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Capitalizing on Serendipity: Parlaying a Citation Report into a Publishing and Evaluation Support Program

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Chapter Title

Capitalizing on Serendipity: Parlaying a Citation Report into a Publishing and Evaluation Support Program

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Introduction

Opportunities for medical libraries to engage in translational medicine activities can be found within existing library services and from the most ordinary of circumstances. The growing emphasis to demonstrate meaningful health outcomes resulting from translational medicine represents prime opportunities for medical libraries. Medical libraries have expertise in knowledge management and bibliometrics, and are familiar with scientific research and publication practices. Building upon this foundation to provide solutions that help to illustrate meaningful health outcomes and translational efforts are among the services that medical libraries can offer in support of translational medicine activities on their campus.

This chapter will review how a citation report request led to a retrospective analysis project to provide an investigator a more robust narrative of impact resulting from a clinical trial research study. The authors will describe the retrospective analysis project, highlight select project findings, and discuss the creation of a new service model at Bernard Becker Medical Library. Recent trends in the United States related to research impact will also be reviewed. We hope this chapter will help inspire other medical libraries to parlay their expertise into programs that provide support for reporting of research impact for authors, investigators, research teams, and administrators.

The Retrospective Analysis Project: Genesis

The date was May 17, 2007 and one of the authors had been recently assigned as a liaison to the Department of Ophthalmology and Visual Sciences at Washington University School of Medicine in St. Louis.¹ The author recognized a patron at Bernard Becker Medical Library as Mae O. Gordon, a faculty member from the department, and Director of the Vision Research Coordinating Center for the Ocular Hypertension Treatment Study (OHTS). The librarian introduced herself to the patron and began to chat about library-related topics. One topic in particular was citation analysis. Dr. Gordon recalled seeing a poster about bibliometrics² presented by Pam Sieving, Informationist from the National Institutes of Health Library (now retired), at the Association for Research in Vision and Ophthalmology 2007 Annual Meeting. Dr. Gordon wanted to know if it was possible provide a citation report based on publications from a clinical research study.

The Ocular Hypertension Treatment Study was a randomized controlled multi-center clinical trial, 1992-2012, conducted in 22 clinical centers in the United States, and funded by the National Eye Institute of the National Institutes of Health (EY09307). OHTS was designed to determine whether lowering intraocular pressure (IOP) in individuals with ocular hypertension either delays or prevents the development of primary open angle glaucoma (POAG). OHTS was the first trial to demonstrate definitively that treatment of elevated intraocular pressure (IOP) delays or prevents the onset of glaucomatous damage. OHTS also identified risk factors for developing primary open-angle glaucoma (POAG) including older age, higher IOP and larger cup/disc ratio, and was the first study to identify central corneal thickness (CCT) as an independent risk factor for the development of POAG.

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The Citation Report

The first step was to identify the peer-reviewed journal articles generated by the OHTS investigators. A website for OHTS contained a bibliography of the publications and abstracts. Twenty six (26) peer-reviewed journal articles were identified from the OHTS bibliography.

The databases Elsevier *Scopus* and Thomson Reuters *Web of Science* were searched to locate citation data. From preliminary review, several of the OHTS journal articles were found to have high citation counts. Through the use of Thomson Reuters *Essential Science Indicators* (ESI), it was determined that the citation counts from *Web of Science* exceeded the average citation rates and ranked high in the percentiles for the field of Clinical Medicine as well as for all fields covered by ESI. These findings were summarized in a report and delivered to Dr. Gordon.

The questions posed by Dr. Gordon were insightful and fundamentally challenged Becker Library to think about publication practices, citations, and ultimately research impact in a new way:

- Why did some articles garner high citation counts and others did not?
- Are citations indicative of significance?
- Do citations serve as a proxy for impact?
- What is a high impact study?
- How could OHTS increase the likelihood of their research being translated into clinical applications?

While publications and citations were neatly quantifiable metrics, the report did not answer Dr. Gordon's questions as to significance and impact. Regular meetings were held throughout summer of 2007 to discuss the questions posed by Dr. Gordon.

The Inflection Point

Review of the literature to shed light on Dr. Gordon's questions revealed one publication of particular interest. A commentary by Wells and Whitworth outlined several examples of meaningful health outcomes and stated, "Traditional academic metrics of research output through peer-reviewed publications and citations are insufficient to satisfy society's expectation that public investment in research results in real benefit to the society."³⁽¹⁴⁾ Dr. Gordon's questions and this commentary underscored the necessity to continue the project as a retrospective analysis to locate evidence of meaningful health and societal benefits resulting from OHTS research study findings.

This impetus was an inflection point for the retrospective analysis project and subsequently led to the evaluation and impact program at Becker Library. A citation report is the initial step of any project or consultation involving assessment of research productivity or impact.

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The Retrospective Analysis Project: Challenges

The challenges were to further review the citing publications (e.g., why were so many publications citing the OHTS articles) as well as determine appropriate and credible secondary sources to find the answers to Dr. Gordon's questions. Before moving forward with the next phase of the retrospective analysis project, additional familiarity with the subject matter was required.

Reference materials, book chapters and dissertations were reviewed to gain an understanding of glaucoma, the scientific progress advancements related to glaucoma, the vernacular, and the current knowledge base. The Computer Retrieval of Information on Scientific Projects (CRISP) database, (now RePORTER, (<http://projectreporter.nih.gov/>), was reviewed to find NIH-funded studies related to glaucoma. Trade publications and professional organizations and societies related to ophthalmology and glaucoma were also consulted (Table 1).

Table 1: Finding the Evidence

- Gain knowledge about the topic of the research study. Become familiar with acronyms, terminology, vernacular, standards, procedures, etc., related to the research topic.
- Read citing documents to determine why a publication was cited. Document the insights gained from review of the citing documents.
- Review the websites of organizations (professional/societal and governmental) and funding organizations related to the research topic.
- Use of non-bibliographic resources is required.
- Trade publications and gray literature are significant sources of evidence and clues.
- Anecdotal knowledge from investigators is required to identify clues of impact and to substantiate correlations from their research study to impact indicators.
- Be prepared for an iterative and messy process.
- Knowledge of the scientific research process in general is helpful as well as an understanding of publication patterns for the research topic and/or field.

Each publication that cited the OHTS articles was reviewed to learn why the OHTS articles were being cited as a means of contextualizing the citations. Next, the gray literature and other sources such as news media, popular press, government documents, technical reports, and policy statements were reviewed to find evidence of uptake of OHTS research study findings beyond citations. Search engines were used for locating gray literature and other sources not typically indexed by bibliographic databases. *LexisNexis*, *ProQuest* and OCLC databases were used for locating of popular press and related news media. The search terms used included:

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- Names of the Principal Investigators: Michael Kass and Mae Gordon
- Full name of the study: Ocular Hypertension Treatment Study
- Acronym of the study name: OHTS
- Medical terms and acronyms related to OHTS: Ocular Hypertension, Glaucoma, Primary Open-Angle Glaucoma (POAG), POAG Suspect, Central Corneal Thickness (CCT), Intraocular Pressure (IOP), Pachymetry, and Pachymeter. (Pachymetry is a technique used to measure CCT and is performed by a medical device called a pachymeter using ultrasound or optical methods).

A list of impact indicators was kept for reference over the course of the project. Impact indicators are defined as specific, concrete examples that demonstrate research impact as a result of a research finding or output. During the project, a number of indicators of impact were identified, beyond those related to OHTS.

The Retrospective Analysis Project: Findings

A follow-up report was delivered to Dr. Gordon in September 2007 and noted specific impact indicators resulting from OHTS research study findings to answer the question of a high impact study (Table 2).

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Table 2: Examples of Impact Indicators for OHTS

Examples of impact based on citation data from OHTS publications:

- Citation rates for publications from the study exceed the median/average rates for that given field
- Publications from the study are among the most frequently cited articles in journals for that given field
- Publications from the study are cited in reviews, consensus developments, curriculum materials, continuing education materials, and insurance coverage positions
- Publications from the study are cited in special articles devoted to highlights of discoveries/advancements in that particular field

Examples of impact resulting from OHTS research study findings:

- Clinically effective approach in the management of a disease, disorder or condition
- Clinical guidelines
- New “standard of care” for a disease, disorder or condition
- Identification of risk assessment factors for a disease, disorder or condition
- Diagnostic criteria for a disease, disorder or condition
- Change in clinical practice
- Procedure that is widely performed with demonstrated clinical efficacy
- Cost-effective means for management of a disease
- Measurement instruments
- Increased quality of life for patients
- Disease prevention measures
- Equipment or tool
- CPT codes

A discussion of three examples of impact indicators resulting from OHTS research study findings follows below.

1. Clinical Guidelines

Clinical guidelines may be developed by government agencies, institutions, organizations such as professional societies or governing boards, or by the convening of expert panels and usually cite references from a research study whose findings were used to support the recommendations as noted in the guideline. Websites of professional organizations related to ophthalmology were searched as was the National Guidelines Clearinghouse, (NGC),⁴ to locate clinical guidelines, if any (see Figures 1 and 2).

Examples of clinical or practice guidelines that cited OHTS findings (as of 2007) included:

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American Academy of Ophthalmology

- Primary Open-Angle Glaucoma Suspect Preferred Practice Pattern™ Guideline, 2005. (Available in eight other languages besides English)
- Primary Open-Angle Glaucoma Suspect Preferred Practice Pattern™ Guideline, 2005. (Available in eight other languages besides English)

American Optometric Association

- Quick Reference Guide for Clinicians Care of the Patient with Open Angle Glaucoma, 2002.
- Optometric Clinical Practice Guideline on Care of the Patient with Open Angle Glaucoma, 2002.

International Council of Ophthalmology/International Federation of Ophthalmological Societies

- Primary Open-Angle Glaucoma (Initial Evaluation), 2007.
- Primary Open-Angle Glaucoma (Follow-up Evaluation), 2007.
- Primary Open-Angle Glaucoma Suspect (Initial and Follow-up Evaluation), 2007.

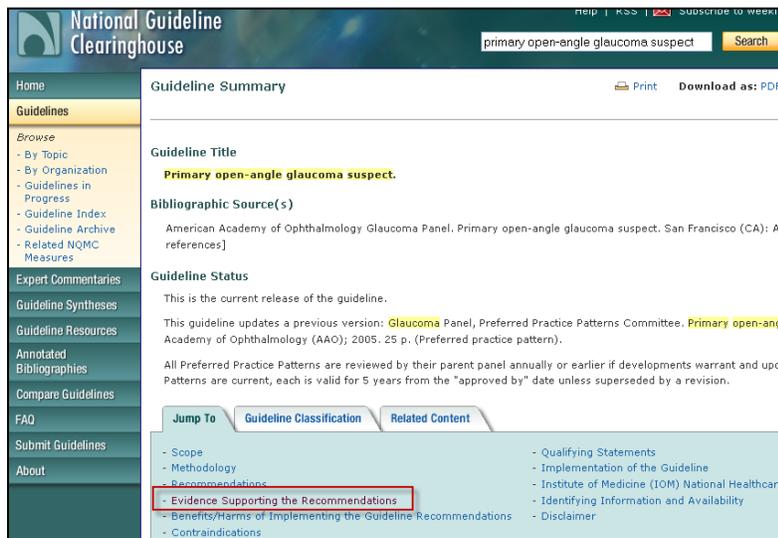


Figure 1. National Guidelines Clearinghouse (NGC) database record for a guideline summary that cites OHTS publications as “Evidence Supporting the Recommendation.” The query used was: Primary Open-Angle Glaucoma Suspect.

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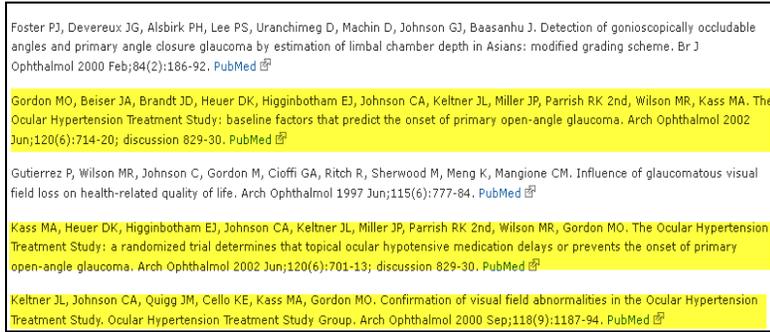


Figure 2. National Guidelines Clearinghouse (NGC) database record that displays three OHTS publications in the “Evidence Supporting the Recommendation” section of the guideline summary.

2. American Medical Association Current Procedural Terminology (CPT) Codes

Current Procedural Terminology (CPT) codes are published by the American Medical Association, (AMA), and updated/revised annually.⁵ The purpose of the CPT coding system is to provide uniform language that accurately describes medical, surgical, and diagnostic services. Adding, modifying, or deleting of CPT codes is performed by a review process involving a CPT Editorial Panel and a CPT Advisory Panel. Each proposed coding change must be supported by peer-reviewed literature. There are three categories of CPT codes:

Category I

Category I codes are the five-digit numeric codes included in the main body of CPT. These codes represent procedures that are consistent with contemporary medical practice and are widely performed.

Category II

Category II codes are supplemental tracking codes that are intended to be used for performance measurement. In compliance with ongoing changes being made because of HIPAA regulations, these codes provide a method for reporting performance measures.

Category III

Category III codes represent temporary codes for new and emerging technologies. They have been created to allow for data collection and utilization tracking for new procedures or services. To be eligible for a Category III code, the procedure or service must be involved in ongoing or planned research. The rationale behind these codes is to help researchers track emerging technology and services to substantiate widespread usage and clinical efficacy.

Prior to 2002, a CPT code specific to pachymetry did not exist. Pachymetry was assigned as a Category III code (CPT 0025T, Determination of corneal thickness, with interpretation and report, bilateral), effective January 2002. As of January 2004, a Category I code, (CPT 76514, Ophthalmic ultrasound, echography, diagnostic; corneal pachymetry, unilateral or bilateral, determination of corneal thickness), was

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assigned. The move from a Category III to a Category I was evidence that a pachymetry, a “new and emerging technology,” demonstrated clinical efficacy.

A clue as to a Current Procedural Terminology (CPT) code resulting from OHTS findings was found in a trade publication related to ophthalmology.⁶ However, supporting documentation for implementation of new CPT codes related to pachymetry was not publicly available. Consultation with policymakers, with the help of Dr. Gordon, confirmed that the OHTS research study findings, along with other glaucoma research studies, resulted in the creation of a new CPT Code, Category III for corneal pachymetry in 2002, with follow-up to a CPT Category I code in 2004.

3. Change in Clinical Practice

Discovery of a change in clinical practice was more elusive. This indicator required self-reported qualitative data from health care providers. However, survey data provided important links between OHTS research study findings and changes in clinical practice. A survey of optometrists was referred to in a trade publication and the source of the data was provided by the members of the Association of Vision Science Librarians (AVSL). Respondents to a 2003 survey of optometrists delivered through the National Panel, Doctors of Optometry, reported that the OHTS findings changed the way they manage glaucoma patients.⁷

The Retrospective Analysis Project: Recap

A traditional citation report was not sufficiently robust to adequately describe the impact of OHTS research study findings and their resulting synthesis into meaningful health and societal outcomes such as new understanding of a disease, change in clinical practice, quality of life benefits, reduction in incidence of disease, and new research directions, to name a few. The OHTS publications that garnered high citation counts were those that described significant research findings. While citation data from these publications provided useful clues for further investigation, the citation counts themselves were not predictive of specific health outcomes.

The most difficult part of the retrospective analysis project was the lack of guidelines or recommended practices for locating evidence of impact indicators beyond bibliometric-based indicators. As noted in the 2010 *Journal of the Medical Library Association* article describing the methodology of the project, the process was neither tidy nor linear.⁸ It was an iterative search process with various keywords and phrases used for queries. Reproducibility of queries, transience and diversity of sources and lack of standard keywords were issues with this project as well as for all impact analysis projects done since 2007 (Table 3). The gray literature was very useful in locating specific indicators of impact as well as serving as clues for other indicators. Despite its drawbacks, the gray literature, (trade publications in particular), contained documented sources to confirm a connection or link between an impact indicator and OHTS research study findings. The Sibbald 2015 work aptly describes both the challenges and paybacks with gray literature for impact purposes.⁹ In some instances, documentation as to a connection or link between a specific impact indicator to OHTS research study findings was not publicly

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available in the literature or other sources. For these instances, verbal and email confirmation with appropriate parties was required to confirm a connection between specific impact indicators and OHTS.

Table 3: Issues with Impact Analysis

- Not a linear process; frustrating at times.
- No automated means of locating evidence of impact.
- Lack of universal definitions for impact indicators.
- Time lag between research discovery and health and societal outcomes.
- Optimal timeframe for starting an assessment of a research study is unknown.
- Supporting documentation for a specific impact indicator and a research study may not be publicly available.
- May be difficult to establish a direct connection or link from a specific impact indicator and a research study.

The retrospective analysis project was not conducted in a vacuum. Pam Sieving provided much support and encouragement as did the members of the Association of Vision Science Librarians (AVSL) who pointed out the availability of annual survey data from health care providers in the field of ophthalmology. The survey data was a critical piece of evidence of impact as it demonstrated a change in how provision of healthcare had changed as a result of OHTS research study findings. Policymakers in the field also answered questions and referred to other sources of information for further investigation. In addition, Dr. Gordon was an essential partner (and continues to be) to the progress of the project.

The Retrospective Analysis Project: Present Day

As of this writing (May 2015), 51 peer-reviewed journal articles have been authored by OHTS. A full list of publications and abstracts is available from the OHTS Bibliography.¹⁰ Becker Library continues to track OHTS. Some examples of impact indicators identified since 2007 include:

- mobile application
- new funded research studies expanding upon OHTS research study findings
- new research direction in basic science research*
- increased usage of a term (CCT) related to OHTS in the literature
- cited in textbooks
- advanced careers of early stage investigators*
- 16 authorized requests for use of OHTS data in Genotypes and Phenotypes (dbGaP) database¹¹
<http://www.ncbi.nlm.nih.gov/gap>

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In particular, two of the above examples (noted with an asterisk) were identified while discussing the project with Dr. Gordon. Consultation with Dr. Gordon revealed that some of the early stage investigators who were involved with OHTS research findings were subsequently awarded independent R01 NIH awards which represent significant and innovative projects. Dr. Gordon and the other OHTS investigators also revealed that the OHTS research study findings spurred a new research direction in basic science research pertaining to the biomechanical properties of the eye. Genetic research is ongoing to determine if CCT is subject to heritability.

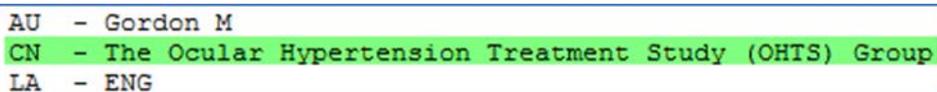
The two examples illustrate the importance of a team-based approach (library and research investigators) to identify and locate evidence of impact resulting from research findings. The process is iterative and requires ongoing consultation with investigators to discover anecdotal clues that may be revealed as indicators of impact and to confirm a connection between specific indicators and research study findings.

Review of Publication Practices

One of the seminal questions posed by Dr. Gordon in 2007 focused on how OHTS could increase the likelihood of their research being translated into clinical applications.

As part of this project, biomedical and general publication practices, including those by OHTS investigators, were reviewed to determine what factors, if any, enhance the discovery and uptake of published research findings. A number of practices were identified and these helped to strengthen the outreach efforts of a newly established Scholarly Communications program at Becker Library to promote strategies for authors to use to enhance the discovery and dissemination of their research.

One practice in particular that helped with discovery of impact indicators was that the OHTS investigators added the name of the study as a corporate author on their publications. This practice facilitates discovery of works by the OHTS investigators and serves as a branding function for the research study. As an example, the name of the study and the acronym are noted in the MEDLINE record display for an OHTS publication as a Corporate Author, (see Figure 3). More information on corporate authorship in MEDLINE/PubMed can be found in the Authorship in MEDLINE® Fact Sheet.¹²



AU - Gordon M
CN - The Ocular Hypertension Treatment Study (OHTS) Group
LA - ENG

Figure 3: MEDLINE/PubMed database record for an OHTS publication in the MEDLINE record view.

Another practice noted as being helpful for facilitating discovery and dissemination of OHTS research findings is the OHTS website which includes the bibliography of publications and abstracts, <http://ohts.wustl.edu/>. Journal articles include the PMID and are linked to the record in the MEDLINE/PubMed database. Conference presentations link to meeting abstracts and files presented at the meetings. At the time of the project, compliance with the NIH Public Access Policy was only “highly

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encouraged" (not required until 2008) and most of the works were not available in PubMed Central (PMC). One recommendation made to OHTS was to deposit a copy of their journal articles into PMC. Toward this end, Becker Library contacted the publishers of the works to obtain permission to deposit a copy (final published version or final peer-reviewed version depending on publisher policies) of the journal articles in PMC.

The Ripple Effects

1. Assessing the Impact of Research Website

As a result of the project, a number of impact indicators related to bench and clinical research were identified including those not specific to the OHTS project. This list served as a checklist during the retrospective analysis project as a means of keeping track of what was located, documented and/or not available. Indicators are defined as specific, concrete examples that demonstrate research impact. Examples of tangible impact indicators include: research studies, clinical guidelines, legislation or policy; quality of life metrics; among many others. The impact indicators were grouped under pathways representing the scientific research cycle for contextual purposes: research outputs; knowledge transfer; clinical implementation; community benefit; policy and legislation; and economic benefit. There was overlap among pathways as some indicators are applicable under multiple pathways.

A framework was constructed from the list of impact indicators and made publicly available via Becker Library website, *Assessing the Impact of Research*, to serve as a practical, do-it-yourself web-based tool for tracking the impact of biomedical research.¹³ The first edition of the website was launched in 2009 followed by a revision in 2012.¹⁴ The website content is governed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 United States License. Users are free to copy, distribute, display, and adapt the content as noted on the website for non-commercial purposes as long as attribution is provided to Becker Library.

The framework of impact indicators is intended to help provide clues or examples to create a narrative of impact beyond publication and citation data as an aid to help with research reporting. Guidance for quantifying and documenting each impact indicator was also developed and made available on the website.

The 2012 website version (current version) contains a list of impact indicators categorized into five pathways:

- Advancement of Knowledge
- Clinical Implementation
- Community Benefit
- Legislation and Policy

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- Economic Benefit

The list of impact indicators is undergoing revision to organize the content in a relational database to enable search capabilities and facilitate sustainability of the content. Additional pathways based on the scientific research cycle are planned as are definitions and a set of recommended practices for locating evidence to establish a connection between a specific impact indicator and a research study or investigator.

2. Application to the Clinical and Translational Science Awards (CTSAs)

In hindsight the project was auspicious as it dovetailed with the launch of a new NIH award program, the NIH Clinical and Translational Science Awards (CTSAs), which are administered by the National Center for Advancing Translational Sciences.¹⁵ The consortium was created to transform clinical and translational research to provide new treatments more efficiently and quickly, one of the key objectives of the NIH Roadmap for Medical Research. Institutions with CTSAs are required to have an Evaluative component to assess the progress of local translational research activities.

This requirement provides libraries an ideal platform to demonstrate their expertise with bibliometric-based methods for evaluation of research productivity and performance. These methods require collection and validation of publication data including reconciling author variants and knowledge of appropriate bibliometric analyses.

The OHTS project helped Becker Library acquire new skill sets that resulted into being appointed to the Tracking and Evaluation Team at Washington University's CTSA, the Institute for Clinical and Translational Science (ICTS) in 2011. Examples of services for ICTS include annual publication and citation reports for ICTS members; reconciliation of author name variants found in databases; recommendations of bibliometric analyses to highlight productivity and performance; development of a collection for ICTS publications in the library's institutional repository, Digital Commons@Becker¹⁶ and identification of impact from ICTS-funded research for reporting purposes, to name a few. The overarching goal of these services is to help ICTS produce meaningful narratives of translational health outcomes resulting from CTSA-funded research.

3. Service Model: Publishing and Evaluation Support program at Becker Library

The identification of research and publication practices during the OHTS project led to the development of a holistic workshop titled: "Enhancing the Visibility and Impact of Your Research" which covers the following areas: establishing an author profile; publication tips; strategies to promote discoverability and dissemination of research findings; tracking research outputs and activities; and tips for creating a narrative about research. This workshop is now provided on a regular basis at Becker Library and is modified for specific audiences, including young investigators and scholars, clinicians, and administrators.

Other workshops developed as a result of the OHTS project include:

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- Who is Citing Your Work?
- Selecting a Journal for Publication
- Assessing the Impact of Your Research
- Using Publication Data to Measure Productivity and Impact

The research and publication practices helped to strengthen the outreach efforts of the Scholarly Communications program at Becker Library established in fall 2007. These practices provided an ideal segue for support services in the areas of copyright, public access mandates, and with recruiting collections for the library's institutional repository, Digital Commons@Becker.

The Scholarly Communications program evolved to the Publishing and Evaluation Support program in spring 2014. Examples of services include publication and citation reports for authors and investigators with contextual narratives; supplementing promotion and tenure packets; recruiting reports; providing justification for funding applications or renewals; assisting with department and institutional benchmarking; and consultation services, among others. One frequent service is review of funding applications and using publication data to help establish an investigator as being best qualified to undertake the research or to demonstrate a gap in the research being proposed. Likewise, a renewal for funding can be bolstered by publication data and citation data.

Another example of a frequent request is a co-author network map to demonstrate collaboration patterns among a group of authors in a research department or specialized research center. The co-author network map is based on publication data and allows for visualization of patterns invisible through publication data alone. Some network maps display coalescence among the authors as seen in Figure 4; other maps show a loosely connected network or clusters which can help identify gaps in collaboration. Per Belter, visualization network services can be a valuable means of helping investigators and institutions with demonstrating the value of their research.¹⁷ Another increasingly popular request is *h* index reports for individuals and departments. The program has further expanded to include support with the new NIH Biosketch format, required as of May 25, 2015. See the Reporting of Impact Trends section for more information on the new NIH Biosketch format.

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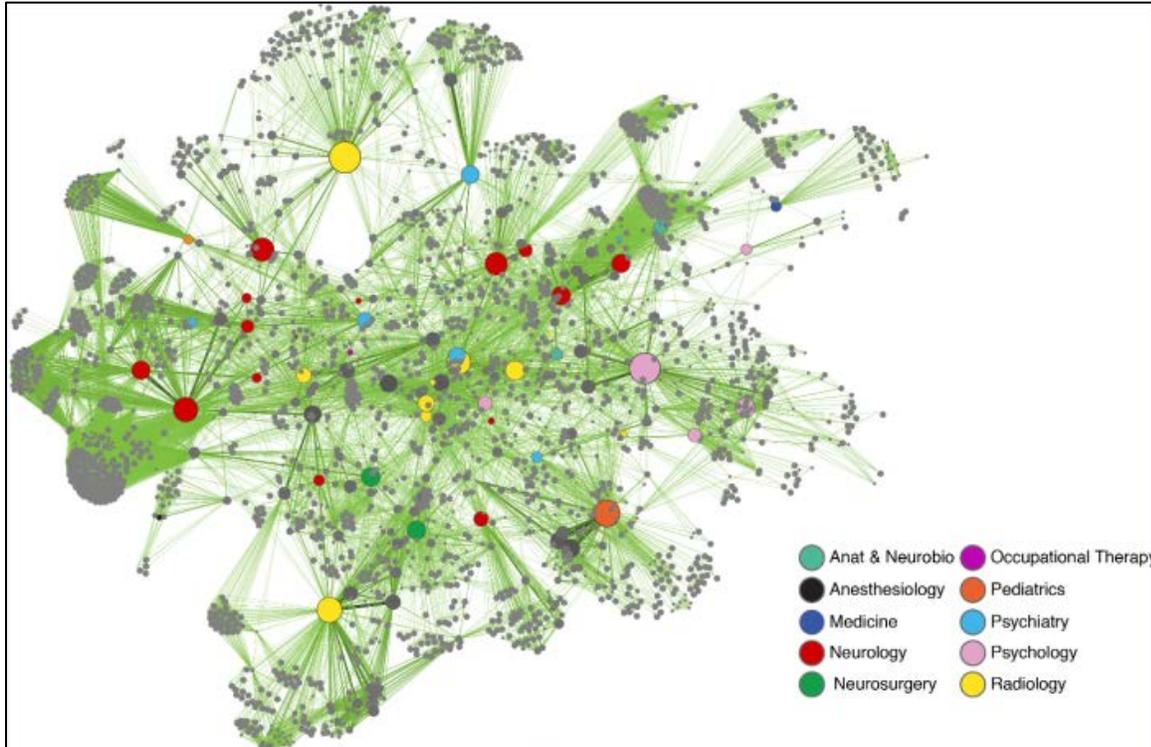


Figure 4: Co-Author Network. Science of Science (Sci2) Tool. Indiana University and SciTech Strategies, <http://sci2.cns.iu.edu>.

Services are provided for authors, investigators, students, research teams and administrators. In some instances, additional consultation is required to clarify the intended message and target audience. Sometimes a “pretty picture” is not the most appropriate means of conveying a specific message for an intended purpose. We also work to establish clear communication with our clients to manage expectations to avoid any surprises or disappointment. All reports include disclaimers as to data sources, especially if from bibliographic databases, (see Table 4).

Table 4: Disclaimers

The Summary Report is based on publication and citation data (including self-citations) from XYZ. Publication and citation data may be incomplete due to coverage and name variant issues.

While publication data can provide compelling narratives, no single metric is sufficient for measuring performance, quality, or impact by an author. Publication data alone does not provide a full overview of impact or influence, nor is it predictive of meaningful health outcomes. Publication data represents but one facet of research outputs and activities by an author. For a list of academic/research outputs and activities, see:

<http://beckerguides.wustl.edu/impactofpublications>.

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Another key component of our program efforts is discretion. Drafts of funding proposals are sent to the library for review as well as information requests for recruitment or tenure purposes which contain highly sensitive information. We emphasize that requests and delivered work products remain confidential and will not be shared with others.

We find that word of mouth is our most effective tool for promoting the new program, and information about the program is available on the library website, (<https://becker.wustl.edu/>), and in resource guides, (<http://beckerguides.wustl.edu/>).

There are a number of challenges with establishing and maintaining this type of service program. Starting a publishing and evaluation support program requires knowledge of evaluation methods, team science and bibliometrics, as well as keeping track of trends and developments in reporting of research by funding agencies and institutions. A significant investment of time is required to learn new software and gain expertise, and keeping up with the literature and trends is an ongoing effort. Specific time periods are especially hectic, particularly around grant application and report dates. Managing expectations as well as other commitments can be challenging during these times. Additional challenges we face and identified by Hendrix include lack of standardization of promotion and tenure criteria among departments on a campus, the time-intensive nature of executing bibliometric analyses, and lack of staffing to perform detailed reports.¹⁸ Despite these challenges, the program is successful, with two full-time staff members devoted to providing support with additional staff members pulled in to help with projects as needed.

Applicability to Other Libraries

Medical libraries offer substantial expertise in navigating the array of resources that exist to illustrate a narrative of research productivity, performance and impact that can be transmuted into innovative programs aligned with institutional needs. Among the expertise and skill sets held by libraries are: bibliographic database management; retrieval and analysis of data; understanding of author/affiliation ambiguity issues; knowledge of publication patterns by authors and investigators; knowledge of the scientific research process including funding mechanisms; to name a few.^{19, 20, 21, 22} Some libraries have staff with expertise in bibliometrics. Per Bladek, bibliometrics is one of the key skill sets that libraries can use to parlay their expertise into “forming a well-informed approach to research assessment at their institution.”²³⁽³³²⁾ Other libraries are generating network maps using social network analysis.²⁴ Such efforts are subject to increased complexity but nonetheless hold promise in strengthening the role of the library among campus partners.²⁵ Evaluation to assess productivity and impact can occur at the individual author level; the department level; the research group level, including physical or virtual research groups; the institutional level; or for a transient population such as scholars/trainees in which longitudinal tracking is required for reporting purposes. Some strategies for getting started are noted in Table 5.

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Table 5: Strategies for Libraries Considering Evaluation Services.

- Capitalize on serendipity—sometimes the best opportunities are simply a result of happenstance.
- Consider your current campus connections - can they help make new connections? Can they identify gaps or needs that the library can address; offer solutions or a plan?
- Ask specific research groups what their criteria is for performance reviews.
- Can the library piggy-back with an existing service model?
- Start small with a single service such as publication and citation reports. Post examples of publication reports that can be done for authors or research groups.
- Learn a new skill set if there is a need for a particular resource or service.
- Partner with campus groups that track university performance for benchmarking purposes or need to provide information to university ranking organizations.
- Become familiar with the literature on bibliometrics and evaluation.
- Adopt a “Did you Know Approach” to allow for subtle introduction to resources and services.
- Become familiar with campus promotion and tenure requirements and develop resources to help individuals with their tenure/promotion packet.
- Identify campus research trends over time.
- Learn new software tools such as *Sci2* (<https://sci2.cns.iu.edu/user/index.php>) , *NodeXL* (<http://nodexl.codeplex.com/>) or *Publish or Perish* (<http://www.harzing.com/pop.htm>).

Reporting Impact Trends

Changes in the landscape towards reporting of research are evident; academic institutions and funding agencies in the United States place a growing emphasis on acknowledging other work products besides traditional journal articles, and moving towards measures that provide tangible outcomes such as knowledge diffusion, synthesis into clinical applications, or influence on public policy. Using numbers, or “counts,” based on productivity and impact (number of publications, number of citations, journal impact factor scores, etc.) is no longer sufficient to demonstrate a return on investment, nor is it meaningful for non-academic audiences.

Funding agencies have been among organizations focusing on more meaningful metrics for reporting of research. The National Science Foundation’s (NSF) Biographical Sketch includes a section titled “Synergistic Activities” to allow for listing of examples that demonstrate the broader impact of an individual’s professional and scholarly activities.²⁶ NSF was also among the first to note a change the focus from the journal article as being the sole research product to include other forms of “products” such as data sets, software, patents, and copyrights.²⁷ The publications section was renamed as the products section.

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Examples include:

- innovations in teaching and training
- contributions to the science of learning
- development and/or refinement of research tools
- computation methodologies, and algorithms for problem-solving
- development of databases to support research and education
- broadening the participation of groups underrepresented in science, mathematics, engineering and technology
- service to the scientific and engineering community outside of the individual's immediate organization

The new National Institutes of Health's (NIH) Biosketch²⁸ requires investigators to provide up to five narratives describing their contributions to science and for each contribution, list up to four peer-reviewed publications including non-publication research products such as:

- audio or video products
- patents
- data and research materials
- databases
- educational aids or curricula
- instruments or equipment
- models
- protocols
- software

The contributions to science narratives represent a focus on accomplishments, not publications and allows for discussion of roles played in scientific discoveries and their significance. The new NIH Biosketch is required for NIH and AHRQ applications as of May 25, 2015.

The Centers for Disease Control (CDC) has developed a framework for public health to demonstrate how CDC Science is making a difference.²⁹ The Science Impact Framework can be used prospectively or retrospectively and utilizes indicators to measure impact towards health outcomes, through five levels of influence: disseminating science, creating awareness, catalyzing action, effecting change, and shaping the future. The National Institute of Environmental Health Sciences (NIEHS) has implemented strong evaluation programs that emphasize reporting of qualitative-based outcomes and produced a manual, *Partnerships for Environmental Public Health: Evaluation Metrics Manual*, which emphasizes harmonized reporting of qualitative outcomes by Partnerships for Environmental Public Health (PEPH) grantees and program staff.³⁰

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Universities and research organizations are also striving to report on research efforts that transcend simple counts and are working to develop harmonized methods for assessment that illustrate meaningful outcomes. The Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science, or STAR METRICS project, launched in 2010, is an example of this effort.³¹ STAR METRICS is an effort led by the NIH and the NSF under the auspices of Office of Science and Technology Policy, (OSTP), in collaboration with research organizations and universities. The objectives for STAR METRICS are to establish uniform and auditable measures of the impact of science spending and to develop measures of impact on scientific knowledge, social outcomes, workforce outcomes and economic growth.

Professional societies and organizations are also emphasizing the need for improving the methods of evaluating and reporting on impact from scientific research. The San Francisco Declaration on Research Assessment (DORA) resulted from a conference of the American Society for Cell Biology in 2012.³² DORA includes a set of recommendations urging funding bodies, publishers and institutions to avoid use of the Journal Citation Reports Impact Factor score as a means of assessing research impact or scientific quality. DORA also encourages others to think beyond the journal article as the primary metric for research output to include other outputs such as datasets and software, and to consider qualitative indicators such as influence on policy and practice. Among other metrics for evaluation research suggested by DORA are article-level metrics, the scientific content of a publication, the influence of a work on policy and practice, and the *h* index.

DORA was followed a statement from The Institute of Electrical and Electronics Engineers (IEEE).³³ The IEEE Statement, "Appropriate Use of Bibliometric Indicators for the Assessment of Journals, Research Proposals, and Individuals," contains a set of recommendations for proper assessment of works in the fields of Engineering, Computer Science and Information Technology. Among the recommendations are that multiple indicators are required for evaluation purposes, and that a journal-based metric should not be used as a proxy for single-article quality or to evaluate individual scientists.

These trends as well as others are relevant for medical libraries that may be considering establishing a program for evaluation services. Libraries should monitor the environment to ensure that evaluation programs are aligned with the changing needs of scholars and investigators.²⁰⁽³⁰⁹⁾ Other trends that can be capitalized by libraries include leveraging features offered by bibliographic databases to help with evaluation; assistance with article-level metrics and their applicability for reporting of impact purposes; and applying new methods of graphically representing data.

Summary

In hindsight, the retrospective analysis project and its ripple effects were serendipitous. The realization that a citation report should only be the start of any project that involves assessment of scientific productivity or performance was a pivotal point for Becker Library. The Assessing the Impact of Research website, the appointment to the ICTS Tracking and Evaluation Team and the new Publishing and Evaluation Support Program were not planned in advance, or even envisioned. It was a matter of being

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at the right place at the right time coupled with Becker Library's willingness to explore the development of a program to meet the needs of authors in the face of the changing landscape towards sharing and reporting of scientific research.

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Resources

As follows are three Zotero (<https://www.zotero.org/>) containing readings related to impact.

- Publication Assessment: https://www.zotero.org/groups/publication_assessment
- Research Impact: https://www.zotero.org/groups/research_impact
- Research Models and Frameworks: https://www.zotero.org/groups/research_modelframeworks

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