NIH Response and Implementation Plan

Long-Term Intramural Research Program Planning Working Group Report

I. Executive Summary

The Intramural Research Program (IRP) of the National Institutes of Health (NIH) is an integral part of the NIH-supported biomedical research enterprise. It plays an important, and critical, role in advancing the mission of the NIH "to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability."

Over the past decade, the entire field of biomedical research – in both the intramural and extramural community – has been affected by declines in inflation-adjusted funding; inadequate ethnic diversity of the biomedical workforce as the U.S. population becomes more diverse; the need for opportunities and appropriate training for talented students to enter productive career paths; changes in the methodologies and costs of conducting research; and a growing need for more effective translation of laboratory science into clinical applications.

The NIH has conducted a series of studies to address these issues and some of them specifically address the IRP. The most recent study, entitled "Long-Term Intramural Research Program Planning," was summarized in a report delivered to the Advisory Committee to the Director (ACD) on December 12, 2014. That report, to which the current document responds in detail, was influenced by descriptions of future plans submitted by leaders of the 23 Institutes and Centers (ICs) that currently conduct intramural research. The individual IC reports, as well as the report from the ACD Working Group, addressed both the distinctive features of each of the intramural programs as well as the common features that give the entire IRP its distinctive attributes: an ability to initiate new research programs swiftly; sustain long-term projects; respond to public health emergencies; and address unmet needs in support of the composite NIH research enterprise.

The ACD Working Group emphasized areas in which the IRP could become more effective as a component of a fully integrated NIH biomedical research effort. Its report calls for changes in the IRP that would enhance its capacity to maintain the culture and facilities needed for outstanding contemporary laboratory and clinical research and to recruit and nurture a diverse and talented workforce. In this response to the ACD report, we emphasize recommendations that address four critical topics.

The NIH Clinical Center (CC). The NIH CC facility, its wide-ranging research and training programs, and its links to associated laboratory research are at the core of the IRP. The CC is the world's largest facility devoted exclusively to clinical research and is the site where much of the IRP clinical research is conducted. The laboratory and translational research infrastructure in the IRP feed this clinical research enterprise as a cohesive operation. For example, the CC will genotype all CC patients in the future and conduct comprehensive phenotyping of this valuable cohort of subjects, who are likely available to return for ongoing analysis and characterization of their diseases. The CC could be recognized as a National Center of Phenotyping for its distinctive role in this endeavor. The future of the CC and, by extension of all clinical research conducted within the IRP, is threatened by difficulties in funding clinical research with a constricted NIH budget, by obstacles to successful recruitment of clinical investigators, and by insufficient interaction with the extramural clinical research community. In considering the recommendations of the Working Group, NIH will attempt to assure a stable budget for the CC; provide mechanisms to build alliances with the extramural clinical research community; enhance the role of the IRP in training the next generation of physician-scientists; and promote existing programs (such as the Lasker Clinical Research Scholars program) and new methods for improving the recruitment of clinical investigators.

The Diversity of the IRP Workforce. The entire biomedical research enterprise has failed to develop a workforce that exhibits the ethnic diversity that characterizes the U.S. population. We believe that the IRP has a responsibility as a component of the U.S. government to lead the nation in addressing this problem – by developing new approaches to train, recruit, and assimilate an increasingly diverse population of scientists into the fabric of scientific investigation. We intend to adopt and expand recommendations that will influence workforce diversity at every career level: (1) trans-NIH search processes for new scientific staff will cast a wider net for talented scientists; (2) new pathways for career development will be established to allow investigators to graduate to independence; (3) a centralized program for recruitment, mentoring, and career development of postdoctoral fellows will be initiated; and (4) the IRP will add to its already comprehensive set of programs for disadvantaged students, including a high-school summer enrichment program, and enhanced graduate and medical training programs.

Recruitment Processes and Career Development. We are seeking to be a dynamic research environment for new generations of imaginative scientists to conduct fundamental research that reveals new principles of biology, provides new understanding of human disease, and changes treatment and prevention paradigms. To accomplish this, we need the most talented and highly motivated scientists. The IRP currently supports scientists with independent research resources (such as tenure-track investigators and senior investigators), staff scientists (who provide essential scientific support for our laboratories), and staff clinicians (who support clinical research by providing patient care, research support, and physician training). More trans-NIH recruitments, such as the NIH-Lasker Clinical Research

Scholars program and the Stadtman tenure-track search process, will be utilized to cast a wide net for the most talented researchers. For our staff scientist and staff clinician positions, we will make known the availability of these positions as they arise and require a more competitive process in choosing successful applicants.

Program Planning and Investment Funds. The IRP takes pride in its potential flexibility, especially its ability to initiate new programs rapidly. However, using those advantages requires flexible funds, as well as authorities, and such funds are limited in the face of declining NIH buying power. To encourage the IRP to take advantage of new research opportunities (especially those that might not fit squarely within the mission of a single IC), we plan to create a pool of funds – initially aiming for 1% of the intramural budget, gradually accumulated over several years – within the NIH Office of Intramural Research to facilitate trans-NIH investments, including collaborative research opportunities and start-up funds for joint recruitments, but not sustained support. Such funds will be used in an analogous fashion to the NIH Common Fund, but dedicated solely to the IRP. We will also encourage individual IC intramural programs to develop a source of funds to pursue such opportunities, if necessary. In addition, scientific experts drawn from the extramural research community and outstanding intramural investigators will be established as a subcommittee to the existing Advisory Committee to the Deputy Director for Intramural Research (ACDDIR), to help the DDIR and Scientific Directors (SDs) identify exciting new research directions that might take advantage of the distinctive environment of the IRP.

Other topics that will be studied by NIH for implementation as a result of the report include: enhancing intramural-extramural collaborations and team science, optimizing the use of shared resources at NIH, and improving the scientific review process.

After receiving this report, the NIH Director asked the IRP to consider how it could build on the ACD recommendations and develop scientific ideas for the IRP going forward into the future. An implementation committee, which included senior scientific and administrative leaders, as well as tenure-track investigators, discussed and developed initiatives that would take advantage of both the IRP environment and the ACD recommendations. These discussions were integrated into ideas proposed earlier by the ICs in their initial synthesis of IRP research opportunities. There are 9 areas of shared scientific opportunity that are particularly well-suited to be pursued in the IRP in the view of the ICs **(Attachment 1)**. A separate proposal that focuses on technology development at the NIH was synthesized as a result of the implementation committee's discussions **(Attachment 2)**. Activities include creating a technology incubator at the NIH, expanding work on structural biology, e.g., cryo-EM, defining genotype-phenotype interactions, and developing computational infrastructure for big data analysis.

NIH believes that the issues addressed and recommendations made by the Working Group's report on the IRP are timely and important. The responses described below should further advance the public's health, help to preserve U.S. pre-eminence in biomedical research, and strengthen the IRP.

II. Introduction

For the past year, the entire NIH research community has engaged in a long-term planning process that culminated in a Working Group (WG) Report from a subcommittee of the NIH Director's Advisory Committee (ACD) entitled the "Long-Term Intramural Research Program Planning Working Group." The charge to the WG from the NIH Director was to make recommendations that would help assure a future for the IRP at least as impressive as its past, including how best to respond to constrained resources, how to assure continued excellence of science conducted in the IRP including any bold new initiatives that would take advantage of changes in how science is conducted and make good use of the distinctive features of the IRP, how to make certain that the unique resources for clinical research contained within the NIH Clinical Center are well-utilized, and how to improve the diversity of the IRP's workforce.

The WG report was provided with: (1) individual planning processes within each of the 23 Institutes and Centers at the NIH that have an intramural program; (2) the integration of these reports into a synthesis document entitled "The NIH Intramural Research Program: A Synthesis of Opportunities, Issues, and Challenges," issued September 29, 2014; (3) several visits of the WG to the NIH, interviews with scientists and leadership at the NIH; and (4) a variety of data provided by the Office of Intramural Research (OIR) in response to specific queries of the working group. Contributions to the synthesis document also came from outside experts who serve as reviewers of intramural research on its Boards of Scientific Counselors (BSCs), and other senior scientific advisors. The WG report was issued on December 12, 2014, after discussion and unanimous approval by the ACD with instructions to consider all of the recommendations and respond to them with appropriate implementation plans.

The WG report contained 15 overarching recommendations with 20 specific sub-elements organized under the general categories of "Research Recommendations," "Workforce Recommendations," "Infrastructure/Facility Recommendations," as well as an "Administration Recommendation." In responding to, and implementing this report, we have taken the liberty of reorganizing our narrative along topic lines that more closely reflect the practical steps that need to be taken for implementation. These issues for response and implementation are based on the recommendations cited in the report (see cross references to the WG report indicated in parentheses below and summarized by issue in Appendix 1) and include:

1. **Strengthening the Clinical Center and clinical research at the NIH**(A4, C2.a-b, D1.a-b)
2. **Promoting diversity** (B1.a-b, C1)
3. **Recruitment and appointment of NIH scientists** (B3.a-c, B4)
4. **Supporting new research opportunities** (A1, A2.a-b)
5. **Enhancing intramural-extramural collaborations and team science** (A3.a-d. D3.a-b)
6. **Optimal use of shared resources at NIH** (D2, D3c, D4)
7. **Improvements in the scientific review process** (B2.a-b)

All recommendations in the WG report are addressed in this format. This plan has been formulated with the help of our IC Directors, SDs, experts in administrative management, and selected scientific staff including mid- and earlier career scientists who will be most affected by the NIH intramural future that we are now projecting.

III. Responses to Topics Based on WG Recommendations

Topic #1: Strengthening the Clinical Center and clinical research at the NIH

Recommendations in this area recognize the extraordinary success and future potential of the world's largest hospital facility devoted exclusively to biomedical research. The overall thrust of these recommendations is that the CC can be utilized even more effectively to conduct cutting-edge clinical and translational studies to support intramural initiatives as part of intramural-extramural collaborations. The NIH CC faces the same inflation rate as hospitals nationwide, and budget constraints affect clinical initiatives by the ICs. Thus, the NIH is in the process of developing strategies to assure stable funding of the CC in the current constrained budget climate.

Funding and Research Focus:

The CC supports the broad, diverse research missions of NIH ICs and serves as a home for investigative initiatives into the pathogenesis and natural history of human disease; the development of state-of-the art diagnostic, preventive, and therapeutic interventions; clinical investigator education and training; and programs for the safe, efficient, and ethical conduct of clinical research. Housed within the CC are exceptional scientific and technological resources that facilitate the conduct of translational and clinical research and equip clinical investigators to investigate disease across a translational continuum. The CC has been identified as a national resource and, as noted in the WG report, new initiatives have been generated to provide these resources to the extramural community (see SMRB report.)

WG recommendations in this area recognize the extraordinary success and future potential of the world's largest hospital facility devoted exclusively to biomedical research. The overall thrust of these recommendations is that the CC can be utilized even more effectively to conduct cutting-edge clinical and translational studies. NIH is in the process of developing strategies to assure stable funding of the CC, but in the current budget climate it is reasonable to assume that sufficient funds to support all eligible research protocols will not be available and that some mechanism needs to be established to assure access to all ICs that have clinical research programs and to align the resources in the CC to the scientific priorities of the ICs.

The work of IRP researchers in the CC is addressed by the following:

1. **The CC will expand its role as a center for development of precision medicine to diagnose and treat both rare diseases and common diseases that have been studied at the NIH for many years. In particular, NIH will pursue the goal of comprehensive phenotyping to complement ongoing intramural and extramural genetic studies and thereby enable the development of more effective treatments.** An emphasis on rare disease research will continue, since it has yielded a treasure trove of information about normal physiology, and for many patients with very rare diseases, the CC is a last hope for diagnosis and treatment. The ability to do extremely detailed phenotyping of patients with both rare and common diseases is a special characteristic of the CC and this capacity will be expanded to enhance the ability of the genetic arm of precision medicine to make predictions in diseases with inherent heterogeneity of expression. For example, some common cancers, neurological diseases, and mental illnesses with genetic components have complex and variable phenotypes. Comprehensive phenotypes will allow assignment of specific genotypes to these discrete phenotypes. [Appendix 2: Compilation of Common Diseases Studied in the CC; Appendix 3: Examples of Phenotyping Studies Done in the CC]. Matching such phenotypes to innovative treatment strategies is at the core of the CC's mission and the use of advanced technologies to very closely monitor treatment responses is a strength of the CC. The CC can also serve as a referral center to allow comprehensive phenotyping of human subjects with unusual genotypes determined at outside sites (see Attachment #2).

2. **The CC is the prime site for rapid response to public health emergencies, e.g. during the HIV, SARS, and Ebola epidemics.** The NIH is already the administrative home for the Public Health Emergency Research Review Board (PHERRB), an IRB dedicated to reviewing multi-site studies on emergent public health issues. Mechanisms also already exist for providing emergency funds when public health issues arise. [Appendix 4: List of Emergency Response Studies]

3. **The SDs have initiated a process to assure better alignment of research needs and priorities with resources at the CC including annual review of the CC budget expenditures by the SDs to assure that major clinical research needs are part of the CC budget so that lower priority expenditures do not exhaust limited resources.**

Training:

4. **In response to the recommendations of the Working Group, we will initiate a new program to bring MSTP students to the NIH for a 3-month clinical research elective**. Currently, the CC houses two major medical student training programs. The Medical Research Scholars Program brings 42 or more medical, dental, and veterinary students for a full year of research at the NIH. This program will be expanded with stable funding and will encompass an even more diverse student population. A second program is the Medical Student Electives Program. We appreciate that many MD-Ph.D. students spend time in medical school and in laboratories, but never have a clinical research experience. The CC Office of Clinical Research Training and Medical Education will develop a 3-month training program that exposes these students to the special clinical research environment at the NIH and provides mentoring and career counseling. All MSTP students will be invited to participate with funding support from their home institutions.

5. **Mechanisms will be developed to support a 3-month elective training at the NIH for medical and MD-Ph.D. students from minority-serving institutions that do not have access to MSTP programs.** This proposal recognizes that minority-serving institutions may not have MSTP programs, but have a medical student body eager to learn more about clinical research. These students will also be invited to participate in a 3-month clinical research experience at the NIH.

6. **NIH will actively recruit Assistant Clinical Investigators (ACI) to utilize this program as an early career training ground for a diverse group of clinical investigators.** Over the past several years, the NIH has developed a robust clinical investigator career pathway that includes Clinical Fellow programs, the Assistant Clinical Investigator (ACI) position (early independence for clinical investigators), and the NIH-Lasker Clinical Research Scholars Program. The ACI program, which provides 3-5 years of independent resources for early career clinical investigators, has been particularly successful with the great majority of its graduates going on to faculty and tenure-track clinical research positions.

7. **Strengthen NIH ACGME training programs in partnership with local institutions through formal agreements to cover personnel exchanges and appointments.**

Intramural-extramural initiatives:

8. **NIH uses the cooperative agreement (UO1) to encourage intramural-extramural collaborations in the CC. To this end, efforts will be made to expand the UO1 program by broad advertising of its availability.** The NIH has considered the feasibility of developing a clinical trials unit at the CC to provide support for phase I trials of promising new treatments conducted autonomously by extramural investigators. Such trials would be in addition to clinical trials currently conducted by intramural investigators. The practical issues of how to staff such a unit and recover the costs of the research are somewhat daunting, however, as is the issue of managing research from afar, and the strong feeling of NIH leadership at this time is that the best approach would be to support research more closely aligned with the current research activities in the CC through collaborations between existing clinical investigators and extramural colleagues, either through the mechanism of a cooperative agreement (U01), or less formal arrangements.

9. **The NIH Bench-to-Bedside Program will be redefined, and the review process and sources of funding will be revised.** Currently, most Bench-to-Bedside proposals come from clinical investigators who are seeking additional funds for initiation or continuation of ongoing clinical projects that lack funding from the IC. This approach may not necessarily select for the highest priority projects. The new **Translational Research Initiative** will specifically seek applications from basic laboratory investigators to work with clinical investigators to develop basic research findings into distinctive, novel clinical diagnostics, therapeutics, and prevention strategies; applications to translate clinical observations into new understanding of basic science by collaborations with laboratory-based researchers will also be encouraged. As is currently the case, extramural collaborators will be encouraged to participate; their participation may enhance the competitiveness of the applications.

10. **Mechanisms are being developed to allow appointments of clinical investigators at the NIH as well as at neighboring academic institutions.** It is clear that the local medical community, consisting of the Walter Reed National Military Medical Center, Johns Hopkins University Hospitals (especially at Suburban Hospital and Sibley Memorial Hospital), University of Maryland, Georgetown, George Washington, Washington Hospital Center, Howard University Medical School, and Children's National Medical Center, as well as a number of local private hospitals, offers many opportunities for meaningful collaboration and partnerships. Specific guidelines that recognize the conditions under which NIH scientific staff can have appointments at outside institutions are being developed. Discussions are underway about joint research and training programs in pediatrics, cancer research, neurosurgery, ENT, and cerebrovascular and cardiovascular disease, including joint programs with Duke and UNC that are near NIEHS.

Topic #2: Promoting Diversity

Despite significant efforts over the years to improve the pool size of persons from under-represented groups in biomedical research and to improve the diversity of its scientific workforce, the intramural research program has not succeeded in recruiting as diverse a workforce as is represented in the U.S. population, or even a representative population of biomedical researchers who matriculate from U.S. graduate, medical, dental, and veterinary schools. NIH in its extramural, grant-supported research has a similar problem, and the working group strongly recommended that the intramural program become a model and a testing ground for new ideas to enhance the diversity of the biomedical workforce.

The NIH views this issue as the need to recruit three separate, yet contiguous under-represented populations as essential to increase diversity. Each requires new creative approaches. These three efforts include: (A) recruiting junior and senior faculty members as independent scientists; (B) recruiting post-doctoral level or pre-tenure track scientists to serve as an immediate or bridging pipeline to faculty positions; and (C) increasing the pool size of undergraduate, post-baccalaureate, graduate and medical students who are being trained for or have possible interest in careers in biomedical research. All these efforts will focus primarily on U.S citizens and permanent residents.

Faculty Recruitment:

1. **Encourage the use of newer trans-NIH central recruitment tools to bring a broader diversity of backgrounds to bear on important research problems being studied at the NIH.** The current NIH-Lasker Clinical Research Scholars Program for tenure-track clinical investigators and the Stadtman tenure-track investigator programs have a more diverse applicant pool, including under-represented minorities (URM), for recruitment to the NIH and in fact have already begun to increase the percentage of URM faculty members. All competitive tenure-track searches at NIH should urge every applicant to apply to these newer trans-NIH processes to assure that all eligible candidates are made available for evaluation by all ICs. The use of these trans-NIH "cluster" recruitments has proved to be a more effective way than IC-specific searches to identify a more diverse group of talented scientists.

2. **Search committees will be trained to recognize implicit bias in the selection process and to appreciate the importance of a diverse faculty population for the solution of complex problems. Faculty members will benefit from a program of professional development, sponsorship, mentoring and advocacy for faculty to foster a climate of belonging and**

inclusiveness. These approaches will be jointly sponsored by the Office of the Chief Officer for Scientific Workforce Diversity, the Office of Equity, Diversity and Inclusion, and the Office of Intramural Research. These organizations will work with the SDs to assure success in recruitment and faculty development.

3. **For difficult to recruit senior personnel or PIs who will receive independent research resources, a central fund of one- time start-up funds and research space should be available to enhance recruitment and encourage trans-NIH hires.** In addition to the full support of ICs to recruit outstanding scientists, funds should be provided via either the Office of the Chief Officer for Scientific Workforce Diversity or the Office of Intramural Research rather than from the IC intramural budgets (also see below). Such funds are especially useful, based on limited past experience, to purchase large equipment and renovate labs and to encourage multi-IC recruitments; these one-time funds become incentives to ICs to pursue hiring such PIs. Priority for limited research space will be given for these difficult-to-recruit personnel.

4. **NIH will develop a senior sabbatical program to bring a diverse group of senior faculty from networking institutions to conduct research with collaborators in our laboratories and clinics.** This sabbatical program, supported by all ICs, for faculty from outside institutions will serve as a source for future recruitments as well as referrals of trainees and potential faculty from their home institutions to initiate collaborations with intramural investigators at NIH or in the academic institution.

Postdoc Recruitment:

5. **A prestigious and diverse group of 20 post-docs per year will be competitively-recruited and supported for up to 5 years as NIH Director's Fellows using a central pool of funds to encourage IC investment in these fellows.** This will create, at steady-state, 100 such post-docs throughout the NIH ICs in all areas of intramural research. The goal will be to give graduated independence during these post-doctoral years to make them ideally suited to compete for pre-tenure track or tenure-track positions (see #6 that follows). Such competitively- and centrally-recruited postdoctoral fellows could also be utilized in the pursuit of shared research opportunities as enumerated in Attachments #1 and #2.

6. **A new competitive, entry- level independent laboratory research position at the NIH, called "Assistant Laboratory Investigator" (ALI) with a new professional designation to encourage accelerated, graduated independence of early career scientists.** This designation signifies the predominant nature of the research conducted and would be similar to the "Assistant Clinical Investigator" position that has been

extremely successful in aiding the transition of clinical fellows into independent research positions. The competitive process for ALI's would be open to outside and internal applicants who have been successful as post-doctoral fellows who are engaged mainly in laboratory research. Initial appointments will be for 3 years with extensions up to 5 years (within the existing NIH 8-year rule to discourage long delays in career development). Resources might include the support for the ALI's appointment as a research fellow, a post-baccalaureate fellow, equipment and a modest research budget. It is anticipated that following a period of support as an ALI, candidates will be more likely to compete successfully for tenure-track positions at the NIH and elsewhere. Some ALIs could be recruited to work on special initiatives such as those described in Attachments #1 and #2.

Increasing the pool size of undergraduates, post-baccalaureate, graduate students and medical students interested in biomedical research:

NIH has been a leader in piloting programs with demonstrated success in recruiting trainees into biomedical research, and providing mentoring and career development leading to successful scientific careers. These include the Community College Program, the NIH Summer Internship Program, the Undergraduate Scholarship Program, the NIH Post-baccalaureate Program and the NIH Academy, the Graduate Partnership Program, and the Medical Research Scholars Program (MRSP). Although each of these has shown some success in recruiting URM trainees, efforts will be re-doubled to attract a more diverse group of eligible candidates, to provide outstanding mentorship and career development, and to guide and track students after they leave the NIH.

In addition to these central programs, many NIH ICs have developed training programs with the goal of improving diversity of their trainees and future faculty. These include INRO (NIAID's introduction to research careers) and ICRC (NCI's introduction to cancer research careers). These programs include a series of introductory lectures from faculty and the possibility of a summer research experience and/or post-baccalaureate training.

7. **NIH will add a summer internship program for high school students from disadvantaged backgrounds, known as the high school science training enrichment program ("Hi-STEP") and will expand clinical research training programs for medical students.** As an adjunct to our Summer Internship Program for which there are many URM candidates, a new "Hi-STEP" program will be initiated this summer (2015) as a 3 week introduction to biomedical research for interested, but laboratory naïve local high school students.

8. **NIH will expand its one-year research program for medical students (the Medical Research Scholars Program, MRSP) and seek more**

applications from students from disadvantaged backgrounds. The MRSP with support from the Foundation for the NIH, the NIH SDs, and the National Institute for Minority Health and Health Disparities, will expand and improve its diversity profile.

9. **NIH will develop a pilot graduate partnership program in collaboration with one or two outstanding institutions that foster quantitative scientific training of students from disadvantaged backgrounds.** The intent of the program is to attract students with training in physics, engineering, chemistry, and computer science to seek graduate degrees in biomedical research areas, with a particular emphasis on data sciences. Initially 10 students will be recommended for this program which will include intensive mentoring and career counseling.

Topic #3: Recruitment and appointment of NIH scientists

The future success of the intramural program depends entirely on our ability to recruit and maintain a talented, creative, and diverse group of scientists.
As a result of the 1994 Marks-Cassell report on the IRP, the NIH dramatically expanded its outreach to improve recruitment. Accordingly, 60% of PI recruitments are from outside the NIH. However, for certain positions (lab-based tenure-track Investigators, and especially Assistant Clinical Investigators, Staff Clinicians and Staff Scientists) a substantial percentage of the scientists who are hired have completed some training at the NIH. The goal is to expand the pool of potential candidates to enhance intellectual and demographic diversity at the NIH and assure a vital scientific future in the IRP. In this spirit, the following efforts are proposed:

1. **Expand the use of trans-NIH recruitment activities such as the Stadtman and NIH-Lasker Clinical Research Scholars programs.** Currently, approximately half of NIH's tenure-track hires occur through IC-specific recruitments. In general, the latter efforts are more likely to find internal candidates than the broader, trans-NIH efforts, and highly qualified candidates who do not match with a specific IC do not have the opportunity to be considered by other ICs. Every candidate for an IC-specific position will be asked to apply through the central process for consideration by the larger community of NIH recruiters.

2. **Enhance advertising and outreach for existing positions.** Specifically, the availability of Staff Scientist and Staff Clinician positions at the NIH will be publically announced on a central website**.** Interested candidates will apply to the IC-specific contact. The selecting official will be required to review applicants whose expertise falls within the research area of interest; the deciding official will assure that among all of the candidates the most qualified was chosen. For Staff Scientists/Staff Clinicians who manage cores

or control significant research funds, individual searches with search committees are required. Each IC will develop guidelines, approved by the DDIR, for recruitment of Staff Clinicians and Staff Scientists.

3. **The Assistant Clinical Investigator (ACI) Program will be expanded and more outside recruitment will be conducted to assure both diversity and high quality of the candidates for this entry level clinical investigator PI position.** The ACI position has proved to be one of the most successful additions to the tools available to the IRP to support careers in clinical research. Currently, the majority of ACIs are former clinical fellows at the NIH who have excelled in research and are identified as future stars. The appointments are made on a competitive basis, but national/international searches are not currently required. Efforts to recruit from outside the NIH will be redoubled, the existence of this program will be advertised, and a website will be developed for early-career clinical investigators to submit their applications.

4. **We have concluded that the most sustainable size of the NIH workforce is the population of scientists who can be housed within the NIH Bethesda-area facilities, and at outlying facilities in RTP, Frederick, Baltimore, RML, Detroit, Boston, and Phoenix.** The outlying facilities each serve mission-specific purposes for their ICs, and are sized to reflect these requirements. At NIH central, there has been a proliferation of off-campus laboratories, and every effort should be made to move these back to campus if they don't require industrial-level facilities. At the same time, replacement and renovation efforts would not be designed to increase space but rather to support safe and efficient operations in a steady state.

   The current campus encourages inter-IC interactions, and the limitations of space serve as a way to define the envelope of science that can be appropriately conducted in the IRP. One of the great strengths of the IRP is its scope of science, and the collaborative way in which NIH scientists interact. By limiting intramural to space available on the NIH campus, these interactions can be encouraged and the need for further growth beyond the current 11% of the NIH budget avoided. Clearly, however, the future size of the IRP will also reflect budgetary constraints and scientific opportunities.

Topic #4: Supporting new research opportunities

The intent of the funds budgeted for research in the IRP is to support new innovative and high-impact research. On occasion the need arises for additional funds to take advantage of special opportunities to recruit a new investigator, purchase an expensive piece of equipment, or stimulate a worthwhile field of science that may be underfunded. In preparation for this review, the ICs developed

reports that included the mission and goals of the IC IRP for the next decade, and these were given to the Working Group to use in its analysis. These reports are analogous to required periodic Blue Ribbon Panel Reports for which they take their place for the next review cycle. It is expected that these IC-specific long-term planning reports will form the basis of future new initiatives at the IC level.

In addition, to implement the specific Working Group recommendations, the NIH will take the following actions:

1. **A standing committee of scientific experts drawn from the extramural research community and outstanding intramural investigators will be established as a subcommittee of the existing Advisory Committee to the Deputy Director for Intramural Research.** This committee will meet annually and issue an informal advisory report on new exceptional opportunities in biomedical research, with an emphasis on those areas that can be best pursued in the IRP. This group will be chosen by the NIH Director and chaired by the DDIR. In addition to providing overall advice about possible exceptional research opportunities and areas of science that could benefit from workshops and meetings at the NIH, members of the group will be asked from time to time for advice about specific projects recommended for funding from the central fund managed by the DDIR. The trans-NIH initiatives proposed by the Scientific Directors (Attachments #1 and #2) could be reviewed initially and periodically by this outside group of experts for suitability to benefit from the IRP environment.

2. **Each IC will provide a mechanism for competitive supplementary funding of exceptional scientific opportunities within their intramural programs.** This recommendation is predicated on the availability of funds for these initiatives within each IC's intramural program. Such funds can be obtained by recovering funds during turnover of research resources from principal investigators who have retired or left, and by savings realized by administrative efficiencies such as improved procurement practices and reduction in off-campus space to achieve reductions in rental costs. ICs may choose to pool such funds to increase their scope and impact. [Appendix 5: List of Projects Stimulated by IC Funds]

   A central fund will be developed to be managed by the DDIR for the purpose of supporting recruitments of hard to recruit scientists, to help purchase expensive equipment that will be shared by several PIs, to encourage the formation of teams to tackle difficult scientific problems, and to support shared scientific opportunities. The source of these funds, eventually totaling up to 1% of the IRP budget, is still under discussion, but several ideas have been advanced to create this common pool of funds including:
   - A modest tap on any increase in intramural funds that exceeds that necessary to pay personnel costs and other infrastructure costs;

- A line-item appropriation as was done for the NIH Director's Discretionary Fund and the Intramural AIDS Targeted Antivirals Program;
- Contributions from the ICs;
- A percentage of the savings realized from trans-NIH administrative changes that improve efficiencies such as (a) trans-NIH procurement activities to allow better pricing; (b) reduced rental costs by moving off-campus laboratory space back to the main campus; (c) savings in maintenance costs on current aging animal facilities in the 14/28 and Poolesville complexes by constructing a new **Center for the Biology of Disease** with replacement animal facilities that require less maintenance; (d) alternative management of intramural IT-enterprise activities to reduce overhead costs and improve service, and; (e) a percentage of royalties received by the IRP. The goal would be to return some of the savings to the organization responsible for the savings and some to the central fund without tapping any of the funds that are currently used to directly support research in the IRP.

Topic #5: Enhancing intramural-extramural collaborations and team science

NIH intramural scientists have a long history of collaborating with their extramural colleagues. This is usually done on an informal basis, but NIH also established the cooperative agreement (UO1 grant) to enable government employees and extramural grantees to work together on projects in which they each play a significant role. Most recently, this mechanism has been used to support the "Opportunities for Collaborative Research at the NIH Clinical Center," and 10 UO1 projects are currently ongoing after the first year of this program (http://cc.nih.gov/translational-research-resources/U01/index.html).

The conduct of team science at the NIH has the potential to enhance productivity and address difficult problems that require multidisciplinary approaches. Given the collegiality of NIH scientists, there is a strong history of bottom-up spontaneous creation of teams as well as a more top-down creation of teams by individual ICs as a means to address specific emergency public health issues (e.g. the epidemiology groups that conduct population-based research, or the teams that respond to public health emergencies such as the recent Ebola crisis). NIH will continue to encourage both *de novo* formation of teams and encourage scientists who work in existing teams by recognizing their contributions during their regular reviews and by providing support as needed (see Topic #7 below).

ICs have developed a heterogeneous array of administrative "best practices" to support synergistic programs among ICs and outside institutions; it may be

beneficial to codify consistent practices across ICs to assure efficient administrative processing. To implement these recommendations, the NIH will do the following:

1. **A team consisting of members of the neuroscience BSCs, representatives of neuroscience leadership at the NIH, and support personnel will be assembled to develop metrics to evaluate in an ongoing fashion the effect of co-habitation of neuroscientists in the new Porter Neuroscience Center.** The goal of this study will be to help guide future space assignments at the NIH to determine whether bringing together scientists in related disciplines from multiple ICs stimulates collaboration, team approaches, and new advances. An alternative hypothesis is that most major advances are made at the interface of different disciplines, and isolating scientists in a research area would make such advances less likely. As suggested by the Working Group, such a study would be valuable in guiding future space assignments at the NIH (and elsewhere).

2. **NIH currently has effective mechanisms to respond to public health crises. However, this recommendation suggests that we could improve the efficiency of our response to such public health emergencies**. A working group with expertise in this area will be assembled to make specific recommendations. They will begin with "Lessons Learned" during the recent Ebola epidemic.

3. **The modest pools of funds created in the ICs and centrally at the NIH can be used to stimulate intramural-extramural collaborations.** Other than informal collaborations between intramural and extramural scientists, there are currently two major mechanisms by which collaboration occurs: (a) the U01 (cooperative agreement) used for various types of IC research and (b) the bench-to-bedside program (redefined as the Translational Research Initiative under Topic #1, item 9, above) in the CC in which translational research projects can receive modest support with a supplement for an extramural collaborator. Although the extramural collaborator receives extra grant funds for the U01 project, the intramural collaborator must often use existing laboratory intramural funds to support his/her component of the research. In some cases, this can be a disincentive to engage in extensive intramural-extramural collaborations. Having a modest source of funds to encourage the intramural component of such collaborations would encourage them. In addition, extramural investigators and/or academic centers may view U01 grants as less prestigious than R01s, despite their long history and the fact that the review process for both grants is identical. An educational effort will be undertaken to describe this opportunity and assure that extramural investigators are enthusiastic about intramural-extramural collaborations via the U01 mechanism.

4. **NIH has hosted over 125 scientific meetings during the past 2 years (see Appendix 6: Meetings Hosted at the NIH). NIH will continue to be an**

important venue for such meetings. The subcommittee of scientific experts established as part of this implementation plan could also be called upon to recommend such meetings as the need arises (see topic #4, item 1, above). New scientific initiatives could take advantage of the convening function of NIH to draw together intramural and extramural partners to discuss and synthesize novel scientific approaches.

5. **In collaboration with the NIH Associate Director for Data Sciences (ADDS), the NIH intramural program will develop a plan for data storage and management as well as enhanced computational capacity. This plan will be presented to the Scientific Directors and IC Directors for review and possible funding.**

Topic #6: Optimal use of shared resources at NIH

Currently, shared research resources at the NIH are of five types, ranging from those for which funding is broadly shared by multiple ICs to those with IC- or Lab/Branch-specific funding: (1) broadly shared resources/facilities are managed by the Shared Resources Subcommittee (SRS) of the Board of Scientific Directors in which each IC, in proportion to the size of their IRP, contributes 25% of the cost of the resource, and the remaining 75% is obtained through service charges; (2) enterprise systems such as IT-support services are supported through a tap to all ICs that covers 100% of the cost of the service; (3) shared cores/facilities are funded by multiple institutes that participate to establish and manage the core; (4) ICs fund specific cores/facilities, some of which are maintained by central funding and some of which work on a fee-for-service basis, and; (5) Labs or Branches fund specific cores/facilities developed to serve the needs of their specific research program. Access by all intramural scientists to any of these shared resources is possible, but in practice access is only guaranteed for all NIHers for cores in categories (1), (2), and (3).

1. **A complete catalog of all cores at the NIH will be developed and made available through an intramural website. Cores will be available to all NIH scientists on a space-available basis.** The new NCI website CRex (https://nci.assaydepot.com/) provides a possible structure on which additional NIH cores could be added. Expansion of cores will be encouraged if the need exceeds capacity in accord with appropriate business models. In addition, efforts will be made to increase efficiencies of cores including extending hours of availability.

2. **All PIs will be made aware, on a regular basis, of the existence of this catalog of cores and the development of new cores will be advertised.**

3. **Since any single IC would not be expected to cover the costs for use of an internal core, a pay model will be developed to allow easy transfer of funds from one IC to another to cover the cost of services.**

4. **The SRS model for the more expensive shared cores will be extended to include shared large-equipment purchases and development of new cores as novel technologies emerge.**

5. **We will survey current "best practices" in the use of electronic notebooks and decide on several pilot projects to explore the feasibility and utility of specific models.** The NIH IRP has attempted to develop standards for the use of electronic notebooks, but commercial products have to date fallen short of expectations. However, based on the WG recommendation, and the general need to convert current laboratory records to electronic media, several independent projects will be undertaken. The ultimate goal is to have all records available electronically, and to have both "inward facing" and "outward facing" components that allow primary data to be made publicly available in a useable format when appropriate or as required by NIH policy on release of large datasets.

6. **The NIH currently reports, on an annual basis, approximately 30 million biospecimens that are stored in repositories in the IRP.** Each PI must report all biospecimens as part of the annual report process and this information is available through the NIH Intramural Database. Any scientist who wishes to have access to biospecimens that are available in amounts that can be shared can learn through this public site which scientists at NIH have such biospecimens and contact them directly to arrange appropriate transfer of materials.

7. **Core facilities of value across the NIH will be given priority for space as it becomes available.** Space at the NIH is quite limited and occasionally the development or growth of an important core is restricted by the availability of space. Priority will be given to trans-NIH initiatives and cores of mutual benefit to scientists in multiple ICs.

Topic #7: Improvements in the scientific review process

Over the past 50 years, NIH has honed its scientific review process to assure rigorous review at the IC level based on appraisals by Boards of Scientific Counselors consisting of world-class scientists conducting primarily retrospective, person-(not project-)oriented reviews.

After considerable deliberation, the NIH leadership has concluded that centralizing the NIH review process strictly along categorical research lines would not achieve

the goals of the recommendation to increase the stringency of the process and would instead undermine some of the distinctive features of the intramural program which have proven so successful in catalyzing creative, high-impact science. Each IC intramural program has both a distinct mission and a portfolio of independent research activities within each IC that are expected to support the IC's mission; hence, central review might harmonize the standards for review in specific categorical areas, but would not consider the variety of contributions of a scientific program to an individual IC. Furthermore, most Laboratories and Branches at the NIH are structured to create interdisciplinary teams of scientists who would be reviewed in a centralized process by different experts (e.g., structural biology, cell biology, immunology, neurobiology, genetics, etc.). As a result, it would be difficult to evaluate the overall contributions of the Laboratory or Branch, which currently occurs readily by multi-expert review at the IC level.

However, there is a need to constantly perfect the review process, especially as science changes, and in the spirit of the recommendations made by the Working Group, the NIH will introduce the following changes into the existing process:

1. **To achieve the goal of a comparable level of rigor in the review of all NIH Principal Investigators, a list of all BSC members will be provided to the chairs of the BSCs who choose *ad hoc* members for their committees, and thus the names of experienced experts who have passed a central review process (see item #2 below) will be made available and encouraged on an optional basis.** This approach will provide cross-fertilization of expertise throughout the NIH, and will assure more uniform standards of evaluation, while still supporting the mission-specific needs of each IC.

2. **The current process of rigorously vetting all BSC members centrally by the DDIR will continue as recommended in the 1993 "Report of the External Advisory Committee of the Director's Advisory Committee."** This process includes assurance that all BSC members maintain world class research programs or have appropriate scientific oversight responsibilities in their home institutions, and requires that at least 1/3 of the BSC members in each IC have a primary source of funding that is not from the IC whose scientists are being evaluated. [Appendix 7: Sample Qualifications of Current BSC Members.]

3. **The chair of each BSC in consultation with the IC Director will choose *ad hoc* BSC members as needed for subject-matter expertise.** This approach assures that neither the Principal Investigator who is being reviewed, nor the Scientific Director who is the recipient of the advice, unduly influences the review process.

4. **At the annual meeting of the BSC chairs, best practices for review will be discussed and promulgated as deemed appropriate.** These requirements will be clearly stated in a revision of the "Review of Intramural Research:

Orientation Guidelines for Boards of Scientific Counselors" and will be incorporated into all IC-specific review processes.

NIH appreciates that there has been considerable variability in the review of Staff Scientists and Staff Clinicians at the NIH. While the current requirement for quadrennial review is followed by all ICs, the rigor and consistency of this review is variable across the NIH. Accordingly,

5. **All Staff Scientists will be rigorously reviewed every four years by the promotion and tenure committee of each IC or by a special committee established at the IC level for this purpose.** Guidelines for this review will be developed by the Scientific Directors.

6. **All Staff Clinicians will be rigorously reviewed every four years by a process that has been established by the IC and vetted by the DDIR and the Deputy Director for Intramural Clinical Research.** These reviews will include the BSC or a high-level IC committee in cases where the Staff Clinician controls independent resources, and will be appropriately constituted for review of Staff Clinicians whose work is primarily clinical support and/or training.

7. **The review processes for Staff Scientists, Staff Clinicians and all Principal Investigators (tenure and tenure-track) will include explicit criteria for success in team science, as appropriate.** By definition, most Staff Scientists and Staff Clinicians are engaged in team science, as are many Principal Investigators (see section on team science below). Although team science is encouraged in the ICs, it is not required. For principal investigators, the Central Tenure Committee already has criteria for tenure that include success in team science. The Scientific Directors will strengthen guidelines to further define and evaluate team science at the IC level and provide these to the BSCs responsible for reviewing research at the NIH.

Appendix 1: Topics #1-7 Based on Specific Recommendations in the WG Report.
Appendix 2: Compilation of Common Diseases Studied in the CC
Appendix 3: Examples of Phenotyping Studies Done in the CC
Appendix 4: List of Emergency Response Studies
Appendix 5: List of Projects Stimulated by IC Funds
Appendix 6: Meetings Hosted at the NIH
Appendix 7: Sample Qualifications of Current BSC Members

Attachment 1: Shared Scientific Opportunities
Attachment 2: Creating and Using New Technologies at the NIH