REVIEW ARTICLE / VUE D'ENSEMBLE

Research Support in Health Sciences Libraries : A Scoping Review

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Abstract: Background: As part of a health sciences library's assessment of its research support services, an environmental scan and literature review were conducted to identify existing research services offered in Canada. Through this process, it became clear that a formal review of the academic literature would be a helpful base from which libraries could identify new models for their own services. To address this gap, we conducted a scoping review of research services provided in health sciences libraries. **Methods**: Searches were conducted in Medline, Embase, ERIC, CINAHL, LISTA, LISS, Scopus, Web of Science, Google Scholar and Google for articles that described the development, implementation, or evaluation of one or more research support initiatives in a health sciences library. We identified additional articles by searching reference lists of included studies and canvassing medical library listservs. **Results**: Our database searches retrieved 7134 records, 4026 after duplicates were removed. Title or abstract screening excluded 3751, with 333 records retained for full-text screening. Seventy-five records were included, reporting on 74 different initiatives. Included studies were published between 1990 and 2017, the majority from North American and academic health sciences libraries. Major services areas reported were the creation of new research support positions, and services for systematic review support, grants, data management, open access, and repositories. **Conclusion:** This scoping review is the first review of our knowledge to map out research support services provided by health sciences libraries beyond "traditional" library services as well as forms of service evaluation conducted.

Introduction

In health sciences libraries, we constantly strive to expand with new services to meet the evolving needs of the researchers we support. As we continue to become further integrated into our researchers' projects, we want to make the most productive use of our time and resources. In 2016, 2 members of our team (MB, SV) were involved in reviewing the research support services offered by the Health Sciences Library at the University of Ottawa. As part of this process, we were interested in identifying the services offered by other health sciences libraries, how these services were implemented, and the degree to which they were evaluated, in order to inform future service development at our location.

We conducted an informal environmental scan of other Canadian academic health sciences library websites, as well as a preliminary literature review. We also reached out via email and telephone to several academic libraries across the country for their input. Through this process, we realized that no formal reviews of research services in the health sciences had yet been conducted (either in Canada or more broadly), and that there was an appetite at other academic libraries for a means to compare services. Given the seemingly ever-present scarcity of resources and time at health sciences libraries, many of the librarians we contacted indicated an interest in

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broadening their range of services without re-invention, false steps, failed attempts, and time lost. That is to say, they would prefer to implement service models that had already been tested and reported on elsewhere.

To this end, we conducted a scoping review to identify reports of research support services in health sciences libraries. We kept our criteria deliberately broad so that our review could inform libraries outside of Canada as well as within. We also endeavoured to examine not only academic health sciences libraries but also hospital and special libraries serving health researchers, so that we might paint a more fulsome picture of the current research service landscape. As such, references to health sciences libraries in this paper imply all academic, hospital, and special libraries that serve medical, allied health, or any other health-related researchers (including dentistry) unless specified otherwise.

The research service landscape that continues to evolve today stems from the period following World War II, when health sciences libraries examined means to better support researchers, keep up with their needs, prove the library's value to them, and even become part of the research team (1-4). This phenomenon of librarians as part of the research process–not only as suppliers of information, but increasingly as active collaborators–took firmer hold in the late 90s and 2000s, with a variety of new services, roles, and positions (5-9). For example, an emerging role in health sciences libraries this century has been the informationist, defined first by Davidoff and Florance (10) as specialists trained in the essentials of both information science and clinical work to more thoroughly bridge the 2 domains. The role has since proliferated in both the literature and job descriptions (8,11,12) and continues to expand to duties including systematic review support, training, and embedded librarianship (8,12-14).

Exploring the reported range of support services for researchers can assist the continued evolution of health sciences libraries. By determining the types of research support services provided by libraries, and the extent of evaluation conducted on these services, we can also build the foundation for a more rigorous assessment in the future of which services are backed by evidence.

Methods

Our protocol follows Arksey and O'Malley's scoping review framework (15). We used the PRISMA reporting checklist for systematic reviews to guide our report, as there are currently no formal reporting guidelines for scoping reviews to our knowledge (16, 17).

Search

One librarian on our team (MB) created the search strategy in Ovid MEDLINE using a combination of index terms and keywords around librarianship, research services, medicine, nursing, dentistry, and the health sciences. The search was peer-reviewed by a second librarian (KF). Once finalized, the search was translated to the other bibliographic databases of interest.

We conducted our bibliographic database searches on February 11, 2017. We searched MEDLINE (Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) 1946 to Present), EMBASE (Ovid, Embase Classic+Embase 1947 to 2017 February 10), ERIC (Ovid, ERIC 1965 to October 2016), CINAHL (EBSCO, from inception), LISTA (EBSCO, from inception), LISS (EBSCO, from inception), Scopus (Elsevier, from inception) and Web of Science (Thomson Reuters, all databases, from inception) to identify reports of research support services provided in health sciences libraries (full Medline search strategy available in Appendix A). We applied no date or language limits.

We imported citations into EndNote X7 and removed duplicates by manual inspection aided by the EndNote duplicate identification feature (18). We imported citations to Rayyan (19) for title/abstract screening, and Covidence (20) for full-text screening. We conducted screening in duplicate (AM, MH, MB, SV), discussing conflicts between screeners and, when necessary, involving a third team member to arbitrate.

In addition to our bibliographic database searches, 1 searcher (MB) conducted a series of advanced Google and Google Scholar searches in August 2017, and again in October 2017, to identify grey literature (Appendix B). For each search, the searcher reviewed pages of 20 results at a time for relevant results until no relevant results were identified for 3 consecutive pages (21, 22). Reports that the searcher deemed relevant were then reviewed in duplicate by additional team members (AM, MH, SV) at the full-text level. To complement the search for grey literature, a team

member (MH) contacted several health sciences library listservs in November 2017 and again in January 2018.

Further, 1 team member (AM) reviewed included studies' bibliographies for additional relevant reports. Reports that were deemed relevant were then reviewed in duplicate by the other team members (MB, MH, SV) at the full-text level.

Screening

We included articles if they:
1) were set in an academic health sciences library (including general science libraries serving health sciences populations), hospital library, or special library with a health focus;
2) described the development, implementation, or evaluation of one or more research support initiatives provided in the aforementioned contexts, regardless of study type; and
3) were available in English or French.

We consider "support initiatives" to be any service aimed at supporting individuals or groups conducting research that fall outside the "traditional" range of services offered in most academic, hospital, or special health sciences libraries (e.g. document delivery, reference services or loaning materials).

We define "research" as a "process of investigation leading to new insights, effectively shared" (23). This focuses our review on what we call "capital R research", which implies the explicit intention on the researcher's part to disseminate new knowledge. This is more specific than more general uses of the term that may imply simple information gathering, or information literacy training with no intention of publishing (e.g. students "researching" for their term paper), or work that informs clinician practice at the bedside but no further.

Extraction

Team members individually (AM, MB, SV) extracted study data in Google Sheets and extractions were verified by a second team member (MH). Conflicts between extractor and verifier were discussed and arbitrated by a third team member when necessary. Data extraction consisted of publication information, context (study country, library type), population (types of researchers supported), service types, service details, and, when available, evaluation methods and findings.

Results

We identified 7134 records through bibliographic database searching. We eliminated 3108 duplicates, and conducted title or abstract screening on 4026 records, with 3751 records excluded at this phase. Full-text screening was conducted on 333 records (275 records from title or abstract inclusion, plus an additional 58 records identified through grey literature searching, records from listserv responses, and reference list searching). Of these, we excluded 258, leaving 75 included records (Figure 1). Of these 75 records, two (24, 25) describe the same service implementation. For the purposes of reporting, we used the publication information from one (24) and merged the service and evaluation information extracted from these two records to treat them as a single study. For this reason, we will refer hereafter to 74 included studies.

Fig. 1 PRISMA Flow Diagram
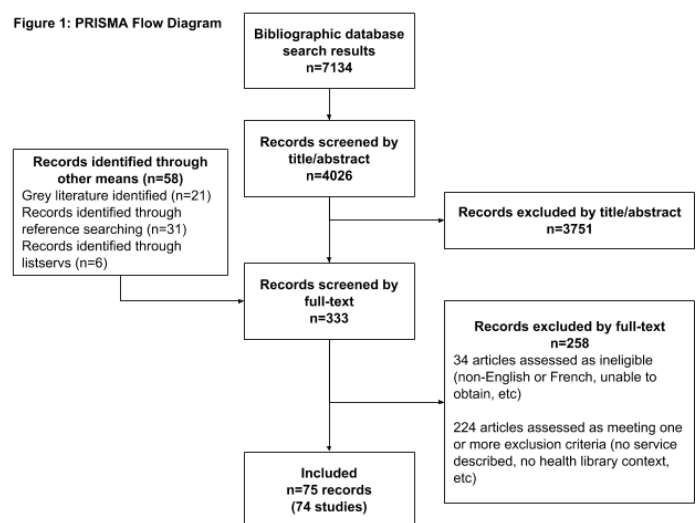
Included studies were published between 1990 and 2017 (Table 1 and Figure 2). Fifty per cent (n=37) of reports were published in the last five years. The year with the highest number of publications was 2015 (n=12). Included studies were most commonly published in the Journal of the Medical Library Association (n=20), Medical Reference Services Quarterly (n=11), and the Bulletin of the Medical Library Association (n=5) (Supplemental Table A).

Tab.1 Included study characteristics

		N =74	100%
Date Published	2013-2018	37	50%
	2007-2012	19	26%
	2001-2006	12	16%
	1995-2000	4	5%
	Pre-1995	2	3%
Study Design	Program Description	49	65%
	Program Evaluation	15	20%
	Research Article - Qualitative	5	7%
	Research Article - Quantitative	6	8%
Country of Origin***	United States	61	82%
	Canada	9	12%
	United Kingdom	5	7%
	South Africa	1	1%
Library Type	Academic	55	74%
	Hospital	8	11%
	Mixed (multiple types reported)	7	10%
	Special	4	5%
Service Type***	Creation of Library Position	27	36%
	Systematic Reviews	25	34%
	Grant Support	24	32%
	Data Management	19	26%
	Research Metrics	15	20%
	Open Access/Repositories	10	13%
	Other	35	47%
Evaluation Conducted		35	47%
Method of Evaluation***	Informal information gathering	17	48%
	Statistics	13	37%
	Surveys	7	20%
	Interviews	2	6%
	Post-workshop evaluations	2	6%
	Focus Groups	1	3%
	Pre-post test	1	3%
	Not specified	1	3%
***Numbers do not equal total included studies because some records reported on multiple countries/services/evaluation methods			

Fig.2. Included studies by year of publication

Number of Publications by Year
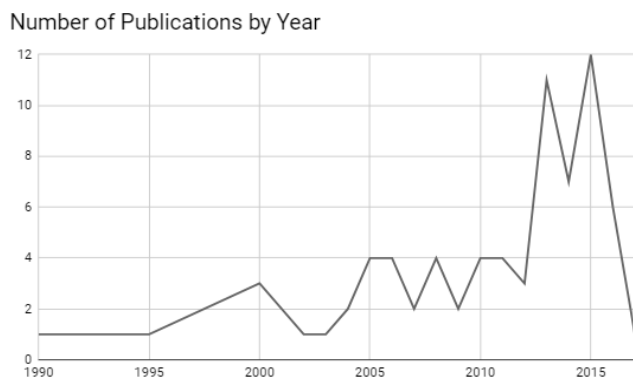
A large majority of included studies were program descriptions (n=49), featuring case studies providing context and information on new service implementations. The next most frequent study type was program evaluation (n=15). These articles described new library services and included an evaluation component. Eleven research articles were included, which consisted of 6 studies focused on quantitative data analysis and 5 focused on qualitative

analysis. Articles predominantly reported academic health library contexts (n=55). Of the remaining 19 included studies, 8 report on hospital library contexts, 7 have mixed contexts (reporting on 2 or more different contexts), and 4 were reports on special libraries, including the National Institutes of Health (NIH) (26, 27), the Veterans Evidence-based Research Dissemination Implementation Center (28), and the British Dental Association Library (29).

Populations served were primarily researchers and academic faculty, although staff, students, clinicians, nurses, and trainees were also mentioned. The most common research support services described were the creation of new research support positions (n=27), systematic review services (n=25), grant support (n=24), data management services (n=19), research metrics services (n=15), and open access publishing and/or repository services (n=10) (Table 2). Other less-represented services were also captured (n=32). These numbers do not equal our number of included reports as many articles reported implementing multiple services (Table 1).

Tab.2 Included Studies by Services Described

Studies	Services Described						
	SR	Grant Support	Metrics	OA/ Repository	Data Mgmt	New Position	Other
Academic							
Braun (2017)			X				
Beasley et al. (2016)	X		X			X	X
Mi (2016)	X						
Rosenzweig et al. (2016)		X					
Blackstock et al. (2015)	X						
Burnette et al. (2015)			X			X	X
Campbell et al. (2015)	X						
Chiware et al. (2015)				X	X	X	
Falconer (2015)	X						
Henderson et al. (2015)		X		X	X	X	
Ludeman et al. (2015)	X						
Rambo (2015)					X		

Studies	Services Described						
	SR	Grant Support	Metrics	OA/ Repository	Data Mgmt	New Position	Other
Read et al. (2015)					X		
Allee et al. (2014)	X	X			X	X	
Hardi et al. (2014)	X						
Janke et al. (2014)		X	X		X		X
Raimondo et al. (2014)							X
Smith et al. (2014)						X	X
Steelman et al. (2014)							X
Black et al. (2013)		X					
Federer (2013)	X	X			X	X	X
Goode et al. (2013)	X				X	X	X
Gore (2013)	X				X	X	X
Hasman et al. (2013)					X		X
Li et al. (2013)					X	X	X
Mann et al. (2013)	X	X					
Pepper et al. (2013)	X						
Vaughan et al. (2013)	X	X	X	X	X		
Johnson et al. (2012)		X		X	X	X	
Reeves (2012)	X					X	
Holmes (2011)		X	X	X		X	X
Tattersall et al. (2011)							X
Wilmes (2011)		X					
Cheek (2010)	X					X	X
Cheek et al. (2010)		X			X	X	X
Hendrix (2010)			X				
Klem et al. (2009)	X						X
Koopman et al. (2009)				X			
Harroun et al. (2008)							X
Song (2008)		X				X	X
Barnett et al. (2007)			X	X			
Banks (2006)		X	X			X	

Studies	Services Described						
	SR	Grant Support	Metrics	OA/ Repository	Data Mgmt	New Position	Other
Epstein (2006)						X	
Minie et al. (2006)							X
Chilov et al. (2005)							X
Robinson et al. (2005)						X	
Tennant (2005)			X			X	X
Helms et al. (2004)					X		X
Moore et al. (2004)							X
Watson et al. (2003)				X			
Florance et al. (2002)					X	X	X
Means (2000)		X					
Yarfitz et al. (2000)						X	
Mead et al. (1995)	X						X
Fenichel et al. (1994)		X					X
Hospital	SR	Grant Support	Metrics	OA/ Repository	Data Mgmt	New Position	Other
Ginex et al. (2016)							X
Ipsaralexi et al. (2015)		X					
Lightfoot et al. (2015)	X						
Dudden et al. (2011)	X						
Leman (2008)		X					
Frumento et al. (2007)							X
Felber et al. (2006)							X
Pratt (1990)						X	
Special	SR	Grant Support	Metrics	OA/ Repository	Data Mgmt	New Position	Other
King et al. (2016)		X	X	X	X	X	X
BDA library to assist... (2014)							X
Whitmore et al. (2008)			X			X	
Harris (2005)	X						

Studies	Services Described						
	SR	Grant Support	Metrics	OA/Repository	Data Mgmt	New Position	Other
Mixed							
Knehans et al. (2016)	X	X					
Macdonald (2015)	X						X
Crum et al. (2013)	X	X	X	X	X	X	X
Holmes et al. (2013)		X	X		X		X
Lorenzetti et al. (2012)		X					X
Glenn et al. (2010)	X	X				X	X
Bai et al. (2000)			X				

Creation of research support positions (n=27)

The most commonly reported research service was the allocation of positions that focused either exclusively or in great part on research support. These positions were created either through hiring or through the transformation of titles and roles of existing personnel. Our data set includes 27 reports (36%) on the creation of at least 1 new position (Table 2).

Position titles varied in specificity. Some titles clearly delineated the job's area of focus, such as director for research data management (30), emerging technologies librarian (31), or Institutional Review Board (IRB) librarian (32). Other titles were more general and did not necessarily share the same primary responsibilities as others with the same title at other institutions, such as informationist (26, 27, 33-37). In total, the 27 reports in this group presented 28 unique job titles, which are listed in Table 2 of the supplementary files. Among these titles, 14 permuted on the name informationist (e.g. information specialist, bioinformaticist). Twelve positions contained librarian in the job title (e.g. translational research librarian, public/private partnership librarian). Five positions included either liaison, analyst, developer, or director in their title. Note that the aforementioned breakdown adds up to more than 28 because some titles, such as bioinformatics librarian, fall into 2 categories.

More significant than their titles were the roles these people fulfilled in supporting research. Some, such as the IRB Librarian (32), had a particular focus, which in this case was to provide literature search and consultative support to 2 IRBs. Others were charged with multiple tasks along the research continuum, such as the University of California-Los Angeles research informationist (38) who reported digitizing lab notebooks, aggregating research data, creating metadata standards for a research team, and offering expert searching and bibliometric analysis services to other teams.

Systematic review (n=25)

Support for systematic reviews was another highly-represented service, appearing in 25 of the 75 reports (34%) (Table 2). The earliest identified report of systematic review or meta-analysis support was from 1995 (39), although it was not until 2009 that systematic review services started being reported regularly (Table 2).

As systematic reviews are complex undertakings, it should come as no surprise that models for research support varied considerably. Depending on the specific implementation, a library's systematic review service could be provided by a single information professional (37, 40, 41) or by a coordinated team (28, 42, 43). In some instances, support consisted of a single main service, such as providing instruction on systematic reviews and their methods (33, 44, 45). In other instances, libraries introduced an array of services, including training, developing search strategies, running searches, managing search results, obtaining full-text reports, and providing methods write-ups (25, 43, 46-51).

Due to the time-intensive nature of systematic review support, some libraries identified the need to introduce fee-based services (24, 48). Knehans, et al. (48) and Beasley and Rosseel (24) both reported implementing a 2-tiered service model, where certain services, such as advising on the systematic review process, were offered at no charge, while services that placed a greater demand on personnel time and expertise, such as designing and running systematic review searches, fell under fee-based services.

Also due to the time-intensive nature of systematic review support, Campbell (42) presented strategies adopted by the University of Alberta's John W. Scott Health Sciences Library to free up personnel time that could then be re-allocated to helping with reviews. Crum's (35) survey study reported on traditional responsibilities (e.g. reference desk, collection development) that were eliminated to free up time for systematic reviews and other services. To demonstrate the value of its time commitment to systematic reviews, St. Michael's Hospital's Scotiabank Health Sciences Library in Toronto (43) tracked the different and significant roles played by library staff on reviews, such as critical appraiser, data extractor, and data synthesizer.

Grant support (n=24)

Twenty-four (32%) of the included studies addressed library services created to support researchers in pursuing grants (Table 2). Some of these services centred on facilitating access to grant funding, frequently in the form of creating databases of funding information (52-55). For example, Fenichel et al. (52) created an online bulletin board that included access to the Sponsored Programs Information Network (SPIN) database of funding sources, and Rosenzweig et al. (55) created a Research and Funding Grants Guide. At the School of Medicine at the University of Washington, a Research Funding Service librarian was hired to liaise between the school and the service, as well as perform "administrative and budget reporting, evaluation and sharing of funding information, and promotion of selected local funding opportunities."(53)

Several libraries offered workshops on grant writing or on grant application requirements. The University of Minnesota Health Sciences Libraries created a workshop to help applicants to the NIH and the National Science Foundation create data management plans (56). The University of Michigan Health Sciences Library, in collaboration with the

Medical School Office of Research, created a workshop and YouTube video on inserting graphics into grant applications (57). Other institutions also created general grant-writing workshops (58).

In addition to workshops, other described services included: the creation of the DMPTool (30), an open source template builder for data management plans; the involvement in grant writing and review (31, 35, 38, 50, 59); the provision of background information support for grant and funding applications (60); and the offer of training required as part of a local funding competition for small clinical projects (61).

Data management (n=19)

Data management was another main category of research support, with 19 (26%) studies examining this area (Table 2). As funding agencies and journals increasingly require sound data management plans, many libraries have stepped in with support. Of the 19 included studies that elucidated grant support services, 10 (53%) also offered data management support, either linked directly to their grant support initiatives or offered alongside their explicit grant support services. Methods of data management support ranged from workshops, like the University of Minnesota Health Sciences Libraries' "Creating a Data Management Plan for Your Grant Application Workshop" (56), to more intensive services where librarians provided their expertise to create data plans (62).

While most libraries reported providing data management training, support, and tool creation (30, 37, 63), 1 reported personnel becoming part of a research team to take on data management activities (38). This library member on the research team provided "advice on data management and curation, including metadata standards and preservation and preparation of data for sharing."(38) Li et al.(64) reported providing in-depth data analysis for researchers. Others' services included support and hosting of institutional repositories to store and share researchers' data (30, 65), enabling access to datasets and creating data catalogues (66, 67), and having dedicated librarians for data management projects (33).

Research metrics (n=15)

Fifteen (20%) studies discussed research metrics services (Table 2). Nine articles focused on research metrics services that libraries should be or were

providing, the majority of which focused on how research metric services were being offered or developed in their library (24-27, 62, 68, 69). In the group of 9 articles, 2 addressed the role of libraries in providing research metric services though not based on services they were providing in their libraries. Holmes (68) discussed results from an environmental scan of what health libraries were doing, while Crum (35) included results from a survey of library administrators and librarians on what they offered or were looking to offer. Hendrix (70) reported on an instruction series developed upon recognizing a need from faculty for more information on research metrics to assist them with tracking their publications for promotion as well as for grant applications.

Beyond general library services, 4 articles focused on researcher publication tracking (71-74). Bai and Kelly (71), Barnette and Keener (73), and Braun (72) discussed creating in-house databases to track their users' publications, and engaging with departments on campus who used the data they collected. Braun (72) noted a new collaboration that developed across campus through this initiative between information technology staff, medical school administrators, and liaison librarians. Burnette (74) provided an overview of a research audit of their institution and the subsequent building of a database to track their researchers' publications. Two reports (34, 59) focused on research impact services provided by librarians embedded in research departments.

Open access and repository (n=10)

Ten reports (13%) mentioned services involving open access and repository support (Table 2). Several libraries described promoting their own or external open repositories to their researchers (26, 30, 65, 75, 76). Koopman and Kipnis (75) described the implementation, promotion, and challenges of the Jefferson Digital Commons institutional repository. Henderson (30) reported on a new director of research data management who identified the library's institutional repository as a possible endpoint for researchers' data. The Cape Peninsula University of Technology's Library in South Africa, as part of the University's RDM Working Group, helped shape the university's RDM Policy (65), part of which involved assisting the university's Institute of Biomedical and Microbial Biotechnology identify laboratory journals for digitization and storage in the institution's repository. The University of Virginia's Claude Moore Health Sciences Library (76) championed open access

publishing in BioMed Central (BMC) with presentations, a newsletter article, a website, and investment in an institutional license to BMC. Even the NIH Library reported getting in on repository work (26). As a government library, the NIH Library was in a unique position to digitize its own public domain publications and place them on open repositories such as the Internet Archive for worldwide use (26).

In the United States, open access and repository services in health sciences libraries have often been a response to the NIH public access policy. Crum and Cooper's (35) survey of 405 librarians indicated that 110 respondents (27%) had in recent years added the role of helping authors comply with NIH public access policy to their repertoires. The Coy C. Carpenter Library at Wake Forest University (73) implemented three changes to better support policy compliance: including PubMed Central ID (PMCID) in its internal faculty member database, offering a Scholarly Publishing Assistance online toolkit, and offering faculty information sessions on open access and NIH policy compliance. Vaughan et al. (62) described how the University of North Carolina at Chapel Hill Health Sciences Library assisted researchers with repository selection and policy compliance. Finally, Holmes (68) reported on providing education and training on policy compliance, as well as further information on the Becker Medical Library's scholarly communication website.

Other services (n=35)

Thirty-five (47%) studies reported additional research support services that did not fall into the largest categories outlined above (Table 2). These less-represented services ranged from sitting on ethics review boards (40, 77), research committees (40, 78-80) or Animal Care and Use committees (81), to serving as full members of research teams (29, 31, 35-38, 59), offering copyright-related services (82) or consent form and research protocol assistance (83). Reported services also included the creation of tools, portals, or taxonomies (35, 37, 67, 78, 84, 85), providing non-systematic review search support (2, 69, 78, 81, 86, 87), creating new library spaces for researchers (88), providing training in various topics of relevance along the research lifecycle (31, 64, 67-69, 78, 82, 83, 85, 87, 89-91), or leading community-building activities such as forming groups or hubs to connect researchers with potential collaborators (26, 69, 74, 91-93).

Reports that include evaluations (n=35)

Among the 74 reports, 35 (47%) included some form of evaluation of the implemented services. Many of these evaluations were largely informal (n=17), with the authors reporting anecdotal feedback they had received after implementing new services (32, 37, 41, 42, 44, 66, 71, 72, 81, 84, 89, 94) or in which they supplemented another form of evaluation along with informal feedback (32, 48, 55, 78, 83). Statistics gathering (n=13) was the second most common form of evaluation, ranging from general usage and activity statistics (40, 43, 48, 50, 55, 57, 75, 79, 88, 95) to more specific forms of data gathering, such as tracking the number of related requests after a seminar (86), tracking the use of the services provided by a bioinformatics librarian (69), and tracking the YouTube views of instructional videos (57).

Other types of evaluations in the reported studies included surveys (n=7), interviews (n=2), post-workshop evaluations (n=2), focus groups (n=1), pre-post test (n=1), and not specified (n=1). One study, conducted by Minie et al. (82), administered a pre- and post-course evaluation for their Bioresearcher Tune-Up Course, a bioinformatics training course. Nine of the studies that reported an evaluation used multiple methods, including combining surveys and statistics (95), user satisfactions surveys and anecdotal feedback (83), and formal surveys, informal surveys, focus group discussions, and summary data (40).

Discussion

This scoping review maps a range of non-traditional services being reported by health sciences libraries to support researchers. While the services described may inspire ideas for new implementations, the proportionally small amount of rigorous evaluation present in the reports, and the fact that no critical appraisal was conducted on these studies, prevents us from being able to make any statement that the services contained herein necessarily model evidence-based practice. Despite these limitations, we have a number of observations from our review.

Among the reports, there was great variety in how health sciences libraries implemented and reported on their services. In some cases, services were introduced and provided by a single person, while in others the implementation was library-wide. In other cases, collaboration with non-library units helped shape new services. Among our included reports are services offered for or in conjunction with institutional review

boards / ethics review boards (32, 40, 77), a faculty's office of research (57), an institution's information technology and administrative units (72), research committees (40, 78-80), and an animal care and use committee (81). Such collaborations can create synergies between libraries and other units to assist researchers more comprehensively than either unit can on its own.

Across implementations, the depth of services also varied. Whereas some libraries might stop at providing users information on a topic through an online guide, other libraries would provide workshops or personnel would work directly on research teams. We attempt to demonstrate this range of depth in a spectrum of service provision in Figure 3, where less time intensive activities (such as information provision or gathering) is shown on one end of the spectrum, and the more time intensive tasks (such as being a member of the research team and completing tasks) sits on the other. Libraries looking to implement new services may consider this spectrum as part of their implementation, by beginning with less intensive services to start and working towards more time-intensive services later, if warranted.

Fig. 3. Spectrum of Services
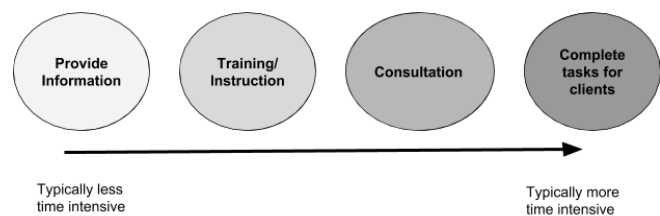
While the majority of services were provided for free (many did not report any fee structure, by which we make the assumption that there were none), a particularly interesting fee-based model was reported by the University of Alberta, where a highly in-demand long-standing embedded nursing librarian contract position was converted into a fee-for-service funded position when budget constraints threatened to cut the position (24, 25). The library at Penn State College of Medicine also implemented a cost recovery model for its systematic review services (48).

If we examine the broad service categories by frequency of publication, we see interesting temporal trends. For one, the creation of new positions to support researchers has been reported since the 1990's and increased in frequency in the last 5 years, as health sciences libraries evolved roles to meet researcher

needs (9). Descriptions of systematic review services increased as of 2009. This is in keeping with our experiences anecdotally as well as in the literature, since the systematic review has grown significantly in popularity in the last 10 years (96), as has recognition of librarians' expertise as expert searchers (97-102). Grant support services were also frequently discussed beginning in 2010, reaching a peak in 2013, and demonstrating a small drop in frequency in the last 3 years. Similar trends were also noticed in research metrics.

Data management services were reported as early as 2002 (89), but the majority of publications are from the last 5 to 6 years. Given the increased interest in "Big Data" over the last 5 years, and technological and methodological developments in the area of data repositories and open data, it is understandable that data management services would be mentioned more frequently in recent history (103). This increase in interest is evident in Canada through the work of the Canadian Association of Research Libraries (CARL) in their release of a white paper entitled "Research Data: unseen opportunities" in 2009 to aid academic libraries in discussing data management on campus and the roles of libraries in the process, as well as their launch of Portage in 2015, a national library-based research data management network (104, 105). In a more international scope, the International Committee of Medical Journal Editors (ICMJE) have released a data sharing statement that takes effect July 1st, 2018 (106). The data sharing statement policy provides guidance for ICMJE journals to ensure that the results of clinical trials contain data sharing plans and statements (106).

Since researchers have been grappling with data management issues for much longer than the last 5 years, it is noteworthy that data management services have only been reported more recently (107). Part of the reason could be that many libraries have developed expertise in data management only recently, as library personnel have become more frequently embedded within research teams and as digital datasets have become more common, cost-effective, and readily accessible to researchers (103, 107-109).

Research metrics, open access, and repository services have all been sporadically mentioned over the last 20 years in small numbers. Two reports of research metrics services were reported last year, although it remains to be seen whether this indicates an increase in those services being reported. In many academic library contexts in Canada, these areas of expertise fall under the role of Data Management and Scholarly Communications librarians, who often serve the entire university rather than specific research disciplines such as health sciences or sociology, providing one reason why these services may be underreported in this review. Likewise, in the international academic community, the conversation of data management and research metrics is a topic that is of concern and interest across many disciplines, not only in health sciences. Tools and documents like the Metric Tide (110) were developed with input from a variety of disciplines. Since our search was restricted to health sciences libraries, it could be that we did not capture reports of services in these domains or they were excluded during screening. Another possibility is that health librarians see providing or supporting research metrics as standard services–indeed similar services have been reported dating as far back as the 1970s (71), so it could be that we are instead seeing a revival and expansion of these services as granting agencies and universities require more proof of impact. This was the case as reported by Barnett and Keener (73), who identified that the library had been responsible for tracking faculty citations since 1977. While the partnership with the dean of the faculty had not changed, the information they collected had evolved over the years. Over time, the information collected was no longer for promotion, tenure, and informing the dean's annual report for the department, but instead, details like PMCID, DOI links, and ties to grant information, research protocols, and funding data had emerged to facilitate research activities. Along the same lines, the Becker Medical Library Model for Assessment of Research Impact was launched in 2009 and revised in 2011 to provide a "framework for tracking the diffusion of research outputs and activities."(111) This model has been discussed elsewhere in the health library literature but with a focus on the development of the tool and not on the library service component of the model (112).

By far, academic library contexts were the most represented amongst our included studies (n=56; 76%). Hospital libraries were less represented in our review (n=7; 9%); however, this may not necessarily indicate that hospital libraries are less interested in research service provision or are offering fewer services. Since there is some evidence that hospital librarians are less likely to undertake their own research, it is possible that such initiatives simply are not being published or presented at conferences (113,114). Special library service contexts are also rarely described (n=4; 5%). Articles such as Crum and Cooper (35) investigated emerging roles for

biomedical librarians and found that "hospital/health facility librarians were less likely than academic librarians to indicate they had added or planned to add an emerging role."(35) Further results from this paper indicated that lack of staffing could be the factor in hospital librarians being less likely to take on new roles (35).

Few authors reported conducting needs assessments as part of their service initiation (55, 62, 64). This was conducted either through surveys (55, 64) or a series of interactive activities with stakeholders (62). Fewer than half (n=35; 47%) of our included studies contain some form of evaluation. Of these evaluations, 48% (n=17) rely, either wholly or in part, on anecdotal or informal feedback. Because of this, future research examining the efficacy of these research services may be difficult; however, since reporting of services is so heterogeneous, such an examination would be challenging in any case. Studies that used more robust methods of evaluation, such as usage statistics, surveys, interviews, or a mix of these methods, were much less frequent. Given the amount of time and planning involved in launching new services or in pivoting existing services to better suit research patrons, future studies need to give greater weight to evaluation and include it as part of the program plan, providing not only information about innovative services, but also accurate measures of their implementation. While assessment is not a new concept in librarianship, its focus has changed. For many years, quantity and utilization of resources were of primary interest to librarians and management as metrics of success. As library services have become more specialized and external stakeholders have required more specific outcome measures, this data has become increasingly insufficient (115).

In order to address this gap, libraries have since examined a variety of aspects of service in order to demonstrate value and efficiency, from quality of service desk service, to satisfaction with a rapid search service and clinical library financial impact, to a variety of other methods (116-123).

In addition to measuring effectiveness of services, Urquhart et al. point out in their impact and assessment of health library services that exploring service weaknesses is also important in order to substantiate anecdotal observations of service issues by the library team as well as provide evidence or justification for launching or adjusting services (124).

Whether or not a formal evaluation is planned for a new service, considering its sustainability will certainly benefit libraries. In that vein, Beasley and

Rosseel (24) proposed evaluating the sustainability of their service implementation in terms of cost and impact on human resources. Applying the principles of Lean, the University of Alberta John W. Scott Library created a model for their research support services that allowed them to offer only the services that their users were going to use (24). The University of Alberta is not the first to use Lean, as Beasley and Rosseel(24) point out, and a growing number of libraries are using Lean to evaluate the efficiency and viability of a wide variety of library services. Tying Lean to sustainability principles in the evaluation of library services may possibly allow for libraries to ensure they are answering the demands of their users, are not creating inefficient workflows, and are carefully examining the value-add of new initiatives (125). Sustainability is another window through which services can be explored to determine weaknesses and, in the era of shrinking library budgets, make best use of resources.

Limitations

Due to the heterogeneous application of research service evaluation, present in only half of the reports included in this review, a definitive statement can not be made on which services work best in which contexts, for whom, and why; however, we can point out interesting features and trends in services we have identified in the literature to inspire ideas and present cases of service implementation.

Additionally, given the nature of the service populations and institutions in the health sciences, with service populations having cross-appointments and clinical appointments, and institutions being university-affiliated hospitals, academic medical centres, and other overlapping functions, it was challenging at times to define the service population. We would have liked to report service provision at a more granular level (e.g. by population group); however, the overlap and blended service populations made it challenging to identify patterns about where research support services were taking place, and exactly who was being targeted.

With 80% (n=61) of the included studies coming from the United States, and with Canada, the United Kingdom, and South Africa representing the remaining 20% (n=9, n=5, n=1), there is a definite focus on research services and views from North America. From the concept of this project to publication, we have tried to be as comprehensive as possible; however, the North American focus in the literature concerned us. We would encourage others to explore

and present or publish on their services and outcomes in other regions of the world.

Conclusion

This scoping review has identified main areas of non-traditional research support provided by health sciences libraries reported from 1990 through to 2017. Health sciences libraries looking to build on their own set of research services now have a collection of program descriptions, evaluations, and studies from which they can draw ideas and identify potential hurdles.

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No competing interests declared.

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Appendix A : Medline Search Strategy

1	librarians/
2	exp libraries/
3	library science/
4	library services/
5	librar*.ti,ab,kw.
6	1 or 2 or 3 or 4 or 5
7	research support as topic/
8	research personnel/
9	research/
10	(research* adj7 (service? or support or facilitat*)).ti,ab,kw.
11	(systematic review* adj7 (service? or support or facilitat*)).ti,ab,kw.
12	(synthes?s adj7 (service? or support or facilitat*)).ti,ab,kw.
13	(scholarly activit* adj7 (service? or support or facilitat*)).ti,ab,kw.
14	7 or 8 or 9 or 10 or 11 or 12 or 13
15	biomedical.ti,ab,hw,kw.
16	medical.ti,ab,hw,kw.
17	clinical.ti,ab,hw,kw.
18	health.ti,ab,hw,kw.
19	medicine.ti,ab,hw,kw.
20	dental.ti,ab,hw,kw.
21	dentist*.ti,ab,hw,kw.
22	nurs$3.ti,ab,hw,kw.
23	15 or 16 or 17 or 18 or 19 or 20 or 21 or 22
24	6 and 14 and 23

Appendix B : Google and Google Scholar Search Strategy

Search string	Search engine
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research|synthesis|scholarly|"systematic review"|"data management" support|service|facilitation	Google
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research|synthesis|scholarly|"systematic review"|"data management" support|service|facilitation	Google Scholar
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research|synthesis|scholarly|"systematic review"|"data management" support|service|facilitation filetype:pdf	Google
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research|synthesis|scholarly|"systematic review"|"data management" support|service|facilitation filetype:pdf	Google Scholar
medical|"health sciences" library research|"systematic review" support|service|facilitation	Google
medical|"health sciences" library research|"systematic review" support|service|facilitation	Google Scholar
medical|"health sciences" library research|"systematic review" support|service|facilitation filetype:pdf	Google
medical|"health sciences" library research|"systematic review" support|service|facilitation filetype:pdf	Google Scholar
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research services	Google
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian research services	Google Scholar
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian "research services"	Google
medical|biomedical|clinical|health|medicine|dental|nursing library|librarian "research services"	Google Scholar

Appendix C: Supplementary files

Tab. A Included studies by Source

Source	N=74
Journal of the Medical Library Association	20
Medical reference services quarterly	11
Bulletin of the Medical Library Association	5
ALISS Quarterly	3
Non-Journal (Grey Literature)	3
Health information and libraries journal	3
Journal of eScience Librarianship	3
Journal of Hospital Librarianship	3
Journal of the Canadian Health Libraries Association (JCHLA)	3
portal: Libraries & the Academy	2
Reference Services Review	2
British dental journal	1
Computers in Libraries	1
Information Outlook	1
Information Services & Use	1
Journal of Academic Librarianship	1
Journal of Agricultural & Food Information	1
Journal of Electronic Resources in Medical Libraries	1
Journal of Library Administration	1
Library Management	1
Missouri medicine	1
Oncology Nursing Forum	1
Proceedings of the American Medical Informatics Association	1
Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation	1
Science & Technology Libraries	1
SCONUL Focus	1
South African Journal of Libraries & Information Science	1

Tab. B Titles of positions created to support research

- bioinformaticist (Glenn 2010, Holmes 2011)
- bioinformatics consultant (Yarfitz 2000)
- bioinformatics librarian (Tennant 2005)
- bioinformatics specialist (Li 2013)
- bioinformationist (Florance 2002, Smith 2014, Song 2008)
- biomedical sciences librarian (Burnette 2015)
- biosciences & bioinformatics librarian (Glenn 2010)
- clinical and translational sciences librarian (Glenn 2010)
- director for research data management (Henderson 2015)
- emerging technologies librarian (Glenn 2010)
- e-research systems developer (Chiware 2015)
- human genetics liaison (Song 2008)
- information services librarian (Pratt 1990)
- information specialist in molecular biology and genetics (Epstein 2006)
- informationist (Allee 2014, Banks 2006, Crum 2013, Goode 2013, Gore 2013, King 2016, Whitmore 2008)
- institute for health informatics library fellow (Johnson 2012)
- institutional review board librarian (Robinson 2005)
- liaison librarian (Allee 2014)
- protocol analyst (Glenn 2010)
- public/private partnership librarian (Smith 2014)
- research informatics coordinator (Glenn 2010)
- research information technologist (Glenn 2010)
- research informationist (Federer 2013)
- research librarian (Cheek 2010, Cheek and Bradigan 2010, Glenn 2010)
- research support librarian (medicine) (Reeves 2012)
- translational research liaison (Smith 2014)
- translational research librarian (Allee 2014)
- translational science information specialist (Johnson 2012)