U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH
NATIONAL CANCER INSTITUTE
20th VIRTUAL NATIONAL CANCER ADVISORY BOARD

Summary of Meeting
8 February 2024

Virtual Meeting
National Cancer Institute
National Institutes of Health
Bethesda, Maryland

NATIONAL CANCER ADVISORY BOARD
BETHESDA, MARYLAND
Summary of Meeting
8 February 2024

The National Cancer Advisory Board (NCAB) convened for its 20th virtual meeting on 8 February 2024. The meeting was open to the public on Thursday, 8 February 2024, from 1:15 p.m. to 4:06 p.m. and closed to the public from 4:15 p.m. to 4:43 p.m. The NCAB Chair, Dr. John D. Carpten, Director, Comprehensive Cancer Center, Director and Chief Science Officer, Beckman Research Institute of City of Hope, presided during both the open and closed sessions.

NCAB Members

Dr. John D. Carpten (Chair)
Ms. Margaret Anne Anderson
Dr. Nilofer S. Azad
Dr. Anna D. Barker
Dr. Richard J. Boxer
Dr. Luis Alberto Diaz, Jr.
Dr. Andrea A. Hayes Dixon
Ms. Ysabel Duron
Dr. Howard J. Fingert
Dr. Christopher R. Friese
Ms. Julie Papanek Grant
Dr. Amy B. Heimberger
Dr. Nikan Khatibi
Dr. Ana Navas-Acien
Dr. Fred K. Tabung
Dr. Susan Thomas Vadaparampil
Dr. Ashani T. Weeraratna
Dr. Karen M. Winkfield

President's Cancer Panel

Dr. Elizabeth M. Jaffee (Chair) (absent)
Dr. Mitchel S. Berger (absent)
Dr. Carol L. Brown (absent)

Alternate *Ex Officio* NCAB Members

Dr. John Gordon, CPSC
Dr. Joseph R. Graber, DOE
Dr. Michelle Heacock, NIEHS
Dr. Michael Kelley, VA (absent)
Dr. Richard Pazdur, FDA (absent)
Dr. Craig D. Shriver, DoD
Dr. Kerry Souza, NIOSH (absent)
Dr. Lawrence A. Tabak, NIH (absent)

Members, Scientific Program Leaders, National Cancer Institute, NIH

Dr. W. Kimryn Rathmell, Director, National Cancer Institute
Dr. Oliver Bogler, Director, Center for Cancer Training
Dr. Philip E. Castle, Director, Division of Cancer Prevention
Dr. Stephen J. Chanock, Director, Division of Cancer Epidemiology and Genetics
Dr. Henry P. Ciolino, Director, Office of Cancer Centers
Dr. James H. Doroshow, Deputy Director for Clinical and Translational Research
Dr. Dan Gallahan, Director, Division of Cancer Biology
Mr. Peter Garrett, Director, Office of Communications and Public Liaison
Dr. Katrina A.B. Goddard, Director, Division of Cancer Control and Population Sciences
Dr. Satish Gopal, Director, Center for Global Health
Dr. Paulette S. Gray, Director, Division of Extramural Activities
Dr. Ed Harlow, Special Advisor to the NCI Director
Dr. Toby T. Hecht, Deputy Director, Division of Cancer Treatment and Diagnosis
Dr. Tony Kerlavage, Director, Center for Biomedical Informatics and Information Technology
Dr. Kristin Komschlies McConville, Acting Director, Office of Scientific Operations, NCI at Frederick
Dr. Douglas R. Lowy, Principal Deputy Director, National Cancer Institute
Dr. Glenn Merlino, Scientific Director for Basic Research, Center for Cancer Research
Dr. Tom Misteli, Director, Center for Cancer Research
Dr. Margaret Mooney, Associate Director, Cancer Therapy Evaluation Program
Dr. Diane Palmieri, Acting Director, Center for Research Strategy
Dr. Henry Rodriguez, Director, Office of Cancer Clinical Proteomics Research
Mr. Jeffrey Shilling, Chief Information Officer and Chief of Infrastructure and Information Technology Services Branch, Center for Biomedical Informatics and Information Technology
Ms. Donna Siegle, Executive Officer and Deputy Director for Management, Office of the Director
Dr. Dinah S. Singer, Deputy Director, Science Strategy and Development
Dr. Sanya A. Springfield, Director, Center to Reduce Cancer Health Disparities
Dr. Louis M. Staudt, Director, Center for Cancer Genomics
Mr. Michael Weingarten, Director, Small Business Innovation Research and Small Business Technology Transfer Programs
Dr. Robert Yarchoan, Director, Office of HIV and AIDS Malignancy
Dr. Maureen Johnson, Executive Secretary, Office of the Director

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THURSDAY, 8 FEBRUARY 2024

I. CALL TO ORDER AND OPENING REMARKS—DR. JOHN D. CARPTEN

Dr. John D. Carpten called to order the 20th virtual meeting of the National Cancer Advisory Board (NCAB). He welcomed members of the Board, *ex officio* members, liaison representatives, staff, and guests. Members of the public were welcomed and invited to submit to Dr. Paulette S. Gray, Director, Division of Extramural Activities (DEA), National Cancer Institute (NCI), in writing and within 10 days, any comments regarding items discussed during the meeting. Dr. Carpten reviewed the confidentiality and conflict-of-interest practices required of Board members in their deliberations.

Motion. A motion to accept the minutes of the 29–30 November 2023 Joint Meeting of the Board of Scientific Advisors (BSA) and the NCAB was approved unanimously.

II. FUTURE BOARD MEETING DATES—DR. JOHN D. CARPTEN

Dr. Carpten called Board members' attention to the future meeting dates listed on the agenda.

III. NCI DIRECTOR'S REPORT—DR. W. KIMRYN RATHMELL

Dr. W. Kimryn Rathmell, Director, NCI, welcomed NCAB members and attendees to the 20th virtual meeting and did a brief introduction, and provided updates on the budget outlook, recent news and events, and research highlights.

Dr. Rathmell noted that her first months as Director have been spent getting to know the NCI and its history. The NCI existed prior to the landmark National Cancer Act (NCA) of 1971, which provided unique authorities to the NCI Director and led to the creation of the NCAB. She commented that the national resources to address cancer are intended to be used in a partnership, and she looks forward to working with the NCAB and getting to know its members.

Dr. Rathmell announced that the cancer community lost a luminary in the field with the recent passing of Dr. Edith Mitchell, Clinical Professor, Department of Medicine and Medical Oncology, Sidney Kimmel Medical College, Thomas Jefferson University, Associate Director for Diversity Programs, Director of the Center to Eliminate Cancer Disparities, Sidney Kimmel Cancer Center, Thomas Jefferson University. Dr. Mitchell served on the NCAB Blue Ribbon Panel for the Cancer Moonshot℠ and had been a member of the President's Cancer Panel.

Brief Introduction. Dr. Rathmell described her background as a physician–scientist. Prior to coming to the NCI, she was Hugh Jackson Morgan Professor of Medicine and Biochemistry, Chair, Department of Medicine, and Physician-in-Chief, Vanderbilt University Medical Center (VUMC). She trained in biophysics and has a keen interest in molecules and how signaling pathways are perturbed in cancer. Her laboratory has worked on foundational science with some translational elements to address questions relevant to kidney cancer. She is a medical oncologist and has treated patients with kidney cancer for more than 20 years, particularly rare tumors of the kidney and hereditary tumors. She trained students in her laboratory and beyond and became interested in training programs. She managed the M.D.-Ph.D. program at The University of North Carolina at Chapel Hill. This appointment, combined with her kidney cancer experience, led her to transition to VUMC in 2015 to become the division chief of hematology oncology. She combined her research (clinical and basic science) and education and was promoted to chair of VUMC's Department of Medicine, thus adding a fourth element of experience: administration. In 2021, she earned a master's degree from the Vanderbilt University Owen Graduate School of Business to better understand the business of health care. All of these components served as

essential preparations for her role as NCI Director. She commented that she is excited to serve in this role and is eager to apply all that she has learned during her journey to the NCI.

Dr. Rathmell noted that she values listening and particularly wants to hear from the NCAB. She and Dr. Gray have incorporated organizational changes to this meeting to allow additional time for dialogue. Today's agenda includes two presentations from mid-career investigators—one intramural and one extramural. Additionally, she has actively solicited input through NCI's social media outlets, such as X (formerly known as Twitter), and has received valuable feedback.

Success requires a diverse team composed of individuals who collaborate and practice their skills. Dr. Rathmell learned the most about such teamwork while working on The Cancer Genome Atlas (TCGA) with 300 individuals, all with different types of expertise, collaborating to produce the final product. As a molecular biologist, she finds nothing more exciting than the opportunity to "untangle a good tangle"—to put a pathway together and to learn who talks to whom and in what sequence. This concept also extends to organizations. Her favorite part of her master's degree program was being able to observe an organization and understand how to improve its operations. She looks forward to working with the NCAB to "untangle some good tangles."

NCI Budget Outlook. Dr. Rathmell noted that a government shutdown due to lapses in appropriations has been averted three times in fiscal year (FY) 2024 with three continuing resolutions (CRs): 30 September 2023, 17 November 2023, and 2 February 2024. The current CR expires 8 March 2024, which is halfway through the fiscal year. Not having a FY 2024 budget has been challenging, and the NCI has made conservative assumptions for the interim grant policies based on FY 2023 appropriations and hopes that they are adequate to move forward. The NCI is part of a complicated federal budget ecosystem, in which the appropriations from Congress cover a significant portion of the national landscape. The NCI considers cancer an important part of the national landscape, but it also interconnects with other components. The CR enacted on 17 November 2023 funds the U.S. Department of Health and Human Services (HHS), including the NIH, through 8 March 2024.

Dr. Rathmell reviewed how the NCI spends its appropriations, noting that 74 percent of the NCI budget supports extramural grants; the majority of these are Research Project Grants (RPGs), which are traditionally R01s. Of the NCI budget, 8 percent supports NCI-Designated Cancer Centers (Cancer Centers) and Specialized Programs of Research Excellence (or SPOREs). The remainder supports intramural research, research management and support, and buildings and facilities. Further details can be found on the NCI Budget and Appropriations website. Dr. Rathmell reminded the NCAB members of the NCI and National Institutes of Health (NIH) budget approval process. The NCI's FY 2023 budget was $7.3 billion (B). Per the NCA of 1971, the NCI submits a Professional Judgment Proposal (also called the Bypass Budget) directly to Congress. This Bypass Budget estimates the cost of the work that the NCI is expected to perform. The overall cost of inflation has been increasing more than the budget estimates for several years. Already behind, the NCI has been asked to implement new initiatives and aims to improve cancer health care. The *Annual Plan and Budget Proposal for Fiscal Year 2024* was increased to $9.9 B, which the President considered before recommending a budget of $7.8 B. The NCI remains optimistic about the FY 2024 budget and its approval. FY 2025 begins 1 October 2024, and for the 2025 Professional Judgment Budget the NCI is proposing a budget increase to $11 B, which reflects inflation and projected costs for such efforts as conducting clinical trials, gathering and analyzing cancer data, and using the data to better serve communities. The President's budget proposal will be released in the spring of 2024.

Since FY 2019, the NCI has been funding an increasing number of extramural awards. Approximately 25 percent of grants awarded during this period were RPGs. The number of NCI modular awards (up to $250,000 in direct costs) progressively decreased from 63 percent to 17 percent. The NCI

decreased the budgets of these awards by 8.5 percent, amounting to $225,000 in direct costs. During this same period, the number of NCI non-modular awards (greater than $250,000 in direct costs) increased from 39 percent to 80 percent, with an average direct cost of $425,000 per grant.

Dr. Rathmell explained that the NCI has been projecting the implication of a "flat" FY 2024 budget, noting that it will be challenging to maintain current efforts. Expenses will increase because of inflation and staff salary increases. The NCI incurs between $75 million (M) and $100 M annually in increased mandatory expenses (e.g., program evaluations, cybersecurity, Center for Scientific Review expenses). To maintain the 12th percentile payline, the NCI will need to add $250 M to the RPG pool to both fund new and noncompeting awards at 100 percent. Without the additional $250 M, the NCI would be confronted with decreasing the payline for new RPG awards and funding noncompeting awards at less than 100 percent. Decreases that were not previously considered will need to be contemplated for the competing renewals of Cancer Center Support Grants (CCSGs) and cancer training awards, as well as for the noncompeting CCSGs. Cuts to the intramural research program are anticipated to be along the levels of the extramural awards. Additional information can be found on the NCI website, including the *NCI Bottom Line: A Blog About Grants and More*.

Dr. Rathmell reflected on her time at VUMC during the COVID-19 pandemic; working during a public health crisis resonates with the NCI budget environment and those decisions she is facing. She served as interim chair of the VUMC Department of Medicine and was overseer of various services, including urgent care clinics, walk-in clinics, primary care, hospital medicine, and intensive and palliative care. She remarked on the need for flexibility to rapidly pivot to align with the university's mission while serving the needs of the community. Evaluating each experience informed new opportunities to deliver care and forge new collaborations, and after 6 weeks as NCI Director, she recognizes some similarities. NCI staff are willing to carefully consider how the NCI is going to manage during this budget crisis. She assured the NCAB that regardless of the timing or outcome of the FY 2024 budget, the NCI will be able to carry on with its mission.

Recent News and Events. Dr. Rathmell highlighted several NCI updates. The National Cancer Plan (NCP) was implemented in 2023. The eight goals of this roadmap encompass the need to prevent cancer, detect cancers early, develop effective treatments, deliver optimal care, eliminate inequalities, maximize data utility, optimize the workforce, and engage every person. The work that the NCI does is everyone's work: To change cancer and end cancer requires every person to be fully engaged in this overall mission.

President Joseph R. Biden announced the reignited Cancer Moonshot 2 years ago, setting bold, but achievable goals to reduce the U.S. cancer death rate by 50 percent by 2047 and to improve the experience of patients with cancer and their families. Dr. Rathmell remarked that ending cancer as we know it will involve understanding cancer better, allowing people to approach a cancer diagnosis without fear, preventing many cancers, and being able to reach communities that previously have not had the access to care that they needed. All these goals are within reach, and efforts to achieve them will benefit from the use of data and science and effective investigative skills.

This is a fortuitous time to be engaged in cancer research, especially with the support of the President and the White House and an NIH Director—Dr. Monica M. Bertagnolli—who is passionate about addressing cancer. This level of support and the availability of numerous tools provides an opportunity to address this major problem of cancer, and the NCI is making progress in each of these reignited Cancer Moonshot goals. NCI Surveillance, Epidemiology, and End Results (SEER) program data show declines in lung, breast, and colorectal cancers over the past 45 years. A recent publication of the Cancer Intervention and Surveillance Modeling Network (CISNET) shows improvements in mortality

that resulted from management of metastatic disease along with prevention and early detection. The researchers reported that people with metastatic breast cancer also are living longer.

Research Highlights. Dr. Rathmell highlighted recent progress in cancer research. On 25 January 2024, during the White House Cervical Cancer Forum, the NCI announced the launch of the Self-Collection for HPV Testing to Improve Cervical Cancer Prevention (SHIP) Trial Network, which aligns with the NCP goal of early detection. The SHIP Trial Network was developed in collaboration with federal and private-sector partners and patient advocacy groups, all addressing disparities. The groups selected to pilot the SHIP Trial Network have populations that need access to testing for HPV for proper risk assessment and effective care management. SHIP directly engages the community, which aligns with the NCP goal to engage every person.

The NCI has numerous accomplishments in cancer research. A detailed list can be accessed online at *Cancer Currents: An NCI Cancer Research Blog*. Dr. Rathmell elaborated on two advances since the last NCAB meeting. A report on the enrollment of existing and new NCI-funded cancer epidemiology cohorts revealed that the new cohorts have a much broader distribution of patients. In fact, enrollment shifted from being 63 percent Caucasian/White to comprising diverse racial/ethnic minority groups, a shift that has occurred partly intentionally and partly organically. This finding contributes to the NCP goals to eliminate inequities and engage every person. These improvements and data provide an opportunity to better serve all populations. In addition, the NCI partnered with the U.S. Census Bureau to examine cigarette smoking among teenagers. The results showed that one of the major contributors of cancer is undergoing a generational change with the decline in cigarette smoking among U.S. adolescents and young adults. The expectation is that in the distant future, the demographics of cancers will shift because of this change. Interestingly, although cigarette smoking decreased, vaping increased. The NCI is monitoring this shift in tobacco exposures. This study aligns with the NCP goals of preventing cancer and maximizing data utility.

In closing, Dr. Rathmell noted that although the budget outlook is not ideal, creative solutions can emerge in the face of challenging situations. The NCI will work creatively, collaboratively, and efficiently to steward the resources for this fiscal year. The Institute's work is ultimately for the benefit of all people, patients, and families affected by cancer, and the NCI will use the NCP as the roadmap to achieve the Cancer Moonshot goals of ending cancer.

Questions and Answers

In response to a request from NCAB Chair Dr. Carpten for her thoughts on NCI's direction in expanding and extending clinical trials, Dr. Rathmell noted discussions within the NCI to identify both the real needs and the opportunities for partnership. This task may entail using the NCI Community Oncology Research Program (NCORP), working with the Department of Veterans Affairs (VA), or working across various spaces to ensure access to trials. The fundamental problem that the NCI is trying to address is that outcomes are poorer in certain regions of the United States and segments of American society. A new working group that she plans to charge will be the best approach for addressing this question.

NCAB Chair Dr. Carpten also asked about ongoing activities within the NCI to address artificial intelligence (AI) in academic research. Dr. Rathmell noted that the NCI has several working groups within its current information technology and bioinformatics structures that are examining opportunities in AI. The NCI is ensuring its representation in AI think tanks to exchange information. NIH-funded research focusing on AI has increased to support several projects, such as image analysis, natural language processing, and use of large data sets; AI will bring exciting NIH-wide partnerships. Dr. Carpten

added that AI in cancer research and associated initiatives within the NCI could be a topic for a future meeting.

Ysabel Duron, Founder and Executive Director, The Latino Cancer Institute, commented on patient advocates who are drafting an AI patient bill of rights because of their concerns about losing control of their data and its use. She encouraged inviting patient advocates to participate in NCI discussions about AI and its potential impact on data sharing and privacy.

NCAB Chair Dr. Carpten asked about the status of integrations and discussions with the Centers for Medicare & Medicaid Services (CMS) and understanding pay and reimbursement and access to care. Dr. Rathmell commented that although the NCI has made advances in research, basic science, translation, and discovery, the major accomplishments will focus on access to care and a health care system that allows patients to receive that care when and where they need it. The NCI seeks to partner to the fullest extent possible with other agencies to address access, including CMS.

Dr. Howard J. Fingert, Vice President, Medical-Oncology, ONO PHARMA USA, INC., is impressed with the funding announcement for research about pragmatic clinical trials to expand access and provide an opportunity to conduct research to help underserved populations. Dr. Rathmell remarked on how pragmatic trials are common-sense clinical trials that mean something to people immediately. NCAB Chair Dr. Carpten noted updates on NCORP as another potential meeting topic.

IV. LEGISLATIVE REPORT—MS. M.K. HOLOHAN

Ms. M.K. Holohan, Director, Office of Government and Congressional Relations, NCI, reported on potential outcomes for FY 2024 appropriations, various legislative complications, and NCI's congressional engagement. There has not been new progress on the FY 2024 appropriations bill for NIH since the last board meeting. The appropriations subcommittees are still working to finalize their spending bills to enable a conference between the House and the Senate and a final measure that can be enacted into law. The twelve appropriations subcommittees did not even receive their allocations until more than four months (131 days) into the fiscal year. The Fiscal Responsibility Act of 2023 (FRA) that was enacted in June 2023 suspended the debt ceiling and set budget caps for FY 2024 and FY 2025. Soon afterwards, House Republicans rejected the deal and decided that they would treat the spending caps as "ceilings, not floors" and marked their bills to a lower level than did their Republican counterparts in the Senate and both House and Senate Democrats. This divide delayed progress on the appropriations bills for several months.

The FRA caps FY 2024 nondefense discretionary spending at FY 2023 levels; limits FY 2025 spending to a 1 percent increase; and allows FY 2024 defense funding to increase by 3 percent, which aligns with the President's FY 2024 "flat" budget. The FRA has a penalty attached to it that will cut government spending for FY 2024 by 1 percent if Congress fails to pass all 12 appropriations bills by 30 April 2024. Funding cuts will be applied to defense and nondefense discretionary funding (i.e., sequester). Some programs are exempt from sequestration (e.g., VA), increasing the burden on others. The Office of Management and Budget has sole responsibility for implementation of sequestration.

Within the Labor-HHS bill, the House declined to continue the $216 M appropriation for the FY 2024 Cancer Moonshot. Furthermore, the House did not include any supplemental funds for the other NIH-led 21st Century Cures programs, the NIH *All of Us* program and the Brain Research Through Advancing Innovative Neurotechnologies® Initiative. While Cures/mandatory funding for the Cancer Moonshot ended in FY 2023, funding for these other initiatives faced steep declines in FY 2024. The Senate bill did continuing these funding streams, and for NCI also and proposed an increase of $60 M to

the NCI base budget. Ms. Holohan stated that it is possible that the appropriators could strategically rescue the NCI from the funding cliff that results from the phasing out of Cancer Moonshot allotments.

Complicating all sort of legislative action is the fact that Republicans have only a two-vote majority in the House, and they will have to rely on the Democrats to pass the FY 2024 spending bills. The vote to impeach Homeland Secretary Alejandro Mayorkas and a stand-alone Israeli aid bill both failed to pass. The Immigration Foreign Aid supplemental bill failed after months of bipartisan negotiation. The Tax Relief for American Families and Workers Act of 2024 (a $79 B family and business tax package) passed the House and is awaiting Senate action. Importantly, this bill would postpone the effective date of changes to the tax code that created new tax liabilities for SBIR companies. The change, part of the 2017 Tax Cuts and Jobs Act, took effect in 2022 and eliminated the 100% deductions for R&D expenses and instead required them to be capitalized and amortized over a 5-year period. If enacted, the 2024 legislation tax relief legislation would postpone those tax changes until 2026.

Ms. Holohan also highlighted some recent hearings and visits. After only 42 days as NCI Director, Dr. Rathmell has completed meetings with several congressional leaders who serve on the Labor-HHS Appropriations Committees. These include appropriations members Senators Shelley Moore Capito (R-West Virginia), Ranking Member, LHHS; Jerry Moran (R-Kansas; John Boozman (R-Arkansas); and Jack Reed (D-Rhode Island). These meetings were positive and informative, and members of Congress are typically interested in learning about the work of the NCI, and ways in which they can be helpful. They care about how investments in biomedical research are yielding results. NCI staff were invited to congressional briefings on neurofibromatosis on 12 January 2024 and national cancer prevention on 6 February 2024. The NCI welcomes invitations from Congress and national cancer groups—including the American Association for Cancer Research, the American Society of Clinical Oncology, and One Voice Against Cancer—to attend hearings. In addition, these groups are able to bring patients to Capitol Hill and can have a local emphasis when they meet with members of Congress.

Questions and Answers

Board member Dr. Ashani T. Weeraratna of Johns Hopkins sought clarity on participating in advocacy roles and the involvement of NCAB members, particularly with the restrictions on lobbying. Dr. Weeraratna indicated that she had recently received a request from the Melanoma Research Foundation to join their advocacy day on Capitol Hill. Dr. Gray clarified that participation in such activities as a private citizen or as a representative of an academic or research institution poses no issues; however, participation as an NCAB member or as a government representative can be a conflict of interest. As such, she encouraged NCAB members to contact the NCI when such requests are received to receive the appropriate guidance and advice regarding participation. Ms. Holohan commented that many board members participate as scientific experts in congressional hearings and briefings, so it is important to clarify what the event is and why the organization is requesting your participation.

V. ANNUAL DELEGATIONS OF AUTHORITY—DR. PAULETTE S. GRAY

Dr. Paulette S. Gray, Director, DEA, requested concurrence by the NCAB on two Delegations of Authority to the Director of the NCI. Dr. Gray described the delegations and provisions in the Statement of Understanding. She noted that Delegation A allows the NCI Director to obtain the services of not more than 151 special experts or consultants who have scientific or professional qualifications. Dr. Gray also explained that Delegation B specifies that the NCAB delegates authority to the NCI Director to appoint one or more advisory committees composed of private citizens and officials of federal, state, and local governments to advise the Director with respect to his or her functions.

The Statement of Understanding with NCI Staff on Operating Principles in Extramural Grants also falls within the Delegations of Authority to the Director, NCI. NCAB operations are conducted in accordance with management and review procedures described in the NIH Manual Issuance 4513. Concurrence of the NCAB with recommendations of initial review groups will be required, except for the following: (1) Training grants and fellowships and other non-research grant applications are not subject to NCAB review and approval and, without other concerns, may be awarded without presentation to the NCAB for concurrence, with the exception of Ruth L. Kirschstein National Research Service Awards. (2) Applications above the 20th percentile will not have summary statements presented to the NCAB unless the Institute is considering an award of such an application, or other special consideration is requested or required by NCI or NIH policy, or for special consideration by an appointed member of the Board. (3) For applications assigned raw scores that are not percentiled, the cutoff will be a priority impact score of 50 for all mechanisms except R41, R42, R43, and R44 awards; for the latter, all scored applications will be included.

Expedited Concurrence: 1) For R01 and R21 applications with percentiled or raw scores that fall within the NCI paylines, a process of expedited concurrence will be used; and 2) the Executive Secretary will alert Board members with responsibility for expedited concurrence when review outcomes for eligible applications are available on the Electronic Expedited Concurrence section of the Electronic Council Book.

Administrative Adjustments: 1) Permission is delegated to the Director, NCI, to allow staff to negotiate appropriate adjustments in dollars or other terms and conditions of grant and cooperative agreement awards. 2) Administrative requests for increases in direct costs that are the result of marked expansion or significant change in the scientific content of a program after formal peer review will be referred to the Board for advice and recommendation. 3) Actions not requiring Board review or advice, such as change of institution, change of principal investigator (PI), phase-out of interim support, or additional support, need not be reported to the Board. 4) NCI staff may restore requested time and support that were deleted by the initial review group when justified by the PI in an appeal letter or when restoration is in the best interest of the NCI and the project is of high NCI programmatic relevance.

To continue responsible stewardship of public funds, the NIH has instituted a policy of Special Council Review of applications from well-funded investigators. Applications from PIs who have $2 M or more in direct costs from active NIH Research Project Grants (RPGs) must be given additional consideration. Immediately following this meeting, applications from PIs who have $2 M in total costs from active NIH RPGs must be given additional consideration. The $2 M will be a threshold, and investigators who have additional research support may still receive additional awards as warranted.

Motion. A motion to approve the NCI Annual Delegations of Authority was approved unanimously.

VI. INTEGRATIVE POPULATION-BASED CHARACTERIZATION OF MOSAIC CHROMOSOMAL ALTERATIONS UNCOVERS ETIOLOGIC INSIGHTS FOR HEMATOLOGIC MALIGNANCIES—DR. MITCHELL J. MACHIELA

Dr. Mitchell J. Machiela, Earl Stadtman Investigator, Integrative Tumor Epidemiology Branch, Division of Cancer Epidemiology and Genetics (DCEG), NCI, presented his group's recent findings on how the germline informs somatic alterations and influences cancer risk. He studies normal tissues prior to tumor formation to characterize changes that promote clonal expansion of mutated cells, and his work capitalizes on decades of intramural and extramural investments to characterize age-related mutations in existing samples.

Clonal hematopoiesis (CH) is acquired when normal cells are mutated, and the mutation confers a survival advantage, allowing mutated cells to expand. Dr. Machiela explained that most individuals with CH do not develop hematologic malignancy, highlighting the need for studies to characterize CH and identify high-risk subtypes. His research focuses on mosaic chromosomal alterations (mCAs) which are large, structural chromosomal alterations. mCAs are usually detected with genotype array intensity data. In contrast, CH of indeterminate potential (CHIP) is characterized by single-nucleotide variants and small indels with deleterious impact on leukemia driver genes. Dr. Machiela briefly described his efforts in repurposing genotype array intensity data to detect mCAs. He explained that specialized algorithms can scan the genome for allelic imbalances, and continuous chromosomal stretches of signal-intensity deviations can provide evidence of chromosomal alterations.

Dr. Machiela and his colleagues have characterized data from more than 1 million study participants to gain insights on the frequency and distribution of mCA. Initial studies identified higher than anticipated mCA frequency. The team reported increases in frequency with increasing age, non-random clustering of events, and notable enrichment in regions known to be altered in hematologic malignancies. Y chromosome loss was identified as the most frequently occurring age-related mCA in males, with overall frequency in excess of 20 percent in elderly populations. Likewise, mosaic X chromosome loss is the most commonly occurring mCA in females; the team observed higher frequency of X mosaicism on the inactivated X chromosome. Studies of X mosaicism in men identified very low frequency, with no observations of male X chromosome loss. Collectively, these studies suggest that mCAs are common in leukocytes of adult populations but vary in frequency by the chromosome affected.

To examine the etiology of mCAs, Dr. Machiela is leading large population-based studies utilizing special exposure populations to identify risk factors. Across all types of mCAs, aging is the strongest risk factor for mCAs, with frequency increasing as age increases. Sex is another well-characterized mCA risk factor, with males having higher frequency of autosomal mCAs relative to females. When accounting for sex chromosome mosaicism, males have further elevated frequency. Ancestry is also associated with mCA risk, with individuals of African ancestry having lower frequency of mCAs than individuals of European or Asian ancestry. Geography also appears to play an important role; children residing in sub-Saharan Africa have displayed rates comparable to middle-aged populations in developed nations.

These data suggest that environmental factors, such as malarial infection, may promote mCA risk. Modifiable risk factors, such as smoking, are also associated with mCAs, with strongest associations observed for loss of the Y chromosome in men. Studies of mCAs also identified a relationship with inherited telomere length; individuals with longer inherited telomere length have increased susceptibility. To date, genome-wide association studies (GWAS) of Y chromosome loss have identified 156 autosomal loci associated with mosaic Y chromosome loss. Dr. Machiela co-led a GWAS on loss of the X chromosome in females; the team identified an additional 56 loci and a rare variant association. A fraction of these X chromosome–loss loci are shared with loss of Y chromosome, and many are located near genes that are associated with blood cell counts, immune function, and cancer predisposition. Additionally, the team identified 44 loci preferentially retained on the remaining X chromosome in females with loss of the X chromosome.

To investigate downstream consequences of mCAs, the team has performed studies of diverse outcomes relevant for disease and cancer risk. They reported that mCAs are strongly associated with increased leukemia risk. Associations are strongest for lymphoid leukemia risk, but they are also present for myeloid leukemia risk. mCAs are also associated with select solid tumor risk, including lung, skin, and prostate cancer, suggesting that mCAs in blood could serve as a barometer for mutational processes in other tissues, but the risk estimates are lower. Although longer inherited telomere length is associated with increased susceptibility to mCAs, individuals with detectable mCAs have shorter measured telomere

length. This suggests a dynamic relationship; cells harboring mCAs might require mechanisms that maintain longer telomeres to promote clonal expansion, but clonal expansion results in telomere length attrition. mCAs are also associated with elevated leukocyte counts. Dr. Machiela also is interested in elucidating potential relationships between mCAs and risk of infectious disease acquisition. His team identified relationships with expanded mCAs and the risk of sepsis and pneumonia, with stronger effects observed in cancer patients. They also noted evidence for increased susceptibility to severe COVID-19.

Building on his previous findings, Dr. Machiela is developing integrative models to improve cancer risk stratification. He is exploring how the incorporation of genetic knowledge can improve risk stratification over clinical risk factor information. Using UK Biobank, his team developed three models that incorporate classical risk factors, genetic risk data from polygenic risk scores derived from GWAS, and information on mCAs and CHIP. This example demonstrates that even for hematologic malignancies, the addition of germline and somatic information results in noticeable improvements in risk. Because mCAs are under selective pressure, their clonal trajectories are dynamic and can exhibit periods of rapid clonal expansion or reversion to normal states.

Dr. Machiela concluded by sharing key findings from his work. First, mCAs are detectable in the blood of cancer-free individuals, indicating increasing genomic erosion with age and highlighting the ability of the hematopoietic compartment to tolerate mutated clones. Next, the distribution of mCAs differs by chromosome, with enrichment in regions commonly mutated in leukemias, although most individuals with mCA clones do not develop hematologic cancers. Furthermore, risk factors for mCAs have a high degree of similarity with hematologic cancer risk factors, indicating the potential to uncover novel etiologic insights. Finally, mCAs are associated with multiple outcomes and could be particularly important for hematologic cancers, suggesting their possible usefulness as a marker for disease risk.

Questions and Answers

NCAB Chair Dr. Carpten asked whether the team has investigated risk factors of epigenetic aging, as well as accelerated aging, in earlier onset of alterations and increased cancer risk. Dr. Machiela replied that he is currently performing methylation analyses to explore the differences between biological and chronological aging. He remarked that these results will be forthcoming within the next several months.

Dr. Anna D. Barker, Chief Strategy Officer, Ellison Institute for Transformative Medicine, University of Southern California, remarked that mCAs are associated with numerous health conditions, such as cardiovascular disease. She added that age is likely to be a critical factor for cancer risk. She asked whether the team's models are a superior predictive tool compared with other methods (e.g., multi-cancer detection tests). Dr. Machiela responded that the models can complement existing data on this topic. mCAs can provide additional information to the models and improve scientists' knowledge of genome deterioration with age. He added that the team is carefully modeling the relationship between mCAs and chronic diseases to avoid potential biases.

In response to a follow-up question from Dr. Barker, Dr. Machiela stated that the team has limited data on mCAs in older age groups; his initial data suggest that certain mechanisms might protect against biological aging in these groups, but more studies in this area are needed.

Dr. Rathmell commented that this work underscores the value of leveraging existing data for new insights, as well as the uniqueness of NCI resources. Dr. Machiela stated that much of his research has required the use of GWAS, and DCEG offers a vast collection of resources in this area. He added that virtual karyotyping has provided new opportunities to study individual germline variation, as well as somatic variation. He is interested in gaining insight into disease mechanisms and predictability.

Dr. Karen M. Winkfield, Executive Director, Meharry-Vanderbilt Alliance, Ingram Professor of Cancer Research, Professor of Radiation Oncology, Vanderbilt University School of Medicine, speculated about the effects of chronic inflammation—which are relevant to communities of color, as well as other disenfranchised communities—on mCA development. Dr. Machiela explained that CH exists on a spectrum, and his team is focused on larger events. He added that inflammation could be associated with smaller point mutations but does not appear to be associated with the larger events. Other measurements for determining inflammation could be explored, but larger sample sizes are needed.

In response to a question from NCAB Chair Dr. Carpten about population diversity within the team's data set, as well as insights related to variation in disease risk and prevalence among groups, Dr. Machiela explained that his current work has focused on existing GWAS data, most of which is limited to European populations. His initial findings, however, suggest that ancestry could play an important role. He is working to develop a larger study of populations residing in Uganda. Dr. Machiela added that GWAS are becoming more ancestry focused, and more relevant data are forthcoming.

VII. DECIPHERING THE COMPLEXITY OF GENOMIC ABERRATIONS IN HUMAN BREAST CANCER FOR PRECISION ONCOLOGY—DR. GAORAV P. GUPTA

Dr. Gaorav P. Gupta, Associate Professor, Radiation Oncology, Biochemistry and Biophysics, Co-Leader, Breast Cancer Program, Lineberger Comprehensive Cancer Center, The University of North Carolina at Chapel Hill, provided an update on opportunities for deciphering the complexity of cancer genomes. Genome rearrangements are a hallmark of cancer and are distinct from single-nucleotide variations, which largely arise from damage to a single strand or double-stranded DNA. In contrast, genome rearrangements arise from a break to both strands of the DNA, known as a double-strand break. The potential misrepair of these lesions can lead to a genome rearrangement. Single-nucleotide variations seem to increase linearly across the lifetime of a normal tissue that progresses to precancer and eventually to invasive cancer. Genome rearrangements are infrequent in precancers, but arise at a much higher rate in overt cancer. The processes that give rise to genome rearrangements—such as whole-genome duplications and tumor suppressor, *p53*, impairment—may be particularly relevant to the process of precancer-to-cancer transition that is important for cancer etiology. Additionally, different cancers from the same histological sites, such as breast cancer, can show vastly different amounts and patterns of genome rearrangements. The causes and clinical implications of these different patterns are not well understood.

Whole-genome sequencing provides a more complete picture of cancer genome rearrangements, but is more complex and resource intensive than targeted next-generation sequencing, which is much more commonly used in the clinic. The 100,000 Genomes Project is ongoing in the United Kingdom and recently published initial findings, evaluating whole-genome sequencing in more than 13,000 consecutive cancers being diagnosed in the project's oncology clinics. The results were promising and demonstrated both the feasibility and potential clinical impact of insights from whole-genome sequencing. These data are potentially creating a pathway to evaluating the use of whole-genome sequencing more broadly in clinical scenarios.

Dr. Gupta highlighted that significant progress has been made toward deciphering the complexity of these genomes, particularly in the Pan-Cancer Analysis of Whole Genomes (PCAWG) study. PCAWG is an international collaboration among the TCGA group in the United States and international researchers. The aim is to identify common patterns of mutation in more than 2,600 cancer whole genomes from the International Cancer Genome Consortium. PCAWG investigators have begun to dissect these complex patterns and have found recurrent signatures of chromosomal instability that are observed across different types of cancers. These findings are incorporating vast amounts of data from DNA sequencing, RNA sequencing, and functional genomics.

Although significant progress has been made in this research, knowledge gaps remain. Dr. Gupta highlighted four such gaps and new research insights. The first knowledge gap is a need to optimally capture the complexity of cancer genomes. A 2023 study published by the Simon Powell Lab at the Sloan Kettering Institute and the Imieliński Lab at the New York Genome Center demonstrated, using linked-read whole-genome sequencing, that the same pattern of copy number aberration and rearrangements observed with short-read sequencing could arise from three different structural rearrangements in the genome. This result could be observed only through this linked-read sequencing method. They found that a specific pattern of rearrangement—reciprocal pair rearrangement—is particularly prevalent in tumor suppressor *BRCA*-deficient cancers. When the genomic pattern being evaluated is known, short-read Illumina-based sequencing can be used to fill the gaps. This study demonstrates that with knowledge of the underlying structure, the team could approximate the signals from the Illumina sequencing and improve their ability to identify homologous recombination-deficient cancers, which may allow the field to better target such treatments as poly adenosine diphosphate–ribose polymerase inhibitors and other targeted therapies.

The second knowledge gap is lack of understanding of the DNA repair processes that drive rearrangement profiles. Extrachromosomal circular DNA in which oncogenes are highly amplified can exist in circles found in the nuclei of aggressive cancers, such as glioblastoma. A study by the Zhang Lab at Duke University found a specific DNA repair pathway mediated by DNA polymerase theta that is required for the generation of these extrachromosomal circles. These findings, initially discovered in *Drosophila* cell systems and then validated in mammalian systems, highlight that this pathway may be druggable because inhibitors to this enzyme are in early-stage clinical trials.

The third knowledge gap is a need for better understanding of how cells evade mitotic catastrophe and what pathways dictate these mechanisms. Two studies recently published by the Ly Lab and colleagues at the University of California, San Diego identified a novel pathway involving the adaptor protein, TOPBP1, and its interacting protein, CIP2A, that clusters broken fragments of DNA that arise in the process of mitotic errors. Clustering of these fragments allows cells to survive this mitotic catastrophe more effectively. The researchers found that cancers that overexpress TOPBP1 and CIP2A have a specific and identifiable pattern of balanced chromothripsis that is observed in a subset of cancers. In their future work, the researchers plan to explore whether this pathway can potentially be targeted therapeutically.

The fourth knowledge gap is a need for increased studies of the interplay between genome rearrangement and immune surveillance pathways. Dr. Gupta's laboratory developed an *in vivo* triple-negative breast cancer mouse model that allows evaluation of modulators of the precancer-to-cancer transition using an *in vivo* CRISPR screen. They found a shared molecular mechanism that was centered around the innate immune sensing of DNA damage in these precancerous cells. The loss of the ability to engage the innate immune system was critical to allow these precancerous cells to progress into overt cancers with high degrees of genome instability. This is an important facet of how cancers with high degrees of genome aberration are able to thrive and evade immune detection, which may have implications for both cancer prevention and immunotherapy response.

Dr. Gupta summarized with a roadmap for precision oncology in genome arrangement. Develop optimized methods for genome characterization, and evaluate strategies and feasibility for clinical translation. Conduct mechanistic studies to uncover the etiology of different genome rearrangement signatures and evaluate their implications for cancer prevention. Interrogate the interplay between genome rearrangement pathways and the immune system in cancer development, progression, and therapeutic response. Identify targetable vulnerabilities of cancers with distinguishable signatures of genome rearrangement or instability.

Questions and Answers

Dr. Rathmell asked Dr. Gupta to comment on his experience as a physician–scientist in radiation research and the role of physician–scientists in general. Dr. Gupta reflected on his long journey training as both a physician and a scientist as well developing and cultivating these two areas, which took some time to coalesce. When he started his laboratory, he was studying fundamental mechanisms while treating patients in the clinic. As a physician and a scientist, he was able to participate in clinical trial development and in the guidance of those trials to ensure the accessibility of biospecimens that would allow for future studies. One such trial was the study of combining immune checkpoint blockade with radiation in patients with breast cancer. This trial is nearly complete, and examining the biospecimens is already revealing new insights on unexpected responses to treatment. Discoveries in the preclinical models can be compared with the trial data. The two facets of his training have culminated in this opportunity.

Dr. Barker commented that early in the TCGA, they stacked and examined all of the changes observed in the tumors they had studied. They found large structural changes, such as copy number signatures, in certain tumors, especially in ovarian cancers. She asked what could be causing or mechanistically producing these genome changes, what is different about these cancers that the field has not been seeing? Dr. Gupta cautioned about the signals that are missed when evaluating only RNA and DNA, not the protein and other signals. The DNA damage response is not well captured by RNA or DNA, and *p53* is lost in the majority of these highly complex genome cancers. He speculated that the interplay of DNA damage with the immune system may be a critical aspect of what could be missing. Dr. Barker added that another missing component in this context is the microenvironment.

NCAB Chair Dr. Carpten asked about the need for incorporating whole-genome sequencing into the clinic. Dr. Gupta could not speak to whether this technology could be applicable to the clinic. He noted that other complex tools, such as spatial transcriptomics and single-cell analysis, are challenging to scale in real-time for clinical use. Simplifying and creating a more pragmatic assay to capture and better understand the biological underpinnings of cancer in a more controlled setting could be one approach.

VIII. ONGOING AND NEW BUSINESS—DR. JOHN D. CARPTEN

NCAB *ad hoc* Subcommittee on Population Science, Epidemiology and Disparities. Dr. Winkfield, Chair of the NCAB *ad hoc* Subcommittee on Population Science, Epidemiology and Disparities, presented the report of the 8 February 2024 meeting. The NCI Director, Dr. Rathmell, provided opening remarks. Dr. Winkfield noted that the Subcommittee briefly reviewed the charge and spent the bulk of its time discussing ongoing work at the NIH relevant to this group. Dr. Katrina A.B. Goddard, Director, Division of Cancer Control and Population Sciences, NCI, provided a detailed update on the efforts of the NIH-wide Social Determinants of Health (SDOH) Research Coordinating Committee (RCC), which was established in 2022. Dr. Goddard pointed out that SDOH account for approximately half of the variation in health outcomes, which significantly affects the Cancer Moonshot goal to reduce cancer mortality by 50 percent in 25 years. Dr. Goddard further noted that the RCC was formed out of an urgent need to develop a coordinated strategy to propel discoveries and to improve individual and population health to reduce health disparities and advance health equity. In 2023, the RCC released a unified conceptual framework for SDOH, the NIH SDOH conceptualization, which is online and available for public review. Dr. Goddard shared with the Subcommittee several of the NCI-supported SDOH initiatives, including the Advancing Cancer Control Equity Research Through Transformative Solutions (ACCERT) Consortium. The Subcommittee posed several suggestions regarding disseminating the RCC programs and any of their outcomes and ensuring inclusion of patient advocates and community voices in the work that is being done. The Subcommittee considered where to focus its efforts over the

next year and discussed the need for novel methods and measurements and bidirectional communication between researchers and the community.

Motion. A motion to accept the report of the 8 February 2024 NCAB *ad hoc* Subcommittee on Population Science, Epidemiology and Disparities meeting was approved unanimously.

NCAB *ad hoc* Subcommittee on Experimental Therapeutics. Dr. Richard J. Boxer, Clinical Professor, David Geffen School of Medicine, University of California, Los Angeles, and Chair of the NCAB *ad hoc* Subcommittee on Population Science, Epidemiology and Disparities, presented the report of the 8 February 2024 meeting. The Subcommittee met to review its updated mission statement. After robust discussion, the decision was made to develop a broader mission statement that would help the NCI today and into the future. In addition, the broader mission statement will consider training and other ways that Subcommittee could serve the cancer community. The Subcommittee discussed the differences between the requirements for academic research and regulatory approval leading to commercialization, which often causes the development of therapeutics to fail. Dr. Boxer explained that the Subcommittee thought a role in training academic colleagues and those requirements would be advantageous to incorporate and agreed to defer the motion for the NCAB to accept the revised mission statement until the June 2024 Board meeting.

Motion. A motion to accept the report of the 8 February 2024 NCAB *ad hoc* Subcommittee on Experimental Therapeutics meeting was approved unanimously.

NCAB Subcommittee on Planning and Budget. Dr. Barker, Chair of the NCAB Subcommittee on Planning and Budget, presented the report of the 8 February 2024 meeting. The NCI Director, Dr. Rathmell, attended the meeting. Dr. Barker reported that the Subcommittee reviewed the charge and heard an update on the NCI budget process by Mr. Weston Ricks, Director, Office of Budget and Finance, NCI, and Acting Subcommittee Executive Secretary. Ms. Holohan joined the meeting and provided a legislative perspective to understanding the NCI budget process. The NCA of 1971 made provision for the NCI to prepare a Bypass Budget, for which this Subcommittee can provide input. Dr. Barker noted that the Subcommittee can play a role in increasing awareness of the Bypass Budget on Capitol Hill. The Subcommittee discussed with Dr. Rathmell the decrease in NCI purchasing power for medical research and ways the Subcommittee can help prioritize how the NCI addresses that decrease. Dr. Barker called attention to the recent report projecting a global increase in cancer of 77 percent by 2050, which highlights that the NCI and NIH have work to do to reverse this trend. NCAB members can operate within their own spheres of influence to assist the NCI.

Motion. A motion to accept the report of the 8 February 2024 NCAB Subcommittee on Planning and Budget meeting was approved unanimously.

Establish Board of Scientific Advisors *ad hoc* Working Group in Support of Efforts to Enhance Community Cancer Research and Quality Care. Dr. Carpten explained that the Board will need to approve establishing a BSA *ad hoc* Working Group in Support of Efforts to Enhance Community Cancer Research and Quality Care. In a brief overview of the Working Group, Dr. Rathmell commented on the increased attention paid to the disparities in cancer outcomes between rural and urban areas and noted that most of the issues were related to access to care. She noted that the main question is how the research community can support better outcomes for patients across America. To address these disparities and issues, Dr. Rathmell noted that over the next 6 months, the Working Group will work to identify which problems the NCI can solve in the short and medium terms; what the NCI's role should be in tackling issues related to obtaining optimal care as indicated in the NCP; and what other resources or components of the government the NCI should partner with, such as the VA, and what other existing

networks the NCI should use to reach people. The NCI also needs more information to inform future investments in this area.

Motion. A motion to concur on establishing a BSA *ad hoc* Working Group in Support of Efforts to Enhance Community Cancer Research and Quality Care was approved unanimously.

Future Agenda Items. Members suggested an update on: 1) NCORP and plans for the future; 2) review of AI in cancer research and internal initiatives in the NCI; 3) NCAB an update on initiatives of the Advanced Research Projects Agency for Health and its interactions with the NCI; 4) revised mission statement for the ad hoc Subcommittee on Experimental Therapeutics; and, 5) report on the cancer screening efforts of the Health Resources and Services Administration (HRSA) and the status of NCI-Designated Cancer Centers that are partnering with HRSA-funded health centers. NCAB members were asked to forward any further suggestions for future agenda items to Drs. Carpten and Gray.

IX. ADJOURNMENT OF OPEN SESSION—DR. JOHN D. CARPTEN

Dr. Carpten adjourned the open session. Only Board members and designated NCI staff remained for the closed session.

X. CLOSED SESSION—DR. JOHN D. CARPTEN

"This portion of the meeting was closed to the public in accordance with the determination that it was concerned with matters exempt from mandatory disclosure under sections 552b(c)(4) and 552b(c)(6), Title 5 U.S.C., and section 1009(d) of the Federal Advisory Committee Act, as amended (5 U.S.C. §§ 1001-1014).

There was a review of grants and a discussion of personnel and proprietary issues. Members absented themselves from the meeting during discussions for which there was potential conflict of interest, real or apparent.

The Board was informed that a comprehensive listing of all grant applications to be included in the **en bloc** vote was in the Special Actions package. Those grant applications, as well as those announced during the closed session, could be considered for funding by the Institute.

The NCAB **en bloc** motion to concur with IRG recommendations was unanimously approved. During the closed session, a total of 2,431 NCI applications were reviewed requesting direct cost support of $980,469,249 and three FDA applications requesting direct cost support of $427,750.

XI. ADJOURNMENT—DR. JOHN D. CARPTEN

Dr. Carpten thanked all the Board members, as well as the visitors and observers, for attending. There being no further business, the 20th virtual meeting of the NCAB was adjourned at 4:43 p.m. on Thursday, 8 February 2024.

Date	John D. Carpten, Ph.D., Chair, NCAB
Date	Paulette S. Gray, Ph.D., Executive Secretary