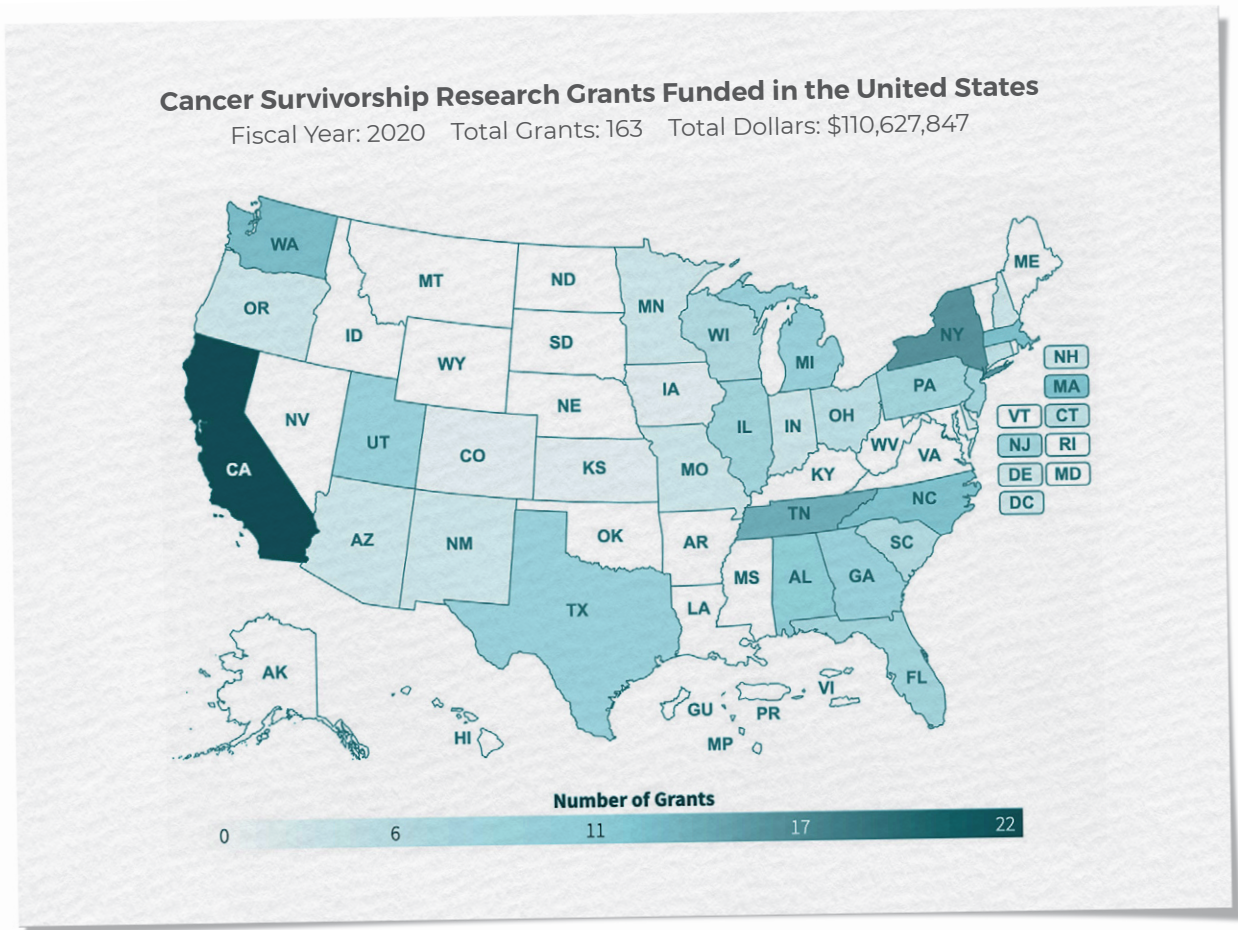
1996 to **August 2021** =

33,032

**PUBLICATIONS**

67

Over the years, the office has supported the growth of the field in terms of numbers and diversity of funded investigators and resources. The office's many collaborations, with organizations ranging from other government agencies to nonprofit foundations, have also been instrumental in helping to advance the cancer survivorship field. OCS co-led the Cancer Survivorship Telephone Workshop Series from 2003 until 2012, a free series that offered cancer survivors, their families, friends, and healthcare professionals practical information to help them cope with concerns and issues that arise after treatment ends. And from 2002 to 2016, OCS and partners held the Biennial Cancer Survivorship Research Conference, bringing together researchers, clinicians, cancer survivors, advocates, policymakers, and public health experts every 2 years to share and learn about the most up-to-date cancer survivorship research.



As the survivorship population grows and changes, the advocacy community in particular continues to play a vital role, most recently ensuring that survivors with advanced or metastatic cancer are not excluded from the cancer survivorship conversation nor resources. Many survivors will continue to be treated for cancer throughout their life and, thus, would not utilize the many resources created for “life after cancer.” OCS recognized the importance of acknowledging this growing population of cancer survivors and correspondingly [changed its definition of “survivor” to formally recognize that there are many different types of survivors](#). The office also brought together stakeholders for a meeting in May 2021 focused on survivors with advanced and metastatic cancers, to explore areas of high priority for research in that specific survivor population.

OCS’s quest to better understand and improve the lives of all cancer survivors is far-reaching. The office recognizes, as Dr. D’Angio did years ago, the importance of multidisciplinary research. OCS supports diverse studies that focus on obesity and cancer, aging and accelerated aging in cancer survivors, digital tools to aid in diagnosis and cancer care, financial toxicity, care coordination, genetic and genomic susceptibility to toxicities, and survivorship health disparities in minority and underserved communities, among many other areas of research. In addition, with the 2018 Childhood Cancer STAR Act, NCI has been able to further support research to improve the care and quality of life of pediatric and AYA cancer survivors. The recently released AHRQ technical brief [Disparities and Barriers to Pediatric Cancer Survivorship Care](#), commissioned by NCI, is one of three evidence reviews that will inform next steps in childhood and AYA survivorship research; this year’s cancer center supplement awards that were focused on childhood cancer survivorship disparities build on this work.

In the future, the office will focus on these and other areas of research, including long-term and late effects of new and emerging therapies, creating new opportunities for training, mentoring, and education in survivorship, and supporting primary care-oriented survivorship research and clinical care. In this 25th anniversary year, OCS continues to recognize its most critical role in cancer survivorship: bringing together and supporting the people, the ideas, and the work that ultimately will improve the well-being of all cancer survivors.

*D’Angio, G.J. (1975), Pediatric cancer in perspective: Cure is not enough. Cancer, 35: 866–870.*



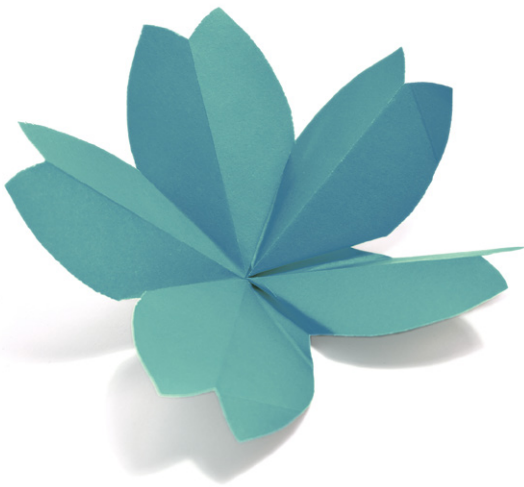
# SURVEILLANCE RESEARCH PROGRAM

## TURNING CANCER DATA INTO DISCOVERY

### **SEER Program: Cancer Registries Supporting Surveillance Research with High-Quality Data**

SEER was created in 1973 by NCI as a response to the passage of the National Cancer Act. Since then, the SEER Program has evolved as the gold standard in cancer surveillance, with 18 central cancer registries representing approximately 50% of the US population and receiving more than 800,000 cancer cases annually. The SEER Program collects and publishes cancer incidence and survival data representing 44.4% of whites, 44.6% of blacks, 69.2% of Hispanics, 55.7% of AIs and ANs, 72.2% of Asians, and 73.5% of Hawaiian/Pacific Islanders. Through this contract, SEER registries are required to utilize [SEER\\*DMS](#) as a secure repository of registry data. The SEER Program registries routinely collect data on patient demographics, primary tumor site, tumor morphology and stage at diagnosis, first course of treatment, and follow-up for vital status. The data collected through the SEER Program is made available for public use through a data use request process. This process has resulted in more than 8,000 dataset downloads as well as more than 1,350 custom dataset requests. The value and uniqueness of SEER data are also quantified through the more than 17,000 publications that have used it for primary analysis and additional 86,000-plus publications referencing SEER data, both since 1973.

SEER data are utilized for federal, state, and nonprofit reports and policy changes, such as hospital and industry utilization to better understand patient populations; data collaboration with industry partners, including pharmacy, claims, genomic, labs, and commercial insurers; and integration with NCI-Designated Cancer Centers, including assessment of catchment areas and integration with research portfolios.



The goals of the SEER Program are to

- collect complete and accurate data on all cancers diagnosed among residents of geographic areas covered by SEER cancer registries
- conduct a continual quality control and quality improvement program to ensure the collection of high-quality data
- periodically report on the cancer burden as it relates to cancer incidence and mortality and to patient survival overall and in selected segments of the population
- identify unusual changes and differences in the patterns of occurrence of specific forms of cancer in population subgroups defined by geographic, demographic, and social characteristics
- describe temporal changes in cancer incidence, mortality, extent of disease at diagnosis (stage), therapy, and patient survival as they may relate to the impact of cancer prevention and control interventions
- monitor the occurrence of possible iatrogenic cancers (i.e., cancers that are caused by cancer therapy)
- collaborate with other organizations on cancer surveillance activities, including CDC's National Program of Cancer Registries (NPCR) and North American Association of Central Cancer Registries (NAACCR)
- serve as a research resource to NCI on the conduct of studies that address issues dealing with cancer prevention and control as well as program and registry operations
- provide research resources to the general research community, including a research data file each year and software to facilitate the analysis of the database
- provide training materials and web-based training resources to the cancer registry community

NCI staff work with NAACCR to guide all state registries in achieving data content and compatibility acceptable for pooling data and improving national estimates.

In May 2018, NCI successfully re-competed the SEER contract with an opportunity to further enhance the SEER Program through expansion utilizing the “ramp-on” process to re-solicit the SEER contract to non-SEER registries. This process concluded in April 2021 with the addition of three new CORE Infrastructure and nine Research Support registries to bring the SEER Program to its current size: 18 CORE Infrastructure and 10 Research Support registries. The 18 CORE registries represent 22 geographic catchment areas, including the Cherokee, AN, and Arizona Indian registries. The establishment of the CORE and Research Support tiers is another unique characteristic of the SEER Program. CORE registries provide data to the SEER Program as well as participate in various quality improvement activities, participate in pilot programs, and provide expertise and best practices within the SEER community through the use of online tools such as SEER\*Educate. Research Support registries do not contribute data to the SEER Program but are available to participate in any task orders issued by NCI as well as leverage linkages established through the use of interagency agreements with databases such as the SSA and the Department of Motor Vehicles.

The completion of the ramp-on process allows the SEER Program to continue to support the cancer surveillance and research communities and support NCI's mission.

## DATA ANALYTICS BRANCH: USING ANALYTICS TO POWER CANCER RESEARCH

The mission of the Data Analytics Branch (DAB) is to advance the science on analytics, modeling, reporting, and interpretation of cancer surveillance data, with the goal of monitoring the progress in reducing the US cancer burden. The success of the cancer surveillance enterprise depends on the availability of analytic tools and methods to analyze the increasing amounts of complex datasets so that we can provide accurate cancer data to relevant audiences.

The DAB focuses on three main areas:

1. Systems for the annual reports of cancer surveillance measures, targeting the needs of different cancer data users
2. Statistical modeling of cancer progress measures, health services utilization, and outcomes
3. New analytic methods for the harmonization, enhancement, and validation of novel sources of data and variables to expand the utility of cancer surveillance data

### Systems for the Annual Reports of Cancer Surveillance Measures

At a higher level and for the more general user of cancer data, [Cancer Stat Facts](#) provides a general overview of incidence, mortality, survival, and prevalence statistics for a single cancer. [SEER\\*Explorer](#), first released in April 2016, has replaced the Cancer Statistics Review for the annual reporting of SEER cancer statistics. It is an interactive website that allows users to tailor graphs and statistics for a cancer site by sex, race, year, age, and stage and histology. The design of SEER\*Explorer has been adopted by other organizations to display their data, including the California registry, NCI-funded POC studies, NAACCR, and NCCR. While Cancer Stat Facts and SEER\*Explorer report pre-calculated summary statistics, [SEER\\*Stat](#) is a software that allows users to analyze and query the SEER data and create analytical datasets for downloading. SEER\*Stat was first released in 1997 and has been expanded to include many types of cancer statistics, including frequencies, rates, trends, survival, and prevalence. SEER\*Stat has almost 15,000 users worldwide and 30,000 runs monthly. The SEER\*Stat Graphical User Interface is being redesigned and will provide a modern look, improved functionality, and graphs. As longitudinal data are being linked to SEER, we plan to include functionality for visualization and analyses of longitudinal data in SEER\*Stat.

### Statistical Modeling of Cancer Progress Measures, Health Services Utilization and Outcomes: Focus on Cancer Prevalence

During the past two decades, substantial headway has been made to extend cancer progress measures beyond incidence, mortality, and survival. The first estimates of US cancer prevalence using data from SEER registries were available in 2002. Since then, US cancer prevalence has been extensively used to quantify the burden of cancer, inform survivorship research, guide health services planning and allocation, and provide data to the American Cancer Society for their survivorship report and to FDA to justify Orphan Drug designations. As of January 2019, there were an estimated 16.9 million

cancer survivors in the United States, which is projected to increase to 22.2 million by 2030. Prevalence estimates, combined with cost estimates from SEER-Medicare, have been crucial to estimating national expenditures for cancer care in the United States. Cancer survivors (i.e., cancer prevalence) represent a growing population, heterogeneous in their cancer trajectories and need for medical care. Because SEER only collects information at diagnosis and follow-up for life status, we are not able to quantify cancer patients in the continuum of care or in recurrence. Methods were used to fill data gaps. For example, we can only estimate metastatic breast cancer (MBC) survivors initially diagnosed with MBC. A back-calculation method was used to estimate that 170,000 women are living with MBC in the United States, and that three in four MBC survivors were women initially diagnosed with early-stage breast cancer and who progressed or recurred with metastasis, and not documented in the registries. Other novel measures include incidence-based mortality data to partition cancer mortality trends by subtype, risk of recurrence measures, trend measures for survival statistics, and expected years of life lost due to cancer.

**New Analytic Methods for the Harmonization, Enhancement, and Validation of Novel Sources of Data and Variables to Expand the Utility of Cancer Surveillance Data**

As SEER expands the collection of cancer surveillance data through linkages, it is becoming crucial to perform evaluation, enhancement, and harmonization of the data sources before the data are released. Initial efforts are focusing on chemotherapy information from oncology practice claims and oral cancer drugs from pharmacies. The work includes comparisons with a gold-standard (i.e., SEER-Medicare) to estimate the sensitivity of the sources in capturing treatment use, coverage percentage of the SEER cancer cases, representativeness of the SEER population, and harmonization of the data prior to release. This area of research will also provide mechanisms for evaluations and pilot analyses by field experts in a “Sandbox” environment. As SEER increases the amount and the depth of cancer data, there is a crucial need for analytics to evaluate, fill data gaps, and harmonize the data so that SEER continues to release high-quality products for cancer surveillance and research.

## **DATA QUALITY, ANALYSIS, AND INTERPRETATION BRANCH: IMPROVING CANCER DATA QUALITY FOR SURVEILLANCE RESEARCH AND CANCER CONTROL**

The Data Quality, Analysis, and Interpretation Branch (DQAIB) designs the quality improvement plan of the SEER Program and develops methods and tools to integrate pathology, genomics, genetics, and medical imaging sources with traditional cancer registry data. By providing clinical and cancer registration expertise to the program and the division, the branch is at the forefront of efforts to release clinically relevant data in support of cancer control research.

### **A Leader in Improving the Quality of Cancer Surveillance Data**

DQAIB plans quality assurance activities in cancer surveillance, supports training activities for data collection, develops new methodologies for quality assessments and control, and enhances the usability of datasets released for cancer control policy development and population-based cancer research. Attendance at the SEER Annual Workshop organized by DQAIB experienced an exponential growth over the last few years, with more than 1,400 registrars attending the 2021 event. SEER\*Educate, a cancer abstracting testing website developed under a DQAIB contract, provides a testing environment for registrars in the United States and abroad, with more than 10,000 testing sessions completed online annually. In addition, the branch maintains and updates several manuals widely used in cancer data collection, such as the Solid Tumor Manual and the SEER Program Coding Manual. Furthermore, a new stage data collection system, the Extent of Disease 2018, was successfully implemented by DQAIB for SEER data collection. The new system increases the granularity of stage data for researchers who investigate the spread of the disease and allows for prognostic staging as recommended by the American Joint Committee on Cancer.

Additionally, DQAIB staff developed the Oncology Toolbox, a set of searchable databases that contain codes from systems used in the clinical care of cancer patients, such as procedure codes mapped to cancer surveillance codes (National Drug Code, Current Procedural Terminology, Healthcare Common Procedure Coding System, and International Classification of Diseases 9 and 10). These tools address the needs of population scientists using cancer surveillance and medical claims data, enabling reproducibility in cancer research. The databases are used in cancer surveillance operations for automation of medical and pharmacy claims processing and incorporation in SEER data.

### **An Innovator in Data Acquisition**

A major portion of current branch activities is geared toward acquisition, evaluation, integration, and release of tumor genomic and germline data. Although a limited number of biomarkers are being collected through the traditional registrar-curated data abstraction, new approaches have been developed to meet the rapidly expanding landscape of precision medicine. These include linkages with genetic and tumor genomic laboratories, and acquisition and automated data abstraction from molecular reports. A linkage of germline tests performed at four genetic laboratories (Myriad, Ambra, Invitae, and GeneDX) with Georgia and California breast and ovarian cancers was completed successfully and scaled to include linkages for all SEER cancer cases. Multigene panels such as OncotypeDX for invasive breast cancer, ductal carcinoma in situ, and prostate



cancer; Decipher Prostate; and Castle Genomic Expression Profiles for uveal and cutaneous melanoma were linked to SEER registry data and are being evaluated for data release. Collaborations are underway to include multigene panels from genomic laboratories, such as Foundation Medicine, Caris Life Sciences, and Tempus.

### **Clinical Expertise in Support of Cancer Collection**

Three initiatives led by DQAIB aim to ensure data quality and usability while simultaneously expanding pathology resources for population-based cancer research: Virtual Tissue Repository (VTR) Pilot, Whole Slide Imaging (WSI) Pilot, and Cancer Pathology Coding Histology And Registration Terminology (Cancer PathCHART).

To address the lack of population-based, molecular research, DQAIB is testing the feasibility of and determining best practices for a future SEER-linked, population-based VTR. The future VTR will use the SEER registries as honest brokers to provide cancer researchers with de-identified, linked data and clinically obtained, formalin-fixed, paraffin-embedded (FFPE) tissue. The VTR Pilot includes two genomics studies (in breast cancer and pancreatic ductal adenocarcinoma), examining cancer cases with unusual outcomes. In both studies, differences between unusual and typical survivors are being analyzed on genomic, transcriptomic, and epigenomic data; histologic features extracted through automated digital image analysis; and demographic factors and treatments. As use of FFPE-derived DNA and RNA in sequencing remains controversial, the quantity and quality of extracted DNA and RNA are being analyzed and compared with historical reports.

A second potential source of pathology-related research resources are digital WSIs. Most current collections are not linked to disease outcomes, case characteristics, and other clinical data. To address the limited availability of WSI collections linked to such data, the Surveillance Research Program (SRP) will obtain digital WSI of routine hematoxylin and eosin stained slides generated through clinical care of cancer cases ascertained through SEER registries. DQAIB is conducting the Pediatric Cancer SEER-linked WSI Pilot, for example, funded through CCDI. In Phase 1, the validity of an open-source, WSI deidentification tool (DSA WSI DeID) is being tested on ~8,000 WSIs for pediatric cancer cases ascertained in 2016 by six SEER registries. In Phase 2, pathologists will annotate these WSIs and rate them according to informativeness to develop a machine learning algorithm that will determine their long-term retention. The selected, deidentified WSIs from the WSI Pilot will be linked to NCCR data as a future, population-based data resource.

The third, pathology data-related effort is Cancer PathCHART, a project DQAIB designed to address four primary data quality and data usability issues that impact registrar coding of tumor site and histology. NCI developed a collaboration between standard-setters in oncology (WHO/International Agency for Research on Cancer [IARC], American Joint Committee on Cancer), cancer registration and surveillance (NAACCR, SEER/NCI, NPCR/CDC, National Cancer Registrars Association, and IACR), and pathology (College of American Pathologists, International Collaboration on Cancer Reporter) that will map tumor histology terminology and coding across all standard-setter resources. Cancer PathCHART will be a suite of resources for tumor registrars, end users of cancer registry data, and tumor registry software vendors. The future suite of webtools will allow users to view mapped histology terminology and cancer coding and will permit searches of histology terminology and codes, their reportability, standard sources, valid site-histology combinations, and years they are valid.

## **SURVEILLANCE INFORMATICS BRANCH: LAYING THE FOUNDATIONS FOR THE INFRASTRUCTURE AND DATA TO SUPPORT PRECISION CANCER SURVEILLANCE**

The Surveillance Informatics Branch (SIB) was established in 2015 to provide leadership and guidance in informatics and technology-related areas as part of SRP's vision to advance cancer surveillance by augmenting the depth and breadth of population-based data to consist of increasingly detailed, timely, accurate, and clinically relevant information. Considering data that inform cancer surveillance, hand in hand with the infrastructure required to collect that data in a meaningful way, SIB focuses on three primary areas:

- 1.** IT and systems infrastructure to support registry operations
- 2.** Exploration of new data sources to improve rich public health surveillance data
- 3.** New informatics and data science tools and methods to improve registry data and efficiency

The ultimate vision is to build a unified pipeline for a SEER ecosystem that includes infrastructure and tools that support cancer surveillance data through its entire life cycle, from initial collection through use, in support of cancer research.

The SEER Data Management System (SEER\*DMS) was designed in 2000, in collaboration with Information Management Services and the SEER cancer registries, and first deployed in 2005. SEER\*DMS supports the core functions of a central cancer registry, including importing, editing, linking, consolidating, and ultimately submitting cancer data to the SEER Program. The centralized data management provided by SEER\*DMS is crucial in ensuring consistent and high-quality data, as well as increasing efficiency of registry operations and sharing of knowledge and experience among registries. SRP is continually considering how to evolve the DMS infrastructure to support and streamline registry operations, for example through dashboards that would allow registries to monitor their data in real-time and to allow DMS to serve as a backbone to integrate new tools that improve registry efficiency and data quality.

One example of how the SEER\*DMS infrastructure evolves to support SRP's efforts to expand the breadth and depth of data on cancer patients is DMS\*Lite, which has been developed to support NCCR, part of CCDI's effort to build a national childhood cohort. NCCR leverages SRP's larger efforts to acquire data on patients beyond the time of diagnosis through linkages to other data sources, such as genomic testing data or claims data, to better understand treatment. NCCR goes one step further, beyond SEER, by including data on pediatric patients contributed by central cancer registries that are supported by CDC's NPCR. DMS\*Lite will be used by the NPCR registries contributing data to NCCR to streamline data submission and ensure uniformity in the data to the extent possible. Linkage of cancer registry data to other data sources is crucial to better capture information about cancer patients beyond their initial diagnosis, to fully understand patterns of care at the population level. For example, SRP now has agreements to receive pharmacy data from major pharmacy chains, which enables the capture of information on oral anti-neoplastic agents, further fleshing out the full treatment course of cancer patients.

In addition to exploring new data sources to better characterize every patient's cancer journey, SRP is looking to achieve near real-time reporting of cancer surveillance data. Crucial to achieving this goal are new informatics and data science tools and methods that can help to improve the efficiency of data collection as well as data quality. The NCI [Joint Design of Advanced Computing Solutions for Cancer](#) collaboration with DOE is bringing us closer to realizing this vision. Collaborative work with computational experts at Oak Ridge National Lab and Los Alamos National Lab has resulted in new machine learning (ML) and natural language processing tools for deep text comprehension of unstructured clinical text to enable accurate, automated capture of reportable cancer surveillance data elements. The initial area of focus for extraction of structured information was electronic pathology reports, which are received by many central cancer registries, and the development of an algorithm to determine tumor characteristics such as site, histology, behavior, and laterality, with a 97% accuracy. Deployed as an application programming interface (API) via the SEER\*DMS infrastructure, the algorithm is currently being tested for deployment across the SEER registries; potential benefits include increased efficiency for pathology reports that can be entirely autocoded by the API, allowing cancer registrars to focus on the more nuanced cases that require human review, and increased accuracy, where the API results may help direct the cancer registrars. To achieve the overall goals of the collaboration, translation of the ML algorithms into the actual clinical workflow of the SEER cancer registries is imperative; successful integration of the ML algorithms in the NCI cancer registries will improve the efficiency, accuracy, and comprehensiveness of the population-based cancer surveillance data that benefits the public, policymakers, and scientists across the research spectrum.

These efforts, spanning from infrastructure to data to tools, will serve to transform cancer surveillance data and help us better understand cancer incidence, prevalence, recurrence, treatment, outcomes, and mortality at the population level. Ultimately, these efforts will help to increase the speed, accuracy, and completeness of data for each person's cancer journey and build foundations of cancer surveillance data for cancer researchers to advance insights that transform the lives of patients.

## STATISTICAL RESEARCH AND APPLICATIONS BRANCH: PROVIDING OPTIMAL STATISTICAL METHODS TO SUPPORT CANCER RESEARCH THAT USES SURVEILLANCE DATA

### Methods and Software

The Statistical Research and Applications Branch (SRAB) promotes the use of optimal statistical measures and methods related to NCI's cancer control and surveillance missions. The branch has a long history of developing innovative methods and software tools for the analysis and interpretation of cancer statistics across different population subgroups, geographies, and over time. Examples include [DevCan](#), [CP\\*Trends](#), and the [Survey-based Population-adjusted Rate Calculator \(SPARC\)](#). DevCan estimates the lifetime risk of being diagnosed or dying from cancer or the risk between any two ages; the well-known "1 in 8 lifetime risk of being diagnosed with breast cancer" comes from this software. CP\*Trends graphically indicates if trends in specific cancers are driven more by factors associated with different birth cohorts (e.g., smoking) or by factors associated with specific years (e.g., introduction of new screening tests). SPARC, now under development, estimates rates when the relevant populations are not available in the US decennial Census, and must instead be estimated from sample surveys like the American Community Survey. Examples include cancer rates for foreign-born residents and rates excluding individuals with a hysterectomy (e.g., useful for uterine cancer).

One of the basic issues in cancer surveillance is the characterization of cancer trends, for which SRAB has developed a tool [Joinpoint](#) that has proven to be uniquely suited to address.

### JOINPOINT

"Is the trend changing?" is a seemingly simple question that is surprisingly difficult to answer using standard statistical methods. The [Joinpoint](#) model provides a solution. Joinpoint identifies a series of connected line segments. For each segment, the trend rises or falls at a constant annual percent change until it changes abruptly at "joinpoints." A data-driven algorithm determines the optimal number and location of the joinpoints. While trends do not actually change so abruptly, this oversimplification of reality (as most models are) has been remarkably resilient in characterizing and guiding the interpretation of trends. The model has been adopted worldwide as a standard for use in analyzing trends in population-based cancer registries and for characterizing trends for other health-related and non-health-related indices. Joinpoint software receives more than 5,000 download requests annually. *The American Statistician* published an analysis of citation patterns that ranked the original Joinpoint methodology as one of the top 50 applied statistical methods published between 1985 and 2002.

## **Producing and Interpreting Cancer Rates, Risk Factors, and the Uptake of Cancer Control Measures at Local Levels**

The presentation and analysis of data at local levels are important for understanding where the highest burden of disease exists, identifying target areas for cancer control programs, and identifying geographic-based clues to the sources of health disparities. Utilizing advanced methods, SRAB has developed estimates of cancer rates, risk factors, and utilization of cancer screening at finer levels of geographic specificity than was previously available.

- ***County-level Screening Rates and Risk Factors Estimates***  
National health surveys, such as the NHIS and the Behavioral Risk Factor Surveillance System, collect data on cancer screening and smoking-related measures at the national and/or state level, but policymakers, cancer control planners, and researchers often need county-level data for cancer surveillance and related research. SRAB has conducted several model-based Small Area Estimation research projects to estimate rates at the county level throughout the United States using Bayesian methods to model the rates as a function of county characteristics utilizing data from national surveys.
- ***Developing Census Tracts Populations as Building Blocks for Meaningful Representation of the Cancer Burden***  
Census tracts are small, homogeneous geographic areas with an average population of about 4,000 individuals. Census tracts populations are generally only available from the US Census in decennial years. While census tracts are too small to develop cancer rates individually, they are the basic building blocks necessary to develop cancer incidence rates for nontraditional geographic areas, such as customized cancer reporting zones and congressional districts, for which incidence rates are often desired. A novel, hybrid methodology to develop census tracts populations was developed using methods jointly contributed by NCI staff and our contractors. These new annual census tracts populations will be widely available to answer questions critical to cancer control and surveillance.
- ***NCI/NAACCR Zone Design Project***  
The Zone Design Project is a collaboration between NCI and NAACCR with voluntary participation of 20 SEER and NPCR registries. The objective is to create custom zones that are more optimal than counties (which vary greatly in size, thus hindering their usefulness) for cancer data reporting across the United States. Automated zone design procedures enabled compact, homogeneous zones with similar, large-enough population size to support stable rates and minimize rate suppression. In each state, the zones are custom-crafted to represent areas that are meaningful for cancer reporting. Our goal is to involve all SEER and NPCR registries and jointly release cancer statistics across the United States.



- **Confidence Intervals for Ranked Cancer Measures**  
[CI\\*Rank](#) is an interactive website that presents ranked, age-adjusted cancer incidence and mortality rates by US state, county, and special regions. Mortality rates for other causes of death are also available. People are inclined to compare things, and ranks make comparisons easy. Federal, state, and local governments use health index ranks for priority setting, program planning, and evaluating the effects of policies or programs. However, ranks can also be misleading, and what is novel about this site is the incorporation of a Monte-Carlo statistical method to estimate confidence intervals for the ranks. The incorporation of this measure of variability allows users to understand that ranks for relatively rare diseases or smaller-population areas may be essentially meaningless because of their large variability, but ranks for more common diseases in densely populated regions can be useful.

# EVALUATING THE IMPACT OF LEGISLATION AND INFORMING PUBLIC POLICY IN CANCER CONTROL

In 1971, a single piece of legislation changed how we view cancer care forever. The National Cancer Act cemented our nation's commitment to science, establishing networks of cancer centers, clinical trials, data collection systems, and advanced research. In this 50th anniversary year of that landmark legislation, we look back at select examples of legislation that have played a pivotal role in enhancing our ability to alleviate the burden of cancer through research, and have laid the foundation for continued progress for the next 50 years.

- **American Recovery and Reinvestment Act (ARRA)**

In 2009, Congress passed ARRA, which supported DCCPS work related to cancer prevention, screening, treatment, and genomics. FYs 2009 and 2010 saw an infusion of ARRA funding that enabled DCCPS to expand and enhance cancer research, helping to move exciting advances forward at an accelerated rate. [DCCPS managed more than \\$187 million in ARRA funds](#) to accelerate research and advance cancer control initiatives. ARRA funding enabled DCCPS to participate in some of the largest study populations ever assembled for cancer research, allowing the collection of new biospecimens and clinical data that continues to advance our understanding of the genetic architecture of cancer. ARRA was a catalyst for more than 65 studies of cancer susceptibility in human populations in seven NCI priority areas relevant to the fields of epidemiology and genetics. Using ARRA funding, DCCPS researchers helped collectively build a national clinical electronic data infrastructure that used prospective, patient-centered outcomes data and connected different clinical databases for comparative effectiveness research (CER), which provided a foundation for the PCORI-supported National Patient-Centered Clinical Research Network (PCORnet). ARRA appropriated significant funds to conduct and support CER, also called patient-centered outcomes research, which compares the benefits and harms of different interventions and strategies to prevent, diagnose, treat, and monitor health conditions in real-world settings. The purpose of this research is to improve health outcomes by developing and disseminating evidence-based information to patients, clinicians, and other decision-makers, responding to their expressed needs about which interventions are most effective for which patients under specific circumstances. The division was responsible for more than \$79 million in ARRA funds to support CER projects in cancer prevention, screening, and treatment, genomic and personalized medicine, and workforce development.

- **The Childhood Cancer Survivorship, Treatment, Access and Research (STAR) Act**  
In 2018, Congress passed the [STAR Act](#) as a comprehensive childhood cancer bill to advance pediatric and AYA cancer research and treatments, improve cancer surveillance, and enhance resources for survivors and their families. The STAR Act authorizes improvements to biospecimen collection and associated infrastructure, registry infrastructure, and research to improve the care and quality of life for cancer survivors, including children and AYAs. DCCPS issued an FOA to efficiently implement major elements of the STAR Act by funding multiple intervention research project grants beginning in FY 2019. The "[Improving Outcomes for Pediatric, Adolescent and Young Adult Cancer Survivors](#)" RFA focused on stimulating the scientific development of effective, feasible, and scalable interventions to address biomedical, behavioral, and psychosocial adverse effects in pediatric and AYA survivors of cancers. The development of interventions to address health disparities and the needs and preferences of minority or other medically underserved populations are of high priority in all research areas. These efforts were extended with a subsequent RFA funded in FYs 2021 and 2022, "[Research to Reduce Morbidity and Improve Care for Pediatric and AYA Cancer Survivors](#)," which includes observational, mechanistic, and intervention studies and aims to comprehensively address all six STAR Act domains ([stated in Sec. 202 of the STAR Act](#)) for pediatric/AYA cancer survivorship research.
- **Childhood Cancer Data Initiative**  
The CCDI is a federal investment of \$50 million proposed to be extended in equal amounts per year for 10 years. The first year of the initiative was funded in December 2019. These funds allow NCI to enhance data sharing, collection, analysis, and access for ongoing and planned childhood and AYA cancer and survivorship research throughout the institute. DCCPS researchers were involved in the NCI CCDI Symposium in July 2019 that convened scientific stakeholders and leaders from academia, government, industry, and advocacy organizations to develop more efficient and more effective means of collecting, analyzing, and sharing the data needed to speed progress against cancers that occur in children and AYAs. In June 2020, DCCPS participated in an ad hoc NCI working group convened to provide general guidance regarding future priorities for the initiative, including the issuance of a [report of 24 specific recommendations](#) to leverage data science and data sharing opportunities. The CCDI extends NCI's ongoing support of childhood and AYA cancer research, as well as complements efforts authorized by two pieces of federal legislation: The [STAR Act](#) and the [Research to Accelerate Cures and Equity \(RACE\) for Children Act](#).
- **Cancer Moonshot**  
The Cancer Moonshot to accelerate cancer research aims to make more therapies available to more patients, while also improving our ability to prevent cancer and detect it at an early stage. In 2016, Congress passed the 21st Century Cures Act, authorizing funding for the Cancer Moonshot over 7 years. To ensure that the Cancer Moonshot's approaches are grounded in the best science, the Cancer Moonshot Task Force established a [Blue Ribbon Panel of experts](#) to make transformative research recommendations to accelerate progress against cancer. To date, NCI has invested over \$1 billion in Moonshot funding, supporting over 240 research projects across more than 70 cancer science initiatives. That investment has led to many important insights

tied to [the Moonshot's key research priorities](#). DCCPS has a lead responsibility at NCI in a number of priority areas identified by the Blue Ribbon Panel, including engaging patients to contribute their tumor profile data; reducing cancer risk and cancer health disparities through approaches in development, testing, and broad adoption of proven prevention strategies; collecting, sharing, and analyzing patient cancer data to predict future patient outcomes; and implementation science. In FY 2020, DCCPS was responsible for nearly 30% of total NCI Moonshot commitments, and over the course of the 7 years, DCCPS will have been responsible for nearly [20% of total NCI Moonshot commitments across over 20 initiatives](#).

- **Tobacco Regulation and Related Tobacco Control Research**

DCCPS's TCRB within BRP leads and collaborates on research and disseminates evidence-based findings to prevent, treat, and control tobacco use in order to create a world free of tobacco use and related cancer and suffering. DCCPS's work informs numerous areas of tobacco prevention and control-related policy. TCRB funded the [State and Community Tobacco Control Research Initiative](#) from 2011 through 2017. Through this initiative, NCI supported both observational and interventional studies that addressed tobacco use and exposure in the United States while also examining the effectiveness of state and community tobacco control policy and media interventions. Funded projects focused on research in five areas: tax and pricing policies, secondhand smoke policies, mass media countermeasures, community and social norms, and tobacco industry marketing and promotion.

The landmark Family Smoking Prevention and Tobacco Control Act of 2009 granted the FDA authority to regulate the manufacturing, marketing, and distribution of tobacco products. Evidence generated by DCCPS-funded research has contributed to FDA's ability to make informed decisions as it determines how to implement its regulatory authorities. The [TCORS](#) are made up of investigators with a broad range of expertise (including epidemiology, economics, toxicology, addictions, and marketing) who conduct research projects around an integrative theme. In 2018, nine centers received funding. NCI programmatically manages four of the nine TCORS 2.0 sites.

DCCPS-funded research has shown that smokefree laws benefit nonsmokers by eliminating exposure to tobacco smoke and benefit smokers by providing an environment that encourages and facilitates quitting. As of April 2020, 36 states, Washington, DC, and Puerto Rico had enacted comprehensive smokefree laws. Several of the US territories also have enacted comprehensive smokefree laws. DCCPS scientists participate on a federal interagency workgroup (comprising the US Department of Housing and Urban Development [HUD], CDC, NCI, and the Environmental Protection Agency), which has convened regularly since 2013 to share current research, disseminate the evidence base, discuss local-level implementation, and encourage the use of evidence-based smoking cessation resources as part of all implementation efforts. Since HUD adopted a policy to prohibit smoking in public housing in 2016, this workgroup has continued to identify opportunities for collaboration between the Department of Health and Human Services (HHS), HUD, and other federal agencies to promote effective implementation of the rule in public housing. These agencies monitor and support implementation and evaluation of the HUD smokefree rule with the goal of protecting all people living in multi-unit housing.

## Selected Examples of the Division's Role in Informing Health Policy

DCCPS supports science that helps inform policies and programs aimed at preventing, detecting, and treating cancer and improving outcomes for cancer survivors. That science includes work to understand and assist those living with a history of cancer, as well as their families. A key focus of this work is evaluating the effect of models of care, incentives, and factors that can be changed to improve care. A portion of the research supported by DCCPS therefore provides policymakers with the practical evidence they need to make effective decisions. The division's long-standing history of collaborating across NIH, HHS, and other agencies makes it uniquely suited to continue to play a role in the generation of evidence to shape and respond to national efforts to improve the value and effectiveness of cancer care. Below are select examples of the division's research contributions related to public policy and illustrates its role in developing a comprehensive base of scientific evidence for policymakers and public health practitioners.

- **American Stop Smoking Intervention Study for Cancer Prevention (ASSIST)**  
[ASSIST](#) put into practice NCI's commitment to prevent and reduce tobacco use across all populations and age groups. ASSIST took evidenced-based interventions from controlled studies and implemented them in 17 states that competed to participate in the initiative. Its underlying rationale—that significant decreases in tobacco use could be realized only with interventions that changed the broader social environment to ensure that social norms shifted to make tobacco use a nonnormative behavior—was a significant departure from previous tobacco control programs and in the vanguard of the “new” public health. Prior to ASSIST, very few states addressed tobacco use at the population level. DCCPS's TCRB (and its precursor, the Public Health Applications Branch) led the ASSIST program, helping to develop a three-pronged intervention using policy development, mass media and media advocacy, and program services to change norms around children and smoking; smoking in public places; and state tax increases to reduce consumption and prevalence. The [ASSIST legacy](#) remains today in the tobacco control professionals whose work continues to reduce the burden of disability and death caused by tobacco.
- **State Cancer Profiles**  
The [DCCPS 2020 Overview and Highlights](#) highlighted the important work of implementation science to bridge the gap between research and practice to improve individual and population health outcomes. DCCPS recognizes that advances in our understanding of implementation processes will have maximum benefit if communicated in a way that supports and informs the important work of cancer control researchers and practitioners, providing them with the tools and resources necessary to help them better understand, plan for, and conduct rigorous D&I studies. One of those tools DCCPS works on is the [State Cancer Profiles](#), a collaboration of NCI and the CDC. State Cancer Profiles supplies health planners, policymakers, and cancer information providers with data, maps, and interactive graphs to help guide and prioritize cancer control activities at the state and local levels. The site illuminates the cancer burden in a standardized manner to motivate action, integrate surveillance into cancer control planning, characterize areas and demographic groups, and expose health disparities. This invaluable tool generates interactive graphics and maps, which provide support for deciding where to focus cancer control efforts.



- **Dietary Guidelines and Physical Activity Guidelines**

The DGAs are jointly issued and updated every 5 years by USDA and HHS. They form the basis for federal nutrition policy and provide authoritative and current evidenced-based dietary advice to promote health and reduce risk for major chronic diseases. DCCPS-supported researchers developed methodologies to estimate usual dietary intake distributions and identify sources of key dietary constituents, including added sugars; the resulting data have proven to be critical for the recent and upcoming versions of the guidelines. The 2020–2025 report includes the first-ever recommendations for Americans from birth through 24 months old, and DCCPS staff provided additional data analyses and methodological context for the committee for this population. In addition, DCCPS collaborated with USDA to develop the [HEI](#), a measure of dietary quality that assesses conformance to the DGAs and has been used in hundreds of studies, including the evaluation of USDA’s multibillion-dollar food assistance programs.

The *Physical Activity Guidelines for Americans* (PAG), which serves as the primary, authoritative voice of the federal government for evidence-based guidance on physical activity, fitness, and health, was first issued by HHS in 2008, and the 2nd edition was released in 2018. DCCPS-supported data resources and analyses led to changes in the 2018 *Physical Activity Guidelines for Americans*, such as the removal of the requirement that activity had to occur in episodes of at least 10 minutes to count toward meeting the guidelines. In 2013, the *Physical Activity Guidelines for Americans Midcourse Report: Strategies to Increase Physical Activity Guidelines Among Youth* was published to provide evidence-based actionable steps to increase physical activity. DCCPS staff were involved in development of all these documents, as well as Step It Up! The Surgeon General’s Call to Action to Promote Walking and Walkable Communities and the *Let’s Move!* initiative.

In addition to these initiatives, DCCPS supports a wide range of research to help inform ongoing public health efforts across the United States and the world. The DCCPS research portfolio includes studies aimed at understanding behaviors and barriers, along with effective interventions to increase the availability of places to be physically active and of healthy food in the home, at schools, in childcare settings, in neighborhoods, and in communities. DCCPS has supported research on topics related to obesity, such as school nutrition policies at school and state levels, policies that tax sugar-sweetened beverages, improvements in built and social environments in public housing, as well as park restoration and changes in public transit.

- **US Preventive Services Task Force Screening Guidelines and Cancer Intervention and Surveillance Network**

DCCPS plans, implements, and maintains a comprehensive research program to promote the appropriate use of effective cancer screening tests, as well as strategies for informed decision-making regarding cancer screening technologies, in both community and clinical practice. For example, the US Preventive Services Task Force (USPSTF) has utilized results from the [Cancer Intervention and Surveillance Modeling Network](#) (CISNET), funded by DCCPS, to estimate the harms and benefits of many different screening regimens to help inform the task force as they develop screening recommendations for breast, colorectal, lung, and cervical cancers. The

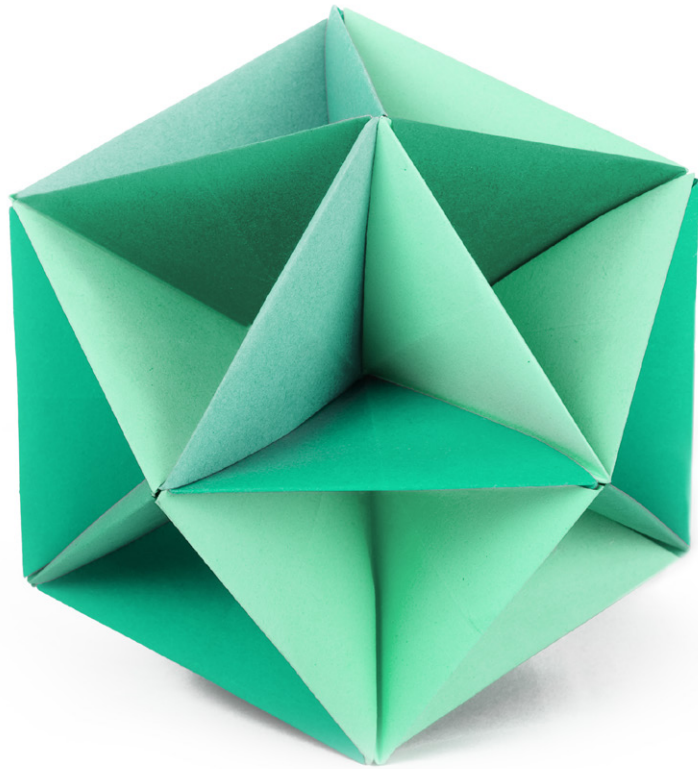
CISNET breast cancer group found that biennial strategies were most efficient for average-risk women, and for women with a two- to fourfold increased risk, annual screening starting at age 40 had similar harms and benefits as screening average-risk women biennially from age 50 to 74. Many of the breast cancer screening analyses were possible, in part, because of the contributions to current screening practices and outcomes by the DCCPS-funded Breast Cancer Surveillance Consortium (BCSC), a well-established research resource for studies designed to assess the delivery and quality of breast cancer screening. This large, standardized dataset presents a unique opportunity for investigators throughout the country to study how mammography screening performance may be improved and how breast cancer screening relates to changes in disease stage at diagnosis, survival, and mortality. In the past 15 years, BCSC data have had an impact on a wide range of scientific and policy arenas beyond the immediate work of the consortium.

For colorectal cancer, the simulation modeling helped to support recommendations that average-risk adults stop screening at age 75, that if a stool-based screening test is performed, a test with high sensitivity is used, and adding computed tomography colonography every 5 years as a screening strategy. In the most recent review of colorectal cancer screening recommendations, CISNET modeling helped to support the change in initiation age of screening from age 50 to 45. The CISNET colorectal group worked with AHRQ and CMS to produce an economic analysis that CMS used to initially inform coverage and the reimbursement level of the fecal immunochemical test (FIT).

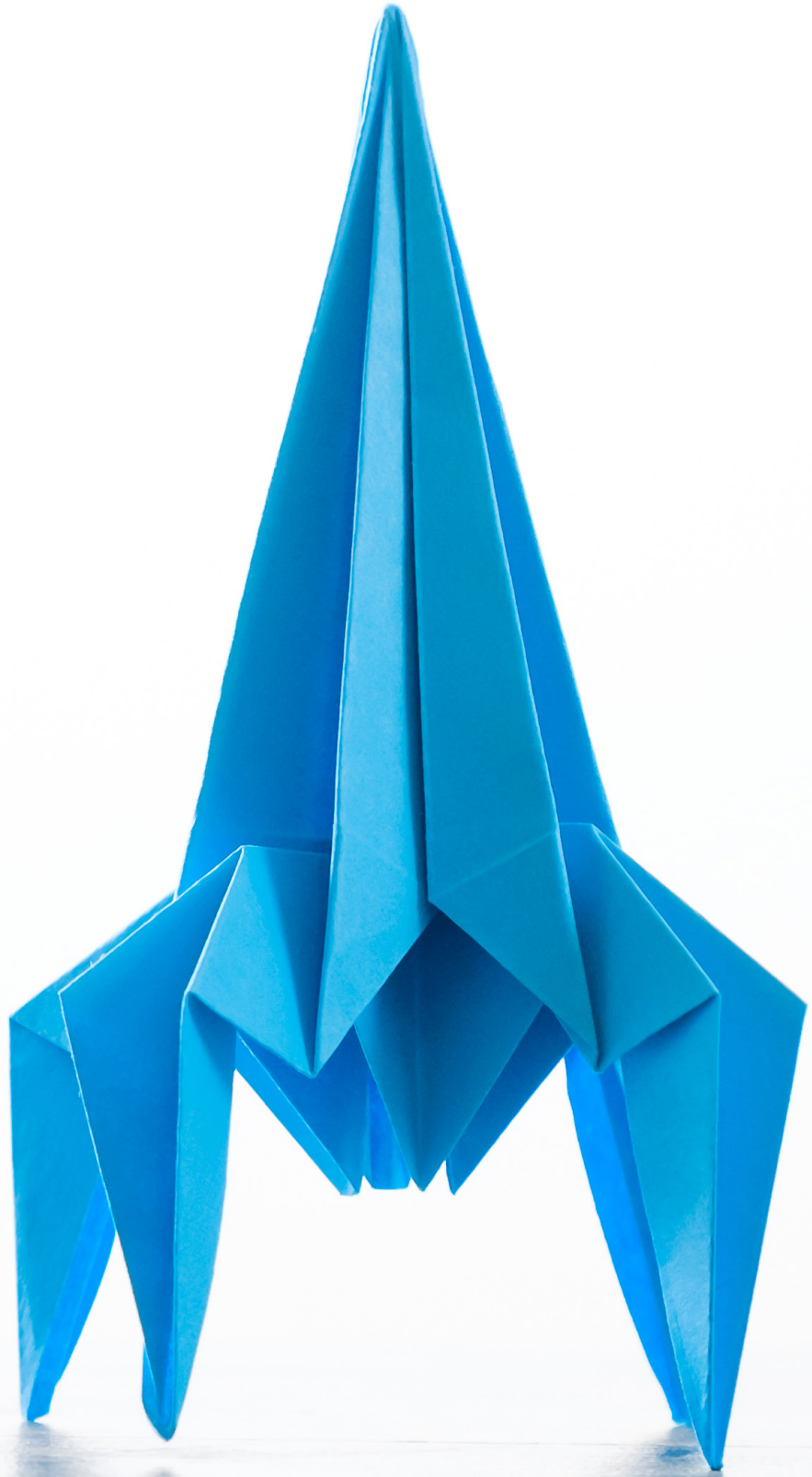
The CISNET lung group considered hundreds of different strategies for lung cancer screening that differed by starting age, stopping age, periodicity, minimum pack years, and maximum number of years since quitting smoking. In a recent update of their prior recommendations, CISNET modeling helped inform the task force to lower the starting age for screening from age 55 to 50 and also a reduction in the minimum number of pack years from 30 to 20.

Modeling by the CISNET cervical group was influential in changing the recommendation from combined cytology and HPV testing every 5 years to high-risk HPV testing alone every 5 years in women age 30 to 65. In addition, the CISNET cervical group responded to the CDC's Advisory Committees on Immunization Practices request for analyses to inform recommendations on mid-adult HPV vaccination.

For a fuller description and many more examples, please check out our report [Informing Policy and Programs 2021](#), which will be published later this year.



PLANNING FOR  
THE FUTURE





# FUTURE DIRECTIONS FOR CANCER CONTROL AT NCI

Reflecting on over 23 years of service in DCCPS, I am struck by how much the directions and impact of the work conducted by the division have depended on the individuals within it. Even in an organization like DCCPS, which depends heavily on teamwork and collaboration, many of our scientific initiatives have begun with one individual's idea, which is then shaped and enhanced by the input of numerous others within and outside the division. The essential seeds of great ideas have come from subject matter experts who themselves were influenced by both the published research literature and innumerable conversations with scientists, advocates, and community members.

Although the cancer control research workforce is vibrant and increasingly diverse, our future success will continue to rely on the recruitment and retention of outstanding individuals committed to public service, who are willing to serve in the government. Academic culture rewards highly visible, individual accomplishment, whereas government relies on selfless service – the willingness to accomplish major goals for the greater good, often without individual credit or identifiability.

Research in cancer control and population sciences, as in many other fields, relies on relentless progress in research tools and methods, and this has been a thematic focus of DCCPS throughout its history. To sustain progress, we will need to continue to incentivize, support, and improve methodological research. Our investments in statistical methods and modeling, exposure and risk behavior assessment, and patient-reported outcomes, for example, have yielded some of the greatest benefits.

Data-driven prioritization has been another hallmark of DCCPS. As the NCI division responsible for collecting, analyzing, and reporting surveillance data of many types, we have a central and essential national role in monitoring progress against cancer. Surveillance and epidemiology also inform our own research directions and priorities. Many efforts, such as the Cancer Trends Progress Report and State Cancer Profiles, have been undertaken to increase the utility and visibility of these data. As with our recent expansion of the SEER Program, the division will need to continually enhance and further disseminate these vital resources, in close collaboration with our colleagues across HHS.

Finally, our public health responsibility requires us to prioritize research that addresses the most important, as well as newly emerging and poorly understood risk factors. A hallmark of the work supported by DCCPS is its public health impact. Tobacco use and obesity are continuing challenges, but other factors require new, fundamental knowledge concerning the risks of exposure (e.g., cannabis) or strategies to reduce risk (e.g., alcohol). And the greatest challenge of our time, health inequity, demands the full exploitation of our research resources and intellectual capacity to alleviate the impact of poverty and discrimination on cancer incidence and mortality.

## **ROBERT T. CROYLE, PHD**

Director, Division of Cancer Control and Population Sciences  
National Cancer Institute

# OPPORTUNITIES FOR RESEARCHERS

In addition to encouraging scientific ideas for researchers through investigator-initiated applications and omnibus solicitations, DCCPS develops and participates in NIH funding opportunities aimed at stimulating new directions in specific research to examine, discover, and test methodologies to improve public health. The following are examples of recent funding opportunity announcements to encourage research projects in emerging or priority areas:

- Modular R01s in Cancer Control and Population Sciences ([PAR-21-190](#))
- Dissemination and Implementation Research in Health ([PAR-19-274](#), [PAR-19-275](#), [PAR-19-276](#))
- Dissemination and Implementation Science for Cancer Prevention and Control in Low Resource Environments ([NOT-CA-20-025](#))
- Notice of Special Interest (NOSI): De-implementation of Ineffective or Low-value Clinical Practices along the Cancer Care Continuum ([NOT-CA-20-021](#))
- Expanding Cancer Control Research in Persistent Poverty Areas ([NOT-CA-21-071](#))
- Intervention Research to Improve Native American Health ([PAR-20-214](#), [PAR-20-238](#))
- Tailoring Follow-up Care for Survivors Using Risk-Stratified Pathways ([NOT-CA-21-019](#))
- Alcohol and Cancer Control ([NOT-CA-20-034](#))
- Telehealth in Cancer Care ([NOT-CA-21-043](#))
- Linking the Provider Recommendation to Adolescent HPV Vaccine Uptake ([PAR-19-358](#), [PAR-19-359](#), [PAR-19-360](#))
- Research on Oral Anticancer Agents in the Contexts of Utilization, Adherence, and Health Care Delivery ([NOT-CA-20-026](#))
- New Information Technology-Enabled Care Delivery Models to Improve Depression Care in Cancer ([NOT-CA-21-085](#))
- Clinical Characterization of Cancer Therapy-induced Adverse Sequelae and Mechanism-based Interventional Strategies ([PAR-19-325](#))
- Use of Biological Information to Understand How the Interplay of Environmental Exposures and Genes Influences Cancer Risk ([NOT-CA-20-002](#))
- Innovative Approaches to Studying Cancer Communication in the New Information Ecosystem ([PAR-19-348](#), [PAR-19-350](#))
- Geospatial Approaches in Cancer Control and Population Sciences ([NOT-CA-20-004](#))
- Leveraging Population-based Cancer Registry Data to Study Health Disparities ([NOT-CA-21-020](#))
- Integration of Individual Residential Histories in Cancer Research ([NOT-CA-21-092](#))

More information about funding opportunities can be found at [cancercontrol.cancer.gov/funding](https://cancercontrol.cancer.gov/funding).

# INVESTMENTS IN CANCER CONTROL RESEARCH

Researchers funded by DCCPS have advanced the science to improve public health for more than two decades, and we celebrate their scientific advances and research accomplishments in cancer control and population sciences. Major programmatic areas include epidemiology and genomics research, behavioral research, healthcare delivery research, surveillance research, and survivorship research.

In FY 2020, DCCPS funded 767 grants valued at more than \$509 million, with work in the United States and internationally aimed at reducing risk, incidence, and deaths from cancer, and enhancing the quality of life for cancer survivors. In addition, the division funded \$88 million in contracts, which include the SEER Program. Though the majority of DCCPS funding is for investigator-initiated research project grants, the division also uses a variety of strategies to support and stimulate research such as multicomponent specialized research centers, cancer epidemiology cohorts, and supplements to NCI-Designated Cancer Center support grants.

While we are still compiling data for FY 2021, a snapshot of [new grants funded in this FY](#) as of August 2021 shows that over 150 new grants have been funded in areas such as cancer survivorship, health disparities and rural cancer control, reduction of alcohol and tobacco use, and genetic testing and counseling. Thanks to higher paylines in FY 2021, we anticipated approximately 15% more new awards in FY 2021. Check our website in the coming months for the full FY 2021 portfolio.

*Learn more about the DCCPS grant portfolio and funding trends at [maps.cancer.gov/overview](https://maps.cancer.gov/overview).*

# TRAINING THE NEXT GENERATION OF RESEARCHERS

NCI is the federal government's principal agency for cancer research and training, and the latter role has been an equal priority for DCCPS since the division's inception in 1997. DCCPS supports training and career development for cancer researchers working at NCI in Maryland, as well as at institutions around the world. Over the years, DCCPS has trained over 470 fellows at NCI alone, some for several years, allocating \$21.3 million to their development. Given that the division is helping to train the next generation of researchers, there is a strong focus on diversity. Of the 2021 class of fellows, for example, 44% considered themselves African American, Hispanic/Latino, Asian, or multiethnic. There is also diversity in educational background of the fellows, with 66% in 2020 holding a PhD or MD, and 34% of the fellows holding a master's or bachelor's degree.

In addition to the fellows trained at NCI, the division supports training programs for extramural researchers along the professional trajectory. DCCPS (with the Division of Cancer Prevention in 2019) has hosted the [New Grantee Workshop](#), bringing together new investigators who recently received their first R01 grant. Through interactive sessions and informal activities, grantees learn strategies to successfully manage their grant; have opportunities to network with colleagues and DCCPS scientific staff; and learn about tools, trends, and resources to support their research. DCCPS will host the next New Grantee Workshop in the fall of 2021.



Attracting, training, and retaining a talented and innovative research workforce for the future is one of NCI's most important responsibilities."

– Norman E. “Ned” Sharpless, MD,  
NCI Director

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*2019 New Grantee Workshop*



This has been a very valuable experience learning about many different career paths. I've really enjoyed my training experience."

DCCPS programs develop and run training that focuses on all parts of the [cancer control continuum](#). The IS program's [TIDIRC](#), for example, now in its fourth year, provides participants a thorough grounding in conducting D&I research—with a specific focus on cancer—across the continuum. While attendees must be accepted to participate in TIDIRC, all training materials are publicly [available online](#). IS also leads the [SPeeding Research-tested INTerventions](#) (SPRINT) program, designed to foster, grow, and nurture an innovation ecosystem for interventionists. SPRINT is run by instructors with extensive startup and teaching experience and is customized specifically for cancer prevention and control interventions. The program provides real-world, hands-on training on how to successfully transform cancer control innovations into market-ready products. The ultimate goal is to create research-tested behavioral interventions that are ready to be put into real-world practice.

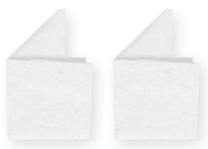
DCCPS's HDRP hosts [MLTI](#), including faculty and guest lecturers who are leading experts in multilevel research, to provide trainees with a grounding in multilevel intervention research, with a specific focus on cancer. HDRP also launched the [NCI/AcademyHealth Healthcare Delivery Research Visiting Scholars Program](#) in 2017, in partnership with AcademyHealth. Through a rigorous application process, midlevel researchers are selected to participate in a year-long, funded, part-time opportunity to develop and pursue new research aims that advance both their own career goals and the field of cancer care delivery research more broadly. This program brings knowledgeable experts in healthcare delivery research to NCI, increasing their understanding of NCI and federal resources and data.



Some of the training supported by DCCPS is more specific, such as the SRP's [training website for cancer registry professionals](#). BRP's [HINTS](#) also offers educational videos, webinars, and conferences to assist researchers and other data users in maximizing use of the HINTS datasets to inform interventions and cancer communication practice.

Training takes many forms, and numerous DCCPS grants and initiatives include a training component. The TREC initiative, for example, fosters collaboration across multiple disciplines and provides training opportunities for new and established scientists who can carry out integrative research on energetics and energy balance. EGRP also supports a number of cohort studies that provide research opportunities to trainees, and the NCI Cohort Consortium has established an Associate Member Council for early-stage investigators and fellows to help foster active involvement in consortium projects.

Another significant component of our training efforts is support from our NCI partners. For example, NCI's Center to Reduce Cancer Health Disparities provides diversity supplements to many DCCPS PIs, to support the research training of students, postbaccalaureate and post-Master's individuals, postdoctoral fellows, and faculty investigators. NCI's Center for Cancer Training provides support to cancer control researchers through the NCI career development (K) awards program, which includes a broad range of funding mechanisms and provides scientists with support to further develop their cancer research careers, transition to independence, expand their existing research programs, or mentor junior investigators.



Really enjoyed my experience at NCI and felt that it prepared me to be a competitive candidate when applying to Ph.D. programs.”



It's been a great experience overall! Definitely felt like more of a normal job than a training program. A lot of projects I worked on were really interesting.”



"I'll be returning to my doctoral degree. My training at NCI has been very helpful to moving forward in my career."

Importantly, DCCPS training addresses health disparities and extends beyond our country's borders. The [GEOHealth](#) program supports the development of institutions within LMICs that will serve as regional hubs for environmental and occupational health-related research collaborations, and, like TREC and EGRP-supported cohorts, also includes support for research training activities, among other priorities.

Past DCCPS trainees are now spread throughout the world, interwoven in innumerable disciplines and populations, many leading the way in cancer control. The division will continue to focus on training, from fellows to established researchers, to ensure the long-term growth and stability of the cancer control research workforce and ongoing progress in the field.



Thank you for everything. My CRTA fellowship experience exceeded my expectations! It has been a pleasure working at NCI."



*NCI/AcademyHealth Healthcare Delivery Research Visiting Scholars Program*

# EXPANDING AND DIVERSIFYING THE CANCER CONTROL RESEARCH COMMUNITY

DCCPS is committed to increasing inclusivity and diversity in cancer control science. As noted earlier in the report, the division places a strong focus on diversity through our programs to train the next generation of researchers. In addition, we are working diligently to establish and promote opportunities for researchers to broaden and expand leadership in science and research.

In 2018, DCCPS released a PAR for Modular R01s in Cancer Control and Population Sciences, an important example of the division's efforts to expand and diversify the research community. This FOA ([PAR-21-190](#)) serves as one way to increase opportunities for investigators, especially early-stage investigators, by encouraging smaller-scale projects for investigators to receive their first R01. We are pleased that preliminary results have shown the Modular PAR mechanism to be successful in that regard, and we will continue to monitor the success of this mechanism in increasing diversity of PIs. Funding R01s to new PIs in cancer research is an important prerequisite for achieving diversity goals.

DCCPS also is committed to facilitating an increase in the number of grants awarded to historically black colleges and universities (HBCUs)/minority-serving institutions (MSIs) and institutions in rural states (IDeA states), with seven awards to HBCUs/MSIs in FY 2020 for \$3 million. While these awards were less than the 10 awards to HBCUs/MSIs in FY 2019, for \$10 million, in the first two rounds of FY 2021, DCCPS has already made awards to 10 HBCUs/MSIs, for nearly \$6 million. In FY 2020, DCCPS made awards to 17 institutions in IDeA states, consistent with the number of awards to these institutions in prior years; however, the total cost of awards to IDeA states in FY 2020 was \$11.5 million, significantly higher than the average total costs over the prior 10 years, which was \$7.4 million.

There is much more work to be done to strengthen diversity, equity, and inclusion in all of our programs and disciplines. In addition to an internal committee working to strengthen DCCPS's commitment to anti-racism, empathy, and equity through collaborations with leadership at all levels of the organization, DCCPS recognizes that this work must be ongoing and comprehensive across NCI and NIH. We are a proud partner to the NCI Equity Council, which serves as a coordinating body for [NCI's Equity and Inclusion Program](#). DCCPS staff are actively involved in each of the five working groups to enhance cancer health disparities, promote diversity of thought in the cancer research workforce, promote an inclusive and equitable community across NCI, and devise strategies to improve communications and outreach to the scientific community.

DCCPS is looking forward to strengthening our partnership with the recently announced NIH's [UNITE Initiative](#). UNITE was established to identify and address structural racism within the NIH-supported and greater scientific community. We believe strongly in the initiative's charge to improve understanding, transparency, communication, and accountability with our internal and external stakeholders. As we forge ahead in initiating and supporting efforts across the institute, DCCPS recognizes that the diversity of our organization and of our investigator community are strengths that enhance our ability to reduce the burden of cancer in the United States, for all populations.



# STIMULATING RESEARCH IN PRIORITY AREAS: REQUESTS FOR APPLICATIONS




RFAs—solicitations for grant applications addressing a defined research topic—reflect the division’s research priorities. Virtually all RFAs are a partnership, including a vetting process and input from the NIH and wider research community. RFAs involve planning from multiple sectors, and each is reviewed by NCI leadership and the NCI’s advisory board prior to their launch.

RFAs are a subset of the FOAs that DCCPS initiates to advance cancer control research. Other mechanisms include, for example, PAs and NOSIs. DCCPS also participates in special initiatives, including [Cancer Moonshot funding opportunities](#), MERIT awards, and the Provocative Questions Program, to name a few.

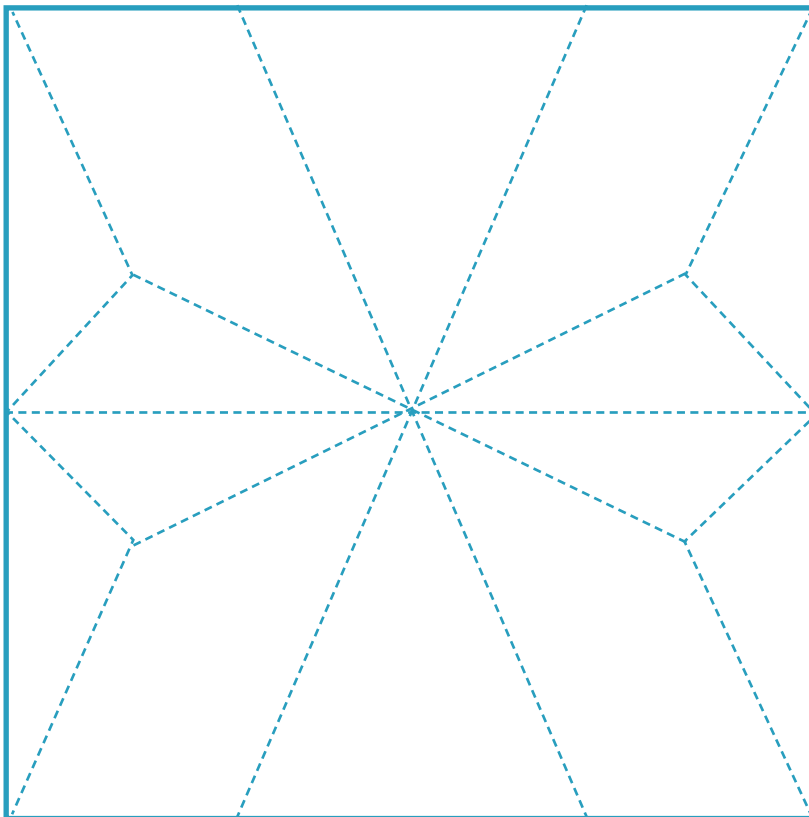
These special initiatives can be launched for a variety of reasons and goals. One such reason is to stimulate science in a new research area where there are few grants in the NCI portfolio. Another is to incentivize and support larger-scale collaborations and consortia, particularly in areas of interdisciplinary science and team science, and to scale up research in an ongoing area that is poised for accelerated impact and translation into patient care.



# REQUESTS FOR APPLICATIONS BY RESEARCH TOPIC AREA

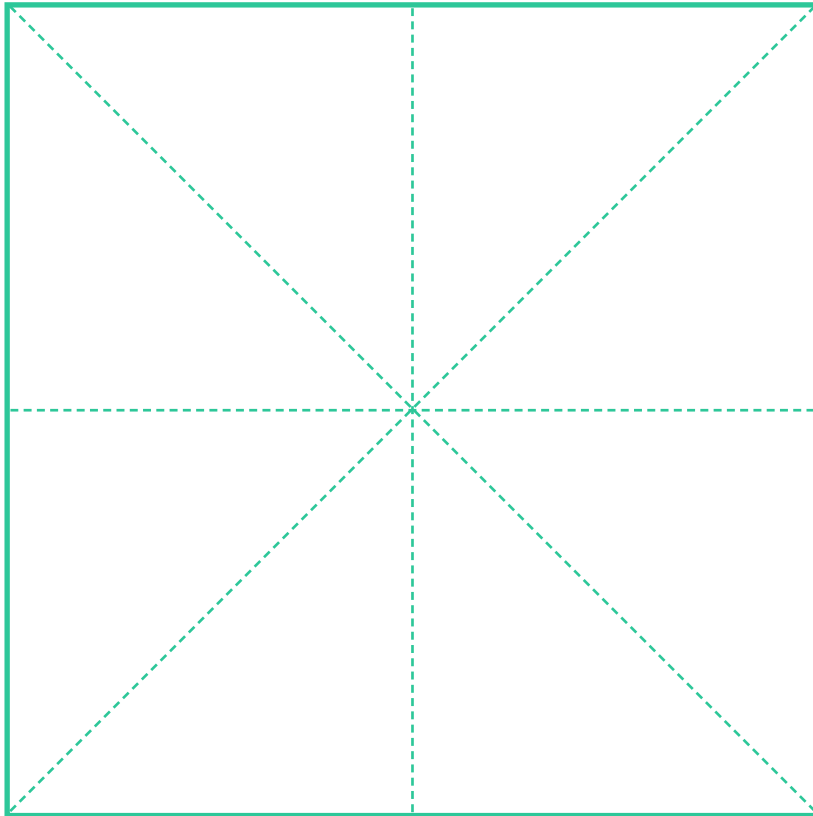
-  DCCPS-Led RFAs
-  NIH Common Fund RFAs
-  RFAs Led by Other NIH Institutes or Centers on Which DCCPS Participates

100



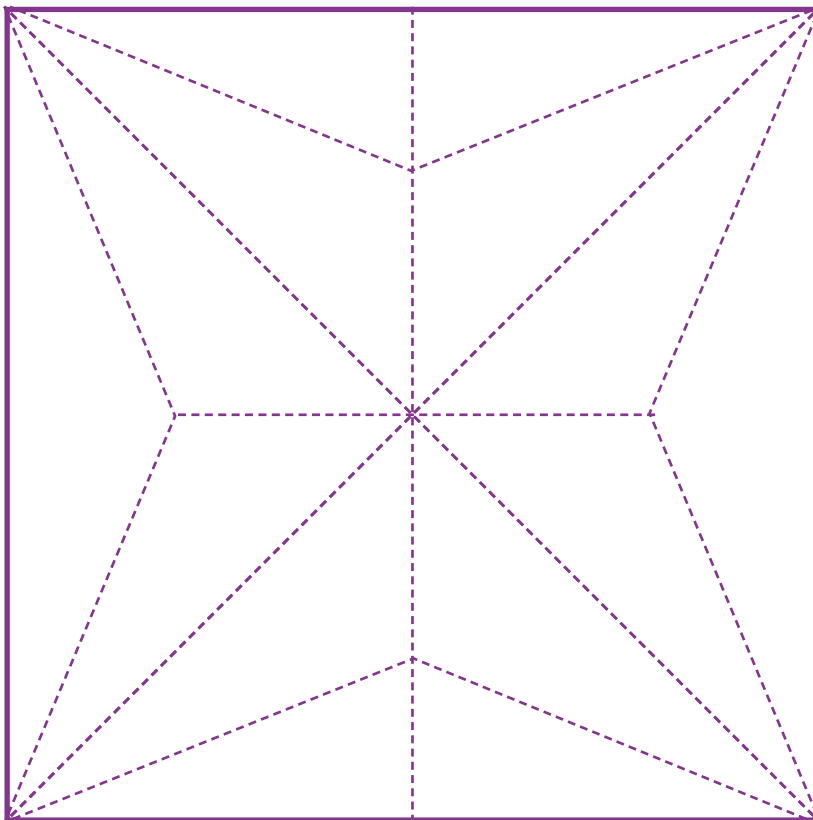
## DCCPS-Led RFAs

- Behavioral/Social Science Research
- Cancer Epidemiology Cohorts
- Cancer Survivorship
- Diet and Physical Activity
- Disparities Research
- Environmental Epidemiology
- Epidemiology and Genomics
- Health Communications Research
- Healthcare Delivery Research
- Implementation Science
- Infectious Disease Research
- Methods and Technology Research
- Statistical Research
- Tobacco Control Research



**NIH Common Fund RFAs**

- Behavioral/Social Science Research
- Cancer Epidemiology Cohorts
- Cancer Survivorship
- Diet and Physical Activity
- Epidemiology and Genomics
- Healthcare Delivery Research
- Metabolomics
- Methods and Technology Research



**RFAs Led by Other NIH Institutes or Centers on Which DCCPS Participates**

- Behavioral/Social Science Research
- Big Data
- Bioethics
- Community-based Research
- Diet and Physical Activity
- Disparities Research
- Environmental Epidemiology
- Epidemiology and Genomics
- Healthcare Delivery Research
- Methods and Technology Research
- Tobacco Control Research

# REQUESTS FOR APPLICATIONS



## DCCPS-LED RFAS

DCCPS provides scientific leadership through the development and implementation of RFAs to fund high-priority research in cancer control.

### Behavioral/Social Science Research

Basic Biobehavioral Research on Cancer-Related Behaviors

Mechanisms of Physical Activity Behavior Change

Scientific Meetings for Creating Interdisciplinary Research Teams in Basic Behavioral and Social Science Research

Transdisciplinary Research on Energetics and Cancer

### Cancer Survivorship

Improving Outcomes for Pediatric, Adolescent and Young Adult Cancer Survivors

Long-Term Cancer Survivors: Research Initiatives

Optimizing the Management and Outcomes for Cancer Survivors Transitioning to Follow-up Care

Research Centers for Improving Management of Symptoms Across Cancer Treatments (IMPACT)

Research to Reduce Morbidity and Improve Care for Pediatric, and Adolescent and Young Adult (AYA) Cancer Survivors

Utilizing Cohort Studies to Address Health Outcomes in Cancer Survivors

### Diet and Physical Activity

Improved Measures of Diet and Physical Activity for the Genes and Environment Initiative

## Disparities Research

NIH-Supported Centers for Population Health and Health Disparities (CPHHD)

Social and Behavioral Intervention Research to Address Modifiable Risk Factors for Cancer in Rural Populations

## Epidemiology and Genomics

Breast Cancer Family Registries (B-CFR)

Cancer Genetics Network

Comparative Systems Genetics of Cancer

Cooperative Family Registry for Epidemiologic Studies of Colon Cancer (C-CFR)

Exposure Assessment Methods for Cancer Research

Informatics Support for Breast and Colon Cancer Cooperative Family Registries

Interdisciplinary Studies in the Genetic Epidemiology of Cancer

New Cohorts for Environmental Exposures and Cancer Risk (CEEER)

Participant Engagement and Cancer Genome Sequencing (PE-CGS)

Regional Variation in Breast Cancer Rates in the U.S.

Replication and Fine-Mapping Studies for the Genes Environment and Health Initiative (GEI)

Transdisciplinary Cancer Genomics Research: Post-Genome Wide Association (Post-GWA) Initiative

## Health Communications Research

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Cancer Research Network Across Health Care Systems ▲▲

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Centers of Excellence in Cancer Communication Research II (CECCR II)

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Centers of Excellence in Cancer Communications Research

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Communication and Decision Making for Individuals with Inherited Cancer Syndromes ■■

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Exploratory Grants for Increasing the Utilization and Impact of the National Cancer Institute's Cancer Information Service

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Health Communications in Cancer Control

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Using Social Media to Understand and Address Substance Use and Addiction ●

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## Healthcare Delivery Research

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Accelerating Colorectal Cancer Screening and follow-up through Implementation Science (ACCSIS) ●●

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Approaches to Identify and Care for Individuals with Inherited Cancer Syndromes ■

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Breast Cancer Surveillance Consortium Expansion ●●

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Cancer Care Outcomes Research and Surveillance Consortium (CanCORS)

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Improving the Reach and Quality of Cancer Care in Rural Populations ■

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Mechanisms of Physical Activity Behavior Change

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NCI Community Oncology Research Program (NCORP)

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Person-Centered Outcomes Research Resource ▲▲

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Population-based Research Optimizing Screening through Personalized Regimens (PROSPR) ●●

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## Implementation Science

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Implementation Science for Cancer Control: Developing and Advanced Centers

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## Infectious Disease Research

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Emergency Awards: Research Projects in SARS-CoV-2 Serological Sciences (U01 Clinical Trial Optional)

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Emergency Awards: SARS-CoV-2 Serological Sciences Centers of Excellence (U54 Clinical Trial Optional)

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## Methods and Technology Research

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Application and Early Stage Development of Emerging Technologies in Cancer Research

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Innovative and Early-Stage Development of Emerging Technologies in Biospecimen Science

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Innovative Technology Development for Cancer Research

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Validation and Advanced Development of Emerging Technologies for Cancer Research

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Validation and Advanced Development of Emerging Technologies in Biospecimen Science

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## Statistical Research

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Cancer Intervention and Surveillance Modeling Network (CISNET)

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Cancer Intervention and Surveillance Modeling Network (CISNET) Incubator Program for New Cancer Sites

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## Tobacco Control Research

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Improving Effectiveness of Smoking Cessation Interventions and Programs in Low Income Adult Populations

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Improving Smoking Cessation Interventions among People Living with HIV ▲▲

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Measures and Determinants of Smokeless Tobacco Use, Prevention, and Cessation

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Prevention and Cessation of Tobacco Use by Children and Youth in the US

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Research in State and Community Tobacco Control Interventions

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Smoking Cessation within the Context of Lung Cancer Screening ●●

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State and Community Tobacco Control Policy and Media Research

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Transdisciplinary Tobacco Use Research Centers

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## NIH COMMON FUND RFAS

The NIH Common Fund is a component of the NIH budget managed by the Office of the NIH Director that addresses emerging scientific opportunities and pressing challenges in biomedical research that no single NIH institute or center can address on its own, and are of high priority for the NIH as a whole. DCCPS capitalizes on this unique resource to encourage high-risk, innovative endeavors with the potential for extraordinary impact in cancer control and population science.

### Behavioral/Social Science Research

Meetings and Networks for Methodological Development in Interdisciplinary Research

Science of Behavior Change: Assay Development and Validation for Interpersonal and Social Processes Targets

Science of Behavior Change: Assay Development and Validation for Stress Reactivity and Stress Resilience Targets

Science of Behavior Change: Use-inspired Research to Optimize Adherence, Behavior Change Interventions, and Outcomes

### Cancer Survivorship

Patient-Reported Outcomes Measurement Information System (PROMIS) Research Sites

### Diet and Physical Activity

Molecular Transducers of Physical Activity Consortium Coordinating Center (CCC)

Nutrition for Precision Health, powered by the All of Us Research Program: Dietary Assessment Center ■■

### Epidemiology and Genomics

Enhancing GTex with Molecular Analyses of Stored Biospecimens ▲

Gabriella Miller Kids First Pediatric Research Program ◆

Human Heredity and Health in Africa (H3Africa) ▲

### Epidemiology Cohorts

Precision Medicine Initiative Cohort Program Participant Technologies Center

### Healthcare Delivery Research

Economic Research on Incentives for Efficient Use of Preventive Services

NIH Health Care Systems Research Collaboratory - Demonstration Projects for Pragmatic Clinical Trials Focusing on Multiple Chronic Conditions

NIH Health Care Systems Research Collaboratory - Pragmatic Clinical Trials Demonstration Projects

### Metabolomics

Metabolomic Data Analysis and Interpretation Tools

Nutrition for Precision Health, powered by the All of Us Research Program: Metabolomics and Clinical Assays Center

### Methods and Technology Research

Transformative Technology Development for the Human BioMolecular Atlas Program





## RFAS LED BY OTHER NIH INSTITUTES OR CENTERS ON WHICH DCCPS PARTICIPATES

DCCPS provides funding and expertise to RFAs led by other NIH institutes and centers that encourage research in high-priority areas in cancer control.

### Behavioral/Social Science Research

Adolescent Brain Cognitive Development (ABCD) Study - Data Analysis and Informatics Center ●

Basic Research on Decision Making: Cognitive, Affective, and Developmental Perspectives

Centers for Mind/Body Interactions and Health

Effects of the Social Environment on Health: Measurement, Methods and Mechanisms

Intensive Longitudinal Analysis of Health Behaviors: Leveraging New Technologies to Understand Health Behaviors ■

Limited Competition: Revision Applications for Basic Social and Behavioral Research on the Social, Cultural, Biological, and Psychological Mechanisms of Stigma

Maintenance of Long-Term Behavioral Change

Mind-Body Interactions and Health

Pathways Linking Education to Health

Predocutorial Training in Advanced Data Analytics for Behavioral and Social Sciences Research (BSSR) - Institutional Research Training Program ●●

Recovery Act Limited Competition: NIH Basic Behavioral and Social Science Opportunity Network (OppNet) Short-term Mentored Career Development Awards in the Basic Behavioral and Social Sciences for Mid-career and Senior Investigators ●●

Research on the Role of Epigenetics in Social, Behavioral, Environmental and Biological Relationships, throughout the Life-Span and across Generations ▲

Site Specific Approaches to Prevention or Management of Pediatric Obesity

Strengthening Behavioral and Social Science in Medical Schools ●●

Substance Use and Abuse among US Military Personnel, Veterans and their Families ●

Time-Sensitive Research on Health Risk and Resilience after Hurricanes Irma and Maria in Puerto Rico and the US Virgin Islands ◆◆

Translating Basic Behavioral and Social Science Discoveries into Interventions to Reduce Obesity: Centers for Behavioral Intervention Development

### Big Data

Biomedical Big Data Training to Active NLM Institutional Training Grants in Biomedical Informatics ●●

Mentored Career Development Award in Biomedical Big Data Science for Clinicians and Doctorally Prepared Scientists ●●

Open Educational Resources for Biomedical Big Data ●●

### Bioethics

Empirical Research on Ethical Issues Related to Central IRBs and Consent for Research Using Clinical Records and Data

### Community-based Research

Recovery Act Limited Competition: Building Sustainable Community-Linked Infrastructure to Enable Health Science Research

### Diet and Physical Activity

Systems-Oriented Pediatric Obesity Research and Training (SPORT) Center of Excellence

## Disparities Research

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Centers for Population Health and Health Disparities

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Methods and Measurement in Research with Sexual and Gender Minority (SGM) Populations ❖

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Overcoming Barriers to Treatment Adherence in Minorities and Persons Living in Poverty

## Epidemiology and Genomics

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Breast Cancer and the Environment Communication Research Initiative ■

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Breast Cancer and the Environment Research Centers/Program ■

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Clinical Sequencing Evidence-Generating Research (CSER2) ▲

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Consortium for the Study of Chronic Pancreatitis, Diabetes and Pancreatic Cancer Coordination and Data Management Center (CSCPDPCC-CDMC)

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Deepwater Horizon Disaster Research Consortia: Health Impacts and Community Resilience ■

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Endocrine Disruptors: Epidemiologic Approaches ■

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Environmental Influences on Epigenetic Regulation ■

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Expanding Genome Integrity Assays to Population Studies ▲

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Genome-wide Association Studies in the Genes, Environment, and Health Initiative - Study Investigators ▲

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Hepatitis C: Natural History, Pathogenesis, Therapy, and Prevention ▲▲

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HLA and KIR Region Genomics in Immune-Mediated Diseases ▲

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Household Air Pollution (HAP) Health Outcomes Trial ■

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Hubs of Interdisciplinary Research and Training in Global Environmental and Occupational Health (GEOHealth) Research Training ■

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Human Health Exposure Analysis Resource: Targeted and Untargeted Exposure Analysis Laboratories ■

Implementation of the National Occupational Research Agenda ■

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Interpreting Variation in Human Non-Coding Genomic Regions Using Computational Approaches and Experimental Assessment ▲

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Investigator-Initiated Research on Genetic Counseling Processes and Practices

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Mechanistic-Based Cancer Risk Assessment Methods ■■

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Obesity and the Built Environment ❖

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Pharmacogenetics Research Network and Knowledge Base ▲

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Polygenic Risk Score (PRS) Methods and Analysis for Populations of Diverse Ancestry Centers ▲

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The Genes, Environment, and Development Initiative ▲

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US-China Program for Biomedical Collaborative Research ▲▲

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Utilizing In Vitro Functional Genomics Advances for Gene-Environment (G x E) Discovery and Validation ▲

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Validation and Field Testing of New Tools for Characterizing the Personal Environment ■■

## Healthcare Delivery Research

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Development of Measures of Fatigability in Older Adults ❖

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Making Quality Count for Consumers and Patients

## Methods and Technology Research

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Collaborative Aging (in Place) Research Using Technology (CART) ▲▲

## Tobacco Control Research

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Abuse Liability Associated with Reduced Nicotine Content Tobacco Products

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Center for Evaluation and Coordination of Training and Research (CECTR) in Tobacco Regulatory Science

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Chemistry, Toxicology, and Addiction Research on Waterpipe Tobacco

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Effectiveness Research on Smoking Cessation in Hospitalized Patients

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International Tobacco and Health Research and Capacity Building Program

---

Interventions to Prevent Electronic Nicotine Delivery Systems (ENDS) Use Among Adolescents

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Maximizing the Scientific Value of Existing Biospecimen Collections: Scientific Opportunities for Exploratory Research

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Mentored Research Scientist Career Development Award in Tobacco Regulatory Research

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NIH Revision Applications for Research Relevant to the Family Smoking Prevention and Tobacco Control Act

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Pathway to Independence Award in Tobacco Regulatory Research

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Revision Applications to Promote Collaborative Research on Addiction at NIH (CRAN): Comorbidity-Related Research ●

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Secondary Analyses of Existing Datasets of Tobacco Use and Health

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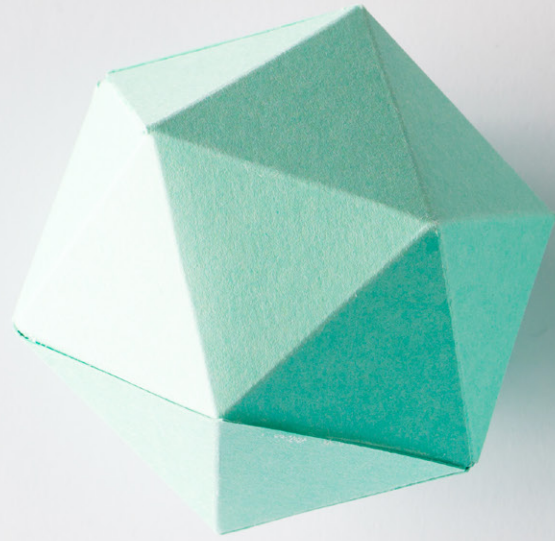
Tobacco Centers of Regulatory Science for Research Relevant to the Family Smoking Prevention and Tobacco Control Act

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Tobacco Control Regulatory Research

## SECONDARY RESEARCH AREAS

- Cancer Epidemiology Cohorts
- Cancer Screening
- Cancer Survivorship
- Diet and Physical Activity
  - Disparities Research
  - Early Detection/Genetic Testing
  - Environmental Epidemiology
  - Exposure/Risk Assessment
  - ▲ Genomics/Genetics
  - ▲▲ HIV/AIDS
  - ▲▲ Infectious Disease Research
  - ▲▲ Informatics/Information Systems
  - ◆ Pediatric/Young Adult Cancer
  - Psychosocial Stressors
  - Rural Populations
  - Sexual and Gender Minorities
  - Substance Use/Addiction
  - Symptom Management
  - Training



BY THE  
NUMBERS









# DCCPS BY THE NUMBERS

As a window into the many ways DCCPS provides return on investment, we highlight here some snapshots of progress over the years.



## 658

A total of **658 cancer control and implementation researchers, practitioners, and funders** have participated in the [Consortium for Cancer Implementation Science \(CCIS\)](#) meeting, formerly the [Implementation Science Consortium in Cancer \(ISCC\)](#), since its inception in 2019. Focused on short- and long-term cancer control priorities, challenges, and opportunities and gaps in the implementation science (IS) space, the CCIS looks across National Cancer Institute (NCI) and other federally funded initiatives; and includes discussions on infrastructure for cross-collaboration. In 2019, 111 in-person attendees alongside an additional 136 virtual participants contributed to the effort. In its second year, 411 participants representing more than 150 institutions around the world joined the discussion. Looking to continue this important work, the 2021 CCIS meeting will be held virtually October 2021.



## 202

[Evidence-Based Cancer Control Programs \(EBCCP\)](#) is a searchable database of evidence-based cancer control interventions and program materials and is designed to provide program planners and public health practitioners easy and immediate access to research-tested materials. Currently, the **202 programs** available on the EBCCP website span a range of health topics, delivery settings, and target populations.



## 3,080

Engaging clinical and public health practitioners in the science and practice of implementation is essential for progress. Yet, practitioners are often unfamiliar with the field and how to apply the science in practice. Designed specifically for cancer control practitioners, [Implementation Science at a Glance](#) provides a succinct overview of the rapidly evolving field. The workbook, which has been **downloaded 3,080 times**, was written by members of the NCI IS team and reviewed by public health practitioners and implementation researchers. The report is available as a [PDE](#), [ePub](#), and [Kindle file](#).



# 185

Since its inception in 2018, the [Training Institute for Dissemination and Implementation Research in Cancer \(TIDIRC\)](#) has provided **185 investigators** with a thorough grounding in conducting dissemination and implementation (D&I) research, with a specific focus on cancer across the cancer control continuum.



# 300,517

There have been **more than 300,000 views** of the "[Did You Know? HPV Español](#)" video, part of the "Did You Know?" video series. A collaboration between DCCPS's Surveillance, Epidemiology, and End Results (SEER) Program and NCI's Office of Communications and Public Liaison, each brief "Did You Know?" video discusses a specific cancer type or a cancer-related topic. The series may be viewed on [SEER's website](#) as well as on [NCI's YouTube Channel](#), under the "Cancer Statistics" playlist. There are now 29 "Did You Know?" videos available.



# 1.77 MILLION

DCCPS's SEER Program collects and publishes cancer incidence, prevalence, and survival data from population-based cancer registries covering approximately 48% of the US population. The SEER Program is the only comprehensive source of population-based information in the United States that includes stage of cancer at the time of diagnosis and patient survival data, providing the greatest longevity for population-based cancer statistics in the United States. The [SEER website](#) has an average of **1.77 million hits** per month.



# 72.2%

**Over 72%** of the Asian American population is now covered by the SEER Program.



# 28

Begun with nine registries in 1973, there are now **28 SEER registries**, with 12 new registries (3 CORE and 9 Research Support) added in 2021.



# 73

[SEER\\*Explorer](#) is an interactive website that provides easy access to a wide range of SEER cancer statistics. It provides detailed statistics for a cancer site by gender, race, calendar year, age, and for a selected number of cancer sites, by stage and histology. There are **73 cancer types** available to analyze in SEER\*Explorer.



# 800,000

There are now **more than 800,000 new cancer cases per year** in the recently expanded SEER Program.



# 100,000

Since the June 2020 launch of the [Smoking and COVID-19 page](#) on the Smokefree.gov website, the webpage has received **nearly 100,000 page views** from users in all 50 states and 125 countries around the world. Users have completed more than 1,000 quit plans.



# 1.9 MILLION

The [vaping cessation content](#) on the [Smokefree Teen](#) website has received nearly **1.9 million page views** since its launch in July 2019. An interactive [vaping cessation quit plan builder](#) was added to the website in July 2020, and users have completed more than 23,000 vaping quit plans since its launch.



# 1,500

The Basic Biobehavioral and Psychological Sciences Branch (BBPSB) has sponsored a [mobile perception laboratory](#) at the Radiological Society of North America, which allowed dozens of investigators to test more than **1,500 radiologist participants** over 4 years, leading to 15 papers and 43 published abstracts.



# 55,000

Across 14 administrations, the Health Information National Trends Survey® (HINTS) has **surveyed more than 55,000 American adults**, tracking profound shifts in the communication landscape. HINTS has a robust community of more than 10,000 data users, who have published more than 600 peer-reviewed papers using publicly accessible HINTS data. The HINTS program also has published more than 40 [HINTS Briefs](#).



# 37

The Classification of Laws Associated with School Students ([CLASS](#)) monitors, classifies, and evaluates **37 school policy areas related to physical education and nutrition**, affecting more than 50 million US children.



# 5,650

The current sample grant applications published by the Epidemiology and Genomics Research Program (EGRP) have been downloaded more than **5,650** times since April 2018.



# 18,755

DCCPS held 98 webinars and virtual meetings in 2020, with **18,755 registrants**.



# 7 MILLION

The [NCI Cohort Consortium](#) has more than **7 million participants** in 61 international cohorts and more than 50 projects that have made scientific discoveries about cancer risk factors and technical advances in cohort methodologies.



# 60

The Cancer Epidemiology Descriptive Cohort Database (CEDCD) contains descriptive information from more than **60 cohorts** in 17 different countries. CEDCD includes brief descriptions of the cohorts, contact information, questionnaires, types of data collected, enrollment numbers, number of cancer cases, and number of biospecimens collected. Its purpose is to foster collaboration and encourage cohort-based research. In 2020, CEDCD was accessed more than 3,500 times with approximately 2,500 new users.



# 73

The [database of Genotypes and Phenotypes \(dbGaP\)](#) at the National Center for Biotechnology Information (NCBI) archives datasets and makes them available to the scientific community. As of 2020, **73 datasets** from DCCPS-funded studies can be accessed through dbGaP.



# 631,534

Since the [Automated Self-Administered 24-hour \(ASA24®\) Dietary Assessment Tool](#) was released in 2009, researchers have collected **631,534 dietary recalls or food records**. On average, 71 new studies register to use ASA24 every month. As of April 2021, studies that used ASA24 to collect diet data published 394 peer-reviewed scientific publications.



# 5,729

The [Healthy Eating Index \(HEI\)-2015](#) is a valuable tool for surveillance, epidemiology, and intervention research and has been cited in nearly 150 articles since its release in 2018. Scientists in DCCPS and the US Department of Agriculture (USDA) collaborated to create HEI, a measure of diet quality that can be used to assess compliance with the [Dietary Guidelines for Americans](#) and to monitor diet quality across an individual's lifespan. The HEI-2015 SAS code has been **downloaded 5,729 times** since 2018.



# 72

Since 1987, the [Patterns of Care \(POC\) initiative](#) has evaluated the dissemination of state-of-the-art cancer therapy and diagnostics into community oncology practice; identified patient-, provider-, and system-level factors that are associated with receipt and utilization of cancer care; and disseminated findings through scientific publications and presentations. To date, POC has collected information on 32 types of cancer, and **72 papers** have been published highlighting the results of this work.



# 31,997

There were **31,997 randomly selected adults** who participated in the redesigned [2019 National Health Interview Survey \(NHIS\)](#), which includes a 5-minute Cancer Control Supplement (CCS). The supplement includes rotating questions about cancer-related health behaviors, risk assessment, and screening. New data are released each September and are publicly available for analysis.





33

**Thirty-three language translations** have been validated—and 17 more are in development as of April 2021—for the [Patient-Reported Outcomes version of the Common Terminology Criteria for Adverse Events \(PRO-CTCAE™\)](#), a patient-reported outcome measurement system developed by NCI to capture symptomatic adverse events in patients on cancer clinical trials. A pediatric module for use with children (or their caregivers if the child is unable to self-report) is also available. The pediatric module is available in English, Italian, and Simplified Chinese, and several other languages are currently being tested, including Spanish, German, Korean, Danish, and French.



2,956

There have been **2,956 publications** using the [HealthMeasures tool](#), which includes the PROMIS, Neuro-QoL, ASCQ-Me, and NIH Toolbox patient-centered measurement tools that enable investigators to capture data on symptoms, functioning, and health-related quality of life.



151

In 2020, there were **151 investigator requests** for new or updated SEER-Centers for Medicare & Medicaid Services (CMS)-linked data, including [SEER-Medicare](#) (128 requests), [SEER-Medicare Health Outcomes Survey \(MHOS\)](#) (9 requests), and [SEER-Consumer Assessment of Healthcare Providers and Systems \(CAHPS\)](#) (14 requests).



1,000

The [NCI Community Oncology Research Program \(NCORP\)](#) is a national network that brings cancer prevention, control, and cancer care delivery research studies to people in their communities. Seven NCORP Research Bases develop and coordinate clinical trials and cancer care delivery research for 14 Minority/Underserved Community Sites and 32 community sites to bring NCI-approved trials to patients in **1,000+ locations** in diverse, community-based hospitals, private practices, and other locations.



76%

In FY 2020, approximately **76% of the divisions' funded awards** included a health disparities component.



# 33,032

Per PubMed, between 1947 (the first year that citations are included in PubMed) and 1995, the number of publications with the words *cancer survivor* was only 2,340. Between 1996, when the Office of Cancer Survivorship was created, and August 2021, there have been **33,032 cancer survivor publications**, reflecting the expansion of cancer survivorship research championed by NCI.



# 28

DCCPS awarded eight early-stage investigators (ESIs) in FYs 2010-12 for work in cancer survivorship. That number grew to **28 awarded ESI investigators** in FYs 2019-21, a 250% increase in 10 years.



# \$ 111,581,130

In 1998, DCCPS funded 13 grants to support cancer survivorship research, at a total of \$3,150,482. By 2020, those numbers grew to 165 grants at a total of **\$111,581,130**.



# \$ 21.3 MILLION

Over the years, DCCPS has trained more than 470 fellows at NCI, some for several years, allocating **\$21.3 million** to their development.



# 44%

Given that the division is helping to train the next generation of researchers, there is a strong focus on diversity. Of the 2021 class of fellows, for example, **44%** considered themselves African American, Hispanic/Latino, Asian, or multiethnic.



