

Outcomes Evaluation
NIGMS Legacy Community-Wide Scientific Resources Pilot Program

National Institute of General Medical Sciences (NIGMS)
Office of Program Planning, Analysis and Evaluation (OPAE)
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Background:

The Legacy Community-Wide Scientific Resources Pilot Program, commonly known as the Legacy Resources program, was initiated in 2010. The goal of this program is to support important “legacy” resources developed as a result of large-scale NIGMS research activities that are central to the mission of the Institute and that demonstrate a high value to the scientific community supported by the NIGMS. Resources eligible for support under this program must *not* be:

- Self-sustaining
- Ready for commercialization
- Renewable under their initial funding activities, or
- Supportable by other National Institutes of Health (NIH) Institutes and Centers (ICs).

Temporary support for up to three years is provided to maintain these resources while plans to transition them to more permanent forms of support are implemented. Through FY 2015, the program has reviewed 14 applications and made seven awards totaling \$8.8M in direct costs and \$13.6M in total costs.

A total of nine resources were included in this evaluation, including five funded projects, three unfunded projects, and one resource application that was withdrawn. Two currently funded projects that were in their first year of funding were not included as they have not had adequate time to implement their transition plans.

Evaluation Purpose and Methodology:

The purpose of this evaluation is to provide information on the outcomes and short-term impact of the program in order to inform further decisions regarding the program’s future. The evaluation thus seeks to answer high-level, over-arching study questions:

- 1) Has the program been successful in accomplishing its intended goals?
- 2) Should the program be continued?

These two high-level questions were, in turn, subdivided into a series of lower-level, categorical questions which guided the evaluation. The following findings are based on an analysis of the information obtained to answer these categorical questions as shown in [Appendix A](#).

A list of the applications that were included in this evaluation and a list of all the applications and awards is available in [Appendix B](#). The results of the bibliometric analysis of R24-related publications is included in [Appendix C](#).

Summary of Findings:

Finding 1: Of the five resources funded under the Legacy Resources program, three have completed their full length of funding while two are currently receiving support. All three resources that have previously received support and completed their full length of funding have found ways to sustain operations beyond the Legacy Resources funding period. With one minor exception, resources not funded under the program no longer exist.

Of the three projects that have completed their Legacy Resources funding periods, only one has been *fully* successful in obtaining other support sufficient to maintain the resource long-term. The two remaining resources have utilized a combination of strategies to remain in operation and continue efforts to secure other support (see Finding 2 below). Thus, all three of these resources have found strategies to survive beyond the Legacy Research funding period, are fully operational, and continue to provide services to the NIGMS research community.

In contrast, none of the four unfunded resources, including three unfunded and one withdrawn, have been successful at obtaining other support or found strategies to sustain full operations long-term.

Finding 2: The pathway to sustainability was not restricted to grant support or commercialization.

As indicated in Finding 1, the two resources that have completed their full length of funding under the Legacy Resources program but have not *fully* transitioned to other support have utilized a combination of strategies to sustain operations. Such a result indicates that there are pathways to sustainability in addition to obtaining grant support, and that these pathways are may be dependent on the type of resource in question. For instance, online resources can incorporate datasets and tools into other existing or on-line platforms through interoperability efforts or can attempt to downscale infrastructure to focus on cost reductions, while more physical or service-based resources can attempt to transition to a fee-for-service model or move some resource functions to other grants. Commercialization alone did not appear to be a viable option for either funded or unfunded resources.

Finding 3: Based on the limited information available, resource utilization rates appear to be stable, indicating a sustained level of interest from the user/scientific community.

The five funded resources (including three that have completed funding and two that are currently funded) have all maintained or increased their utilization rates during the Legacy Resources funding period, indicating a sustained level of interest from the NIGMS scientific community. Additionally, all of the funded PIs cited growth in their respective scientific areas as well as a lack of other sources for the services and products they provide as the basis of an ongoing need for the resources.

Evaluating resource utilization was the most challenging aspect of this evaluation. Most PIs indicated that the only data they possessed regarding this topic was included in their progress reports, which were often inconsistent, incomplete, and/or difficult to interpret. Additionally, although most PIs stated that they would provide additional utilization data, no additional data was submitted. Submission of clearly structured and articulated progress reports might therefore serve as an area of potential improvement for the program’s administration.

Finding 4: NIGMS-supported programs that are expiring in the near future are likely to have resources that will be eligible for Legacy Resources support.

A list of programs that may contain resources that will become eligible for support in the next four fiscal years under current eligibility requirements is included in Table 1. It is important to note, however, that not all of these projects include resources, so these numbers are likely to be an overestimate of the true number of eligible resources. In addition to the programs shown in Table 1, resources from the Protein Structure Initiative may become eligible if no other funding opportunities are established or otherwise become available. U54s could become eligible on a case-by-case basis (depending on the funding opportunity). Because this information represents a current inventory of programs, it does not account for any potential changes in funding policies.

Table 1. Programs That May Contain Resources - Current Eligibility Requirements

Program	FY16	FY17	FY18	FY19
COBRE (P30)	8	12	8	13
NCSB (P50)	2	2	1	2
Totals by FY	10	14	9	15

If current eligibility requirements are modified to allow unsuccessful competing projects to apply for support, there are additional programs that are likely to contain resources that would become eligible for support. A list of these programs is included in Table 2.

Table 2. Additional Programs That May Contain Resources– If Unsuccessful Competing Projects Are Deemed Eligible

Program	FY16	FY17	FY18	FY19
BTRR (P41)	2	4	4	4
Trauma/Burn (P50)	1	1	1	2
Totals by FY	3	5	5	6

Other NIH ICs have programs similar to the Legacy Resources program, but with differences in implementation (e.g., NIAAA’s PAR-13-391, NIAID’s PAR-13-242, and NHGRI’s PAR-14-191). These programs generally have longer timeframes for support (five years), are eligible for renewals, and, to varying degrees, allow development of new resources. It is unlikely that NIGMS-developed resources would be eligible for support at other NIH ICs given the requirement that the proposed work be within each ICs mission.

In addition, there are no known current or planned NIGMS initiatives that would support eligible resources if the Legacy Resources program is not continued, aside from a limited number of R24 awards for PGRN-related resources.

Conclusions:

1. High-Level Question 1: Has the Legacy Resources program been successful in accomplishing its intended goals?

If program success is defined as *full transition of funded resources to other sources of support* by the end of the Legacy Resources funding period, the program has had only moderate success, given that only one of the three completed projects meets this criterion. However, if program success is defined as resource *continuance* beyond the Legacy Resources funding period, then the program can be deemed as more successful as all three of these resources continue to be fully operational and are serving the scientific community. While all of the resources that received Legacy Resources funding are fully operational and have transitioned (or are making progress toward transitioning) to longer-term sources of support, none of the unfunded application resources has been able to transition and, save one minor exception, no longer exists.

Although the available data on utilization rates and user communities is limited, there are indications that the resources - both completed and currently funded projects - continue to be utilized by researchers both within NIGMS and in the broader NIH community, and in most cases, utilization rates have been stable, and in some instances, increasing. PIs reported in interviews that their user communities are broadening and some reported increasing numbers of users, which is supported by the results of bibliometric analysis. Analysis of citations of R24-related publications indicates that the published acknowledging the funded resources has been well received by the scientific community and of reasonable impact.

2. High-Level Question 2: Should the Legacy Resources program be continued?

Based on the transition outcomes of the resources included in this evaluation, as funding for large-scale NIGMS programs expires, resources contained within such programs are likely to have difficulty finding alternative sources of funding or strategies to maintain operations. Additionally, there are no known or planned NIGMS initiatives that would support “legacy-type” resources if the program is not continued.

Consideration should also be given to the cost of the program relative to the cost of funding investigator-initiated research (R01s). As shown in [Appendix B](#), Table B-1, the average yearly direct cost of an R24 award is \$328,348, versus \$250,000 for an R01. On average, for each R24 funded, 1.6 R01s could be funded.

If the program is continued, the recommendations below may help strengthen the program and increase the utility of future evaluations.

Recommendations:

1. Strengthen the language in future FOAs, particularly pilot programs, to further emphasize the importance of metrics and evaluation. Resources developed as part of a grant should be encouraged to find ways to track users and should encourage the appropriate citation of the resource by its users/user community in publications, track the number of such publications/citations in which the resource is actually referenced, and find additional methods of measuring productivity and impact.
2. Any concerns noted by reviewers regarding lack of adequate evaluation plans or insufficient metrics should be addressed with PIs upon award to ensure that progress reports contain the required data and require documentation that the deficiencies have been addressed.
3. Program officers (POs) should review progress reports to ensure that the required information is included or that there is an explanation why it is not included, and should address any concerns with PIs.
4. Consider developing a reporting template or standard reporting format for capturing utilization rates in progress reports and monitor compliance through regular review and follow-up by POs.
5. Encourage principal investigators (PIs) to conduct and share results of internal evaluations.

Appendix A: Evaluation Questions and Data Sources

Evaluation Questions	Source of Data
Over-Arching Question 1: Program Success	
Were resources transitioned to other support?	QVR, FR, PI Intv, PR
What is the impact of each supported resource on the broader NIGMS research community?	SS, Pubs, PI Intv, App, PR
What is the fate of unfunded application resources?	QVR, FR, PI Intv
What is the fate of resources supported through other measures?	QVR, FR, PI Intv
Over-Arching Question 2: Programmatic Necessity	
Will the supported resources continue to be essential to the user community in the future?	PI Intv, PO Intv, Pubs, PR
What is the user community in relationship to the broader research community?	PI Intv, Pubs, PR, App
What current or future alternatives are there for support if this program is not continued?	PO Intv, PI Intv
What programs do other NIH ICs utilize for resource maintenance?	PO Intv
Can the resources be commercialized through the use of SBIR funding, and if so, what are the financial consequences?	PI Intv
What is the current pool of NIGMS developed resources that could become eligible in the near future: 1) under current eligibility requirements and 2) if eligibility requirements are changed to make unsuccessful re-competing projects eligible.	PO Intv, QVR

Legend:

App	Application
FR	Federal RePORTER
PI/PO Intv	Principal Investigator/Program Officer Interview
PR	Progress Report
Pubs	Publications and citations
QVR	Query, View and Report System
SS	Summary Statement

Application texts were reviewed to determine the transition plan for each resource, the self-reported metrics used for tracking resource utilization, and the operation/maintenance plan for each resource.

Summary Statements were reviewed to assess the perceived quality of and need for the resource, the quality and feasibility of the transition plan, the strength of the operation and maintenance plan, and the balance between these factors in determining whether a project was funded.

Progress reports and program checklists were scanned for information connected with the self-reported metrics and transition goals, in addition to any alterations in the metrics or transition plan as the resource discovers setbacks, opportunities, or alternative metrics.

Interviews with Project PIs were conducted to answer a number of questions relating to the outcomes of the program. For each funded resource, the contact PI was interviewed using a set of structured questions relating to their transition efforts, alternative sources of funding considered during the application phase, alternative sources of funding presently considered / obtained, and a descriptive profile of the community that the resource serves. For each unfunded resource, the contact PI was interviewed, with a focus on whether the work proposed under the R24 mechanism was able to continue, the efforts made to sustain the resource, and any transition plans that may have arisen from this process. The interviews were structured and utilized a set order of questions which were provided to the PI prior to the interview.

QVR and Federal Reporter searches were conducted using the PI of record and the institution of association to search for alternative funding attempts / successes, subsequent outcomes after the end of funding, and to verify information obtained through interviews with project PIs.

Publications acknowledging funding / use of resource and citations (where appropriate) of these papers were obtained to evaluate the utility of the resource to the user community, the breadth of the user community, and the impact of the work conducted using the resource.

Text analysis of the NIGMS R01 and Legacy Resources grants portfolio was performed to characterize the research communities served by supported resources. Abstract and specific aims texts were extracted from QVR and processed using IN-SPIRE to create clusters of documents that share similarity based on unique sets of terms within the application. Documents within the same cluster tend to focus on similar areas of research.

Appendix B: Award and Application Detail

Project Awards and Commitments

Table B-1. Summary of Awards and Commitments

	Awards (7) FY11 – FY15	Commitments FY16 – FY17	Total Costs FY11 – FY17	Average Yearly Total Program Costs FY11 – FY15	Average Yearly Cost per Award FY11 – FY15
Direct Costs	\$6,895,314	\$1,943,725	\$8,839,039	\$1,379,063	\$328,348
Total Costs	\$10,464,807	\$3,125,344	\$13,590,040	\$2,718,008	\$498,324

Applications

Table B-3. Applications Included in this Evaluation

PI Name	Grant #	Project Title	Status
Funded			
Cummings	GM098791	Protein-Glycan Interaction Resource of the CFG	Funding Ended 8/14
Fahy	GM107784	LIPID Metabolites And Pathways Strategy (LIPID MAPS)	Year 3
Prisinzano	GM111385	Legacy continuation of the KU CMLD Mission	Year 2
Sasisekharan	GM098650	Legacy Informatics Resources for Glycomics	Funding Ended 8/14
Xiao	GM102656	Bridging Sustainable Distribution of TRBD Bioinformatics Resources	Funding Ended 8/15

Table B-4. All Applications FY11 - FY15

Appendix C: Bibliometric Analysis

An analysis of publications acknowledging the five funded resources was conducted to provide information on the utility of the resources to the scientific community both within and outside NIGMS, the breadth of the user community, and the impact of the research conducted using the resources. The results of that analysis are summarized below.

A PubMed search identified 78 publications in 2012 - 2015 that contained an acknowledgement of a funded resource. It is important to note, however, that it is more difficult to track publications by resource users than those that are directly tied to funding. Resources must rely on their users and collaborators to acknowledge their services by including a resource grant number in their publications, and if they fail to do so, publications are not linked to resources in PubMed. Although resource users are encouraged and reminded to include the resource grant number in their published papers, they often fail to do so.

The table below includes a breakdown of the 78 publications and associated citations by resource and year. There are a number of factors that likely account for the differences in publication and citation counts shown in the table, including publications not acknowledging the resource (as discussed above); the nature of the resource; the types of research supported; and the length of time since receipt of the Legacy Resources award. This last factor is important because there is a “lag” time between receipt of initial funding and publications acknowledging a new grant, and as a result, more recently-funded resources may have fewer publications. Additionally, long-term

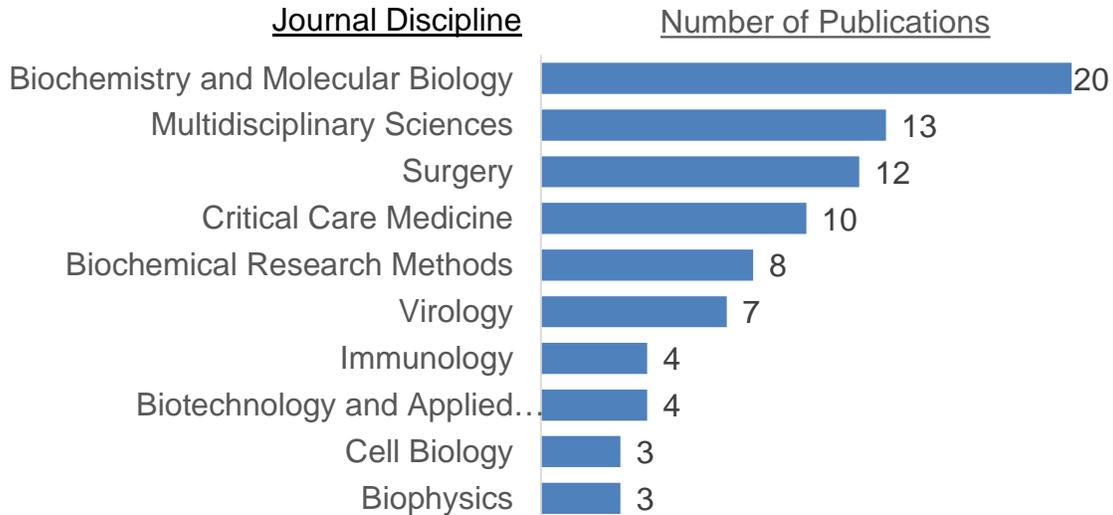
resource users may have acknowledged certain resources but continued to use the resources' previous grant numbers for some time before changing to the new grant number.

Table C-1. Publications and Citations by Resource

PI	Project (Green Shading Indicates Active R24 Grant During FY)	Publications per Year					Citations (SPIRES) (2012 – 2013)	Citations (Web of Science) (2012 – 2013)
		2012	2013	2014	2015	Total		
Cummings	Protein-Glycan Interaction Resource of the CFG	3	21	17	4	45	551	542
Sasisekharan	Legacy Informatics Resources for Glycomics	0	0	0	1	1	0	0
Xiao	Bridging Sustainable Distribution of TRBD Bioinformatics Resources	0	15	7	5	27	789	698
Fahy	LIPID Metabolites and Pathways Strategy (LIPID MAPS)	0	4	0	1	5	23	26
Prisinzano	Legacy Continuation of the KU CMLD Mission	0	0	0	0	0	0	0
	Grand Total	3	40	24	11	78	1363	1266

Alignment of Published Work to the NIGMS Mission

As shown in the figure below, the journal disciplines for the 78 publications spanned a number of scientific areas within the NIGMS mission, with a heavy focus in biochemistry and molecular biology. Publications in biochemistry and molecular biology and multidisciplinary sciences were primarily associated with the Protein-Glycan Interaction Resource of the CFG (Cummings), while the surgery and critical care medicine publications primarily arose from the Bridging Sustainable Distribution of TRBD Bioinformatics Resources grant (Xiao).



The top 3 disciplines for publications are Biochemistry, Molecular Biology and Multidisciplinary Sciences, and Surgery.

Figure C-1. Journal Disciplines of Publications

The results of an analysis done using IN-SPIRE, shown in figure C-2, below, provides additional evidence that the work supported by the resources is in close alignment with the NIGMS mission and, additionally, that the funded resources have continued to serve small- to moderately-sized communities of researchers.

In the figure below, each grey dot represents an R01 grant in the 2014 NIGMS portfolio, and each red dot represents an NIH-funded grant that co-published with one of the five funded resources. The analysis indicates that the funded resources are reasonably well-integrated into major clusters within the NIGMS grants portfolio. Although these results are more weighted towards resources with more acknowledged publications (TRBD Bioinformatics Resources and the CFG Protein-Glycan Interaction Resource), they suggest that the published work aligns closely with the NIGMS portfolio and mission.

IN-SPIRE Text Analysis

- Grant crediting Legacy Resource support (includes non-NIGMS and non-R01 grants)
- 2014 NIGMS R01 Grant

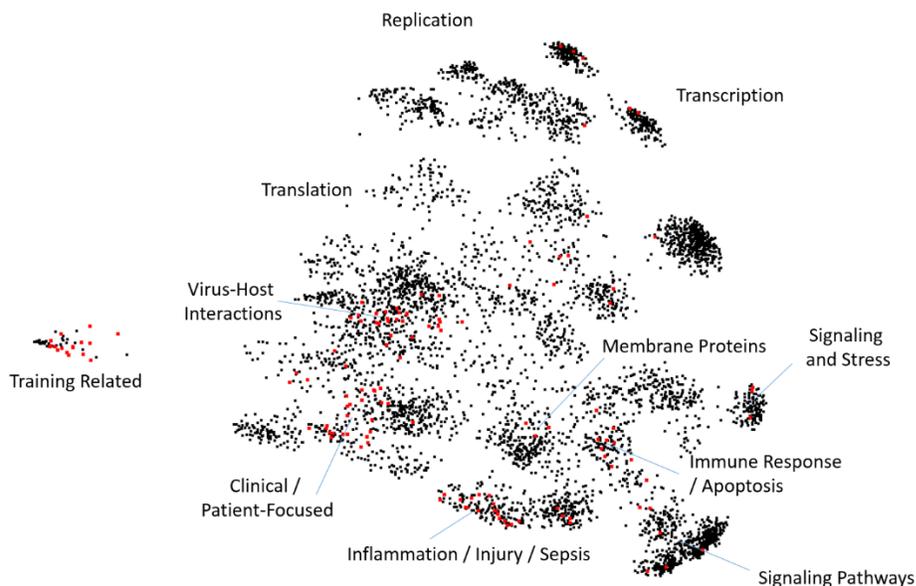


Figure C-2. IN-SPIRE Analysis

Description of Analytical Methodology: Abstract and specific aims texts were extracted from QVR and processed using IN-SPIRE to create clusters of documents that share similarity based on unique sets of terms within the application. Documents within the same cluster tend to focus on similar areas of research. Sample documents from clusters were read to identify major themes in line with NIGMS-funded research. Keyword searches were also performed to assist in validating these themes.

Utility of the Funded Resources to Researchers Outside NIGMS

Of the 78 R24-related publications identified, 33 (42%) were supported solely by NIGMS and 48 (62%) had additional support from at least one additional IC. Among the 48 co-funded publications, 307 PIs were identified who have not received funding from NIGMS. However, this number is likely an overestimate. Due to the methodology that was utilized - tracing publications to grants, then grants to investigators - it is unlikely that all of these investigators were directly involved in the work associated with these publications, especially in the case of larger center grants. For instance, 130 investigators were connected to seven non-GM P30 grants. Even given these caveats, these findings suggest that the resources were well utilized by researchers outside NIGMS.

The following table and figure include a breakdown of non-NIGMS supported publications by resource and IC.

Table C-2. Non-NIGMS Supported Publications by Resource

PI	Project	Total Publications (All ICs)	# Publications Supported by Other IC	% Publications with Non-GM Support
Cummings	Protein-Glycan Interaction Resource of the CFG	45	32	71%
Xiao	Bridging Sustainable Distribution of TRBD Bioinformatics Resources	27	12	44%
Fahy	LIPID Metabolites and Pathways Strategy (LIPID MAPS)	5	4	80%

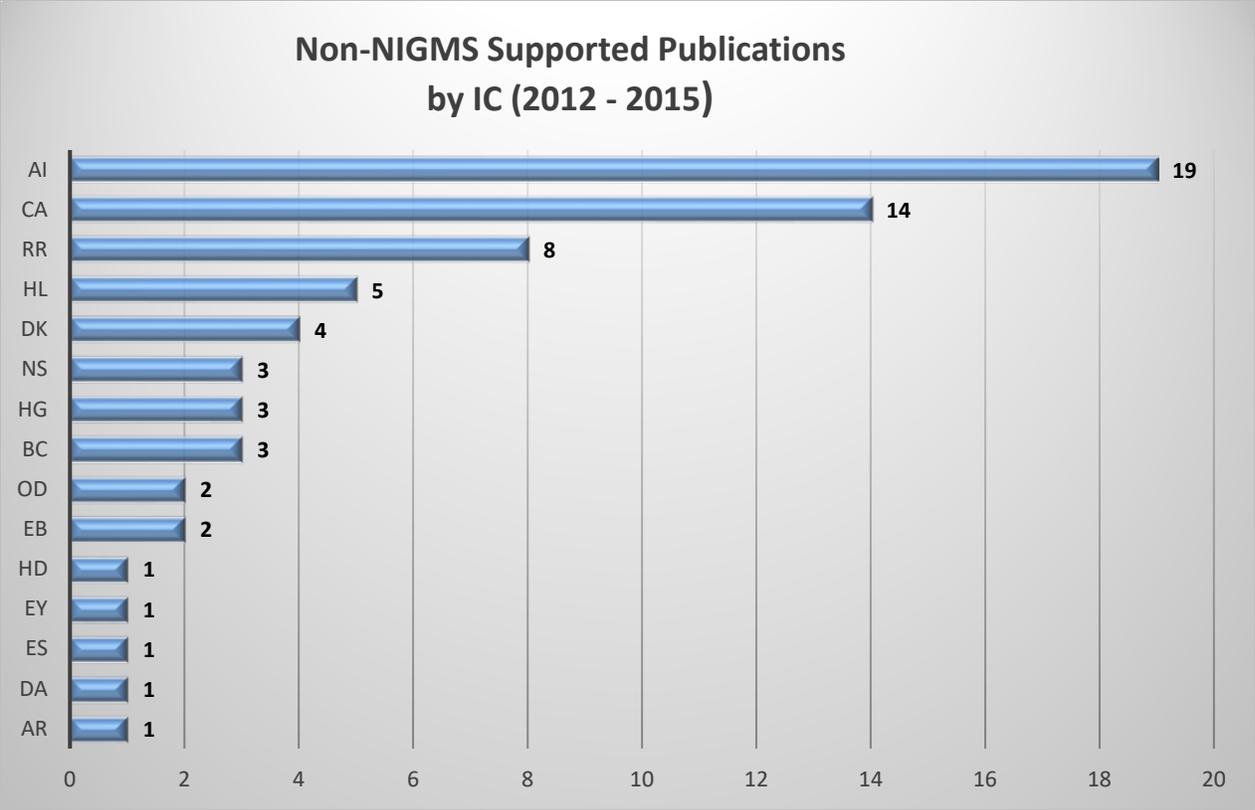


Figure C-3. Non-NIGMS Supported Publications by IC

Note: The numbers shown in the chart add up to more than 48 because publications may have been supported by more than one IC. Although the chart shows 18 ICs, BC should be counted with CA, as it is a division of the NCI.

Impact

Analysis of citations produced in the first two years of the program (up to 2013), indicates that the R24-related published research has been well-received by the scientific community and has had reasonable impact. As shown in Figure C-4 below, in comparison to other publications in the same fields and publication years, slightly over four times as many R24-related publications ranked in the top 20%; nearly twice as many ranked in the top 10%, and nearly five times as many ranked in the top 1%.

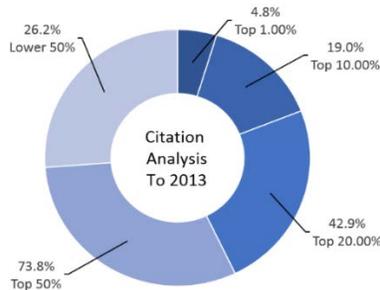


Figure C-4. Citation Analysis (Web of Science)

Publication/Citation Cost Analysis

Even given the caveats mentioned above regarding likely undercounts of publications and citations, the cost per publication has been comparable to other center-like mechanisms (~\$130k / publication), with a slightly lower efficiency in terms of citations (~\$8,000 / citation), as shown in the following table.

Table C-3. Publication/Citation Cost Analysis

Program	Activity	Cost per Publication	Cost per Citation	# of Citations per Publication
Legacy Community-Wide Scientific Resources Pilot Program (NIGMS)	R24	\$130,000	\$8,000	16
Integrative Cancer Biology Program (ICBP) (NCI)	U54/U56	\$187,000	\$5,500	37
Physical Science - Oncology Centers (PS-OC) (NCI)	U54	\$160,000	\$5,500	25
National Centers for Systems Biology (NCSB) (NIGMS)	P50	\$132,500	\$6,000	32
National Centers for Biomedical Computing (NCSB) (Roadmap)	U54	\$131,000	\$5,500	32