National Human Genome Research Institute

Evaluation of the Centers of Excellence in Genomic Science (CEGS) Program

FINAL REPORT

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A program funded by the
National Human Genome Research Institute

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Context and evaluation aims

The National Human Genome Research Institute (NHGRI), part of the U.S. National Institutes of Health (NIH), is committed to sharing details of its organization and research programs with the scientific community and the public. As part of an increased effort to assess outcomes of its programs, NHGRI performed a mixed-methods evaluation of one of its flagship extramural grant programs, the Centers of Excellence in Genomic Science (CEGS, https://www.genome.gov/Funded-Programs-Projects/Centers-of-Excellence-in-Genomic-Science). Since the inception of this program in 2000, 31 Centers have been established and supported with the explicit aim of stimulating the development of novel genomics approaches for conducting biomedical research using the datasets and technologies developed by the Human Genome Project and beyond.

In contrast to individual, investigator-initiated research (e.g., that supported by "R01" grants), CEGS grants fund development of new concepts, methods, approaches, tools, and technologies that utilize the expertise of multidisciplinary groups of investigators as well as substantial infrastructure. The Centers are also required to develop plans for outreach, thereby diversifying researchers and research participants, and to share resources with the broader research community. To date, the Centers have been characterized by a high degree of novelty, strong potential for making a major impact on the field, integrated approaches, and the ability to take scientific risks in pursuit of a significant advance (i.e., "high-risk, high-reward"). Both technology development and the linking of technologies to biological challenges have proven to be fundamental to the CEGS program.

The aims of the evaluation were to assess:

1. What did the CEGS program achieve from 2001 – 2022 as a result of key program activities?
2. How did the program influence genomic science knowledge and utilization of genomic research?
3. How did program funding impact grantees' careers?
4. What have been the strengths (outcomes and achievements) of the program? Are there suggestions/opportunities for improvement?

Summary of program evaluation findings

The CEGS grant mechanism has funded breakthrough techniques, resources, and approaches that have transcended genomics to stimulate many areas of biomedical research.

CEGS grants have 14 times more patents than subject-comparable individual investigator grants, in alignment with their mission to develop new technologies and tools.

CEGS grants produced more papers and more highly cited papers per grant than comparison R01 grants, but fewer papers per $1M of funds. This is likely due in part to the additional requirements for infrastructure and outreach for CEGS grants.

Scientists at all educational levels felt that the CEGS grants contributed to their careers and provided them opportunities that would not have been possible otherwise. An analysis of grant applications and awards demonstrated that CEGS grants enabled investigators to maintain comparable levels of success to other individual investigators.

Relative strengths of the CEGS grant mechanism include the high-risk, high-reward nature and focus on technology development with links to biological questions. Suggestions for improvement include widening the focus beyond nucleic acids, increasing training opportunities and resources, and developing a smaller/shorter version of a similar mechanism.

Methodology

The program evaluation used a mixed-methods evaluation design, detailed in Figure 1 and Appendix.

Teams from NHGRI and Ripple Effect, Inc. performed a quantitative portfolio and bibliometric analysis of both 31 CEGS grants and a group of 245 comparison R01 grants, by abstracting and reviewing data from multiple databases including NIH IMPACII, biomedical publications databases, the US Patent Office (USPTO), and Google Patents. The comparison group of R01 grants were selected using a match of overall direct funding from NHGRI in each year and by general subject area.

NHGRI and Ripple Effect administered a survey to researchers on CEGS grants from 2001-2023, not including any of the main principal investigators, to collect data on program outcomes, impact, strengths, and limitations. Ripple Effect then reviewed and inductively coded responses to open-ended survey questions to identify key concepts and themes that emerged from the data.

NHGRI conducted semi-structured qualitative interviews with 28 principal investigators, focusing on seven questions about successes/challenges from their own CEGS grants and opinions on the program as a whole. The NHGRI team then analyzed the interview transcripts through a coding framework to determine emergent themes, and integrated those themes with findings from the quantitative phase.

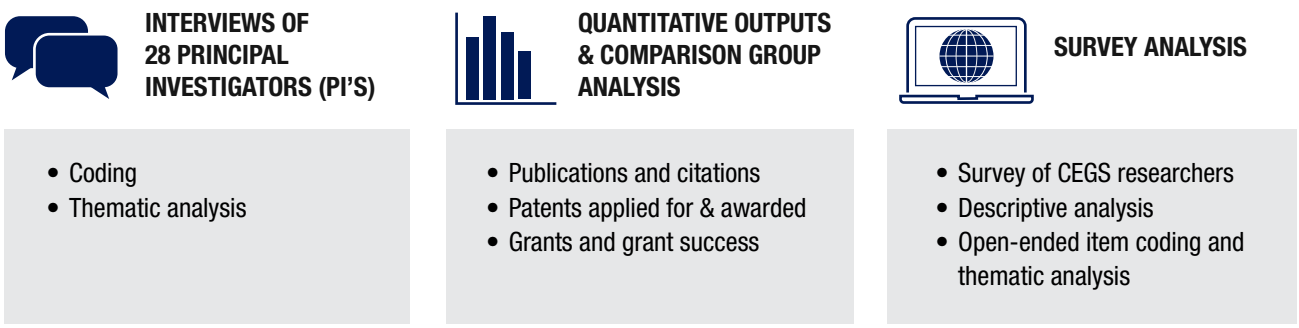

Figure 1: Summary of program evaluation methodologies used.

	CEGS Grants	Comparison R01 Grants
Number of Grants	31	245
Number of Unique Contact PIs	36	224
Cumulative Direct Funding	$387 million	$374 million
Average Direct Funding Amount	$12 million	$1.5 million
Average Grant Length	5 years	3 years

Table 1: Comparison of CEGS with a selected group of NHGRI-funded R01 grants. The comparison group of R01 grants were selected using a match of overall direct funding from NHGRI in each year and by general subject area.

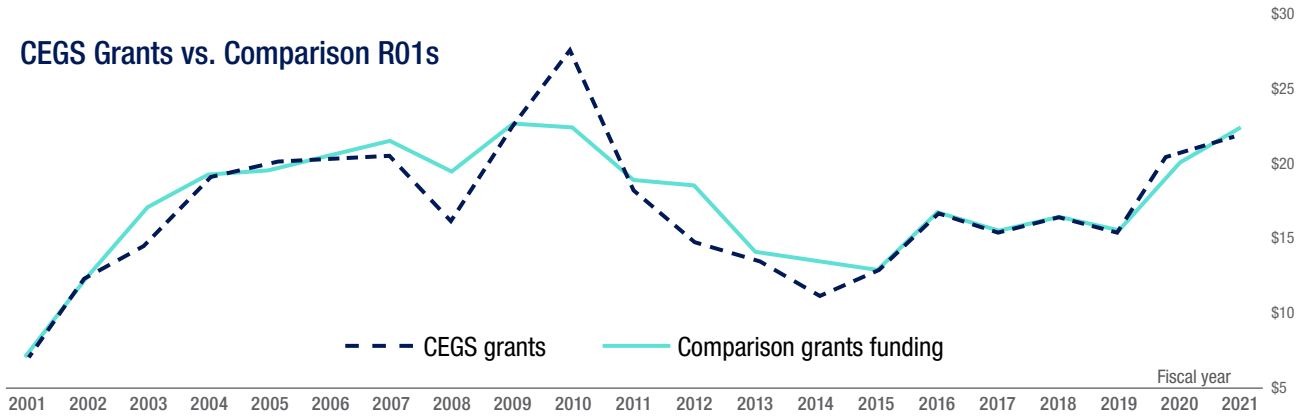

Figure 2: Relative direct funding levels (in millions of US dollars) for the CEGS and comparison R01 groups of grants used in these analyses, over time from 2001-2021. Disparities in the years 2009-2011 stem from the availability of extra funds provided by the American Recovery and Reinvestment Act of 2009.

Publications	Patents	Grants
Publications produced	Number of patent applications	Applications (Type 1)
Citations received	Number of patents awarded	Awards won (Type 1)
Journal Impact Factor (JIF)	Percent of patents expired due to non-payment of fees	R01 applications (Type 1)
Journal Citation Index (JCI)	Patent citations	R01 awards won (Type 1)
Relative Citation Ratio (RCR)		Direct funding (All award types)
NIH percentile		Total funding (All award types)
Citation lag		

Figure 3: Analysis metrics used for quantitative comparison of CEGS and comparison R01 groups of grants.

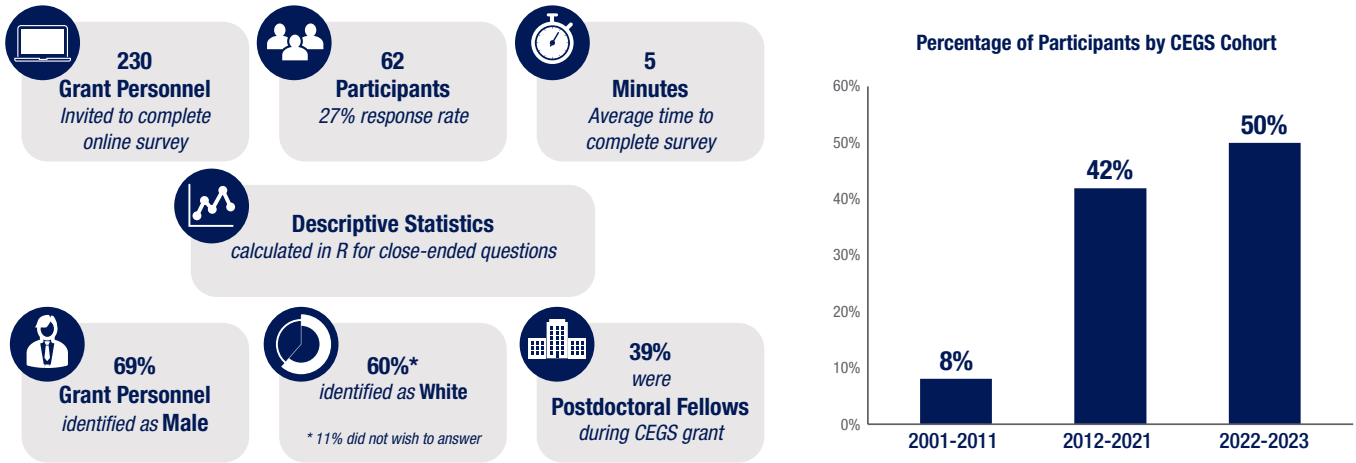

Figure 4: Survey participant demographics by majority answers and relative time cohort.

What did the CEGS program achieve from 2001 – 2022 as a result of key program activities?

- A prominent finding from the survey analyses indicated that most survey participants felt that genomic advances had been achieved by their CEGS grant projects (Figure 5). Researchers reported that their CEGS projects contributed to genomics research in all areas targeted and supported by the CEGS program, including the development of new methods and technologies, new understanding of biological problems, new data analysis methods for genomics, and new concepts in genomics.

- Survey results further reinforced this conclusion: when participants were asked to define advances in genomics due to their CEGS grant, they detailed the new techniques that had been developed, including new genome-analysis and proteomics methods (Figure 6).

- Selected techniques, resources, and approaches developed from CEGS funding are listed in Box 1 (with more data in evaluation question 2).

- When asked to name the biggest success of their grant, CEGS principal investigators consistently named new technologies, methods, resources, and approaches that the grant enabled them to develop and disseminate (Figure 7). Principal investigators also pointed to the freedom to take risks, change biology or create new fields, link biology and technology, create new collaborations, overcome difficulty/challenges, and train other researchers.

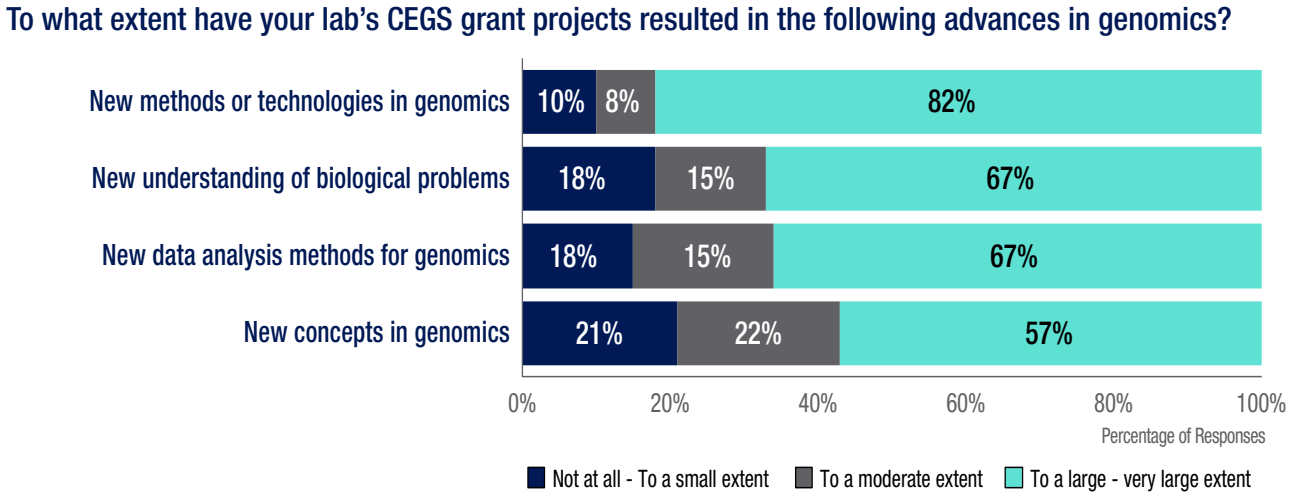

Figure 5: Results from the CEGS researcher survey. The four categories of new advances in genomics come directly from previous CEGS program announcements.

"..RNA-bound proteins resulted from the project originally geared towards DNA-protein interactions."

"...Population-scale genome analysis efforts for various consortiums."

"... further development of new data analysis methods integrating various 'omic data types."

Themes	
Proteomics	5
Genomics	4
Genome Editing	4
Single Cell Omics/Organelle Multiomics	4
Cellular/Sub-Cellular	2
Community Engagement	2
Transcriptomics	2

Figure 6: Themes present in responses by survey participants, when asked for specific advances in genomics due to their CEGS grant. Specific researcher-provided quotes are on the left.

Box 1 CEGS funding contributed to breakthrough techniques, resources, and approaches, including:

Techniques

- RNA-Seq
- Single-cell ATAC-Seq
- Perturb-Seq
- Orthogonal Cas9 proteins used in parallel for genome editing

Resources:

- Human Cell Atlas
- Atlas of Variant Effects
- Collaborative Cross
- Stickleback model system

Approaches:

- Single-cell genomics
- Epigenetic epidemiology

Figure 7: Themes from responses given by principal investigators of the CEGS grants during qualitative interviews to the question "What was the biggest success of your CEGS?"

How did the program influence genomic science knowledge and utilization of genomics research?

Publications and citations

- CEGS-funded research was reported in 1,871 publications between 2001 and 2021 (Figure 8). These publications were cited a total of 251,112 times by the end of 2022.
- CEGS-supported publications had: (1) a median relative citation ratio (RCR) of 1.6, meaning those articles received 60% more citations than other NIH-funded articles published in the same fields and in the same years; and (2) a median NIH percentile of 68%, meaning those articles received more citations than 68% of other NIH-funded research articles (Figure 9).

Publication Characteristic	CEGS Grants (n=31)	Comparison Grants (n=245)
Number of Unique Publications	1,871	4,746
Number of Publications Per Grant (Median)	39	12
Average Cost of Publication	$206,612	$78,850
Publications per $1,000,000	5	13

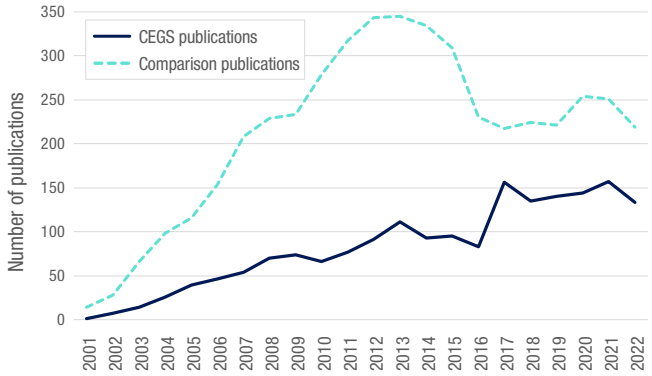

Figure 8: Publication metrics for CEGS and comparison grants. On the left is a table comparing number of publications and other metrics, and on the right is a figure showing the relative number of publications from each group for each year from 2001-2022.

Citation Metrics	CEGS Grants Publications (n=1,871)	Comparison Grants Publications (n=4,746)
RCR (Median)	1.6	1.2
NIH Percentile (Median)	68	57
Citation Lag (Median)	119 days	154 days
JIF (Median)	13	9
JIF Percentile (Median)	93	89

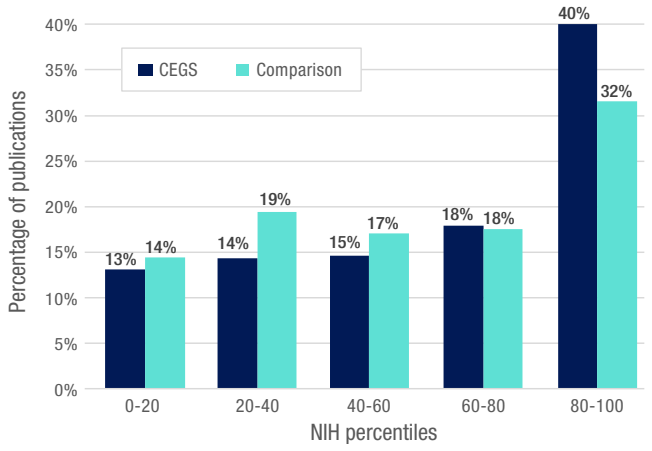

Figure 9: Additional publication metrics for CEGS and comparison grant groups. On the left is a table with RCR (relative citation ratio), NIH percentile (percentile rank of RCR compared to all other NIH publications), citation lag (days from publication to first citation), JIF (journal impact factor) and JIF percentile (ranking journals on a 0-100 scale by JIF). On the right is a graph of the NIH percentile measures by percentage of publications for each type of grant.

- The 31 CEGS grants produced a median of 39 publications per grant, and these publications received a median of 36 citations. The selected group of 245 comparison R01 grants, with similar topics and a similar amount of direct funding, produced a median of 12 publications per grant, and these publications received a median of 31 citations.
- Publications that cited CEGS grants were published in journals with higher impact factors than the publications which cited the comparison R01 grants. The median Journal Impact Factor (JIF) percentile for journals that published articles that acknowledged CEGS grants was 93, whereas the median JIF percentile for published articles that acknowledged the comparison R01 grants was 89.
- When calculating funding-adjusted bibliometrics, CEGS grants produced 5 publications per $1M in direct funding compared to 13 comparison R01 publications per $1M in direct funding. CEGS grants publications received 650 citations per $1M in direct funding compared to comparison R01 publications that received 2,004 citations per $1M in direct funding.
- These results are consistent with a specific quote from one principal investigator who said, "in terms of changing direction of science, I think that's where [the CEGS] was successful. I think R01s are great for basic science, you know, crank out results. I mean, my lab has mostly run on R01s throughout my career. And I really think, you know, bang for buck, you probably get more per dollar in terms of productivity. But I don't think you change things that way."

In summary, the CEGS grants produced more papers and more highly cited papers per grant than comparison R01 grants but fewer papers (and citations of those papers) per $1M of investment. This is likely due in part to the additional requirements for infrastructure and outreach for CEGS grants.

Patents and transformative results

- The CEGS grants were cited in a total of 102 pending patent applications and 126 patents that were awarded; these patents received an average of 53 citations from other patents. The comparison R01 grants were cited in 36 pending patent applications and 96 patents that were awarded; these patents received an average of 27 citations from other patents.
- Sixty five percent of CEGS grants had at least one patent, and the CEGS grants as a whole had an average of 7.4 patents per grant. 16% of the comparison R01 grants had at least one patent, and the comparison R01 grants as a whole had an average of 0.5 patents per grant.
- Principal investigators praised the CEGS program for enabling science that transcends a narrow genomics focus. For example, one person stated that with an individual R01 grant, "you don't think about what the problem [is] in front of the community, right? The CEGS basically asks you to solve the problem in front of the community." Another suggested, "Top success? I would say it was the ability to partner with several other laboratories and researchers to do science that none of us probably would've been able to do alone." A third commented that, "I think that's been a huge boon to genomic science. That's the kind of funding that I find most useful actually, is when there's an opportunity to swing for the fences. Do science that, you know, may not necessarily be successful, but if it does it's going to change things. And even if it's unsuccessful in its original goals, you know that interesting discoveries will come from it."
- Methods developed with CEGS funding have gone on to be widely used by the biomedical research community, with one specific measure being their use in awarded NIH grants studying multiple medical conditions and funded by multiple NIH institutes/centers. Two examples with this measure are shown in Figures 10A-C for RNA sequencing (or RNA-Seq); and Figures 11A-C for single-cell Assay for Transposase-Accessible Chromatin using sequencing (or scATAC-Seq).
    - The development of RNA-Seq was supported in part by grant P50HG002357, which funded a CEGS from Fiscal Years 2001-2012. RNA-Seq was first mentioned in this grant's non-competing continuation application in 2008, with critical papers being published from this grant in 2008 and 2009. For example, Figure 10C demonstrates that RNA-Seq has gone from only being included in awarded NHGRI grants in Fiscal Year 2008 to being included in grants funded by nearly every NIH institute/center by Fiscal Year 2023.
    - The development of scATAC-Seq was supported in part by grant P50/RM1HG007735, which funded a CEGS from Fiscal Years 2014-2023. The technique was first mentioned in awarded NIH grants in 2014, including in this CEGS grant. The first two papers mentioning the technique were published in 2015, one of which came from this CEGS grant.

> *"I think the high-risk, high-reward aspect of CEGS and just the general vibe it sends out is one of the crown jewels in the entire NIH system."*
>
> -CEGS principal investigator

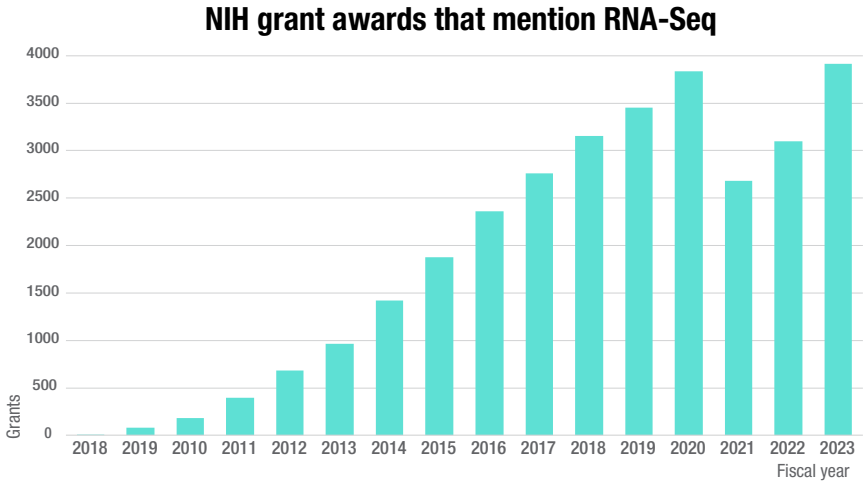

Figure 10A: NIH grant awards that include the use of the RNA-Seq technique by fiscal year. The number of grants using "RNA-Seq" for each fiscal year was determined by using NIH's iSearch Grants tool and the following filter criteria: NIH awarded grants only, types 1 and 2, through Fiscal Year 2023. Manual curation was used to remove duplicate grant numbers and subprojects from the final counts. Searchable fields for "RNA-Seq" were title, abstract, specific aims, research strategy, progress report, and summary statement.

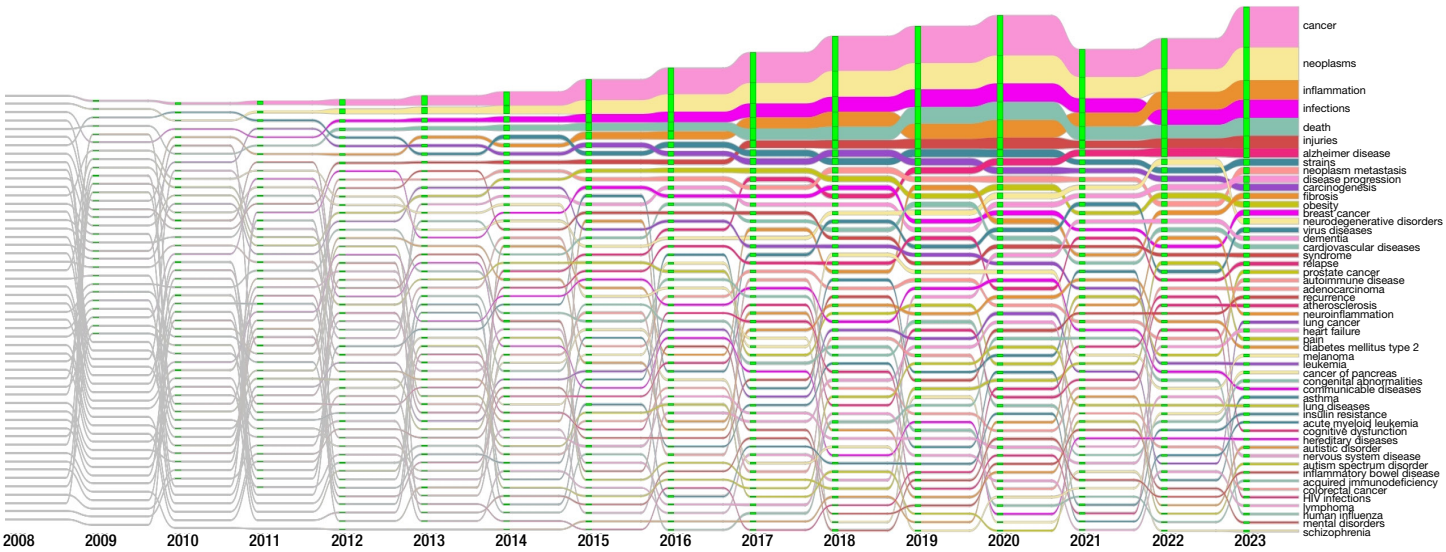

Figure 10B: Timeline of use of RNA-Seq in NIH-awarded grants (type 1 and 2) to study medical conditions.

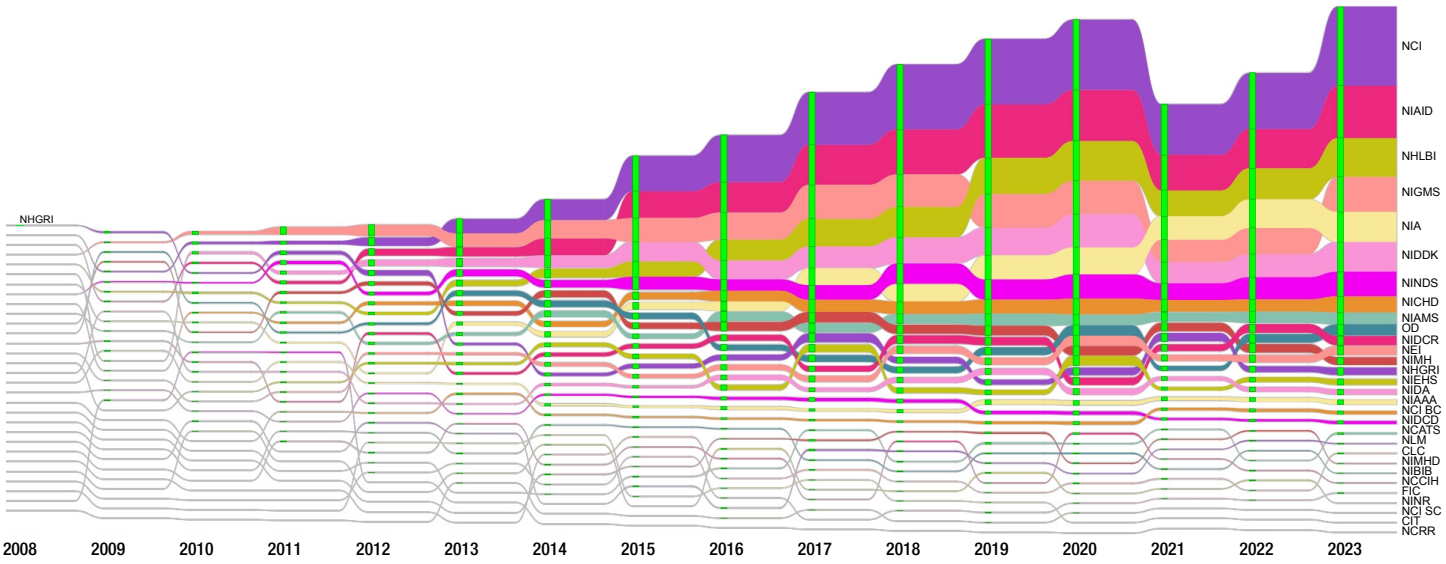

Figure 10C: Timeline of use of RNA-Seq in NIH-awarded grants (type 1 and 2) by funding institute/center.

Data from the grants in Figure 10A, including subprojects, were analyzed with the IN-SPIRE™ software. The medical conditions researched (Figure 10B) and NIH-funding institutes/centers (Figure 10C) of these RNA-Seq grants are shown over time with fiscal years on the x-axis. Conditions are diseases, disorders, syndromes, illnesses, or injuries that are automatically extracted from grant text using natural language processing software that identifies phrases and synonyms along with their associated MeSH semantic type. The width and relative position of each bar represent how many grants were mapped to that condition (or funding institute/center) in that fiscal year. As seen in Figure 10B, cancer (light pink) and neoplasms (yellow) were the two most studied conditions in these grants from Fiscal Year 2011-2023. Green vertical lines show which conditions (Figure 10B) or funding institutes/centers (Figure 10C) were active in each fiscal year. For example, Figure 10C shows that in Fiscal Year 2008 NHGRI was the only funding institute/center on a grant that mentioned RNA-Seq (using the filtering criteria).

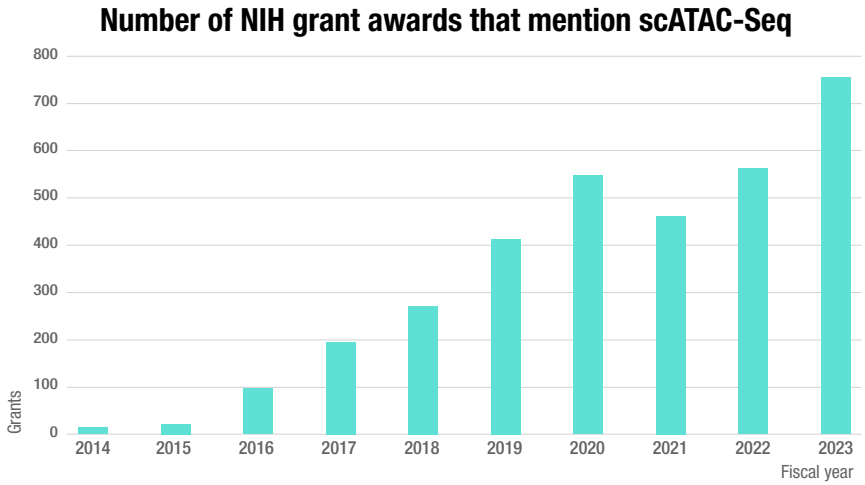

Figure 11A: NIH grant awards that include the use of the scATAC-Seq technique by fiscal year. The number of grants using scATAC-Seq for each fiscal year was determined by using NIH's iSearch Grants tool and the following filter criteria: NIH awarded grants only, types 1 and 2, through Fiscal Year 2023. Manual curation was used to remove duplicate grant numbers and subprojects from the final counts. Searchable fields for "single-cell ATAC-Seq" were title, abstract, specific aims, research strategy, progress report, and summary statement.

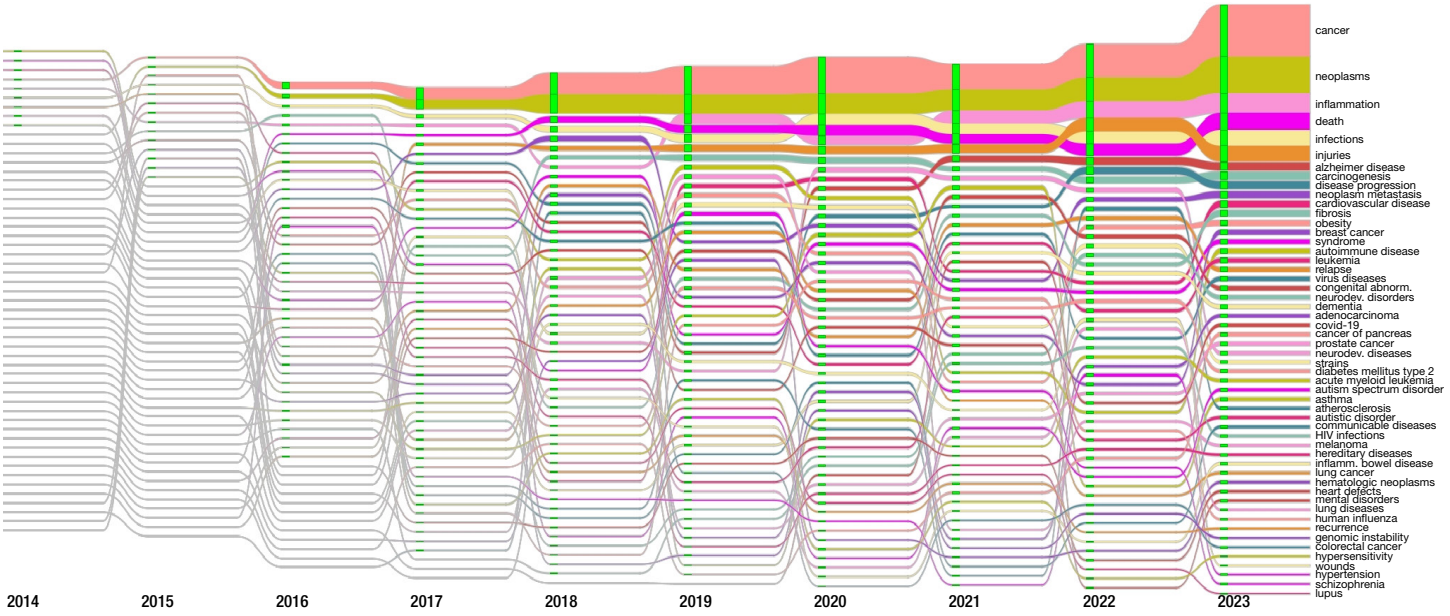

Figure 11B: Timeline of use of scATAC-Seq in NIH-awarded grants (type 1 and 2) to study medical conditions.

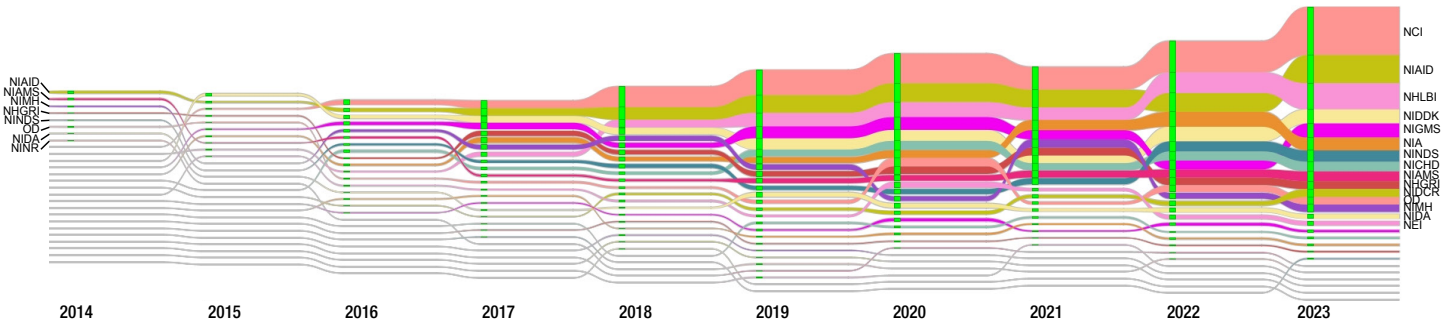

Figure 11C: Timeline of use of scATAC-Seq in NIH-awarded grants (type 1 and 2) by funding institute/center.

Data from the grants in Figure 11A, including subprojects, were analyzed with the IN-SPIRE™ software. The medical conditions researched (Figure 11B) and NIH funding institutes/centers (Figure 11C) of these scATAC-Seq grants are shown over time with fiscal years on the x-axis. The width and relative position of each bar represent how many grants were mapped to that condition (or funding institute/center) in that fiscal year. As seen in Figure 11B, cancer (peach) and neoplasms (mustard yellow) were the two most studied conditions in these grants from Fiscal Years 2015-2023. Green boxes show which conditions (Figure 11B) or funding institutes/centers (Figure 11C) were active in each fiscal year. For example, Figure 11C shows that eight institutes/centers were funding scATAC-Seq grants in Fiscal Year 2014, including NHGRI (labeled on the left of Figure 11C).

In summary, CEGS grants were 14 times more likely than comparator NHGRI R01's to produce a patent. In keeping with this finding, scientists commended the contributions of the CEGS as going beyond "standard" genomic science to enable transformative approaches and discoveries. Methods developed within CEGS grants have gone on to be used in grant applications that study many medical conditions and that received funding from all areas of biomedical research.

How did program funding influence grantees' careers?

- Analysis of yearly productivity measures (Table 2 and Appendix) found that the CEGS did not specifically increase the odds of winning future NIH grants for its investigators. Despite putting in more applications in the time period after the grants included in this analysis ("post-grant"), both the CEGS and comparison groups had no significant change in award rates post-grant, on a yearly average. Both groups also received more direct funding post-grant, with the CEGS investigators starting from a much higher total direct funding rate but the comparison group seeing a higher relative increase on average.

Averages	CEGS Grantees – Pre-Grant (n=36)	CEGS Grantees – Post-Grant (n=31)	Comparison Grantees – Pre-Grant (n=187)	Comparison Grantees – Post-Grant (n=214)
Applications	1.06	1.7	0.97	1.2
Awards	0.39	0.38	0.27	0.35
R01 Applications	0.54	0.66	0.53	0.61
R01 Awards	0.16	0.10	0.11	0.10
Total Direct Funding	$680,314	$1,179,259	$281,814	$754,988

Table 2: Comparison of yearly grant funding productivity by CEGS grantees and comparison R01 grantees in pre- and post-grant periods, or the years before/after the grant that was used in the funding analysis.

- Survey responses demonstrated that the CEGS program supported researchers in various career stages, including graduate students, postdoctoral fellows, junior faculty, staff scientists, and senior faculty.
- The majority of survey participants reported engaging in education and outreach activities specifically related to their work with the CEGS, including summer programs, journal clubs or scientific seminars, and undergraduate courses and mentoring.
- In their interviews, the principal investigators regularly cited training and career progression of staff as one of the highlights of their CEGS. One principal investigator stated their CEGS grant was "I'd say, one of the highlights of what I was able to do in my career, because it provided the opportunity to do some really exciting new science and technology development that I feel has made an impact." Another felt proud that their grant's main technology product "was invented by a graduate student…who was actually a first-generation college student" and "because of that success, [they] went directly from PhD to become a faculty member now at Harvard." They added "you have a chance to really launch somebody's career."

In summary, CEGS grants alone did not demonstrably enable the average investigator to be more successful with NIH grant applications, but the program enabled career advancement and the creation of and participation in valued scientific outreach activities.

What have been the strengths (outcomes and achievements) of the program? Are there suggestions / opportunities for improvement?

Strengths

- In both the survey and interview data, the most commonly reported strength of the CEGS program was its role in fostering collaborations, coordination, and networking. Investigators stated, “the only reason that [our project] was possible was because it was very highly interdisciplinary research that I don’t believe we could do without a CEGS” and praised “the ability to partner with several other laboratories and researchers to do science that none of us probably would’ve been able to do alone.”
- Additional CEGS strengths and advantages noted by survey and interview participants include supporting ambitious, high-risk and high-reward research; providing freedom and flexibility in their research; and providing support and resources to its researchers.
- Investigators also appreciated the focus on technology development, for example pointing out: “often people who are already doing technology development and willing to take those risks who were now looking at the NIH saying, ‘Who is willing to be accepting of this kind of tech development?’ And there aren’t too many mechanisms. CEGS is one.” In addition, another appreciated that “it allows you to link the technology development with the biology in a way that no other grant does.”

Suggestions / Opportunities for Improvement

- Given the chance to specifically comment on CEGS program outreach activities, survey participants cited the need for more workshop and training opportunities along with a need for more targeted outreach of diverse populations, including underrepresented minorities and undergraduate and high school students.
- When asked if the CEGS program had captured a suitable breadth of genomics to date, many of the investigators said yes, but there was a common theme that NHGRI should ensure that CEGS go beyond nucleic acids. This was seen in comments including “I would say that CEGS should be doing proteomics or metabolomics” and “I think the drawing hard lines of once it’s not nucleic acid-based, it’s no longer within the purview of the NHGRI, has been a disservice to genome biology as a whole.”
- Investigators expressed concerns about the flat or decreasing budgets of the grants over time, particularly given the infrastructure requirements for CEGS projects.
- Multiple investigators suggested that NHGRI consider a shorter and/or smaller CEGS-like grant program that would also be high-risk, high-reward while maintaining the emphasis on “tool development linked to driving biological projects.”

Recommendations

While completing the assessment, some themes emerged that might be useful to consider for the CEGS project and NHGRI funding in the future. We suggest that NHGRI should:

- Continue to take a long-term and multifaceted approach towards funding research through multiple mechanisms, including funding multi-investigator interdisciplinary teams through P50 and RM1 mechanisms and more traditional R01 mechanisms as both had positive outcomes and different types of impacts in advancing the field of genomics.
- Continue providing a flexible and collaborative environment for researchers to conduct their genomics research through the CEGS grants, while considering options for adopting components of the CEGS mechanism (such as the "high-risk, high-reward" description) to other grant programs.
- Provide and promote accessible resources to CEGS grantees and the genomics field more broadly.
- Continue recent efforts to place a greater emphasis on outreach to underrepresented and undergraduate groups to increase and diversify the number of genomics researchers in the field.
- Continue to evaluate other outcomes and areas of impact that were not directly assessed in this evaluation, including collaboration, innovation, and disruption, which were identified as CEGS advantages.

"I would love to see the CEGS program be able to create more incentive structures that help grow on, build on each other's work as a community. I feel like the CEGS meeting was the first time I realized that we had a CEGS community. And I was so excited. I would love to just grow that community as more integrative and incentivize collaboration and building on each other's work in some fashion because it really can spawn greater impact as well as greater innovation."

-CEGS principal investigator

Appendix

Comparison group identification: All of the comparison R01 grants started within 1 year of new CEGS grants, received a similar amount of annual and cumulative direct funding, and topic areas were similar to those of the CEGS grants as screened by NHGRI staff. Once an R01 was selected for inclusion in the analysis, all subsequent years of funding for that R01 were kept in the analysis. Additionally, any R01 grant with a CEGS contact principal investigator (PI) was excluded from the comparison group analysis.

Publication/patent/grant data sources: Ripple Effect used the NIH IMPACII/QVR (Query/View/Report) system to gather data on NIH grants and grant applications. The data for the bibliometric analysis were gathered from NIH RePORTER, PubMed, iCite, CrossRef, and Web of Science databases. Patent analysis data was gathered from the United States Patent and Trademark Office (USPTO) database and Google Patents.

Grant productivity analyses: Data on the applications and awarded grants were collected from the IMPACII/QVR database for every contact PI on the comparison and CEGS grants, beginning at the start of their career and ending in 2022. To account for the different amounts of time that CEGS and comparison grantees had to compete for grants before receiving their respective reference grants, Ripple Effect calculated the yearly productivity for both groups of grantees. This was done by taking the number of years that CEGS and comparison grantees had to compete for grant funding beginning the year of their first grant application and ending the year before they received either a CEGS or comparison grant. The team then calculated how many grants were applied for, how many grants were won, and how much funding was awarded for each year that a grantee could compete for NIH grants during the pre-grant period. To measure the success of the CEGS and comparison grantees in winning subsequent awards, Ripple Effect gathered data on all Type 1 NIH grants and applications beginning two years after grantees received their respective reference grants and ending in 2022. Success rates were then calculated by dividing the per PI statistics by the number of years each grantee had to compete for subsequent grants. Yearly statistics were chosen as a measure to account for the fact that CEGS and comparison grantees had varying amounts of time to compete for grants and grant funding after receiving their respective grants.

Survey: The team designed a 13-item survey instrument that included both open- and close-ended items and was pre-tested by NHGRI staff before being finalized and programmed into Qualtrics. The survey was determined exempt under the “Not Human Research” designation by the NHGRI IRB. Invitations were sent to personnel at all levels of participation in CEGS grants except the contact PIs.

Interviews: NHGRI staff designed and conducted semi-structured qualitative interviews with 28 CEGS contact PIs, from grants spanning the entire CEGS program range of 2001-2023. The interview guide and protocol was also determined exempt by the NHGRI IRB.

Further methodological details and publicly available data can be provided upon request from emu.nhgri@nih.gov.

For more information on the CEGS program, visit:
genome.gov/Funded-Programs-Projects/Centers-of-Excellence-in-Genomic-Science

"We really developed an entirely new methodology. We, unfortunately, also found out its limitations….Which is probably a good thing… it was the only way to do this work that otherwise probably never would've seen the light of day."

"Science without failure is not science. It's service….I would like to think that the CEGS are a mechanism to nucleate and to allow emergence of excellence in genome science, and not just to reward people that are good."

"I think you could adjust the parameters some. But I think that type of outlook and that risk taking and especially a focus on things that aren't so obviously immediately translatable or technological, I think is hugely important, you know. And I hope NHGRI keeps -- in whatever mechanism and whatever they call it and whatever the size is, I hope they keep doing it, or if anything, I think they should expand it."

"[Our summer workshops] created a living legacy where the problems and the methods and the approach and the whole organism and combination of molecular genetics plus biology could then live on way beyond the period of the initial CEGS grant."

-CEGS principal investigators

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