New activities and changing roles of health sciences librarians: a systematic review, 1990–2012

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Objective: The paper identifies and documents new health sciences librarian activities and roles during the period from 1990–2012.

Methods: A systematic review of the literature was conducted using MEDLINE, Library and Information Abstracts, Library Literature, Scopus, and Web of Science. To find new roles that might not yet have been described in the literature, job announcements published in the Medical Library Association email discussion list archives from 2008–2012 were searched. For inclusion, an article needed to contain a substantive description of a new role and/or activity performed by librarians and be in the field of medical or health sciences librarianship. Papers that did not describe an actual (rather than proposed) librarian role were excluded.

Results: New roles identified through the literature search were: embedded librarians (such as clinical informationist, bioinformationist, public health informationist, disaster information specialist);

systematic review librarian; emerging technologies librarian; continuing medical education librarian; grants development librarian; and data management librarian. New roles identified through job announcements were digital librarian, metadata librarian, scholarly communication librarian, and translational research librarian. New twists to old roles were also identified: clinical medical librarian, instruction librarian, outreach librarian, and consumer health librarian.

Conclusions: While the main purposes of health sciences librarianship remain the same, the new roles represent major new activities so that, for many librarians, daily on-the-job work is completely different.

Implications: This list of new activities should inform students contemplating medical librarianship careers, guide formal and continuing education programs, and encourage other librarians to consider these new services.

INTRODUCTION

In 1938, Keys, reference librarian at the Mayo Clinic, outlined the responsibilities of the medical librarian. They were (1) preservation of books and journals, and (2) distribution of the knowledge in those books and journals. This latter responsibility included cataloging, indexing, and teaching others how to use the materials. He also lamented the time burden imposed by these responsibilities, suggesting it would be Utopia for librarians to have the time for actual reading: "It is, of course, unheard of that a librarian should be so bold as to read." In "Looking toward 1970," he anticipated better cataloging, medical librarian educational textbooks, and a graduate school for medical librarians [1]. That was all. Keys did not anticipate the changes that would begin before 1970.

By the end of the century, many new roles and activities had appeared. By 1998, when the Medical Library Association (MLA) celebrated its first one hundred years, Homan noted, "Dramatic advances in research, health care, and information science have occurred since 1898" [2]. For example, in the 1960s, MEDLARS, a computerized bibliographic system, produced the annual *Cumulated Index Medicus*, one volume that could be searched by hand. A search over a previous decade required looking at only ten volumes, rather than the dozens of separately bound journal volumes. By the 1970s, MEDLINE had been implemented. It connected MEDLARS, the large reference database, with a commercial telecommuni-

cations network. Now librarians were able to conduct computer-aided searches.

In the 1980s, the MEDLINE database became searchable using Grateful Med software. This program could be installed on desktop computers to allow individual health professionals without specialized search training and without a librarian to search the millions of journal article references in MEDLINE.

By 1989, Berners-Lee, a British scientist at CERN, had invented the World Wide Web. The web was originally developed to meet the demand for automatic information sharing between scientists in universities and institutes around the world. By the end of 1990, prototype software for a basic web system was demonstrated for use by the general population [3]. Toward the end of the 1990s, MEDLINE became available free of charge on the web through PubMed [4].

New information technology and the web triggered an "information explosion on the digital front" [5]. It was now possible for a library client to access information from a desktop without involving a librarian.

PURPOSE

These changes were associated with dramatic transformations in the roles of many librarians. However, while there are articles on how health sciences librarians need to build on the past and re-engineer themselves to meet the information demands of the

future, the authors found no systematic review of actual new roles or activities. The purpose of this review is to document and categorize new roles and activities during the period from about the beginning of the Internet to the present, 1990 to 2012. For purposes of this paper, ''health sciences librarians'' is used to mean medical librarians or librarians who work in health care environments.

METHODS

Search strategy

A literature search was conducted in January 2013 using five databases: Library Information Science Technology Abstracts, Library Literature, MEDLINE, Web of Science, and Scopus. Time limits were set to include 1990, when commercial Internet service providers began to emerge, through 2012. Search terms were selected to retrieve articles on a single concept, new health sciences librarian roles. A broad search of the literature was conducted first. Search terms were:

[librarians or medical librarians or health sciences librarians or hospital librarians] or [medical libraries or health sciences libraries or hospital libraries and librarians] and [emerging roles or renewed roles or new role or professional role or job title or job description or role]

To find new roles that might not yet have been described in the literature, we examined job announcements published in archives from 2008 to 2012 for MEDLIB-L, an MLA email discussion list. The list's ''advanced search'' feature was used to find listings that had ''job'' or ''position'' in the title of the email message. Job titles or activities identified from the job announcements that were different were used as text words for another search paired with the text word ''librarian.'' ''Different'' was a subjective measure based on the criteria of (1) not in the list of new roles from the literature, and (2) not in the current or traditional activities of health care librarians as understood by the authors. This search was also conducted in the same five databases used for the first search.

Published literature inclusion and exclusion criteria

Descriptive articles of actual new roles that health sciences librarians have embraced from 1990 to 2012 were included. ''New'' means described or implied as such by the article's author that seemed to be rational claims. To be included, an article also had to include a substantive description of the role. That means the article had to include enough detail to suggest a real position or role, rather than only a proposed role. We excluded commentaries, editorials, and articles that described the need for new roles but did not describe a situation in which the role was operational. We found that descriptions of new roles did not always indicate that they were librarian roles. A probable connection to a new librarian role was

inferred from these activities because the description occurred in a library-oriented medium.

It is understood that there is a continuum between new *activities* and new *roles*. If an article described a function and said it was a role, we included it. If an article described activities that we felt represented a new role, we also included it. If an article described activities that generally were subsidiary to traditional roles, we did not include it as a new role but added it to the category of ''new twists, old roles.'' Our intention was to identify major new roles and activities documented in the years 1990 to 2012, regardless of whether they were defined as a specific role or not. Our mode was to be inclusive rather than exclusive.

To provide clarification and depth of understanding of the new roles, in some cases, we included related citations to supplement the citation that first identified the role.

Search retrieval results

A total of 371 citations were retrieved in the first search. The second search using search words gleaned from job announcements retrieved 144 citations. The results of the 2 sets were combined for a total of 515 citations. Of these, 91 citations were duplicates, leaving a total of 424 citations to be screened for eligibility. Three hundred forty-six citations from the eligibility group were excluded because they did not meet the criteria for inclusion and/or did not describe an actual role. Seventy-eight citations describing new roles were kept for further review. Of the 78 articles, 28 were further excluded because they did not describe actual new roles. Fifty articles were then reviewed further to identify a new role and/or activity and the first citation to mention the new role or activity during the time frame of 1990–2012. The PRISMA diagram (Figure 1) shows the flow of information through the different phases of this review [6].
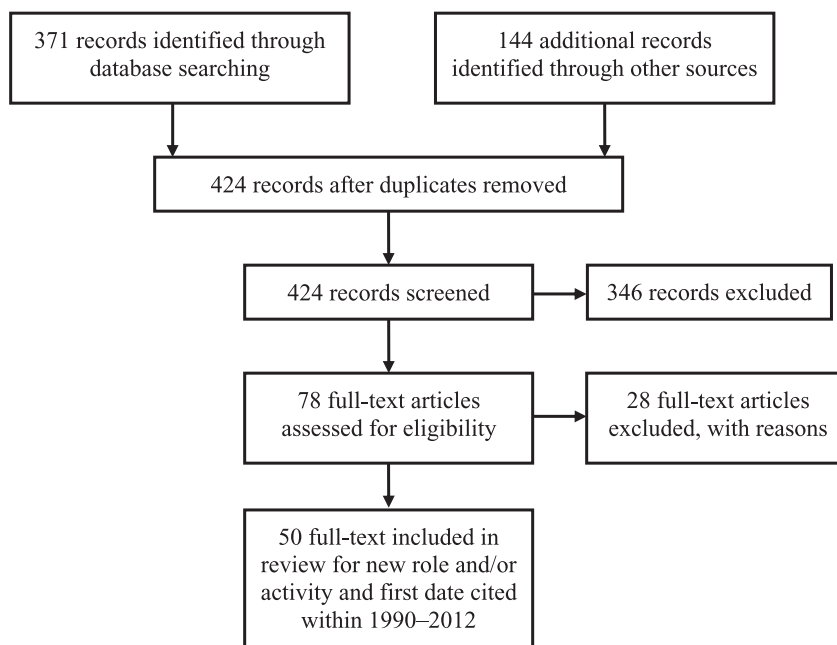
RESULTS

We present the results in three categories: (1) roles or activities identified from traditional literature, (2) roles identified from job announcements, and (3) new twists on enduring roles. In Table 1, we list the first citation that we found for the role and, in some cases, additional citations that add clarification. We did not intend to include all articles found that describe the role or activity.

I. Health sciences librarian roles identified from literature

1. Embedded librarian. Embedded librarianship focuses on the client user. It brings the library and the librarian to users in their work environment, wherever they are: office, laboratory, or home. Shumaker defines this ''growing trend'' this way: ''if a regular part of a librarian's work involves participat-

Figure 1
PRISMA study flow diagram

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┌─────────────────────────────┐      ┌─────────────────────────────┐
│ 371 records identified through│      │    144 additional records    │
│      database searching      │      │ identified through other sources│
└─────────────────────────────┘      └─────────────────────────────┘
                │                                    │
                ▼                                    ▼
          ┌───────────────────────────────────────────┐
          │     424 records after duplicates removed    │
          └───────────────────────────────────────────┘
                              │
                              ▼
              ┌───────────────────────┐      ┌─────────────────────────┐
              │  424 records screened  │─────▶│  346 records excluded    │
              └───────────────────────┘      └─────────────────────────┘
                              │
                              ▼
              ┌───────────────────────┐      ┌─────────────────────────┐
              │   78 full-text articles │─────▶│  28 full-text articles   │
              │  assessed for eligibility│      │ excluded, with reasons   │
              └───────────────────────┘      └─────────────────────────┘
                              │
                              ▼
              ┌───────────────────────┐
              │  50 full-text included in│
              │ review for new role and/or│
              │ activity and first date cited│
              │     within 1990–2012    │
              └───────────────────────┘
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ing in a group, community, or organizational unit primarily made up of non-librarians, providing knowledge and information services as a part of the group, then that librarian is participating in a growing trend of embedded librarianship where their services are in settings outside the library'' [7]. Two prominent types of embedded librarianship are the liaison role and the informationist role.

1a. Liaison role. Liaison librarians are defined as librarians who are formally designated as the primary contact between the library and one or more departmental or administrative units. They participate as a part of the group [8]. Their purpose is to improve the transfer of information between the library and users, to improve the quality of collections and services that match their clients' needs, and to enhance the library's image. Liaison librarian responsibilities are often seen as being divided among reference, instruction, and collection development

[9]. Traditional library services are offered in the user's work environment rather than in the library. This role is different than the older ''designated contact'' librarian role, in which a librarian is selected to be the receiver of requests from a group.

One of the first appearances of liaison services was in 1991. The Houston Academy of Medicine-Texas Medical Center Library initiated an outreach project using a health sciences librarian as liaison to Baylor College of Medicine's Center for Biotechnology, located several miles from the campus medical library. The service strengthened the relationship between these scientists and the librarians [10]. Another early article described the contractual arrangement in 1995 between Yale University's Countway Library and a medical school department that showed how a professional librarian can be integrated into the institutional environment and take on new roles. As liaison to the curriculum development

Table 1
New roles or activities for health sciences librarians documented in the literature, 1990–2012

Activity/role	Early articles identified
Embedded	Shumaker, 2007 [7]
Liaison	Pratt, 1991 [10]; Schatz, 1995 [11]
Informationist	Davidoff, 2000 [12]
Clinical informationist	Sladek, 2004 [17]; Guise, 2005 [16]
Bioinformationist	Lyon, 2006 [19]; Rein, 2006 [20]
Public health informationist	Rook, 2001 [21]
Disaster information specialist	McKnight, 2006 [23]; Reynolds, 2010 [22]
Systematic reviews	Beverly, 2003 [26]; Harris, 2005 [27]
Emerging technologies (emerging technology librarian, user experience librarian)	Crum, 2003 [30]; Farrell, 2011 [31]
Continuing medical education	Gluck, 2001 [33]
Grants development	Blobaum, 2007 [34]
Data management (research data librarian, data services librarian)	Carlson, 2011 [35]; Gore, 2011 [36]

department of the medical school, the librarian was involved in curriculum planning, software support, and computing facility support [11].

1b. Informationist role. Informationist was defined by Davidoff, in a 2000 editorial, as a health information professional on clinical teams who is trained in science or medicine as well as information science [12]. This new role for librarians would include answering clinical questions by reading the full text of the most pertinent articles, identifying and extracting relevant information, writing brief synopses of their findings, and sending the resulting information product to the user, and the role is distinct from the traditional medical librarian [13].

Variations of the informationist concept emerged over the next few years. All were called informationists with specific subject knowledge or skills. For completeness, we note that some would say that more subject knowledge is not required of informationists; however, it is not the purpose of this review to identify all the requirements for informationist positions. It is also noted that informationist programs are not identical. Each informationist program is customized to the needs of the group it supports. This customization is unique to the informationist role [14].

Informationist specialties began with the clinical informationist and now include bioinformationists, public health information specialists, and disaster information specialists.

Clinical informationist. A clinical informationist is a librarian with specific clinical and/or scientific qualifications gained either through graduate education or experience [15]. Guise evaluated Vanderbilt University's five-year clinical informationist program in 2005. In their program, informationists answered questions on rounds with synthesis of evidence-based medicine (EBM) literature and supported outpatient care through a service called ''evidence consult'' [16]. At an Australian hospital, clinical informationists attended medical in-patient ward rounds and clinical meetings in the respiratory medicine, sleep disorders, and rheumatology units. Evaluation of the service found that the medical staff not only used the clinical informationist service, but the service contributed to clinicians' medical decision making, clinician education, and clinical outcomes [17].

Bioinformationist. Bioinformatics is an interdisciplinary field that develops and improves methods for storing, retrieving, organizing, and analyzing biological data. Bioinformatics is now moving to encompass all levels of biological analysis, and several case reports have described librarians' involvement in this subject area. As the need for specialized information in molecular biology and genetics becomes more central in health care organizations, many librarians are increasing their skills and competencies in this subject area [18].

Bioinformationist librarians at Harvard University, University of Florida, University of Minnesota, and Vanderbilt University compared information about their bioinformationist services and programs at their institutions. They found all four programs developed partnerships with units on their campuses and offered knowledge management, instruction, and electronic resource support. The librarians acted as a first line of support, directing users to specific databases and researchers [19]. Purdue University's bioinformatics specialists collected researchers' information needs through careful observation of researchers in their work environment, in their laboratory meetings, and through interviews with department chairs and individual researchers. The information was used to develop a bioinformatics program to serve the information needs of researchers in their organization [20].

Public health informationist. Providing information to those who work in the public health sector supports critical policy decisions in health care. The public health informationist at St. George Hospital in London assisted in public health postgraduate training. The position grew to include a centralized support service for disseminating information in which the librarian became a hospital team member and provided information support. The services eventually broadened to become a part of the public health network in the region [21]. Another example of public health informationist support occurred during a week-long Federal Emergency Management Agency (FEMA) exercise. By being part of the FEMA team, the public health informationist provided information at the point of need [22]. Public health informationists are specializing even more and are becoming experts in providing information during disasters, in other words, *disaster information specialists*.

Disaster information specialist. Health sciences librarians demonstrated how they can contribute to disaster preparedness after Hurricane Katrina. Proactive reference and information services were set up in a mobile home in Baton Rouge. From that temporary site, librarians were able to provide reference services during the disaster's many phases to both health care personnel and families affected by the disaster [23].

The National Library of Medicine (NLM) implemented a special program as a collaborative effort to promote the role of information specialists in providing disaster-related information resources to the workforce and communities. NLM's Disaster Information Specialist Program offers training courses, resources, funding for disaster outreach programs, and an email discussion list to share information [24].

Sarasota Memorial Health Care System, one of the participants in NLM's Disaster Information Specialist Program, established a librarian position as a key member of the hospital's emergency preparedness team. Some of the librarian's functions included participating in emergency preparedness meetings, noting unfilled needs and questions, and distributing updated information quickly to users at the time of need [22].

2. Systematic review librarian. A systematic review is a summary of literature that assesses and evaluates studies on a particular issue. Researchers use an organized and clearly stated method of locating,

assembling, and evaluating a body of literature on a particular topic using a set of specific criteria [25].

Health sciences librarians now serve on systematic review teams and often are coauthors of published reviews. A team of information professionals at the Centre for Health Information Management Research at the University of Sheffield conducted a systematic review on the topic ''health information needs of visually impaired people.'' In conducting the systematic review, the librarians identified ten librarian roles that support systematic reviews: project leader, project manager, literature searcher, reference manager, document supplier, critical appraiser, data extractor, data synthesizer, report writer, and disseminator [26]. Similarly, another observational case study ''chronicled a librarian's involvement, skills, and responsibilities in each stage of a real-life systematic review.'' In conducting actual systematic reviews, the author identified librarian activities as expert searcher, organizer, and analyzer. As expert searcher, the librarian must interact with the investigators to develop terms required for a comprehensive search strategy in appropriate sources. As organizer and analyzer, the librarian must effectively manage the articles and document the search, retrieval, and archival processes [27].

Recently, a *systematic review librarian* position opened at the United States Department of Agriculture's (USDA's) Center for Nutrition Policy and Promotion [28]. The center works to improve health by developing and promoting dietary guidelines that link scientific research to nutrition needs. This position documents that the activity is needed and can constitute a full-time role.

3. Emerging technologies librarian. The health sciences librarian's role has always been to connect the user to information in direct and efficient ways. The new role called *emerging technologies librarian* focuses on the methods that libraries can use to deliver services and information with new technologies. Job titles are varied. An advertisement for the University of North Carolina School of Information and Library Sciences lists job titles of recent graduates as: ''information architects, system analysts, database designers, usability engineers, web application developers, and more'' [29].

In these roles, librarians design, develop, and manage their libraries' website. They integrate new web applications, social media, and mobile interfaces to support the ability to access information. Often these librarians advise clients about web development, Web 2.0 and 3.0 technologies, social networking, virtual worlds such as Second Life, gaming, podcasting, video, e-learning services, distance education, semantic web, and other current and future technologies.

Skilled website developers perform *usability testing* to assure that user needs are met. One of the first articles to discuss usability testing in a health sciences setting came from researchers at Oregon Health & Science University. They evaluated the usefulness of the library's website as an orientation tool for students [30].

Social media technologies are expanding the ways that librarians are collaborating, creating, and disseminating information. For example, librarians at the Mayo Clinic developed customized courses for library staff, health sciences faculty, and nurse educators using Web 2.0 and social media tools such as blogs, really simple syndication (RSS), wikis, and other networking tools [31]. Librarians at the University of Texas Health Science Center at San Antonio created a blog to support their health information outreach activities [32].

4. Continuing medical education librarian. Continuing medical education (CME) consists of educational activities that help clinicians maintain, develop, and increase their knowledge and skills. Librarians can work collaboratively on CME teams. A 2001 article described how professional librarians were selected by the Connecticut State Medical Society to be active members of the society's team that reviews the CME programs that are offered by Connecticut's hospitals. Librarians who participated in this effort provided collaboration that revealed new and important roles for librarians on an accreditation team [33].

5. Grants development librarian. Many different types of grants are available from both public and private agencies at the national, state, and local levels. Clinicians, researchers, and administrators are often unaware of available external funding opportunities and how to secure those funds. Health sciences librarians have the opportunity to become resources for information about available grants and can use their expertise in the grant-writing process.

A grants information service was established by the Governors State University Library, located in University Park, Illinois. It serves as a model for hospital and other health care libraries. This grant service showed how hospital librarians are ideally suited to promote grant writing in their organizations and how they can make a valuable contribution by teaching the grant-writing process [34].

6. Data management librarian. The National Science Foundation in 2011 announced it would require data management plans in all grant proposals. Researchers must make a plan to manage their data before beginning a research project and then follow that plan throughout the research life cycle in order to ensure usability, preservation, and access to the data. Many federal agencies and other funders now require or are considering requiring grant applicants to include a data management plan in their proposals. Librarians can help researchers develop their data plans to help them manage, curate, archive, and share their data.

The University of North Carolina Libraries created a data management committee made up of ten different librarians from various branch libraries,

Table 2
New roles for health sciences librarians identified by job announcements, 2008–2012

Job title	Activity	Institution/job announcement year
Metadata librarian	Provides creation of and access to an institution's data and library's digital and print content through metadata creation cataloging and metadata standards	Virginia Commonwealth University, 2008 National Library of Medicine, 2009 East Carolina University, 2010 Harvard University, 2010
Digital content librarian	Coordinates and promotes digital resources and services, assists in selection and implementation of digital resources	State University of New York, 2010 Florida Hospital College of Health Sciences, 2010
Scholarly communication librarian	Encourages participation in open access and facilitates scholarly communication, develops open institutional repositories for dissemination of research results	City of Hope, 2009 Oregon Health & Science University, 2011
Translational research librarian	Explores and develops new methods of information support for basic and clinical biomedical research	University of Wisconsin, 2012 Wayne State University, 2012

including a data services librarian. The committee developed data management training for the university community. They covered understanding of data management plans, strategies for handling data, and digital repository access. They also developed a web portal for researchers with templates for formulating data management plans, examples of language for data management plans, and other guides and links [35].

Librarians in the Research and Scholarly Communications Department of the Lamar Soutter Library developed a subject guide that provides researchers with easy access to resources for data management, including an annotated list of popular, relevant datasets that are available online; news and updates about data management, data sharing, and the open data movement; and links to peer-reviewed articles about data management [36].

While not specifically labeling them *data management librarians*, Creamer found twenty health sciences librarians who conducted data interviews with researchers to assess their data needs, worked with researchers to develop data management plans, taught data literacy to their patrons, and accessed data sets from published literature for their patrons' research [37].

II. Roles or activities identified through job announcements

Job announcements in MLA's email discussion list, MEDLIB-L, were reviewed for the last five years to identify new roles or titles for health sciences librarian positions that were not identified in the literature (Table 2). We found four roles that are familiar but for which we found no published reports in the health sciences literature. Based on the presence of the job description, we assumed that these roles are being filled or will be performed in the near future.

1. Digital librarian. Position announcements appeared twice in the last five years with digital librarian as a title. Responsibilities included managerial tasks that emphasized planning for and oversight of digital library projects, and leadership and expertise in digital library areas. Trend analysis, such as

monitoring the standards and practice of current digital libraries, was usually critical in these jobs [38].

As early as 1995, Braude wrote, "Exactly what a digital library is and how it is to be organized have not yet been determined, and the bibliographic organization of digital information has not been sufficiently addressed" [39]. The definition that he sought seems yet to be realized. Developments in both medical informatics and medical librarianship indicate a need for greater collaboration between these specialties to achieve their common purpose: the creation, classification, and dissemination of scholarly information.

2. Metadata librarian. The title metadata librarian appeared in the late 1990s and reflects the new challenges of tracking, organizing, and improving user access to data as resources shifted to digital resources. While metadata are often defined broadly as "data about data," librarians generally use the term to mean descriptive metadata that helps users access information, much like a catalog card file helps users locate a book in the library. Metadata librarian positions often evolved from cataloger positions but focused on providing other types of metadata besides standard catalog records, typically for digital materials.

As an example, the main responsibility for the metadata librarian in one job announcement was to create and maintain taxonomies for digital and hard copy documents. Digital librarians also test controlled vocabularies for sustainability in order to improve continued access. Old ways of cataloging and classifying print materials often are not flexible enough for rapidly changing digital resources.

3. Scholarly communications librarian. Traditionally, the term "scholarly communication" was narrowly defined as the system for disseminating scholarly work, primarily through journals. More recently, the definition has been broadened to include the creation, transformation, dissemination, and preservation of knowledge [40]. It encompasses the entire process by which faculty, researchers, and other scholars share and publish their findings within and beyond the academic community.

Position announcements for scholarly communication librarians have appeared in the last five years. The position responsibilities typically included: promote a digital resources library or institutional repository, explore new opportunities for publication (including open access models), assist individuals interacting with editors and publishers, provide support for complying with government deposit mandates such as the National Institutes of Health (NIH) public access policy, explore new ways of publishing, and provide open access materials to faculty and students. This role may include ensuring perpetual access to clients' published resources and negotiating for archival and/or perpetual access licenses.

4. Translational research librarian. Translational research connects basic research to patient care by promoting the translation of research discoveries into clinical applications. An example of librarians working in this area comes from the Becker Medical Library of Washington School of Medicine, where librarians provide specialized knowledge, customized programs and services, and information services to support translational research through three areas: bioinformatics, scholarly communications, and consumer health and community outreach [41].

III. New twists on old roles

Health sciences librarian roles have always evolved to meet new challenges. Four prominent examples of new twists (important changes) have occurred in established roles since 1990: clinical medical librarian (CML), instruction librarian, outreach librarian, and consumer health librarian. These activities are usually related to or are part of traditional activities.

New twist 1: clinical medical librarian. The CML role was described in 1971, so it is not new since 1990. Lamb recognized a need to bridge the gap between volumes of information and its relevance to the health care professional. Biomedical librarians were placed in a patient care setting. They could attend rounds, note questions asked, and go back to the library to find the answers and make photocopies of the relevant articles for the clinical team [42]. Later, Literature Attached to Charts (LATCH) emerged whereby photocopies of searches were attached to a patient's chart. CML programs continued through the years, but by 1991, some were asking if CMLs were viable in the new automation age [43].

More recently, clinical librarians in some programs have begun to "project themselves not as information 'servers' who trail the team in an auxiliary capacity, but as an integral part of the group with a specialized expertise that can contribute vitally to clinical situations" [12]. Some think the role of clinical medical librarianship is evolving into a new role: clinical informationist [44].

New twist 2: instruction librarian. Librarians have always embraced the teaching role. Library users have been taught how to use the library catalog, print abstracts, indexes, and other library resources. Today, instruction includes not only how to use library resources, but also how to use new technology to access information. When PubMed became available to the end user, librarians began teaching students and faculty how to search the new database in their own offices or homes and helped users develop skills to find information on their own.

Librarians are teaching other related nonlibrary services such as how to best use bibliographic managers (EndNote, RefMan, and others) and to use academic teaching services such as Blackboard, Google Documents, and other platforms that are used in instruction.

MLA stated that health sciences librarians should work to "understand curricular design and instruction in order to teach ways to access organize and use information" [45]. In 2012, the *Journal of the Medical Library Association* published a special issue that was devoted to instruction in health sciences libraries [46]. Librarians now teach for-credit classes in medical school curricula and use of non-bibliographic databases in the biosciences. Instruction is moving outside the library and becoming more embedded in the user's world.

New twist 3: outreach librarian. A legacy program, outreach, provided library services to groups of hospitals. For example, circuit rider librarians at the Cleveland Health Sciences Library served five hospitals in a shared program in the 1970s [47]. In another program, also in the 1970s, circuit librarians provided library services to clinicians in rural northwestern North Carolina. After the pilot, the physicians voted to continue the service and share the costs [48]. In the 1980s, health sciences librarians provided library and information services to clinicians in Area Health Education Centers (AHECs). And in 2000, a circuit librarian became a virtual librarian for the AHEC in her area, providing services almost entirely electronically [49].

Outreach now usually means providing information to rural practitioners. But outreach can mean reaching out to users in one's own institution. The National Cancer Institute-Frederick Scientific Library provided an outreach program to its research labs by providing a "laptop librarians service," in which librarians took a laptop, spent time in research buildings, and provided users with necessary information [50]. The difference between "outreach" in these cases and "informationists" might be the depth of specific specialized knowledge required, but both roles embody the trend of moving library services outside the library.

New twist 4: consumer health librarian. Consumer health programs have been around since health sciences librarians first offered patient education materials in their libraries for patients and their families. The Houston Academy of Medicine-Texas

Medical Center Library, which is open to the public, conducted a user survey in 1980 and confirmed that the general public was asking for more health information [51]. Growing consumer interest in health-related information created a need for librarians to provide a service to manage and provide information to the public.

This service broadened further to *reach out* to the community. For example, librarians offered pamphlets at health fairs and other community meetings. Now, consumer health involves advanced technologies like interactive websites and connection of consumer health information to the patient record, bringing information for patients to the point of care [52]. MLA offers a Consumer Health Information Specialization for librarians, allowing librarians to document their expertise in this specialty [53].

DISCUSSION

Our goal in conducting this review was to identify, within the timeframe of 1990 to 2012, actual new roles for health sciences librarians. We searched published literature and reviewed job announcements. We found sixteen new roles or activities, twelve from the literature and four from job announcements, and four major new twists in traditional roles. These lists should be useful to teachers of library science, to library planners and decision makers, and to students contemplating a librarian career.

The literature on emerging roles in health sciences librarianship is not robust. We feel it underrepresents the new roles that health sciences librarians have undertaken in recent years. Many articles argue that we must change what we do as librarians to survive in our field, and they often describe possible new activities for librarians but do not document if the activities have actually been incorporated into job responsibilities.

The distinctions between roles and activities, and between new roles versus twists on traditional roles, are subjective. Nevertheless, we produced a list that reflects major changes in the health sciences librarian's work and can serve as a basis for discussion.

In the past few years, new technologies have lightened librarians' burdens by reducing clerical work associated with library services. Further, since clients can obtain materials directly without going to a library or interacting with a librarian, the librarian's role is less critical. Thus one trend has been that librarians have less to do, and their role as intermediaries in information-seeking activities has diminished. On the other hand, at the same time, technology has presented new challenges and opportunities to expand the librarian's role. Keys's role of knowledge distribution is the same today, but different. *Knowledge* is now often called *information*, and the way it is distributed has changed enormously. Very often, it is distributed without flowing through a library at all.

While automation relieved librarians of some duties, it provided time to develop and extend services outside the physical library. At the same time, outside information services began competing with the library (e.g., Google Scholar, PubMed, independent journal subscriptions, and electronic newsletters that summarize current journal articles and news). Also, the health sciences information universe expanded exponentially beyond printed books and journals. It can be argued that increased demand for electronic information coincided with librarians' ability and need to exploit new technologies, which leads to new librarian roles.

In one sense, though, little has changed. Keys, in 1938, identified two basic roles for health sciences librarians. The first, preservation of books and journals, has diminished in most librarians' lives (except archivists, of course). The second, *distribution of knowledge and ideas*, including teaching and facilitating access to knowledge, has changed dramatically in character, though not in intention. Librarians continue to provide information to support the work of their users; just the means of doing so have changed.

Study limitations

We used only two sources to identify new roles, published literature and job announcements. Information from blogs, electronic mailing lists, unpublished papers, and conference or meeting presentations was not included. It is possible, even likely, that new roles have been created but not described in the sources that we used. Also, this review was limited to English language articles. Admittedly, the duties of the roles described here overlap, but they are defined by their general thrust and often by special training needs. Decisions about characterization of activities and roles are necessarily subjective.

CONCLUSIONS

For the period 1990 to 2012, twelve new roles from the literature, four new roles from job announcements, and four new activities in heirloom roles were identified. These new roles represent major changes in how health sciences librarians serve their institutions and users. They reinforce the librarian's role as a specialized professional participating in new technology to distribute information (knowledge) to their clients and to participate in expanded roles outside the library.

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